ADB

Technical Assistance Consultant's Report

Project Number: 47381
December 2014

Sri Lanka: Water Resources Development Investment Program

For
Ministry of Irrigation and Water Resources Management
Democratic Socialist Republic of Sri Lanka

Asian Development Bank

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

47381

FINAL REPORT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
CAG	–	Comptroller and Auditor General
CAPC	–	Cabinet Appointed Procurement Committee
CEA	–	Central Environmental Authority
CP	–	Concept Paper
DOI	–	Department of Irrigation
DPC	–	Department Procurement Committee
EIA	–	Environment Impact Assessment
EOI	–	Expression of Interest
GBL	–	Geotechnical Baseline Report
GOSL	–	Government of Sri Lanka
IA	–	Implementing Agency
ICTAD	–	Institute for Construction Training and Development
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
MFP	–	Ministry of Finance and Planning
MPC	–	Ministry Procurement Committee
MPP	–	Master Procurement Plan
MRB	–	Mahaweli River Basin
NCPCP	–	North Central Province Canal Project
NPA	–	National Procurement Agency
NWPC	–	North Western Province Canal
OH & PF	–	Overheads and Profit Factor
PAC	–	Public Accounts Committee
PDA	–	Project Design Advance
PE	–	Procurement Entity
PMDSC	–	Program Management, Design and Supervision Consultant
PPC	–	Project Procurement Committee
PPP	–	Public private partnership
PPTA	–	Project Preparatory Technical Assistance
PSB	–	Procurement Support Bureau
RF	–	Resettlement Framework
RIP	–	Resettlement Implementation Plan
RPC	–	Regional Procurement Committee
SBD	–	Standard Bid Documents
SIWRM	–	Strengthening Integrated Water Resources Management
SLPI	–	Sri Lanka Prosperity Index
UEC	–	Upper Elahera Canal
UNICITRAL	–	United Nations Commission on International Trade Law
WTP	–	willingness to pay

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I. OVERVIEW

A. Introduction

1. This Technical Assistance Completion Report (Final Report) presents the due diligence findings of the Asian Development Bank's Project Preparatory Technical Assistance (PPTA) for the **Water Resources Development Investment Program** (WRDIP) in Sri Lanka (ADB Project: 47381).[1] The PPTA was conducted from April to December 2014.[2]

2. At the national level, Sri Lanka has abundant access to water resources with about 50,000 million cubic meters (MCM) of annual runoff and an annual per capita endowment (ACE) of 2,500 cubic meters (m^3), well above the 1,700 m^3 threshold defining water stress.[3] However, there are significant spatial and temporal variations; the northern dry zone river basins contribute only about 11% of the country's total runoff volume and only during the December to February period. This amounts to a local ACE of 1,200 m^3 indicating severe water stress which is compounded by regular droughts. Consequently, agricultural productivity in this region lags behind other wetter regions in Sri Lanka with 25% to 30% lower paddy yields and cropping intensities.[4] This stress also impacts water availability for drinking and commercial users. This causes significant constraints for social and economic development which may be exacerbated in the future by anticipated population growth and climate change.

3. Historically, Sri Lanka has addressed these constraints by constructing many small cascade systems of reservoirs (called 'tanks') and transfer canals. In the 1960s, under the Mahaweli Development Program (MDP), [5] the government decided to augment water within these systems with available water resources in the Mahaweli River Basin (MRB) using large transfer canals and reservoirs. The MRB is Sri Lanka's largest river basin, comprising 18% of Sri Lanka's area and providing 21% of the country's overall runoff. Over time, the government has revised the MDP accounting for socio-economic changes and national development priorities. The government's current priorities and investment roadmap are described in the Mahinda Chintana[6] for the irrigation and water resources sector. These focus on ensuring availability of adequate water quantities for irrigation; improving management, productivity and usage efficiency of water to meet rising demands; and minimizing spatial variations in water availability through implementing trans-basin diversions to divert available water to dry zone areas.

4. The updated MDP will address the government's sector priorities by constructing the North Central Province Canal Project (NCPCP), an outstanding investment component of MDP. The NCPCP will be implemented in two sequential phases: Phase 1 will transfer water from the MRB to existing reservoirs in the Central, North Central and North Western Provinces; and Phase 2 will extend the transfer of MRB water from the North Central Province reservoirs to existing reservoirs

[1] The terms of reference for TA 8633-SRI are included in Appendix 1.
[2] The PPTA's work program is presented in Appendix 2 that highlights key milestone dates and tasks.
[3] Annual per capita water endowment is the notional volume of water (in m^3) which is available to each resident of a region, country, etc., expressed on an annual basis. It is calculated by defining the volume of accessible/reliable freshwater available each year, and is allocated as a notional allowance to each person.
[4] The Sector Assessment is included in Appendix 3.
[5] The objectives of MDP are to utilize MRB's surplus water for irrigation of 365,000 ha to attain food self-sufficiency, provision of land and job opportunities to landless people, and maximize hydropower generation.
[6] Government of Sri Lanka. Ministry of Finance and Planning. 2013. *Mahinda Chintana Public Investment Strategy, 2014-2016*. Colombo.

in Northern Province, and will eventually augment drinking water supplies to Jaffna and Kilinochchi.[7] The WRDIP encompasses works to be done under Phase 1. Implementation of the WRDIP will assist the government complete outstanding water conveyance investments under the MDP, whose completion is a key priority of the government. The investment program will support the objectives of MDP to maximize the productivity of MRB water resources by transferring available water to Sri Lanka's northern dry zone areas[8] for irrigation, drinking and commercial purposes. This will accelerate local and national economic growth.

5. The investment program is fully consistent with the objectives of ADB's Country Partnership Strategy 2012-2016 for Sri Lanka.[9] It will assist the government in addressing major constraints for sustaining inclusive economic growth with infrastructure development to improve connectivity and service delivery to lagging regions. Tranche 1 of the investment program is included in ADB's Sri Lanka Country Operations Business Plan 2014-2016.[10] It is also consistent with ADB's Water for All policy[11] and Water Operational Plan 2011-2020.[12]

B. Investment Program

6. The WRDIP will finance three investment projects – the Kalu Ganga - Moragahakanda Transfer Canal (KMTC) and the Upper Elahera Canal (UEC), the North Western Province Canal (NWPC), and the Minipe Left Bank Canal Rehabilitation (MLBCR) – and three consultancy packages under the government's planned NCPCP amounting to approximately $675 million. The Ministry of Irrigation and Water Resources Management (MIWRM) is the executing agency (EA), and the Mahaweli Authority of Sri Lanka (MOSL) and the Department of Irrigation (DOI) are the implementing agencies (IAs).

7. The WRDIP will also address other key sector priorities through two consulting packages: (i) improving system efficiencies and water productivity (ISEWP) with recommended investments considered for inclusion in Project 3; and (ii) strengthening institutions with integrated water resources management (SIWRM). A third consulting service package will be for the Program Management, Design and Supervision Consultants (PMDSC).

8. The investment program follows the multitranche financing facility (MFF) modality and is scheduled from 2015 to 2024. Tranche 1 is to commence in 2015 with advanced action and retroactive financing. Tentatively, Tranches 2 and 3 are scheduled to start in 2016 and 2018, respectively. The MFF modality will (i) allow the financial needs and readiness of the investments to be met, (ii) provide adequate time to prepare the tunnel investments, (iii) optimize implementation sequencing of projects, and (iv) meet absorptive and implementation capacities of the government. The investment program adheres to the MFF constituents appropriate for concept clearance, and its policy framework and roadmap will be updated during investment program preparation.

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[7] ADB. 2011. *Report and Recommendation of the President to the Board of Directors: Proposed Loans and Technical Assistance Grant to Sri Lanka for the Jaffna and Kilinochchi Water Supply and Sanitation Project*. Manila.

[8] The northern dry zone area, where average annual rainfall is less than 1,500 mm, comprises North Central Province, North Western Province and the northern half of the Eastern Province. These areas will directly benefit from this investment program. Planned future water transfer investments that rely on this investment program will also benefit Northern Province. Evapotranspiration rates in this area exceed 2,000 mm per annum.

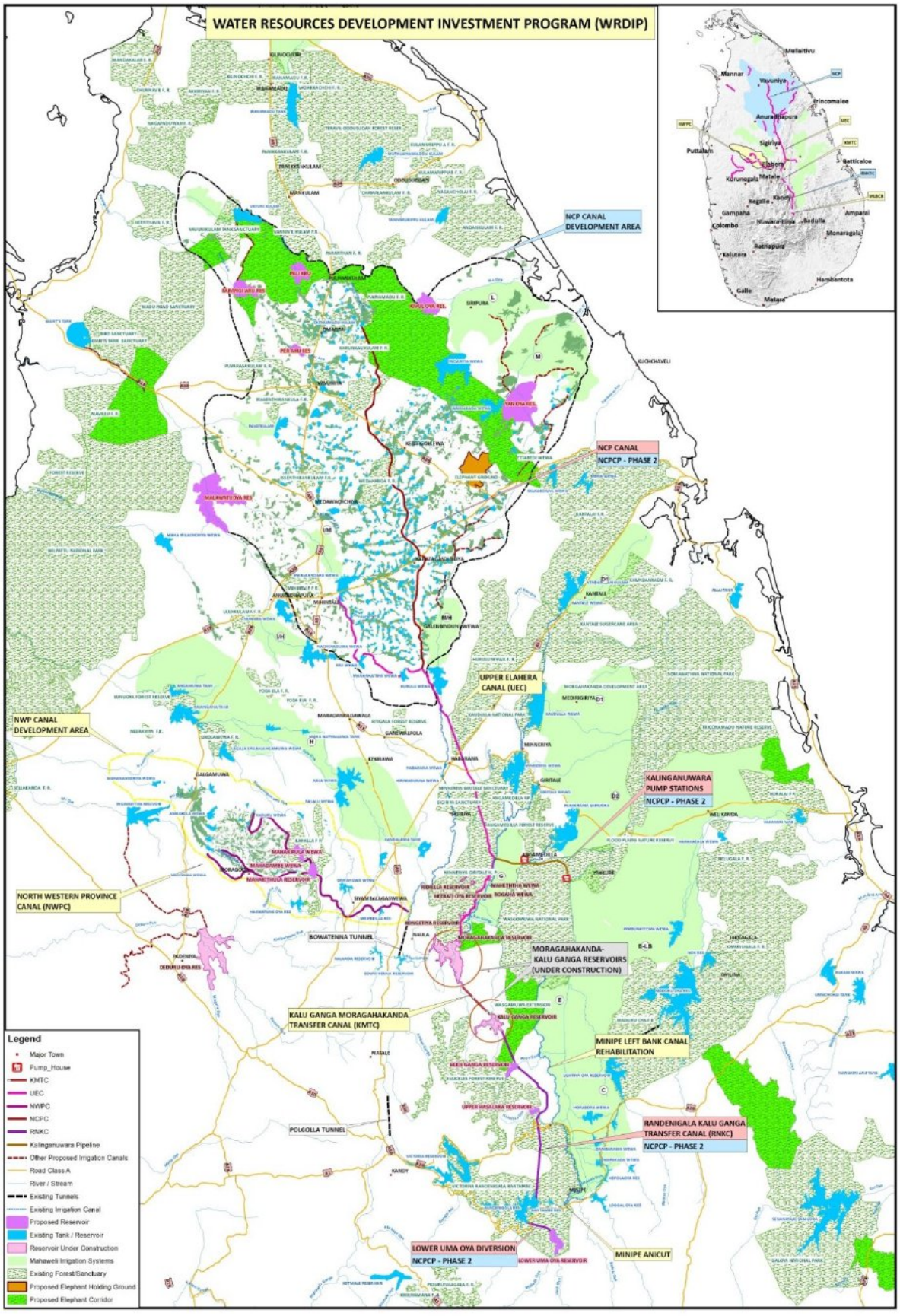
[9] ADB. 2011. *Country Partnership Strategy: Sri Lanka, 2012-2016*. Manila.

[10] ADB. 2014. *Country Operations Business Plan: Sri Lanka, 2014-2016.* Manila.

[11] ADB. 2003. *Water for All – The Water Policy for the Asian Development Bank*. Manila.

[12] ADB. 2011. *Water Operational Plan 2011-2020*. Manila.

Figure 1: Layout Map of the Water Resources Development Investment Program



Source: MCB, 2014

C. Impact, Outcome, and Outputs

9. The investment program's impact will be improved water productivity for economic growth in former conflict and dry zone areas. Its outcome will be secured access to water resources for agricultural and non-agricultural purposes in northern dry zone areas. The outputs will be (i) Output 1: water conveyance infrastructure developed, (ii) Output 2: systems for strengthening integrated water resources management and improving system efficiencies and water productivity developed, and (iii) Output 3: efficient multi-disciplinary investment program management.

10. The MFF will comprise three tranches:[1] (i) Tranche 1 will implement the MLBCR, NWPC Stage 1 and certain non-tunnel segments of the UEC; (ii) Tranche 2 will implement KMTC and the TBM tunnel segment of the UEC; and (iii) Tranche 3 will implement NWPC Stage 2 and remaining tunnel and non-tunnel segments of UEC. Implementation of the MFF is tentatively scheduled from 2015 to 2024. The packages for Outputs 2 and 3 will be undertaken concurrently from 2015 to 2024 under Tranches 1 and 3.

11. The WRDIP focuses on water scarcity, food security, and poverty issues in project-affected areas. It aims to provide better and secured irrigation water supply enabling the cultivation of most of paddy land in both Maha and Yala seasons in each year, thereby improving incomes of farming households who constitute more than 90% of project-affected households (PAHs). No new lands are identified for irrigation by the WRDIP. The main benefit of the investment program will be increased cropping intensity of existing cultivated lands under major and minor irrigation schemes. In addition, the investment program will provide safe drinking water to a large population which suffers now from drought and the lack of safe drinking water. The investment program will raise agricultural production on 32,823 ha of existing command area by increasing cropping intensities from 135% to 186%.[2] Additional benefits will arise from increased drainage return flows within the existing cascade systems that downstream communities will use. Once Phase 2 of the NCPCP is completed, the irrigated area commanded by the investment program will increase to 103,400 ha with a cropping intensity of 183%. Cropping intensities, yields and command areas may be further increased through water use efficiency initiatives identified under the ISEWP package, which will also encourage diversification into less water consuming and higher valued crops. The NCPCP will also convey 85 MCM for non-agricultural users under the WRDIP and a further 100 MCM to the North Western Province under Phase 2.

[1] The tentative implementation schedule is included in Appendix 8.
[2] The Water Balance Assessment is included in Appendix 4.

D. Due Diligence

12. Due diligence has been carried out for the WRDIP on the basis of technical, economic, social and environmental criteria. The scope of the PPTA was to: (i) review the technical and economic viability and designs of the three investment projects under the investment program; (ii) review and update safeguard measures; (iii) review civil works contract documents and advise government engineers to ensure they meet necessary criteria; (iv) prepare the ISEWP consultancy package; (v) undertake financial and procurement assessments of the EA and IAs; and (vi) prepare all requirements to meet the processing criteria for the MFF and its first tranche. The activities under this PPTA led to the preparation of a program proposal in ADB's format for financing an investment program.

13. Economic and financial analyses undertaken for the investment program indicate that the NCPCP, part of which would be financed from the proceeds of the MFF and the first tranche, are both economically viable and financially sustainable. Increased agricultural production is the most important quantifiable economic benefits, accounting for about 90 percent of total quantified benefits. Other quantifiable benefits include increased provision of raw water for domestic, municipal and industrial uses, and increased hydropower generation. The indirect benefits of induced economic activities and investments by the upstream water infrastructure were not quantified, although expected to be significant. The economic internal rate of return (EIRR) is estimated at 12.5%. The EIRR is almost equally sensitive to changes to the investment cost and the economic benefits. If the investment cost is 4.6 percent higher or the benefits are 4.4 percent lower than in the base case, the EIRR will fall below the economic opportunity cost of capital of 12 percent. However, in recognition of the project's substantial non-quantified benefits, if a minimum required EIRR of 10 percent is adopted, the investment cost may be 29 percent higher or benefits 22 percent lower before the project switches from being economically feasible to economically infeasible.

14. The MIWRM engaged the Mahaweli Consultancy Bureau (Pvt.) Limited (MCB) to prepare and update the feasibility studies, detailed designs and safeguard documents in order to revise and improve them further, as necessary, to meet the government's and ADB requirements. Technical review and updating of feasibility-level and detailed designs and cost estimates were done by the PPTA of the available designs and geological and geotechnical information for all planned tunnel segments, and advised on updated cost estimates, additional geotechnical investigations, contracting methods, and detailed engineering. These technical due diligence outputs are organized into the following appendices of this report (i) a sector analysis and assessment, (ii) a water balance assessment, (iii) a climate change vulnerability assessment, (iv) the technical review summaries, (v) an institutional and policy assessment, (vi) detailed project construction cost estimates, and (vii) an economic and financial assessment.

15. The NWPC and UEC are classified as category A for environment and the MLBCR classified as category B in accordance with ADB's Safeguards Policy Statement (2009). The necessary safeguards requirements have been completed including the Environment Impact Assessments (EIAs) for the NWPC and UECP and an Initial Environmental Examination (IEE) for the MLBCR, all prepared by MCB. The MLBCR is unlikely to cause any significant environmental impacts. The potential impacts, mitigation measures, and monitoring and reporting requirements

are presented in the environmental management plans (EMPs) prepared for each EIA/IEE. The EMPs set out specific environmental safeguards and mitigation measures to be incorporated into the tender documents and define institutional responsibilities and associated cost estimates. An Environmental Assessment and Review Framework (EARF) was prepared by the PPTA to guide the formulation of safeguards documents for future tranches according to the government and ADB's policy requirements.[3]

16. The NWPC and UEC are both classified as category B for involuntary resettlement.[4] Resettlement implementation plans (RIPs) were prepared for each project to ensure that there are adequate social safeguards for person that shall be affected by permanent or temporary land acquisition including provisions for (i) replacement of assets or properties lost, (ii) rehabilitation of affected persons, and (iii) restoration of their incomes, or better, from pre-project level.[5] The PPTA prepared a Poverty and Social Assessment (PSA)[6] based on the findings of pre-feasibility socio-economic surveys, resettlement census, environmental field surveys, and academic studies that have been conducted in the project areas in the recent past to examine opportunities, constraints, and potential social impacts of the proposed projects on affected communities. The design and implementation of a robust and accessible grievance mechanism to be provided to the affected population is a key ADB requirement.

[3] The EARF is included in Appendix 13.
[4] UEC Tranche 1 is category "C" for resettlement as no land or persons will be affected by the 6.2 km length of canal to be constructed during the first tranche. However, Tranche 1 investment costs will be sufficient for all resettlement activities to be undertaken for the entire investment program.
[5] A Resettlement Framework (RF) and three RIPs were prepared by the PPTA: (i) NWPC- Tranche 1, (ii) NWPC, and (iii) UEC. The RIPs are included in Appendix 12.
[6] The Poverty and Social Assessment is included in Appendix 14.

II. DESCRIPTION OF THE PROPOSED PROJECT

A. Overview

17. The NCPCP will be implemented in two phases starting in Q1 2015 with completion scheduled for Q4 2023. The WRDIP will implement Phase 1 of the NCPCP structured into three financing tranches comprising multiple stages of three major investment projects:

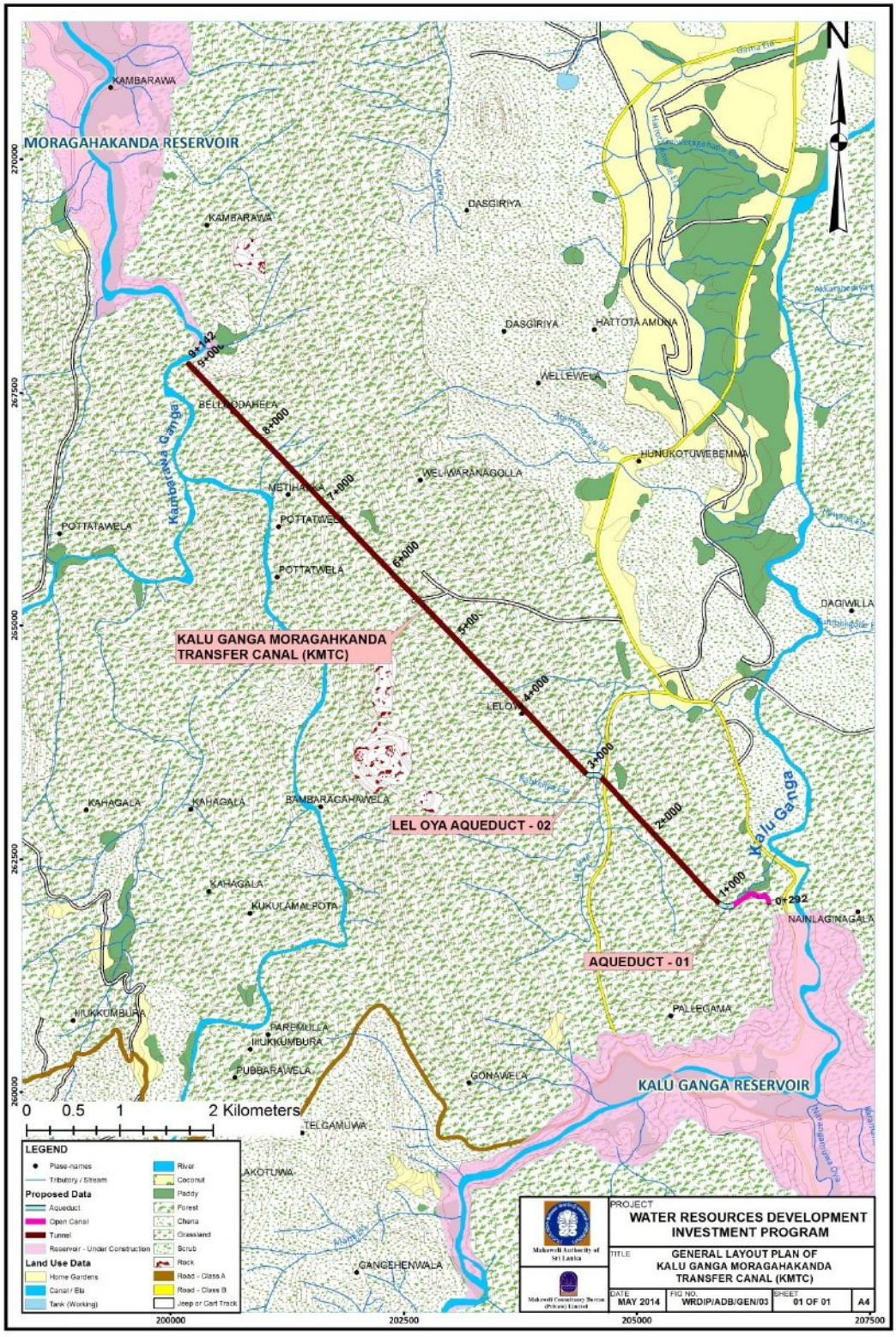
(i) The Upper Elahera Canal (UEC) Project. This comprises two parts. Firstly, the 9-km Kaluganga-Moragahakanda Transfer Canal (KMTC) will convey up to 771 MCM of water annually between Kaluganga and Moragahakanda Reservoirs, both of which are currently under construction. The reservoirs will retain local runoff and Mahaweli River flow diversions before supplying downstream irrigation and water supply schemes. Secondly, the 65.5-km Upper Elahera Canal (UEC) will annually convey up to 974 MCM northwards from Moragahakanda Reservoir to the existing Huruluwewa and Manankattiya Reservoirs, which feed existing irrigation and water supply schemes. Construction of the UEC is divided into three stages corresponding with each tranche: (a) Stage 1 will construct the first 6.2 km of open canals and associated structures of the UEC; (b) Stage 2 will use a tunnel boring machine (TBM) to construct a 26 km tunnel of the UEC, and two tunnel segments of the KMTC will be built using the drill and blast method (7.8 km); and (c) Stage 3 will construct remaining 50 km of open and cut-cover canal sections and two tunnels ranging from 70 m to 0.69 km using drill and blast method.

(ii) The North Western Province Canal (NWPC) Project will annually withdraw 130 MCM from Dambulu Oya River and the existing Nalanda Reservoir (via the existing Wemedilla Reservoir) to command new and existing irrigation and water supply reservoirs located throughout North Western Province via 96 km of new and upgraded canals including a new 940 m tunnel and two new 25 m tall earth gravity dams impounding the planned Mahakithula and Mahakirula Reservoirs. The NWPC will be constructed in two stages: (a) Stage 1 will construct the 29 km of open canals between the Wemedilla tank and the new Mahakithula and Mahakirula Reservoirs, the two dams, and the tunnel using drill and blasting method; and (b) Stage 2 will construct the remaining open canal sections and associated structures. Stage 1 will be implemented in Tranche 1 and Stage 2 in Tranche 3.

(iii) Minipe Left Bank Canal Rehabilitation (MLBCR) Project, located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork's weir by 3.5 meters to regulate generation inflows, (b) construct new automatic downstream-controlled intake gates to the left bank canal; (c) construct new emergency spill weirs to both left and right bank canals; and (d) rehabilitate the 74-km Minipe Left Bank Canal, including regulator and spill structures, to improve conveyance and reliability of service to existing farmers.

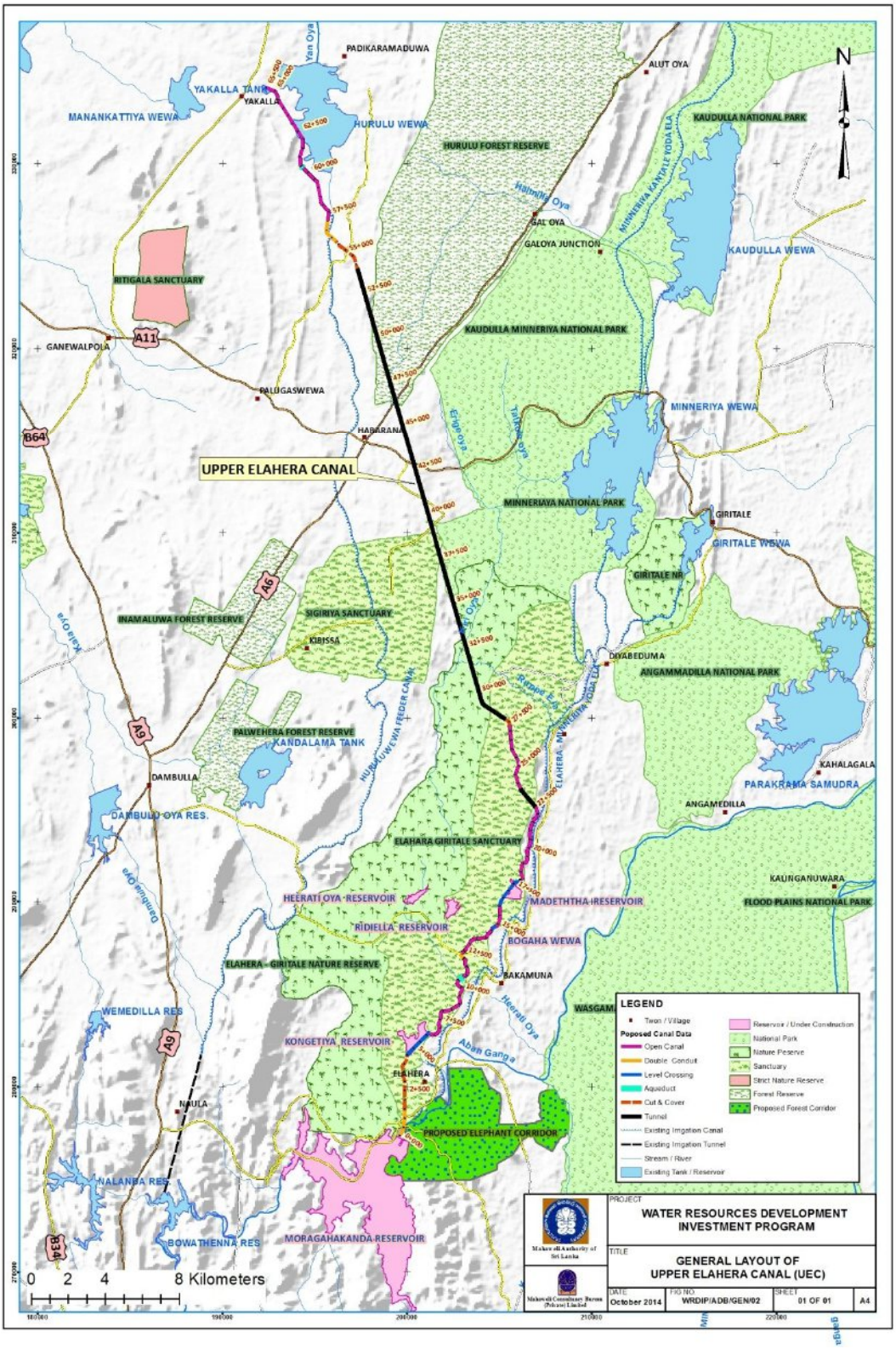
18. Future investments under Phase 2 (not under this investment program) will: (i) transfer additional water from Mahaweli River to Kaluganga Reservoir and the UEC; and (ii) construct the NCPC that will take water to the Northern Province.

Figure 2: Layout Map of the Kalu Ganga – Moragahakanda Transfer Canal



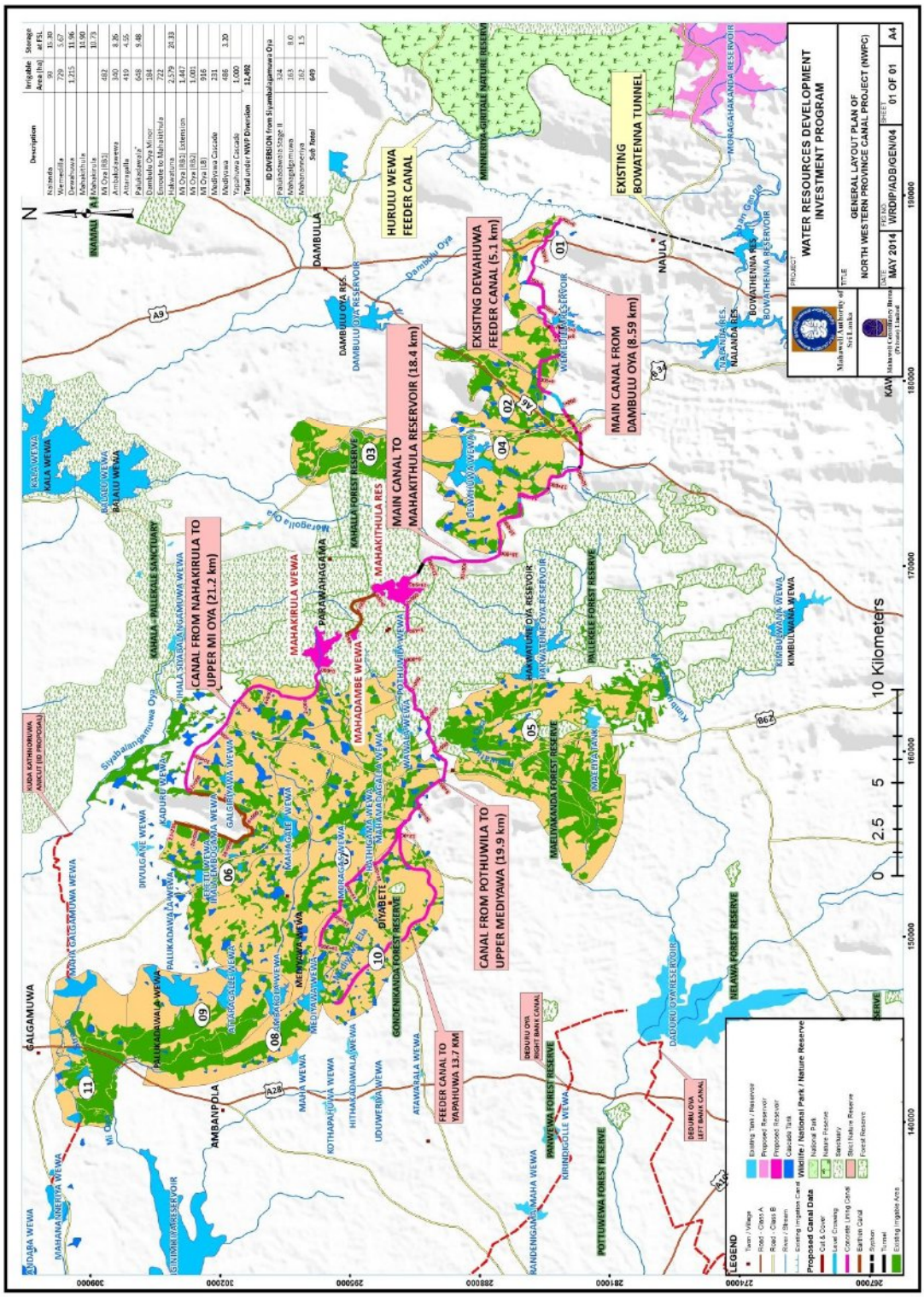
Source: MCB, 2014

Figure 3: Layout Map of the Upper Elahera Canal



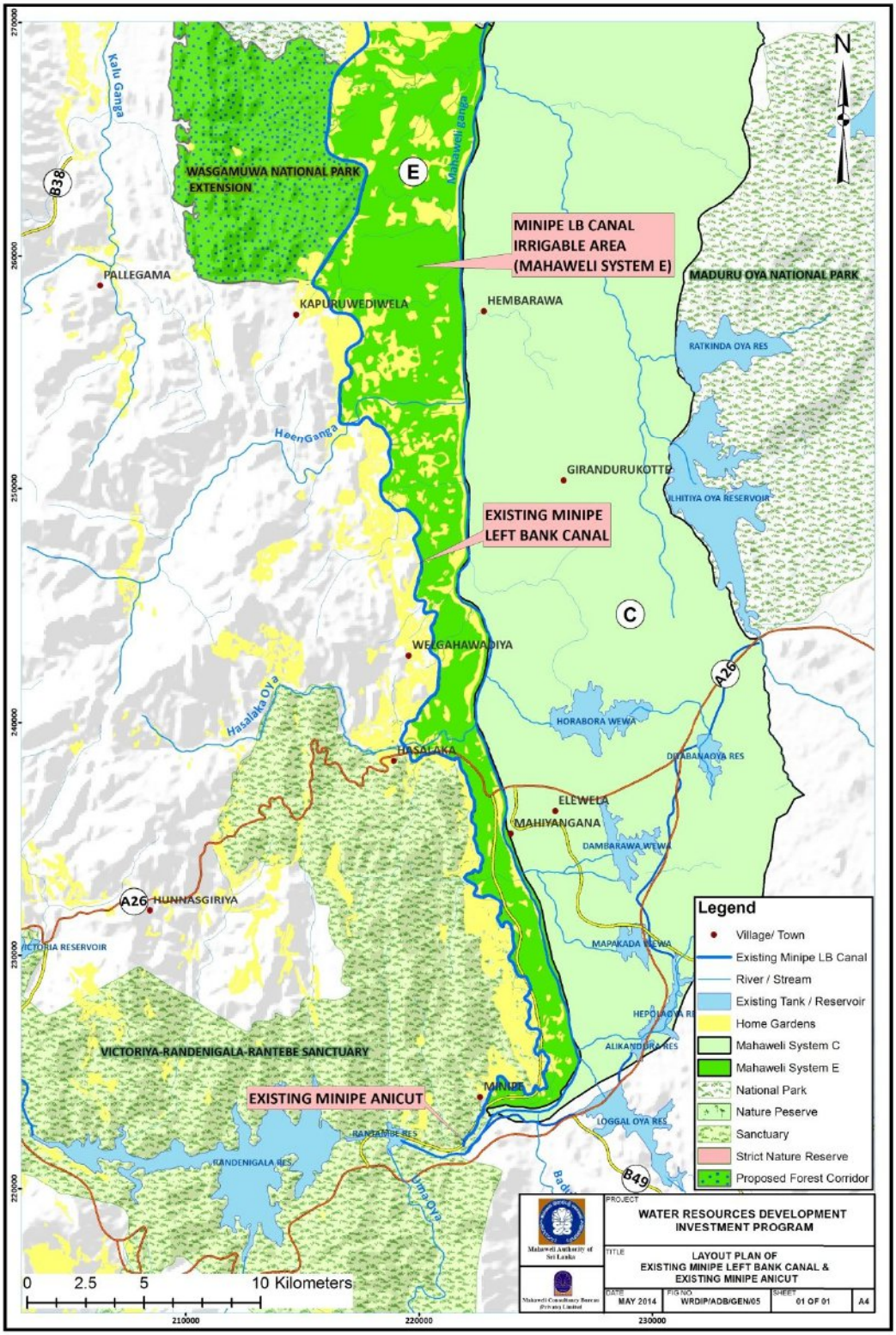
Source: MCB, 2014

Figure 4: Layout Map of the North Western Province Canal



Source: MCB, 2014

Figure 5: Layout Map of the Minipe Left Bank Canal Rehabilitation



Source: MCB, 2014

B. Final Project Designs

1. Technical Review

19. The purpose of the PPTA technical due diligence review was to confirm that planning, engineering, hydraulic design, civil design, and implementation details of the proposed project were done in accordance with established professional principles, practices and criteria to allow final project evaluation and preparation of ADB project documents to proceed. Technical reviews of more specific disciplines have been identified and conducted as necessary.

20. All aspects of the detailed feasibility studies were examined including:

- Range of options considered, their engineering and technical viability
- Assessments of capital and operating costs, and the achievable cost savings
- Rationales for the proposed design, specific components, and operational modes
- Timescale for project implementation

21. The PPTA technical review of existing feasibility studies and associated reports focused on the following main items:

- Feasibility Studies prepared by the MCB (during 2012-2013)[7]
- Results of surveys and geotechnical investigations, particularly as regards to tunnel layout, design and construction
- Supporting studies and reports, as applicable

22. The MIWRM developed a HEC-RAS model[8] for the UEC in order to better understand the dynamic inter-actions between the design and operation of the canal and possible flow conditions, particularly in terms of the level crossings and transient times for flows in the system. The allowable hydraulic headloss and other aspects of the design of the inlet and outlet structures and transition sections will be the subject of further modeling and analysis.

[7] These feasibility studies include: *Final Report for Consultancy Services on Modification to Configuration of Moragahakanda – Kalu Ganga (M-K) Projects to Integrate NCP Project Layout* (date: May 2013); *Final Report for Consultancy Services for Feasibility Studies for Diversion of Mahaweli Water to Upper Mi Oya & Hakwatuna Oya Basins in Kurunegala District via Existing Bowatenna Tunnel* (date: October 2013); *Final Report for Consultancy Services for Feasibility Studies and Detailed Design of Raising/Modifications to Minipe Anicut and Rehabilitation of Minipe Left Bank Canal* (date: March 2013); and *Pre-Feasibility Study for the Implementation of North Central Province Canal* (date: February 2012).

[8] Pathirana, K.P.P., K.A.U.S. Imbulana, S.D. Gunatilake, and A.G.T.N. Jayaweera. 2013. *Hydraulic Modeling of the Upper Elahera Canal*. Interim Report.

2. Detailed Design Technical Summaries

23. During the PPTA the MCB, under the direction and guidance of the MIWRM, prepared Technical Summaries of each feasibility study / detailed design in order to present the latest findings and recommendations, and cost estimates since the preparation of the original feasibility studies.[9] The existing feasibility studies and detailed designs have been through a formal review process utilizing ad hoc Technical Review Committees (TRCs) comprising representatives from the MASL, DOI and other relevant stakeholders or interested parties. In addition to discussions at technical review meetings recorded in minutes of meeting, written comments were provided in the form of letters from the PPTA Consultants. The Technical Summaries for the KMTC-UEC, NWPC and MLBCR are organized into the following sections: (i) scope, (ii) system overview, (iii) project components, (iv) base data, (v) design criteria, (vi) water availability, (vii) implementation, (viii) benefits, and (ix) costs.

C. Cost Estimates

24. The total estimated construction cost for the investment program is Rs. 72,600 million. For the economic and financial assessment of the WRDIP, updated engineer's base cost estimates were prepared for each contract package as summarized in **Table 1**.[10] On the basis of these, final construction cost estimates for the entire program were prepared by adding the following (i) taxes and duties, (ii) physical contingencies, and (iii) price contingencies. In addition to the base cost estimates, the program costs associated with the following were determined: (i) environmental mitigation, (ii) resettlement, (iii) consulting services, and (iv) recurrent costs.

25. The updated construction cost estimates (engineer's base costs) have been prepared on the basis of (i) updating the bill of quantities for each tender according to the most recent design revision and modifications; (ii) updating the basic unit rates to 2014 amounts;[11] (ii) applying an Overheads and Profit Factor (OH & PF) per the government's classification of domestic construction firms doing civil works; and (iii) the addition of physical contingencies (10%).[12] The regular rate for physical contingencies in ADB projects of this nature is 10% for civil works and 5% for goods and equipment, and land acquisition.

26. The government will separately fund modifications and upgrades to the minor tank cascades to be supplied with irrigation water from the NWPC. This includes about 300 minor tanks of varying sizes, most of which have ungated outlets (spill weirs). To improve the equity of water distribution and overall system efficiency, these minor tanks would be upgraded by installing gated outlets, measurement devices, and other minor works. An indicative cost estimate was prepared by the MCB based on a pilot study being carried out in Pihimbiyagellawa Cascade in the Malwathu Oya Basin.

[9] The Technical Summaries are included in Appendix 6.
[10] The Engineer's Estimates for civil works packages are included in Appendix 7.
[11] MIWRM. 2014. *Engineer's Unit Rates for Construction Works*. Rates Committee, MIWRM, Colombo. (New rates are applicable from 01 January 2014.)
[12] A physical contingency of 20% was applied to the NWPC civil works package for the Mahakithula and Mahakirula Reservoirs.

Table 1: Summary of Engineer's Base Cost Estimate by Contract Package

No.	Description	Tranche	Rs. Million[1]
Minipe Left Bank Canal Rehabilitation (MLBCR)			
NCB-1	Rehabilitation of Minipe LB Canal (0+000 km to 30+140 km) - Stage 1	1	357.94
NCB-2	Rehabilitation of Minipe LB Canal (30+140 km to 49+820 km) - Stage 2	1	177.36
NCB-3	Rehabilitation of Minipe LB Canal (49-820 km to 63+650 km) - Stage 3	1	701.80
NCB-4	Rehabilitation of Minipe LB Canal (63+650 km to 73+960 km) - Stage 4	1	327.84
NCB-5	Rehabilitation & Electrification of 8 Nos. Radial Gated Structures and Improvements to 2 Nos. Cross Regulators of Minipe LB Canal	1	148.90
ICB-1	Raising of Crest of Minipe Anicut Including Water Control and Measurement Facilities for LB and RB Canals	1	743.39
	Subtotal – 1 (MLBCR)		**2,457.23**
North Western Province Canal (NWPC)			
NCB-1	Construction of Main Canal from Wemedilla LBMC to Nebadagahawatta Wewa (0+000 km to 5+250 km) and New Sluice & Tail Canal (0+000 km to 0+600 km)	1	744.38
ICB-1	Construction of Mahakithula Inlet Tunnel, Mahakithula and Mahakirula Reservoirs, Feeder Canal Length 3.66 km from Mahakithula to Mahakirula Reservoir[2]	1	6,397.55
ICB-2	Construction of Main Canal from Nabadagahawatta Wewa to Mahakithula Reservoir Inlet Tunnel (5+250 km to 22+460 km)	1	2,864.32
NCB-2	Construction of Mi Oya RB1 Canal from Mahakirula to Galgiriyawa (0+00 km to 13+731 km)	3	1,130.54
NCB-3	Construction of Mi Oya RB2 Main Canal from Galgiriyawa to Kaduruwewa (13+731 km to 21+232 km)	3	459.86
NCB-4	Construction of Main Canal from Mahakithula Reservoir to Potuwila Tank (0+000 km to 1+491 km) and Potuwila Tank to Upper Mediyawa (0+000 km to 19+980 km)	3	1,517.91
NCB-5	Construction of Yapahuwa Canal From Mediyawa Canal (0+000 km to 11+200 km)	3	790.18
NCB-6	Construction of Main Canal from Dambuluoya to Wemedilla LBMC including Dambuluoya diversion structure (0+000 km to 8+590 km)	3	1,603.53
	Subtotal – 2 (NWPC)		**15,508.27**
Upper Elahera Canal and Kaluganga Moragahakanda Transfer Canal (UEC & KMTC)			
ICB-1	Construction of Upper Elahera Canal (0+100 km to 6+226 km)	1	3,312.45
ICB-2	Construction of Main Tunnel of Upper Elahera Canal by One TBM (27+509 km to 54+249 km)	2	31,086.72
ICB-3	Construction of Upper Elahera Canal (6+226 km to 27+509 km)	3	6,231.46
ICB-4	Construction of Upper Elahera Canal (54+249 km to 65+500 km)	3	5,729.89
ICB-5	Construction of Feeder Canal from UEC to Manankattiya-Eruwewa Stream & Widening the Eruwewa-Mahakanadarawa Stream	3	2,597.40
ICB-6	NCPCP Water Management Software	3	260.00
ICB-2	Construction of Kaluganga - Moragahakanda Transfer Canal with Drill & Blasted Tunnels (0+292 km to 9+161 km)	2	5,441.23
	Subtotal – 3 (UEC and KMTC)		**54,659.15**
	Total		**72,624.65**

[1] Inclusive of 10% physical contingency
[2] Inclusive of 20% physical contingency
ICB = international competitive bidding, NCB= national competitive bidding
Source: PPTA 8633-SRI

27. A total of six (6) tunnels will be constructed with the following lengths and diameters. The technical report prepared by the PPTA Consultant covering the geological conditions and a geotechnical design assessment of the tunnels and dams is included in **Appendix 6**.

UEC			
Tunnel 1 = 70 m	6.0 m base width	Horseshoe	Drill and blast
Tunnel 2 = 690 m	6.0 m base width	Horseshoe	Drill and blast
Tunnel 3 = 26,040 m	7.75 m dia.	Circular	TBM
KMTC			
Tunnel 1 = 1,840 m	5.5 m base width	Horseshoe	Drill and blast
Tunnel 2 = 5,992 m	5.5 m base width	Horseshoe	Drill and blast
NWPC			
Tunnel = 940 m	5.0 m base width	Horseshoe	Drill and blast

D. Investment and Finance Plan

28. The cost of the investment program is estimated at $675 million (refer to **Table 2**). The government has requested an MFF in an amount up to $453 million equivalent from ADB's ordinary capital resources and Special Funds resources to help finance a part of the investment program. The MFF will consist of up to three tranches, subject to the government's submission of related periodic financing requests, execution of the related loan and project agreements for each tranche, and fulfillment of the terms and conditions and undertakings set forth in the framework financing agreement.

29. The financing plan is in **Table 3**. The first tranche will be financed, in part, from a loan from ADB's OCR ($76 million) and a loan from ADB's Special Funds resources ($74 million). The OCR loan will have a 26-year term, including a grace period of 5 years, an annual interest rate determined in accordance with ADB's LIBOR-based lending facility, a commitment charge of 0.15% per year, and such other terms and conditions set forth in the draft loan agreement. The loan from ADB's Special Funds will have a 25-year term, including a grace period of 5 years, an interest rate of 2.0% per year, and such other terms and conditions set forth in the draft loan agreement.

Table 2: WRDIP Investment Program
($ million)

Item	Amount[a]	
	Investment Program	Tranche 1
A. Base Cost[b]		
1. Water conveyance infrastructure constructed or rehabilitated	467	116
2. Systems for SIWRM and ISEWP developed	4	2
3. Multi-disciplinary investment program management operational	46	31
Subtotal (A)	**517**	**149**
B. Contingencies[c]	**131**	**29**
C. Financing Charges during Implementation[d]	**27**	**11**
Total (A+B+C)	**675**	**189**

SIWRM = strengthening integrated water resources management, ISEWP = improving system efficiencies and water productivity

[a] Includes taxes and duties to be financed from government resources ($15 million for the first tranche and $54 million for the investment program).

[b] In mid-2014 prices.

[c] Physical contingencies computed at 10% for civil works and equipment. Price contingencies computed at 0.3%-1.4% on foreign exchange costs and 6.0% on local currency costs; includes provision for potential exchange rate fluctuation under the assumption of a purchasing power parity exchange rate.

[d] Includes interest and commitment charges. Interest during construction for the OCR loan has been computed at the 5-year forward LIBOR plus a spread of 0.6%. Commitment charges for the OCR loan are 0.15% per year to be charged on the undisbursed loan amount. Interest during construction for the Special Funds Resources loan has been computed at an interest rate of 2% per year.

Source: Asian Development Bank estimates.

Table 3: WRDIP Financing Plan

Source	Investment Program		Tranche 1	
	Amount ($ million)	Share (%)	Amount ($ million)	Share (%)
Asian Development Bank				
Ordinary capital resources (loan)	262	39	76	40
Special Funds resources (loan)	191	28	74	39
Cofinanciers[a]	116	17	-	-
Government of Sri Lanka	106	16	39	21
Total	**675**	**100**	**189**	**100**

[a] To be confirmed. Initial discussions are taking place with potential cofinancier(s).

Source: Asian Development Bank estimates.

III. SECTOR BACKGROUND

A. Sector Assessment

30. **Agriculture and natural resources** is a key sector in Sri Lanka contributing to improving household food and financial security, as 80% of the population are rural and of which 70% are dependent on the sector for their livelihood.[13] The sector as a whole accounts for more than 10% of GDP, 30% of employment and 25% of export revenue. However, the contribution to GDP has declined in recent years, and productivity needs to increase to keep pace with rising demand for domestic consumption and to achieve national goals of food self-sufficiency and poverty reduction.

31. While Sri Lanka is a relatively water rich country, with more than 2,300 m^3 per capita and demand to supply ratio of 25%, the challenge is the distribution of water, between a 'wet zone' of high availability and low demand, and a 'dry' zone of low availability and high demand. This is not a new problem as evident from the long history of building dams (minor tanks) and transfer canals. Today's challenge is to develop the potential of untapped water resources to improve livelihoods and living conditions in water scarce areas in the interests of inclusive growth and national development.

B. Water Balance Assessment

32. The reliability of water availability from the Mahaweli River Basin for the investment program is essential to assess under both current and future water demand conditions to determine supply reliability and impact of the projects on other existing and planned water uses within the MDP. As presented in the Water Balance Assessment (**Appendix 4**), the planned scheme development, inclusive of the WRDIP, has been comprehensively assessed within the context of the existing scheme and proposed future developments. The outcome of this assessment confirms the reliability of water availability, within acceptable levels of supply reliability to meet the program requirements, and without impacting on other existing water uses and planned water resource development projects and uses within the Mahaweli Scheme. It is also potentially sensitive to climate change impacts, particularly in terms of impacts on water demand due to predicted temperature increases and changes to rainfall patterns (refer to the Climate Risk and Vulnerability Assessment[14]). The results of this water balance assessment confirm that the water supply requirements for consumptive and non-consumptive uses are consistent with the planned climate-resilient development of the WRDIP.

33. The assessment utilized the Mahaweli Water Balance Model to evaluate a number of scenarios for incrementally expanding scheme development over a number of stages. The Mahaweli scheme is a complex system with multiple water sources, storage sites and transfer routes for water supply. In terms of water demand there are a large number of command areas with varying levels of internally-generated water resources. The numerical model was used to optimise supply and demand scenarios, within a set of operating rules for hydropower generation, and irrigation and drinking water supply allocation rules.

[13] The Sector Assessment is included in Appendix 3.
[14] See Appendix 5 Climate Risk and Vulnerability Assessment of the PPTA Final Report and the RRP Supplementary Appendix 4 Project Climate Risk Assessment and Management Reporting.

34. **Table 4** presents a summary of the system areas supplied, fully and partially, from the Mahaweli Scheme currently and in the future, as well as the current and planned cropping intensities (CI, %). The total scheme irrigated area is currently approximately 146,000 ha, and with Phase 1 this will be extended out to 162,000 ha with the addition of areas in NWPC, the compensation area (1,420 ha) to be developed downstream of the Moragahakanda Reservoir (System D1), and addition of System I (3,264 ha). With the completion of Phase 2 the scheme area will increase to 232,500 ha, with the addition of the NCP minor and major tank cascades (47,500 ha), extension of the NWPC (1,000 ha), extension of System I (to 5,264 ha), addition of System B Right Bank Canal (10,000 ha), addition of the Kantale sugar estate in System D1 (6,576 ha), and expansion of System MH by 3,500 ha. It should be noted that the table refers to the MDP as a whole, current and future, inclusive of all systems (including those not part of the WRDIP).

Table 4: Irrigation Systems by Phase

Irrigation System	Current		Phase 1		Phase 2	
	Area (ha)	CI (%)	Area (ha)	CI (%)	Area (ha)	CI (%)
A	7,050	2.00	7,050	2.00	7,050	2.00
B	18,500	1.78	18,500	1.80	28,500	1.80
C	22,800	1.88	22,800	2.00	22,800	2.00
D1	26,520	1.91	27,940	1.91	34,516	2.00
D2	10,480	1.99	10,480	2.00	10,480	2.00
E	7,530	1.95	7,530	2.00	7,530	2.00
F	3,000	2.00	3,000	2.00	3,000	2.00
G	6,210	1.85	6,210	2.00	6,210	2.00
H	34,545	1.89	34,545	1.89	34,545	1.89
I			3,264	1.80	5,264	1.80
IH	4,907	1.67	4,907	1.83	4,907	1.83
MH	4,210	1.53	4,210	1.80	7,710	1.80
NCP					47,500	1.80
NWP			11,492	1.80	12,492	1.80
Total	**145,752**	**1.88***	**161,928**	**1.91***	**232,504**	**1.89***

Source: MCB, 2013 (derived from Water Balance Study Report) (*) Cropping intensities for the area under direct scheme command, that is as supplied with water (partially or fully) from the Mahaweli Ganga (which differs from that reported below, which include areas not under command for the purpose of determination of project benefits).

C. Climate Risk and Vulnerability Assessment

35. The Mahaweli scheme is characterized by the high storage volume (more 50% of the mean annual volume) and the multiple transfer points, from the Pologolla in the upper catchment, Randenigala below the main dam cascade and (planned) pumping from the lower catchment at Kalinganuwara. The multiple storage dams and multiple transfer points offer a number of options for system operation to optimize water transfer and hydropower generation under a range of water supply situations. In essence the scheme under normal hydrological conditions has more than enough water to meet demands with mean annual volume of 5,500 MCM compared annual demand of 3,700 MCM. However, one constraint is to maintain hydropower generation and water availability during prolonged droughts. The potential impacts of climate

change were tested under different water supply and demand scenarios.[15] The approach was to look at a range of possible impacts so to provide an indication of the scale of impacts as the basis for determining the scale of necessary adaption measures, if any.

1. Climate Risk Screening

36. The project climate risk screening includes the preparation of a screening report based on the program[16] and an AWARE risk assessment for the project and sub-projects. The screening report and the AWARE assessment report are presented as annexes to the Climate Risk and Vulnerability Assessment (CRVA). While there are a number of climate change parameters, the principal ones directly relevant to the project for the assessment of risk and adaptation measures are changes in temperature and rainfall.

37. The climate sensitive components are identified as (i) changes in hydrology of the Mahaweli River Basin due to a decline in annual runoff resultant reduction in water availability, and (ii) a reduction in reservoir capacity due to siltation as a result of increase SWM precipitation exacerbating soil/bank erosion in the upper catchment and loss of reservoir storage capacity.

38. The screening report identified the climate changes under the A2 scenario for the Mahaweli Basin as a rise of 1.8ºC in average annual mean temperature, and an increase of 4.2% (85 mm) in annual precipitation, but with a higher increase in the lower catchment (>4%) and lower in the upper catchment (<4%). It also identified seasonal differences in precipitation with a decrease of 3.8% in the December to April period (corresponding to the NEM) and 11% increase for the May to November period (corresponding to the SWM).

39. Additional risk analysis was also prepared by ADB using the AWARE project assessment. The AWARE assessment evaluates risks within individual topic categories (16) and overview final project risk. The individual risks are presented on a radar chart within three color bands; green band (inner circle) suggests a lower level of risk in relation to a risk topic, red band (outer band) suggests a higher level of risk and orange band (middle band).

40. The key risk topics include temperature increase rated high, precipitation increase, precipitation decrease, water availability, wind speed increase and onshore category 1 storms. The most relevant to the specific project activities and infrastructure include:

- **Temperature increase**; higher temperatures and heatwaves may increase crop water demand (due to higher evapotranspiration) and reduce crop productivity (due to temperature sensitivity).
- **Increased SWM precipitation** may lead to increased runoff and therefore erosion and siltation of water courses, reservoirs, and flooding and landslide events
- **Decreased NEM precipitation** may result in higher soil moisture deficits, and therefore increase irrigation demand and reduce crop yields.

[15] The Climate Risk and Vulnerability Assessment is included in Appendix 5.
[16] ADB. 2014. *Climate Risk Screening Report- Water Resources Development Investment Program*. Draft Report. Manila.

- **Water availability** at local project command area level and for transfer from the Mahaweli river basin is directly linked to the changes in precipitation above.
- **Wind speed increase**; high peak speeds may be associated with more extreme weather events particularly onshore storms.
- **Extreme events;** due to more frequent and intensified rainfall events.

2. Impacts and Vulnerability Assessment

41. The impact assessment shows the principal climate change effects likely to directly impact on the project are air temperature which impacts on water demand and agricultural productivity, and those related to precipitation; annual and seasonal changes and frequency and intensity of events, which determine water availability and hazard risks (flooding, landslides and siltation). All models predict an increase in mean annual temperature, with the A2 and B2 generally being within the range of 1.2 to 4ºC. In a 2010 IWMI publication[17] mean temperature is predicted to increase by 0.9 to 4ºC (over the 1961-1990 baseline) by the year 2100, as a result Maha season irrigation water requirements for paddy would increase by 13-23% by 2050.The current trends and model predictions for temperature indicate that it is most likely to increase over the project lifetime, to 2050 and beyond. As outlined above, the best estimate is an increase of up to 2ºC by 2100. As discussed below the project implications are likely to be an increase in irrigation water demand and potential adverse impact on crop productivity.

42. However, rainfall projections are highly variable and contradictory, but with the majority predicting a higher MAP. Those predicting higher MAP envisage an increase in SWM rainfall, and decrease in NEM rainfall. De Silva[18] predicts MAP increase by 14% for A2 and 5% for B2 (baseline 1961-1990); a NEM rainfall decrease by 34 to 26% (for A2 and B2 respectively), and increase of SWM rainfall by 38% to 16% (for A2 and B2 respectively). The projections also infer an increase in the variability and intensity of rainfall events. Though there appears to be consistency that in terms of seasonal change, with SWM precipitation increasing and a decline NWM precipitation. Changes in precipitation would have a number of impacts on the project, lower rainfall would reduce water availability, both at field level (reduce effective rainfall) and basin level i.e. transfer from the Mahaweli, and higher rainfall would increase water availability and reduce irrigation demand, and therefore could be an opportunity for increased productivity (increase irrigated areas and higher cropping intensity). Changes in rainfall intensity may also have implications for system design, on duties of canals, cross drainage structures and reservoirs capacities.

43. The approach to assessing vulnerability is to determine the sensitivity of the project to likely climate change driven changes in water demand and availability. Sensitivity was tested for the scenarios of **increased water demand** (Scenario 1) and **decreased water availability** (Scenario 2) and at three levels (5%, 10% and 15%), which are likely to exceed likely change

[17] IWMI. 2010. *Impacts of Climate Change on Water Resources and Agriculture in Sri Lanka: A Review and Preliminary Vulnerability Mapping*. Report No. 135. International Water Management Institute, Colombo.

[18] De Silva, C.S. 2013. Impact of Climate Change on Water Resources and Agriculture in Sri Lanka. *Climate Change Impacts and Adaptations for Food and Environmental Security, Proceedings of the International Conference Colombo,* Sri Lanka, 30-31st July 2013.

levels. The scenarios were applied to the Mahaweli Water Balance model[19] to determine the impact on scheme water balances, water availability and hydropower generation to Mahaweli Scheme at full development. The increase in irrigation demand was applied as a percentage increase in reference evapotranspiration (for the six main climate stations), and thus carried through into irrigation water demand and combined system demand. The decrease in water availability was applied to inflow values at the key flow nodes including Kotmale, Pologolla, Victoria, Randenigala, Lower Uma Oya, Rantambe and Kalinganuwara.

44. The model output includes (i) the number of years for the three reliability criteria over the modelled period (40 years) that were not met, (ii) the volume of water pumped at Kalinganuwara to compensate for upstream diversions (at Polonuwara and Randenigala) to the NWPC and UEC, and (iii) the scheme's annual energy production. The model results for Scenario 1 indicate the system will have full reliability at +5% ETo increase for all sub-projects, and full reliability for both the NCP major systems and MLBC at the higher demand levels. However, partial failure for the NCP minor and NWP systems occurs at a +10% ETo increase, and full failure at a +15% ETo increase. With an increase of in crop water demand of +15%, the amount of pumping at Kalinganuwara would have to increase to about 700 MCM compared to base case annual volume of 400 MCM, which would create an additional scheme cost. The results for Scenario 2 show a similar results, with no failures for the -5% decline in inflows, but with failure at the -10% and -15% for NCP minor cascades and the NWPC. The NCP major cascades and MLBC remain reliable at the -10% and -15% availability levels. Pumping would also have to increase at Kalinganuwara to compensate for the associated increase in diversions upstream at Pologolla and Randenigala. Energy production progressively declines due to the lower volumes of water with the system, by 16% of annum generation with a 15% reduction in inflows.

45. In addition to increased water demands for irrigation, temperature rise may also adversely impact on rice production. Rice is highly sensitive to temperature during the reproductive stage, with significant increases in grain sterility occurring when temperatures reach above 34ºC.[20] This is more likely to occur during the Yala season, when temperatures can exceed this threshold. Given that rice is the principal crop within the project areas (and in Sri Lanka) any decline in productivity could adversely impact on project financial and economic performance, as well as household food security and income.

[19] The Mahaweli Water Balance Model is a mathematical computer used for the planning and management of the Mahaweli Scheme. The model integrates the scheme inputs, functions and outputs, including inflows, reservoir storage, hydropower generation and water issues (allocations) for irrigation and domestic drinking water supplies. It was developed in the 1980s by the Canadian consulting firm, Acres International, as a purpose-built package for the Mahaweli Scheme. It is used by the MASL for in preparation of seasonal operational plans (Maha and Yala) and for system management. The model was also used in preparation of the Water Balance Study Report (MCB, Oct 2013) for assessment of development options for the NCPCP.

[20] Horie T., J.T. Baker, H. Nakagawa, T. Matsui. and H.Y. Kim. (2000). Crop Ecosystem Responses to Climatic Change: Rice. In: *Climate Change and Global Crop Productivity*. (Editors K.R. Reddy and H.F. Hodges). CAB International, Wallingford, UK. pp. 81-106.

3. Potential Adaptation Measures

46. The investment program is inherently a climate change adaptation measure because it will increase water storage and transfer from wet and dry areas. However additional specific adaption measures are included in the infrastructure designs such as provision for increased flows in the canals and cross-drainage structures. Furthermore, the investment program includes soft components for climate resilience that will: (i) assist irrigation managers to improve system water management and farmers to increase agriculture water productivity; and (ii) assist the government improve their policies and institutions based on the principles of integrated water resources management.

47. ADB (2012)[21] states that "*the purpose of adaptation assessment is to identify and prioritize the most appropriate adaptation measures to incorporate into the project. This includes the identification of strategies to minimize damages caused by the changing climate and to take advantage of the opportunities that a changing climate may present".*

48. Climate adaptation options in the agriculture sector can be classified into four groups (i) engineering options (structural; specifications, design standards, irrigation etc.); (ii) non-engineering (management, operation, maintenance, capacity building etc.); (iii) biophysical (plant breeding); and (iv) maintaining the status quo (ie, 'do nothing'). The following paragraphs outline a number of adaptions options for the potential project climate change vulnerabilities.

49. Options for adapting to an <u>increase in water demand</u> include:

- Improve irrigation efficiencies[22] to reduce irrigation demand; current system efficiencies are low due in part to significant conveyance losses (estimated to be of the order of 30-40% some project areas), and there is considerable room for improvement through investments in canal and water control infrastructure (at cascade tank and farm levels).
- Reduce cropping intensities[23]; a reduction in cropping intensity would reduce overall irrigation demand, and however, while relatively low cost to administer this would reduce project and farm benefits.
- Improve cascade system water management; there is potential for improvement of the scheduling of irrigation diversions to reduce losses to percolation and drainage, thus improve system conveyance efficiency.
- Improve farm irrigation management; current application efficiencies are reportedly low and there is potential to improve on-farm irrigation scheduling.
- Change cropping regimes; the promotion of lower water demand and higher value cropped (vegetables) is part of the ongoing development planning, which should reduce water demand.

[21] ADB. 2012. *Guidelines for Climate Proofing Investment in Agriculture, Rural Development and Food* Security. Manila
[22] Engineering option
[23] Non-engineering option

50. Options for adapting to a decrease in water availability include:

- Reduce irrigation demand; through the above option(s)
- Increase water storage capacity; there is some potential to increase storage capacity within the project command areas through construction of new reservoirs and heightening of existing tanks.

51. Options for adapting to a decrease in rice productivity include:

- Improve farming practices; changes to on-farm practices such adjustments to planting dates to avoid flowering during high temperature periods, and selection of more heat tolerant varieties
- Improved plant breeding; the development of heat tolerant varieties less sensitive to peak temperatures.
- Crop diversification; as mentioned above there is potential for diversification to other more profitable crops with lower water demand as is planned under the Stage III of the NCPCP.

52. Options for adapting to an increase in flood risks include

- Design standards; review current design standards for water infrastructure (dams, cross drainage and protection) to verify compliance with potential increase in flood event magnitudes and return periods and if necessary (during project implementation) modify detailed design.
- Water resources management; improve catchment and river basin management to better capacity, planning and monitoring to reduce flood risk.

53. During project implementation the above options will be further developed within the ISEWP and SIWRM consultancy components of the WRDIP to support improved water resources and irrigation planning and management, within the project areas and more generally within the Mahaweli Basin.

IV. IMPLEMENTATION

A. Implementation Schedule

54. The WRDIP will be implemented over 10 years with construction starting Q1 of 2015 as shown by the implementation schedule in **Appendix 8**. Tranche 1 will commence in 2015 and be completed by 2020. Tranches 2 and 3 are tentatively scheduled to commence in 2016 and 2018, respectively.

55. The status of each civil works package is summarized in **Table 5** (as of mid-December 2014). As of December 2014, the detailed designs, drawings and BoQs for each package were under preparation.

B. Procurement

1. Procurement Requirements

56. The scope of the WRDIP essentially comprises (i) establishment of a PMU and a PIU for each of the three investment projects, (ii) recruitment of an international consulting firm(s) for implementation assistance to the PMU and PIUs (ie, the PMDSC), (iii) civil and electrical/ mechanical works for the new construction and rehabilitation of irrigation and drinking water conveyance and distribution systems and ancillary works, and (iv) procurement of goods including software, IT equipment, project vehicles, office furniture, etc. These are detailed in the draft Procurement Plan. The Procurement Plan has been prepared for the sub-projects in Project 1 (ie, Tranche 1), and categorizes the works according to either national competitive bidding (NCB) or international competitive bidding (ICB) packages. The threshold amount for ICB for works is $15 million and for goods is $2 million. No changes to recently revised procurement thresholds are proposed.

57. Procurement under the investment program comprises the following major items: (i) 9 ICB civil works packages ($497 million); (ii) 11 NCB civil works packages ($61 million); (iii) 5 NCB good packages ($5 million); (iv) implementation consultants ($45 million); (v) shopping ($2 million); and (vi) provisions for community works and force accounts ($3 million).

58. Procurement to be financed from the ADB loans under the MFF will be strictly carried out in accordance with ADB's Procurement Guidelines for goods, works, services and consultants (March 2013), as amended from time to time. To foster competition the ADB permits bidders from all eligible countries to offer goods, works and service for all ADB-financed projects.[24] This means that, in general, eligible foreign firms will be able to participate in bidding for the NCB packages.

59. The PPTA Consultant in consultation with the MIWRM and the MCB prepared specimen NCB and ICB bid documents (using SBDs as updated by ADB in March 2014). The first NCB and ICB bids were forwarded to ADB for their review and approval during the PPTA. The ADB will review and approve all subsequent bid documents for packages under advanced contracting, as well as all ICB bid documents under the investment program.

[24] ADB. 2013. *Procurement Guidelines*. Manila.

Table 5: Status of Civil Works Packages (as of December 2014)

Water Resources Development Investment Program - Tranche 1 - Package Status														
Package	Description	Designs		Drawings		Cost Estimates		BOQ		Bid Documents				
		Feasibility	Detailed	Feasibility	Detailed	Feasibility	Engineers	Draft	Final	Draft	PMU/PIU Approval	MIWRM Approval	ADB Approval	
TRANCHE 1														
Minipe Left Bank Canal Rehabilitation														
MLBCR-NCB-1	Rehabilitation of LB Canal (0+000 km to 30+140 km) - Stage 1	Complete	Complete	Complete	Complete	Complete	Complete	Complete	In Progress	1-Dec-14	15-Dec-14	1-Jan-15		
MLBCR-NCB-2	Rehabilitation of LB Canal(30+140 km to 49+820 km) - Stage 2	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	1-Dec-14	15-Dec-14	1-Jan-15		
MLBCR-NCB-3	Rehabilitation of LB Canal(49+820 km to 63+650 km) - Stage 3	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	1-Dec-14	15-Dec-14	1-Jan-15		
MLBCR-NCB-4	Rehabilitation of LB Canal(63+650 km to 73+960 km) - Stage 4	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	1-Dec-14	15-Dec-14	1-Jan-15		
MLBCR-NCB-5	Rehabilitation & Electrification of Radial Gated Structures and Improvements to Cross Regulators of Minipe LB Canal	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	1-Dec-14	15-Dec-14	1-Jan-15		
MLBCR-ICB-1	Raising of Crest of Minipe Anicut Including Water Control and Measurement Facilities for LB and RB Canals	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	15-Dec-14	1-Jan-15	15-Jan-14		
North Western Province Canal														
NWPC-NCB-1	Main Canal from Wemedilla LBMC to Nabadagahawatta Wewa (0+000 to 5+250 km) & Construction of New Sluice & Tail Canal (0+000 to 0+600km)	Complete	Complete	Complete	Complete	Complete	Complete	Complete	In Progress	Complete	15-Jan-15	1-Feb-15		
NWPC-ICB-1	Mahakithula Inlet Tunnel, Mahakithula and Mahakirula Reservoirs, Feeder Canal Length 3.66 km from Mahakithula to Mahakirula Reservoir	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	1-Jan-15	15-Jan-15	1-Feb-15		
NWPC-ICB-2	Main Canal from Nabadagahawatta Wewa to Mahakithula Reservoir Inlet Tunnel (5+250 to 22+460 km)	Complete	Complete	Complete	In Progress	Complete	Complete	Complete	In Progress	1-Jan-15	15-Jan-15	1-Feb-15		
Upper Elahera Canal														
UEC-ICB-1	Upper Elahera Canal (0+100 to 6+226 km)	Complete	Complete	Complete	Complete	Complete	Complete	Complete	In Progress	Complete	15-Dec-14	1-Jan-15		

60. The government requested ADB's approval for advanced contracting to expedite implementation of the WRDIP. Advance contracting was approved by senior ADB management during the PPTA.[1] Retroactive financing is approved by ADB board to allowable provided that the total eligible expenditure under such financing does not exceed an amount equivalent to 20% of the Tranche 1 loan amount, and must have been incurred not more than 12 months before the loan signing. The government has been informed that the approval of advance action and retroactive financing does not commit ADB to finance the relevant projects under the investment program.

2. Procurement Capacity Assessment

61. A Procurement Capacity Assessment (PCA) for the MFF has been carried out by the PPTA Consultants for the MIWRM, MCB and MASL.[2] The agricultural sector and the WRDIP procurement classification is assessed as moderate (category B). The procurement engineer of the PMU/PIUs will monitor and report on the implementation of the procurement plan and will organize the procurement activities. Measures to strengthen the capacity of the project management and implementation staff in undertaking procurement activities will need to carried out including training on procurement and other aspects of project implementation.

62. The National Procurement Agency (NPA) was established in 2004 under Presidential Directive. The institution, which functions under the Ministry of Finance and Planning (MFP), is mandated to study, revise and adopt the procedures and processes of public procurement. The NPA brought out a Procurement Guideline and a Procurement Manual in 2006 applicable for goods and works. During 2007 standard requests for proposal and guidelines for consultants, non-consultant services, standard bidding documents (SBD) for works and goods and SBD for shopping procedures were issued by the NPA. The procurement guidelines have the backing of the country's laws and are applicable to all government institutions for the procurement of works, services and supplies and disposal of government assets. These Guidelines have been drafted in association with the major funding agencies such as the World Bank, the ADB and the Japan Bank for International Cooperation, to ensure they are harmonized to the maximum extent in order for their usage in foreign-funded projects as well. The Guidelines are available on the NPA's website as downloadable documents in English, Sinhalese and Tamil.

63. Based on the procurement capacity assessment of the agriculture sector and WRDIP, the following measures for improvement of procurement capacity are recommended:

- The NPA has been inactive and its autonomy eroded. It is essential to revive it as an independent agency tasked with procurement reform.
- Since the capacity of local irrigation works contractors is limited to small-size packages up to $4.7 million, for the WRDIP road sector contractors may be encouraged to bid.
- The working period is limited due to short closure period of irrigation canals. For such works, specifications could consider providing pre-fabricated lining sections / in-situ pavers instead of conventional methods of canal lining.

[1] ADB Memorandum, dated 11 September 2014: Proposed MFF for SRI: Water Resources Development Investment Program – Request for Approval of Advanced Contracting.
[2] The Procurement Capacity Assessment is included in Appendix 9.

- In the mid-size contracts ($10-40 million), there are few qualified contractors in Sri Lanka; foreign bidders may be less interested. It would therefore be preferable to keep contract packages small (<$10m) or large (>$40m). Unless the local contractor's capacity to bid is increased, the competition for the mid-size contracts would be limited. The qualifying criteria may be set at the lower range as suggested in ADB guidelines for simple and repetitive works. The criteria of 50% of similar contract experience instead of 80% and 40% of financial criteria for lead and 20% for other joint venture partners are recommended.
- There is a need to upscale the capacity of experienced small Sri Lankan contractors to enable them to carry out large works by encouraging joint ventures and by adopting relaxed qualifying criteria as suggested in para above. State must increase the size of bid packages, enabling local contractors to gain experience in doing larger contracts. This could be achieved in a medium term period (3-5) years by combining similar works into larger bid packages wherever feasible.
- Consider empowering MPC/DPC/PPC/RPC to approve higher value procurements of works, goods and services. The quantum and scale of projects is increasing in Sri Lanka, delegation of higher authority would help speed up decisions and procurement.
- Provide training and encourage preparation of the technical specifications and development of ToRs by officers at the field level to ensure work requirements are specifically captured. Such capacity is limited at present.
- Encourage involvement of the mid/senior-level officers in development of procurement plans, bid evaluation and in approval processes.
- Contract administration and management skills with particular focus on contract variations, settlement of claims and disputes, adjudication and arbitration need to be strengthened by regular on the job training by involving expertise from project consultants (such as through the PMDSC) in these activities.
- Skill development of contractors needed in areas of preparation and submission of bids and contract conditions with particular focus on variations/ extra work orders/ repeat orders, orders for additional delivery/ modifications, time extensions, liquidated damages/ bonus, and contract amendments. The skill development programs to cover both NPA guidelines and international approaches (such as FIDIC) to improve contractors understanding.
- Bid documents to explicitly state '*The NPA procedure for appeals is not applicable'* since it seems to have caused confusion in ADB financed contracts previously.
- Quick payments to contractors to be ensured; paying 75% of claim amount after preliminary checking of work done within three working days would go a long way in easing cash flow problems and increasing bidding capacity of contractors.
- Consider including bonus payment clause in bid documents to encourage contractors to complete work in time.
- Capacity development program for high-level officials should be designed to improve the capacity for procurement in the MIWRM, DOI and MASL.

3. Civil Works Packages

64. Bid documents will be prepared following ADB's Standard Bid Documents (SBDs). For procurement of ICB contract packages the single stage two envelope bidding procedure with Large Works Conditions of Contract will be used. For procurement of NCB contract packages the single stage two envelope bidding procedure with Small Works Conditions of Contract will be used. International competitive bidding (ICB) will be followed for civil work contracts costing $15 million or more. Civil works contracts costing less than $15 million will be procured through national competitive bidding (NCB) procedures acceptable to ADB. Numerous small service contracts or community works (to be determined in consultation with project area community groups / civil society organizations and awarded as a community works contract) costing less than $20,000 each may be directly contracted. These works are non-competitive in nature, i.e. excavation of small field channels, their lining, turfing and other miscellaneous works adjoining canals. Works by government-owned entities (for activities which cannot be done by competitive contracting) shall be done by Force Account method.

4. Goods and Equipment

65. Operation and maintenance equipment in multiple lots of small value (aggregate amount $2 million) would be procured using either NCB or shopping procedures, as per the applicable threshold procurement ceilings. Office equipment and vehicles, hardware and software for the IAs would be procured in various lots. In procuring goods and related services, the ICB procedure will be used if the estimated cost is at least $1 million and the NCB procedures if the cost is between $0.1 million and $1 million, and shopping if the estimated contract amount is less than $0.1 million.

5. Consultant Services

66. Project 1 will finance two consulting services packages ($27.5 million). An international firm or consortium will be recruited as the PMDSC and as the ISEWP consultants to support the IAs for the duration of first tranche. They will be procured through the QCBS (90:10) procedure. A technical expert panel using individual consultant selection process would be hired as required.

6. Allocation of Risk and Selection of Contract Type for Underground Works

67. This section summarizes recommendations with respect to the allocation of the risk between the parties for underground works in the WRDIP, in particular for the tunneling contracts for the KMTC and UEC, and the selection of the appropriate type of FIDIC contract. The contract conditions, including the details of any amendments to the standard FIDIC General Conditions made through the Particular Conditions, have a fundamental effect also on the structure and content of many of the technical parts of the tender documents. The finalization of many aspects of the project concept therefore requires the details of the contractual arrangements to have been confirmed. Extensive experience with the implementation of major hydropower and tunneling projects, and especially the application of the various FIDIC standard types of contract, has shown that in order to be able to establish the optimum contractual relationship between the contractor and the employer, it is very important to (i) allocate the risk for the detailed design, and between the parties in the most advantageous (and practical) manner; (ii)

ensure that construction risks are allocated in the most robust and cost-effective manner; and (iii) select the correct FIDIC contract form as the basis of the construction contract.

68. These issues are intrinsically related, such that it is appropriate to discuss them simultaneously. A major element of this consideration is the degree to which risks are allocated to the Contractor in relation to unforeseen physical conditions. The construction works in the WRDIP comprise different elements with various types of procedures for producing the final constructed design. However, the risk for detailed design should be allocated to the contractor primarily for the hydro-mechanical, mechanical and electrical works. Provided these works are small in volume compared with the civil works, they are normally contractor-designed works included within the main re-measurement contract. The technical specifications would, therefore, be formulated in order to provide the contractor with all the information he requires as well as to define the performance and other criteria which his designs for this equipment must satisfy. The employer would then retain the responsibility for the detailed design of the remainder of the works. The responsibility for the detailed design activities involved in determining the rock support requirements in the tunnels and shafts should remain with the employer.

69. The appropriate type of contract for the underground works component of the WRDIP is most likely, as for all the other construction works, is the FIDIC Pink Book[3] form used as part of the ADB's SBDs. This method of compensation and this allocation of design responsibility are fully compatible with the contract philosophy, which defines the structure and content of the Pink Book, into which an amendment could be made (through the Particular Conditions) governing the contractual details of the specific contractor's design obligations. This has also been the experience of and the solution applied on similar projects worldwide.

C. Investigations Program

70. An investigations program was conducted during the PPTA by the Geological Survey and Mines Bureau (GSMB), the GeoEngineering Consultancy, the Geology Department of the University of Peradeniya, and the Central Engineering Consultancy Bureau (CECB). The status of the geotechnical investigations being carried out for the dams and tunnels is summarized in **Table 6**.

[3] The Multilateral Development Banks (MBDs) Harmonised Edition of the 1999 Red Book (FIDIC Conditions of Contract for Construction) is the form of contract in the ADB's SDBs for Large Works Conditions of Contract referred to in the previous section.

Table 6: Status of Investigation Program (as of December 2014)

Project	Investigation	Institute	Current Status	Progress (%)	Submitted Contractor to MCB	Submitted MCB to PPTA
UPPER ELAHERA CANAL						
UEC Tunnel No 1 (70 m)	Geological mapping	GSMB	To be done		Not submitted	
	Geophysical investigation	GSMB	To be done		Not submitted	
	Drilling	DOI	3 of 3 Completed	100%	All logs and core box photos submitted	
	Tectonic evaluation using aerial photographs	MCB	Completed	100%		All sections submitted
UEC Tunnel No 2 (690 m)	Geological mapping	GSMB	To be done		Not submitted	
	Geophysical investigation	GSMB	To be done		Not submitted	
	Drilling	DOI	Completed	100%	All logs and core box photos submitted	
	Tectonic evaluation using aerial photographs	MCB	Completed	100%		All sections submitted
UEC Tunnel No 3 (26.04 km)	Geological mapping	GSMB	Completed (CH 28+000 to 55+000) to be done CH 28+000 to 27+000	100%	Draft map submitted up to CH 28+000 to 55+000	Draft map submitted
	Geophysical investigation	GSMB	Completed CH 55+000 to 29+000 to be done 28+000 to 27+000	97	Draft sections submitted (around 3 km)	Draft sections submitted (around 3 km)
	Drilling (21 boreholes)	DOI	19 completed of 21 bore holes and 2 in progress	90	15 borehole logs and core box photos submitted of 21 boreholes	15 borehole logs and core box photos submitted of 21 boreholes
	Drilling (25 boreholes)	GSMB	24 completed of 25 bore holes and 1 in progress	96	17 borehole logs and core box photos submitted of 25 boreholes	17 borehole logs and core box photos submitted of 25 boreholes
	Tectonic evaluation using aerial photographs	MCB	Completed	100%		All sections submitted
KMTC Tunnel 1A (1.843 km) and Tunnel 1B (6.017 km)	Geological mapping	University of Peradeniya	Completed	100%	Not submitted	
	Geophysical investigation	University of Peradeniya	In progress	20	Not submitted	
	Drilling	Geo Engineering Consultants	Completed (8 Boreholes)	100%	All logs and core box photos submitted (Final Report)	All logs and core box photos submitted (Final Report)
	Tectonic evaluation using Aerial photographs		Completed	100%		All sections submitted
NORTH WESTERN PROVINCE CANAL						
Mahakithula Tunnel (0.94 km)	Geological mapping	University of Peradeniya	Completed	100%	Geology map submitted	
	Geophysical investigation	University of Peradeniya	Completed	100%	2D Resistivity Longitudanal profile sub mitted	2D Resistivity Longitudanal profile submitted
	Drilling (4 boreholes)	CECB	3 completed and one is in progress of 4 boreholes	75	3 logs submitted of 4 Boreholes	3 logs submitted of 4 Boreholes
	Tectonic evaluation using Arial photograph	MCB	Completed	100%		All sections submitted
Mahakirula Reservoir Dams	Drilling (8 boreholes)	GSMB	Completed	100%	All logs and core box photos submitted (Final Report)	All logs and core box photos submitted (Final Report)
	Geophysical investigation	GSMB	Completed	100%	Final Report submitted	
Main Structures	Drilling (64 boreholes)	CECB	Completed	100%	Package 1 and 3 submited (Final Report)	Package 1 and 3 submited (Final Report)
Minipe Anicut	Drilling (8 boreholes)	GSMB	Completed	100%	Final Report submitted	Final Report submitted
UEC KMTC NWPC	Laboratory tests	Munich University (Germany)	First set of sample testing completed, second set of sample test are in progress	50	Final Report submitted	Final Report submitted
		NBRO	In Progress	60	UCS, Tensile strength & Index property test data submitted, Potential Reactivity and Chemical analysis for marble test data remain to submitted	UCS, Tensile strength & Index property test data submitted, Potential Reactivity and Chemical analysis for marble test data remain to submitted

D. Financial Management

71. A Financial Management Assessment (FMA) was undertaken for MIWRM and its two agencies: the DOI and the MASL;[1] these agencies will be responsible for managing, operating and maintaining the infrastructure after its commissioning. The MIWRM together with the two agencies have an annual budget allocation of over $400 million and are experienced in implementing large hydropower and water resources development initiatives. The assessment concludes that MIWRM has sufficient experience and capacity to manage the project funds as well as adequate fund flow, accounting and budgeting arrangements. The overall pre-mitigation financial management risk is rated as Moderate (category B). The financial management and procurement arrangements are considered adequate. Improvements required are: (i) preparation of a detailed procedural manual and training in ADB's disbursement and procurement guidelines; (ii) incorporation of details of the program in separate notes in to their appropriation account; (iii) development of five-year corporate plans which are to be updated annually; (iv) reviewing and updating the key performance indices of MIWRM and its agencies to improve reporting and monitoring; and (v) strengthening contract administration and management skills through regular on the job training.

E. Stakeholder Assessment and Strategic Communication Plan

72. The PPTA Consultant prepared a draft Strategic Communications Program (SCP) in coordination with the IAs and other relevant government agencies for the investment program comprising (i) a communication strategy, (ii) a communication action plan, (iii) a communication monitoring and evaluation system, and (iv) a capacity-building and knowledge management plan.[2] Implementation of the SCP will engage and inform relevant WRDIP stakeholders and sectors with timely, accurate, and comprehensive information shared among stakeholders. A Stakeholder Analysis and Communications-based Assessment were undertaken to assess the communication needs of project-affected people within the project areas, civil society organizations, and more broadly, other stakeholders within the scope of the investment program.

[1] The Financial Management Assessment is included in Appendix 11.
[2] The Stakeholders Analysis and Strategic Communications Program are included in Appendix 15.

V. ECONOMIC ANALYSIS

A. Introduction

73. **Scope.** This supplementary appendix contains a detailed analysis of the economic costs and benefits of the NCPCP. The first phase of this project involves the Minipe Left Bank Canal Rehabilitation, the construction of the NWPC, and the construction of the KMTC and adjoining UEC. These investments will be co-financed from the proceeds of ADB's proposed MFF for the WRDIP. The construction of the KMTC and UEC, which account for about two-thirds of the cost of Phase 1, is needed to implement Phase 2 of the NCPCP. This second phase mainly consists of the construction of the Kalinganuwara Pumping Station, the Lower Uma Oya, the Randenigala - Kaluganga Transfer Canal and the NCPC. Because the infrastructure to be financed by the MFF is needed to realize economic benefits that will accrue upon completion of the Phase 2 investments (and is indeed designed at the scale that is required to realize these benefits), the economic analysis presented here covers the entire NCPCP, instead of the part that will be co-financed by the MFF.

74. **Basic assumptions.** The project's incremental economic costs and benefits were identified and (to the extent possible) quantified for the period 2015-2060 (30-year useful life period from completion of Phase 2). All costs and benefits were expressed in mid-2014 economic prices including physical contingencies, but excluding transfer payments. For internationally traded inputs and outputs, economic prices (at farm gate) were derived from international border prices adjusted for the cost of transportation, handling, processing and packing. For non-traded inputs and outputs, financial prices were obtained from local markets and converted into economic prices using the standard conversion factor (the SCF was estimated at 0.91). The economic price of farm labor was estimated by applying a shadow wage rate factor (SWRF) of 0.7 to the financial price of this input.

B. Economic Costs

75. **Types of economic costs.** The incremental economic costs of the proposed NCPCP consist of the project's incremental economic investment cost, and the incremental economic cost of operations and maintenance (O&M) of this infrastructure during the project's economic lifetime. The incremental cost of increased agricultural production (such as increases in the cost of seeds or fertilizer) was not considered here, but taken into account when estimating the net economic benefits arising from such increases. The incremental cost of increases in raw water provision for domestic, municipal and industrial (DMI) uses, and hydropower generation was treated similarly. The economic cost of adverse social impacts was not estimated separately, because the investment cost already includes the cost of compensating affected persons for economic losses caused by the project. The economic cost of adverse environmental impacts was deemed negligible, and the economic investment cost also already contains a provision for environmental mitigation.

76. **Incremental economic investment cost.** This cost consists of the investment cost of the proposed infrastructure for NCPCP, including project management costs, and the cost of environment and social mitigation. The total economic investment cost of NCPCP was estimated at Rs215 billion (or approximately $1.64 billion), of which 35 percent for Phase 1 and

the remaining 65 percent for Phase 2 (**Table 7**). The investment cost of both phases includes an allocation for the cost of rehabilitating minor tanks, to ensure that the benefits from the primary irrigation infrastructure accrue to the intended beneficiaries. To reflect the benefits that may accrue after the end of the project's economic lifetime in 2060, the residual value of the project was set at 20 percent of the economic investment cost.

Table 7: Economic Investment Cost of NCPCP (2015-2029)
(constant mid-2014 prices)

Investment Cost Item	Construction Period	Rs b*	%Total
PHASE 1		**71.3**	**35**
Minipe Left Bank Canal Rehabilitation	2015-2019	2.8	1
North Western Province Canal	2015-2022	15.1	8
UEC and KMTC	2015-2024	46.3	23
Other**	2015-2024	7.0	3
PHASE 2*		**130.4**	**65**
Kalinganuwara Pumping Station	2015-2019	24.9	12
Other Phase 2 investments	2020-2029	105.4	52
TOTAL		**201.7**	**100**

Source: ADB, based on MCB
* Project management, capacity building, environmental mitigation, social mitigation
** Includes the cost of project management and environmental and social mitigation

77. **Incremental economic O&M cost.** The cost of routine O&M mainly consists of pumping costs, and the cost of cleaning and minor repairs of project assets, and was estimated at 1.5 percent per year of the economic investment cost. In 2050, hydraulic steel structures and mechanical equipment would need to be replaced. The one-time replacement cost was estimated at 10 percent of the economic investment cost.

C. Economic Benefits

78. **Types of economic benefits.** The NCPCP will finance investments in infrastructure that will enable the implementing agencies to divert water from the Mahaweli River to water-scarce areas in and around the NCP. Upon completion of the proposed investments, the available supply of water is expected to increase by over 1,200 MCM per year.[3] The increase in available water will be allocated to hydropower, DMI uses and agriculture. The following quantifiable economic benefits were considered:

(i) increased agricultural production,
(ii) increased provision of raw water for domestic, municipal and industrial uses, and
(iii) increased hydropower generation.

In addition, the following benefits were assessed qualitatively: increased food self-sufficiency, and increased internal security. Taken together, these non-quantifiable economic benefits were deemed significant.

[3] MCB. 2012. *Water Balance Study of NCP Canal Project*, hereafter also referred to as "the Water Balance Study".

1. Economic Benefits from Increased Agricultural Production

79. **Overview.** The primary economic benefit of NCPCP is increased agricultural production through improved deliveries of irrigation water. More specifically, improved irrigation water supply is expected to result in: (i) an increase in the cultivated area within existing irrigation systems (during the dry season, a substantial part of agricultural land is left idle in areas not served by irrigation systems), and (ii) an increase in the production of high-value crops (such as fruit and vegetables). It was conservatively assumed that yields on currently cultivated areas would not increase. The project would also help avoid losses to agricultural production in currently harvested areas arising from an expected increase in the air temperature.

80. **Agricultural production without project.** The project will improve irrigation in an area of about 232,500 hectares of irrigable land in Sri Lanka's dry zone ("the Agricultural Benefit Area"). About 214,500 hectares is currently already used to grow crops, mostly paddy, and the remaining 18,000 hectares will be cultivated upon completion of Phase 1. In the "without project" scenario (WOP), it is anticipated that agricultural production will decrease over time as a result of an increase in the air temperature in the project area (increasing crop water demand), which will be 1.3ºC to 1.7ºC higher in 2050 than during 1961-1990.[4] In 2060, the final year of the project's economic lifetime, total production would be about 5 percent lower than in the "with project" (WP) scenario.

81. **Economic benefits from increased agricultural production on new harvested areas.** At present, cropping intensities (CIs) in existing cultivated areas are suppressed, mainly because of persistent shortages of irrigation water. Records of the Mahaweli Authority of Sri Lanka (MASL) indicate that cropping intensities are about 50 percent lower in Yala (the dry season, which usually lasts from May to August) than in Maha (the wet season, which starts in September ends in March of the following year). At present, the average cropping intensity of the Agricultural Benefit Area is 1.42. This means that (1.42 x 232,500 =) about 331,000 hectares is harvested on an annual basis. Upon completion of the project in 2030, the CI will increase to 1.86. As a result, and taking into account the impact of climate change, the harvested area will be about 107,000 hectares larger, and annual agricultural production over 1 million tons higher vis-à-vis the "without project" scenario (**Table 8**).

Table 8: Harvested Area and Agricultural Production, 2030

Crop	Harvested Area ('000 hectares)			Agricultural Production ('000 tons)		
	WOP	WP	Incremental Area	WOP	WP	Incremental Production
Paddy, Maha	196	226	30	1,001	1,154	153
Paddy, Yala	96	135	38	493	687	194
OFCs	33	66	33	231	462	231
Sugarcane	-	7	7	-	460	460
TOTAL*	**325**	**433**	**107**	**1,725**	**2,763**	**1,038**

Source: ADB (assumed allocation), MASL (other)

[4] C. S. De Silva. *Impact of Climate Change on Water Resources and Agriculture in Sri Lanka*. Proceedings of the International Conference on Climate Change Impacts and Adaptations (2013).

82. **Economic benefits from increased production of high-value crops.** A pre-feasibility study prepared by MCB for the MIWRM contains expected cropping patterns for the "with project" scenario.[5] These patterns are broadly comparable to current cropping patterns in Systems B, C and H (major irrigation systems in or near that Agricultural Benefit Area that already enjoy an adequate supply of irrigation water). The study anticipates that about half of the increase in the harvested area for OFCs will be used for banana and maize (24% each), and the remainder for vegetables (14%), green gram (14%), dry chillies (11%), ground nut (11%) and big onions (2%). These assumptions were adopted for the analysis.

83. For each crop, estimates were prepared of the producer surplus per hectare of harvested area. The producer surplus was measured as follows:

Economic value of final outputs at farm gate
- Economic value of agricultural inputs (except labor)
+ Economic value of hired and family labor
= Producer surplus

84. The economic value of final outputs, as well as labor and other agricultural inputs, was estimated by converting financial prices into mid-2014 economic prices using the conversion factors mentioned in paragraph 2. Assumed yields were actual yields realized in System B, C and H during 2008-2011 (2008-2012 for paddy), so that the realization of the economic benefits does not rely on assumed increases in agricultural productivity (**Table 9**). Financial prices of inputs and labor in Systems B, C and H were deemed representative for harvested areas to be developed by the project; for paddy, these prices were taken from bi-annual surveys conducted by the Department of Agriculture.[6] For other crops, financial prices were taken from MCB's economic analysis. The present value of the economic benefits from increased agricultural production in existing and newly developed harvested areas is estimated at Rs98.8 billion, or about 90 percent of the total present value of the project's quantifiable benefits.

Table 9: Average Yields for Selected Crops in Systems B, C and H (ton/hectare)

	2008	2009	2010	2011	2012	Average
Paddy, Maha	5.2	5.3	5.3	4.0	5.2	5.0
Paddy, Yala	5.2	4.9	5.3	5.4	5.2	5.2
Maize	1.9	1.8	2.0	2.2	NA	2.0
Chillies (dry)	1.4	1.8	1.9	1.8	NA	1.7
Green gram	1.0	1.1	1.1	1.3	NA	1.1
Ground nut	1.5	1.6	1.8	1.7	NA	1.6
Banana	18.3	16.6	17.6	19.0	NA	17.9
Big onion	12.9	12.9	13.0	14.7	NA	13.4
Vegetables	10.2	8.6	10.8	13.7	NA	10.8
Sugarcane	-	-	-	-		70.0*

Source: ADB (assumed allocation), MASL (other)
* Average of sugarcane yields elsewhere in Sri Lanka, based on G.C. Samaraweera (2011)

[5] *Economic Analysis in Financial and Economic Terms of the North Central Province Canal Project of Mahaweli Development Program* (MCB, 2012).
[6] *Cost of Cultivation of Agricultural Crops.* Department of Agriculture (various years). Biannual surveys on the cost of cultivating paddy were collected for all districts in Sri Lanka, for 2007-2012 (Maha and Yala).

2. Economic Benefits from Increased Provision of Raw Water for DMI Uses

85. **Overview.** An important secondary economic benefit of the NCPCP is improved provision of raw water for domestic, municipal and industrial (DMI) uses. The MCB Water Balance Study envisages that, by 2030, the project will provide 162 MCM of raw water per year to the districts of Anuradhapura, Matala, Polonnaruwa, Vavuniya and Trincomalee ("the DMI Benefit Area"), which will be used to provide piped water to about 830,000 persons. It is important to note that this amount is the planned allocation of raw water from canals constructed by the project to the National Water and Sewerage Development Board (NWSDB). The project will not invest in water treatment plants or infrastructure needed to convey water from treatment facilities to final users; this would be the responsibility of the NWSDB, local authorities and other organizations. In 2012, the total population of the DMI Benefit Area was about 2.3 million, or 11 percent of the national total. About 26 percent of households in the area had access to piped water, below the national average of 31 percent.

86. **Typology of economic benefits from increased provision of raw water.** The economic benefits of the NCPCP project with respect to raw water consist of:

(i) **Economic benefits from improved sources of non-piped drinking water supply.** The proposed irrigation canals will provide more (and more reliable) supplies of raw water to areas that are currently water-scarce. This will provide substantial benefits to persons living in the DMI Benefit Area, also to those without access to piped water, mainly by lowering the cost of obtaining water for domestic uses (easier access to water sources, no need to pay water vendors) and by lowering health costs (better quality water, more reliable supply of water). This is especially relevant given the very high incidence of chronic kidney disease (CKD) in the DMI Benefit Area, which is widely believed to be associated with the absence of safe and clean drinking water supply.

(ii) **Economic benefits from improved sources of piped drinking water supply.** The project will enable the NWSDB to provide piped water at a lower cost than without the project, mainly because of substantial cost savings on transmission mains, source works and groundwater development. In addition, because the project already provides raw water, this would not only lower the cost of providing water, but would presumably enable the Board to achieve its coverage targets for the project area earlier than would otherwise be the case. This would provide economic benefits of piped water (which are higher than the economic benefits of non-piped water) to a sizable number of beneficiaries in the DMI Benefit Area at an earlier stage than without the project.

87. **Economic benefits from improved sources of non-piped drinking water supply.** Upon completion of the irrigation canals and supporting infrastructure, persons without piped water will have improved access to raw water that they can collect, treat and store or consume. This benefit is, however, only likely to accrue in Yala (when water tends to be scarce) and to persons living near the newly constructed irrigation canals. Upon completion of the Upper Elahera Canal in 2023, this “area of influence” will mainly consist of the southern part of the Anuradhapura District. Once the NCPCP is completed in 2029, the area of influence will also

contain the central and northern parts of the Anuradhapura District and most of the Vavuniya District. At present, an estimated 500 persons per year die from CKD in this area alone, and the improved provision of non-piped water is expected to result in substantial benefits from avoided loss of life. Improved sources of non-piped water will also result in time saved from not having to collect water which could translate into productivity gains for those engaged in income-generating activities, and other health benefits (unrelated to a reduction in the CKD mortality rate). The net present value of the quantifiable benefits from improved sources of non-piped drinking water supply (including health benefits from reduced CKD mortality) is estimated at Rs5.3 billion, or about 5 percent of the total present value of the project's benefits.

88. **Economic benefits from improved sources of piped drinking water supply.** The average per capita investment cost of piped water supply systems in the DMI Benefit Area was approximately US$600 expressed in 2012 financial prices including taxes; about 30 percent—or US$184 per capita—consisted of the cost of primary transmission mains, source works and groundwater development. This amount was converted into economic prices to obtain an estimate of cost savings for providing raw water induced by the project.

89. It was assumed that, in the "without project" scenario, coverage of piped water service in the DMI project area will continue to increase by the historical growth rate of 1 percent per year, from 26 percent in 2012 to 74 percent in 2060. Assuming that NWSDB and local authorities wish to maximize the benefits from the increase in raw water to be provided by the project, the "with project" scenario assumes that the increase in coverage will be higher than 1 percent per year in two periods: upon completion of Phase 1 (2024) and Phase 2 (2029) of the project. As a result of the acceleration of the connection program, the economic benefits of piped water will accrue to several hundreds of thousands of beneficiaries in an earlier stage than without the project (and, because of the above-mentioned savings, at a lower case than in the "without project" scenario. The present value of the acceleration of piped water coverage is estimated at Rs4.8 billion, or about 4 percent of the total present value of the project's benefits.

3. Other Economic Benefits

90. **Economic benefits from increased hydropower generation.** Initially, the project will result in an increase in hydropower generation of 18GWh per year. As a result, the Ceylon Electricity Board will not need to purchase this amount from independent power producers (IPPs), which would otherwise be relied on to meet increases in demand for electricity. In 2012, the average cost of a kWh of electricity generated by an IPP was Rs21.79.[7] Excluding taxes, this was equivalent to Rs21.23 (or US$0.16) in mid-2014 prices. This amount was used as a conservative estimate of the economic benefit of generating one kWh of hydropower (the estimate is conservative because the cost of thermal power generated by IPPs does not fully reflect environmental costs).[8] From mid-2018 to 2029, the economic benefit of incremental hydropower generation was estimated at Rs382 million per year. From 2030 until the end of the project's economic lifetime in 2060, the economic benefit is minus Rs892 million per year, because hydropower generation would drop by 42GWh per year after the opening of the NCP Canal. Even

[7] *Generation Performance in Sri Lanka (2012, First Half)*. Public Utilities Commission of Sri Lanka.

[8] Because the hydropower plants in the Mahaweli complex do not need to be modified to increase generation, the economic cost of producing an incremental unit of hydropower was assumed zero.

though the hydropower losses in 2030 and after are, in absolute terms, greater than the hydropower gains during 2018-2029, the net present value of the hydropower generation is nonetheless positive over the economic lifetime of the project. This is because the gains are realized earlier than the losses. The net present value of incremental hydropower generation is Rs0.2 billion, or about 0.2 percent of the total present value of the project's benefits.

91. **Economic benefits from increased food self-sufficiency (not quantified).** The NCPCP would help increase the national paddy production by about 350,000 tons per year (equivalent to 8 percent of Sri Lanka's production in recent years), thereby further improving the country's self-sufficiency in rice. The project would also help to reduce Sri Lanka's dependency on the import of sugar. At present, imports cover over 90 percent the country's demand for sugar. The development of the Kantale area is expected to result in a significant increase in domestic sugar production (in 2012, about 7,000 hectares of sugarcane was harvested nationwide; this is almost the same area as the 6,600 hectares to be developed in Kantale).

92. **Economic benefits from increased internal security (not quantified).** The NCPCP is the capstone of the MDP, which was formulated in 1968 with the objective of harnessing the hydropower and irrigation potential of the MRB. The Civil War that ravaged Sri Lanka from the early 1980s until 2009 caused major delays in implementation of MDP, and impoverished most of the area that stands to benefit from NCPCP. This observation especially applies to the districts of Anuradhapura and Vavuniya, which were located in the front line of the conflict, and where most of the project's beneficiaries are living. This means that the project will also serve the higher-level goal of restoring prosperity, indirectly, to help prevent the resumption of civil strife in the area.

D. Comparison of Economic Costs and Benefits

93. **Assessment of economic feasibility.** The ENPV (discounted at the assumed economic opportunity cost of capital of 12 percent) of the project is estimated at Rs4.8 billion. This means that NCPCP is considered economically feasible. The same conclusion can be derived from the project's EIRR, which is estimated at 12.5 percent (slightly higher than the minimum required rate of 12 percent). As expected, increased agricultural production is the most important source of quantifiable economic benefits, accounting for over 90 percent of total benefits (**Table 10**). Benefits from increased raw water provision accounts for most of the remainder. Economic benefits from incremental hydropower generation are not significant. It should be noted, however, that the project is expected to generate significant non-quantifiable benefits, especially by accelerating the socio-economic development of an area that was adversely affected by internal conflict during most of the past three decades.

Table 10: Composition of Quantifiable Economic Benefits of NCPCP

Economic Benefit	Present Value of Benefits	
	Rs billion	% Total
1. Increased agricultural production	98.8	90.5
2. Increased raw water provision	10.1	9.3
3. Increased hydropower generation	0.2	0.2
Total	**109.2**	**100.0**

Source: ADB (2014)

E. Distribution Analysis

94. **Distribution of project benefits to stakeholder groups.** Three stakeholder groups were considered: government, agricultural producers and water consumers. Their gains and losses can be summarized as follows (**Table 11**):

(i) **Government.** The government will finance the investment and O&M cost of the project. Because the project will not generate incremental revenue (with the exception of a small increase in revenue from hydropower), this stakeholder incurs a substantial net loss.

(ii) **Agricultural producers.** The project is expected to generate a substantial producer surplus, mainly because it will increase in the harvested area through better provision of irrigation water and mitigate adverse impacts of climate changes. These benefits accrue to agricultural producers, who therefore capture most of the net gains.

(iii) **Water consumers.** The project will improve the provision of raw water to the benefit area. This will benefit consumers of non-piped water, in the form of health benefits and time saved for the collection and storage of water. It will also benefit consumers of piped water, many of whom will gain access to a piped water connection at an earlier stage than compared to a "without project" scenario.

The poverty impact ratio (PIR), which measures the share of project benefits accruing to the poor, was estimated at 32%.

Table 11: Distribution of Project Benefits (Rs billion)

Present Value of:	Government	Agricultural Producers	Water Consumers	Total
Economic benefits				
- Agricultural benefits	-	98.8	-	98.8
- Piped water benefits	-	-	4.8	4.8
- Non-piped water benefits	-	-	5.3	5.3
- Hydropower benefits	0.2	-	-	0.2
Economic costs	(104.4)	-	-	(104.4)
GAINS AND LOSSES	**(104.1)**	**98.8**	**10.1**	**4.8**
Proportion to the poor (% total)*	6.7	7.6 / 40.0	7.6 / 40.0	
Benefits to poor	(7.0)	39.5	2.4	35.0
Poverty Impact Ratio (PIR)				**32.0%**

Sources: ADB estimates, WB (2013), IFAD (2014).
* Assumed poverty rates: national 6.9%, rural 7.6%, small farmers 40%.

VI. FINANCIAL ANALYSIS

95. **Introduction.** The MFF for the WRDIP will finance a series of projects that will be operated and maintained by two entities that form part of the MIWRM. These are the MASL and the Department of Irrigation (DOI). The MFF-financed projects will not (and were not designed to) generate direct financial revenue that could be used to cover the incremental operations and maintenance costs. Instead, the MIWRM will finance these costs from its own sources. This section first presents estimates of the expected O&M costs of WRDIP. It then presents estimates of the past and projected budgets of MIWRM, and concludes that the Ministry is likely to have sufficient financial resources to cover the expected O&M costs.

96. **Incremental O&M costs.** The cost of routine O&M mainly consists of pumping costs, and the cost of cleaning and minor repairs of project assets, and was estimated at 1.5 percent per year of the investment cost. In 2050, hydraulic steel structures and mechanical equipment would need to be replaced. The one-time replacement cost was estimated at 10 percent of the investment cost. From 2015 until 2024, incremental O&M costs are in the order of Rs200 million per year. Upon completion of the Upper Elahera Canal, these costs will increase substantially, to about Rs1.2 billion (all prices are expressed in mid-2014 financial prices). Refer to **Table 12** for incremental O&M cost estimates in selected years.

Table 12: Financial Cost of Incremental O&M of WRDIP
(Rs billion, mid-2014 prices)

	2015	2020	2025	2030	2040	2050	2060
Routine O&M cost	0.2	0.2	1.2	1.2	1.2	1.2	1.2
Replacement cost	-	-	-	-	-	7.6	-
Total	**0.2**	**0.2**	**1.2**	**1.2**	**1.2**	**8.8**	**1.2**

Source: ADB estimates

97. **MIWRM budgets.** In recent years, the MIWRM budget almost doubled when expressed in mid-2014 financial prices, from about Rs25.8 billion in 2011 to Rs50.5 billion in 2014 (**Table 13).** The increase was mainly caused by a very substantial increase in the Ministry's capital expenditure budget, especially for the Uma Oya Diversion Project and the Moragahakanda and Kalu Ganga Reservoir Project. It was conservatively assumed that the MIWRM's budget would increase with general price inflation. This means that, in mid-2014 prices, the total budget would remain Rs 50.7 billion per year (or approximately $390 million).

Table 13: MIWRM Annual Budget*
(Rs billion, mid-2014 prices)

	2011A	2012B	2013E	2014MP	2015MP	2016AP>
Recurrent expenditure	3.9	3.9	3.8	3.8	3.7	3.7
Capital expenditure	21.9	35.4	39.4	46.7	46.9	46.9
Total	**25.8**	**39.3**	**43.3**	**50.5**	**50.7**	**50.7**

Source: ADB estimates, based on MIWRM (2014)
* A: actual, B: revised budget, E: estimate, MP: MIWRM projection, AP: ADB projection

98. **Incremental O&M cost as a percentage of the MIWRM budget.** ADB does not have a formalized method to assess the financial capacity of an executing or implementing agency to provide the minimum required subsidies for a project. For previously ADB-financed projects, it was assumed that an agency is financially capable to provide the required subsidies if these do not exceed a significant portion of the agency's total budget. Throughout the implementation period of WRDIP (2015-2060), the incremental O&M cost of the project will not exceed 2.3 percent of the MIWRM's total budget (**Table 14**), except in 2050 (when hydraulic steel structures and mechanical equipment would need to be replaced). The MIWRM was therefore deemed as having the financial capacity to cover the project's incremental O&M cost in all years except 2050 (when it may require financial support from the government to cover the project's one-time replacement costs).

Table 14: Financial Cost of Incremental O&M of WRDIP as Share of MIWRM Budget (%)

	2015	2020	2025	2030	2040	2050	2060
Incremental O&M as % Budget	0.4	0.5	2.3	2.3	2.3	17.3	2.3

Source: ADB estimates

VII. SAFEGUARDS PLANNING

A. Key Safeguards Documents

99. The WRDIP will have three Projects implemented in three tranches. Implementation of all three Projects will be initiated during the time period of Tranche 1. Therefore, all three Projects have been categorized for safeguards and assessments prepared prior to ADB Board approval. The following safeguards documents were prepared for the investment program as per ADB's SPS and the government rules:

(i) Environmental assessment and review framework (EARF)
(ii) Initial Environmental Examination (IEE) for the MLBCR sub-project in Project 1
(iii) Environmental Impact Assessment (EIA) for the UEC-KMTC and MLBCR sub-projects in Projects 1, 2 and 3
(iv) EIA for the NWPC sub-project in Projects 1 and 3
(v) Resettlement Framework (RF)
(vi) Resettlement Implementation Plan (RIP) for the UEC-KMTC sub-projects in Projects 1, 2 and 3
(vii) RIP for the NWPC sub-project in Projects 1 and 3

100. The EARF and the RF serve to guide safeguard assessments and the preparation of relevant safeguards documents in all Projects of the MFF. The safeguard frameworks cover sub-project specific information and requirements in accordance with ADB's SPS: (i) the general anticipated impacts of the sub-projects likely to be financed under the investment program on the environment, involuntary resettlement, and indigenous peoples; (ii) the safeguard criteria that are to be used in selecting sub-projects; (iii) the requirements and procedure that will be followed for screening and categorization, impact assessments, development of management plans, public consultation and information disclosure (including the 120-day disclosure rule, if required), and monitoring and reporting; and (iv) the institutional arrangements (including budget and capacity requirements) and the government's and ADB's responsibilities and authorities for the preparation, review and clearance of safeguard documents.

101. No Indigenous Peoples issues are foreseen to be addressed during the investment program implementation. Project 1 is categorized as C for the indigenous peoples safeguard. There are no indigenous peoples as defined by ADB's SPS in any of the areas of Project 1 and subsequent projects under the investment program. As these would also be categorized as C, an Indigenous Peoples Planning Framework has not been prepared.

B. Implementation Arrangements

102. A safeguards cell will be established in the PMU. The safeguards cell will be responsible to oversee overall monitoring and verification of environment and resettlement activities of the investment program. Two counterpart personnel with relevant experience will be assigned to the safeguards cell which will have responsibility for ensuring compliance of the safeguards requirements including (i) environment and (ii) resettlement including gender. While EA will be responsible for overall coordination, planning, and financing of resettlement program, the implementation of RIPs is the responsibility of PMU.

103. The Project Director of each sub-project of Project 1 will assume primary responsibility for the environmental assessment as well as implementation of EMPs for their respective components. An environmental officer will be assigned to the project teams under the Project Director for each project. The duties of the environmental officer will include: (i) oversight of construction contractors for monitoring and implementing mitigation measures; (ii) preparing and implementing environment policy guidelines and environmental good practices; (iii) liaising with the environmental agencies and seeking their help to solve the environment-related issues of project implementation; (iv) providing awareness training on environmental and social issues related to the program and; (v) preparation of environmental monitoring reports every 6 months for EIAs and once a year for IEEs (as required by ADB).

104. In addition, the PIU environmental officer with assistance from the environmental consultant engaged by the PMDSC will: (i) update the environmental assessments including EMP based on detailed designs; (ii) ensure EMPs are included in bidding documents and civil works contracts; (iii) provide oversight on environmental management aspects of the project and ensure EMPs are implemented by the contractors (iv) facilitate and ensure contractors comply with all government rules and regulations regarding permits as well as any other relevant approvals required for works; (v) supervise and provide guidance to the contractors to properly carry out implementation of the EMPs; (vi) review, monitor and evaluate the effectiveness with which the EMPs are implemented, and recommend necessary corrective actions to be taken as necessary; (vii) consolidate periodic environmental monitoring reports to ADB; (viii) ensure timely disclosure of final environmental assessments in locations and forms accessible to the public; (ix) take corrective actions when necessary to ensure no environmental impacts; (x) conduct ongoing consultation with the community during implementation of the project; and (xi) establish a grievance redress mechanism and ensure it is operated satisfactorily.

105. The PMU will have resettlement unit or cell with a full time specialist (s) who will assist the formulation of RIPs, resettlement due diligence reports and resettlement monitoring reports. The PMU will develop the specialist(s) ToR(s) and forward them to ADB for review. The specialist(s) key activities include: (i) screening of proposed projects for potential resettlement impacts and risks; (ii) reviewing of project alternatives to avoid or minimize resettlement impacts; (iii) assessing social impacts of the project; (iii) formulating an appropriate strategy for public consultations and resettlement information disclosure; (iv) formulating RIPs with resettlement consultants; and (v) establishing GRM and monitoring of their effectiveness.

106. The PMU/PIU will monitor the RIPs' implementation to determine whether resettlement goals have been achieved and livelihood and living standards have been restored, and to recommend how to further improve implementation. For this, each project will elaborate specific, relevant and detailed monitoring indicators. The PMU/PIU will prepare half-yearly monitoring reports to submit to EA and ADB. The reports will focus on whether resettlement activities have complied with IR safeguard principles and loan covenants of the project. The report will also document consultations conducted with PAPs and summaries of issues identified and actions taken to resolve them. It will also provide a summary of grievances or complaints lodged by PAPs and actions taken to redress them and the specific activities conducted to restore and improve income sources and livelihoods of PAPs.

C. Involuntary Resettlement

107. The NWPC and UEC-KMTC sub-projects will have significant involuntary resettlement impacts on PAPs and are classified as category B.[9]

1. Resettlement Framework

108. The PPTA formulated a comprehensive Resettlement Framework (RF) for the WRDIP, based on local compensation policies, land laws, land acquisition laws and regulations, and the Involuntary Resettlement Safeguard Policy of ADB (SPS 2009).[10] The RF outlines the structure and composition of RIPs. It guides the EA and IAs on how to identify potential involuntary resettlement impacts and what specific actions are to be taken to avoid or at least mitigate adverse resettlement impacts and risks. It also highlights the type of data and information that resettlement planners should collect and safeguard standards that the project should maintain. The RF shows that the local resettlement regulatory framework substantially matches the international best practices in resettlement that are incorporated in the Resettlement Safeguard Policy of ADB. The RF provides guidance on how to address issues such as stakeholder consultation and resettlement monitoring that fall short of the resettlement standards established in Resettlement Safeguard Policy of ADB.

2. Resettlement Implementation Plans

109. RIPs were prepared for the NWPC and UEC-KMTC sub-projects.[11] A comprehensive socioeconomic survey was conducted by MCB in 2014 to identify the nature and significance of potential project impacts on potential PAPs. A resettlement census was conducted in May and June 2014 in the sub-project areas to obtain a demographic overview of the total affected population. It covered the PAPs' assets and main sources of livelihood affected, and their socioeconomic status. The gender-disaggregated socioeconomic data have been used to determine if special actions are needed by poor and vulnerable households, especially female-headed households, to overcome their socioeconomic marginality and disarticulation. As the detailed project design are been completed parallel to the census of project-affected households and persons, the data presented in the RIPs should be taken as final for the affected sub-project areas.

110. The RIPs prepared for the UEC and NWPC sub-projects addresses land acquisition, compensation, resettlement assistance, income restoration and improvement, and physical relocation requirements. Both RIPs include social impact assessments. The RIPs will be implemented in close consultation with the stakeholders, particularly with PAPs through focus group discussions and stakeholder consultation meetings. Women's participation will be ensured by involving them in public consultations at various stages of project preparation and implementation, and by arrangements which would enhance their ability to attend such meetings.

111. Field surveys conducted during the PPTA and the environmental impact assessment identified the number of households in each village in the respective sub-project area. The PAPs

[9] The portion of the UEC to be constructed in Tranche 1 is category C for resettlement as no land or persons will be affected by this length of canal (0-6.2 km).
[10] The RF is included in Appendix 12.
[11] The RIPs are included in Appendix 12.

depend on farming as their main source of income supplemented by wage and salaried employment. Most of them live in permanent houses and others in semi-permanent and temporary houses. The canal traces of the UEC and NWPC have been revised several times to mitigate environmental and social impacts. Because of these adjustments to the canal traces, the land area and number of households affected by the WRDIP have been substantially reduced.

112. Civil works implementation at the MLBCR sub-project will not be scheduled during the normal irrigation season to minimize the risk of disruption. It is not anticipated that any land acquisition or permanent displacement will take place. Any impact would be associated with construction and should be limited in its scope and duration. A resettlement framework with compensation matrix has been prepared and agreed with the government, consistent with ADB's policy for sector projects, to address any impact, should it occur.

D. Environment

113. An EARF has been prepared to guide environmental assessments of succeeding tranches under the investment program.[12] Categorization and assessments for succeeding tranches will be carried out in accordance with the requirements of the EARF, guidelines and policies of the Ministry of Environment and Renewable Energy, and ADB's SPS.

114. The MLBCR sub-project in Project 1 is classified as category B according to ADB's SPS. An IEE was prepared for the MLBCR and includes an EMP that describes mitigation measures to be adopted during design, construction and operation of the project. The EMP is a plan for mitigating all anticipated environment impacts during project construction and operation. Specific mitigation measures with details on location, time and responsible agency for implementation are given in the EMP.

115. The NWPC and UEC-KMTC sub-projects are classified as category A for environment in accordance with ADB's SPS as they traverse through forest reserves. An EIA was prepared for each sub-project. A range of mitigation measures have been proposed to avoid or minimize negative impacts, and to achieve effective offsets for any residual impacts. Impacts on physical resources, human settlements and land use, biodiversity and natural resources, community health and safety, and occupational safety and archaeological/historical resources have been identified. The long term impacts of the proposed sub-projects under the investment program on physical archaeological, historical and physical cultural resources, socio-economic aspects, are not significant. A large proportion of adverse impacts are confined to the construction phases and they can be minimized and mitigated with appropriate and timely interventions, with adequate supervision and monitoring by the project proponent and other stakeholders.

E. Social Impact Assessment

116. The PPTA Consultant has led a group of local consultants in collecting socioeconomic data and information at the NWPC, UEC, MLBCR and KMLC sub-projects. The surveys focused on property losses, impact on income and livelihood, poverty, and social dimensions of relocation, consultation and information dissemination among potential project-affected persons and communities.

[12] The EARF is included in Appendix 13.

117. The PPTA Consultant reviewed the preliminary reports on socioeconomic conditions of the project areas of the NWPC and UEC and found them to be satisfactory for the purposes of formulating EIAs and EMPs of the sub-projects. However, the Consultant found that the findings of the reports do not provide the required information on land losses, relocation needs and compensation packages. The Consultant therefore decided to conduct resettlement focused surveys and due diligence in each sub-project area. The PPTA Consultant updated the survey questionnaires and determined the type of qualitative data required. It also guided the survey team on carrying out of a due diligence exercise in the KMTC section to ascertain whether the UEC will have any impact on communities and persons. The communities along the MLBC have also been consulted to determine the impact, if any, of proposed canal refurbishment on them.

APPENDIX 1

PPTA CONSULTANTS' TERMS OF REFERENCE

Detailed Tasks and/or Expected Output

1. Team Leader

(i) Providing overall direction of the TA team, provide quality assurance for all outputs from the team, and manage relations with the executing agency (EA) and implementing agencies (IAs), and undertake TA workshops/seminars to discuss inception, interim and draft final reports.

(ii) Preparing a brief inception report within 20 days of fielding that sets out the structure or table of contents of TA outputs for finalization in consultation with the EA and ADB, and which includes a work plan to meet the necessary loan processing schedule.

(iii) Preparing a brief interim report within 60 days of fielding within the structure of the final report that includes initial outputs from the TA team.

(iv) Preparing a complete draft final report within 120 days of fielding. The structure of the report and appendices will be discussed during the inception period.

(v) Establishing baseline data and result targets (as per preliminary design and monitoring framework [DMF]) with the TA team, and arranging necessary surveys and data collection.

(vi) Finalizing the investment program's implementation schedule and structure including defining the subprojects under each tranche.

(vii) Reviewing and updating as necessary the feasibility assessment of Project 1 and the overall investment program with support from the TA team. This includes updating their reporting and ensuring the following aspects are completed to ADB's standard: (a) infrastructure and program design (with climate change resilient designs); (b) costs, arrangements, schedules; (c) economic and financial impacts, and environmental, and social safeguards including actions to enhance the participation of vulnerable groups; and (d) risk assessments and mitigation measures.

(viii) Reviewing the designs, cost estimates, contract documents and procurement procedures of packages to be implemented under Project 1 with support from the TA team to ensure they comply with ADB requirements. Assist the EA to improve as necessary.

(ix) Assisting the EA with tendering, contract award, and mobilization of Project 1 civil works contractors.

(x) Leading preparation of the MFF (and Project 1) packaging covering the following aspects, following the set formats for framework financing agreements and periodic financing request, and facility administration manual (excluding the terms of reference for the Program Design and Management Consultant): (a) component design, cost estimates and financing, implementation arrangements, detailed implementation plan, procurement plan, and monitoring and evaluation with effective management information system (MIS); (b) Institutional

arrangements for effective multidisciplinary project implementation; and (c) capacity development plan.

(xi) Assessing other sector related investments and programs currently underway or planned in the future by the government, including with external donor support and identifying opportunities for coordination with this investment program.

(xii) Preparing an investment roadmap for Sri Lanka based on available information and discussions with the government.

(xiii) Preparing a monitoring and evaluation framework for the investment program.

(xiv) Supporting the ADB with preparing loan processing documents including the Report and Recommendation of President, appendices and link documents.

(xv) Supporting the ADB during missions, meetings, and preparing mission documents, as necessary.

2. Irrigation and Water Resources Specialist

(i) Assessing the water balance of the Mahaweli system using available information and appropriate software to confirm monthly water availability for each subproject and impacts to other systems, if any. The water balance should also consider: (a) the future water availability accounting for planned national developments, land use changes and anticipated climate change; (b) the water requirements for a range of crops and cropping patterns for command areas that will be affected by the investment program using appropriate methodologies and software; and (c) other water users and environmental needs.

(ii) Reviewing the proposed layouts and designs of the investment projects and confirming they are suitable to meet the needs of the project, or recommending improvements, if any.

(iii) Reviewing the technical specifications for canals, structures and reservoirs and recommend improvements where required (tunneling elements to be the responsibility of the Tunneling Specialist).

(iv) Reviewing the cost estimates of the projects (excl. tunneling elements) and ensure they are accurate. Coordinate with other team members to ensure contingencies are appropriate and include allowance for price escalation of materials and labor, and foreign exchange fluctuations.

(v) Reviewing available information on past and current irrigation and water resources planning, management and practices, and with guidance from relevant government agencies, Farmer Organizations, and other key stakeholders, prepare the consulting packages: (a) "Improving System Efficiencies and Water Productivity" with detailed scope of the package including costs and terms of reference; and (b) "Strengthening of Integrated Water Resources Management" with an initial outline of the package, approximate costs and outline of the terms of reference.

(vi) Preparing a brief report on likely climate change impact in Sri Lanka to the water resources and agriculture sector using available information.

(vii) Undertaking a sector analysis and assessment of the agriculture and natural resources sector specifically focusing on the following subsectors: irrigation, drainage and flood protection; water-based natural resources management; and agriculture; and including assessing the EA, IAs and other relevant government agencies following diagnostic analysis approach including establishing the institutional and legal context of this investment program and its linkages with other national initiatives.

(viii) Preparing draft and final reports detailing the above tasks and outputs

3. Tunneling Specialist

(i) Reviewing available designs and geological survey information for all planned tunnel segments to be constructed under the investment program which include those associated with the KMTC, UEC and NWPC.

(ii) Recommending additional geotechnical investigations, if necessary, and support the government with supervising the investigations and analysis of results.

(iii) Advising on tunneling and contracting methods, undertake a comparative analysis of options, benefits, risks, mobilization and implementation schedules, and costs; and recommend preferred construction methods for each of the three projects.

(iv) Advising on all other matters that are related to or may affect tunneling works, for example: (a) types of tunneling machines, their procurement and mobilization to site; (b) auxiliary and ancillary plant requirements; (c) access requirements (including a review of current access routes); (d) staffing requirements; (e) ancillary works; (f) technical specifications requirements; (g) contract management and supervision requirements; (h) environmental impact and management considerations; (i) interfacing considerations with other associated contracts; (j) health and safety considerations; (k) insurance; etc.

(v) Advising the government engineers on finalizing the detailed engineering design for the North Western Province including updating of engineering cost estimates.

(vi) Updating the cost estimates and implementation schedule for constructing the KMTC and UEC tunnels based on available information.

(vii) Designing the consulting package for preparing the feasibility designs of the KMTC and UEC tunnels and associated facilities, including preparing the consultant's terms of reference which will be included within the responsibility of the PMDC. The level of detail of the feasibility designs should be appropriate for the contracting modality.

(viii) Advising on the prequalification requirements and selection criteria for the tunneling packages, the general procurement process, implementation schedule for contracting and implementing tunnel construction, and provide any other associated information as necessary.

(ix) Preparing and leading workshops for the TA Team, ADB and government to discuss technical and contractual matters relating to the planned tunneling packages, as required.

(x) Preparing draft and final reports detailing the above tasks and outputs.

4. Safeguards and Social Development Specialist

(i) Preparing a social impact assessment of the identified project affected persons from both involuntary resettlement and Indigenous Peoples policies perspectives, following ADB's Safeguard Policy Statement (SPS, 2009).

(ii) Undertaking a 100% census of the affected persons based on a preliminary design of the project, to be finalized upon the availability of a detailed design.

(iii) Undertaking a sample socio-economic survey (agree on a sample size in discussion with ADB and the EA).

(iv) Preparing a resettlement framework for the investment program.

(v) Preparing resettlement plans for Project 1.

(vi) Carrying out both a poverty analysis and a gender analysis of the population within the investment program area.

(vii) Preparing a Summary Poverty Reduction and Social Strategy for the investment program.

(viii) Undertaking consultations with key stakeholders, including farmers organizations, and the Ministry of Labor, on the requirement to comply with internationally recognized core labor standards (CLS) will be conducted, and mitigation measures, including monitoring of the CLS will be included in the PFR and FFA.

(ix) Reviewing and reporting on the safeguard measures on all associated facilities, including discussing issues that may affect the investment program and recommending remedy actions, if any.

(x) Reviewing and updating the Environmental Impact Assessments and Initial Environmental Examination, if required.

(xi) Preparing an Environmental Assessment Review Framework for the investment program.

(xii) Preparing draft and final reports detailing the above tasks and outputs.

5. Economist and Financial Management Specialist

(i) Collection of appropriate available survey data from the government or other institutions, for example "cost of cultivation" survey or other regular data collection, and undertaking either cross-sectional analysis with control for selection/placement bias (e.g. Propensity Score Matching, endogenous switching regression, etc.) or panel analysis using fixed effects models. The methodology of the analysis will be agreed with ADB prior to initiating the analyses.

(ii) Characterization of baseline input-output characteristics for agricultural production at system, major and minor tank levels from household survey data for each major season of production.

(iii) Characterization of current level of Farmer Organization's participation in operation and maintenance of the project area from the baseline survey.

(iv) Identification of current seasonal cropping patterns in proposed irrigation command areas and likely patterns of cropping pattern change under irrigation expansion from household survey and and/or secondary sources at the system, major and minor tank levels.

(v) Using collected data in an econometric analysis that effectively isolates the effect of irrigation development from covariates, including factors conditioning program placement and farmer participation, so as to rigorously predict the effects of irrigation expansion on cropping intensity, yields and variable production costs (methods may include Propensity Score Matching, endogenous switching regressions, instrumental variables or other control function approaches).

(vi) Calculation of conversion factors for translating financial prices into economic prices.

(vii) Application of parameters on cropping patterns, baseline input-output characteristics, and expected "treatment" effects of irrigation to calculate output market supply shifts and consequences for producer, consumer and labor in explicit economic surplus analyses for major crops

(viii) Valuation of the drinking water supply benefits of the project in terms of anticipated health benefits (Disability Adjusted Life Years) and/or willingness to pay using household survey and secondary data.

(ix) Compilation of detailed costing of the investment program and Project 1, collecting component-wise detailed costs from other experts, and contribute to project packaging. The consultant will follow the guidance set out in the ADB's Financial Due Diligence Note (2009) and Note on Preparation and Presentation of Cost Estimates (2008, revised 2010) and will prepare project cost estimates using Excel for each main project cost item including base costs, physical contingencies, price contingencies, and financial charges during implementation. Base costs are expressed in domestic currency and on real price basis. Base Costs also distinguish between foreign exchange and local currency components, as well as recurrent and investment costs, and separate identification of taxes included within cost components. Project costs would also include estimates of resettlement costs.

(x) Application of costing and economic surplus estimates in economic rate of return analysis.

(xi) Sensitivity and switching value analysis on the parameters estimated and key assumptions/risks underpinning the rate of return calculations.

(xii) Providing guidance to the national Financial Management Specialist and ensure their outputs meet ADB's requirements.

(xiii) Preparing draft and final reports detailing the above tasks and outputs.

6. Financial Management Specialist

(i) The consultant shall coordinate closely with the EA and IAs to obtain all relevant information, including but not limited to last three years audited financial statements, procurement plans, 10 year projected financial statements, cash flow forecasts, information required to compute cost of capital, loan relending ratios and any other relevant information.

(ii) The consultant shall support the international Economist and Financial Management Specialist with preparing the investment program costing and a financial analysis of the investment program. The consultant will follow the guidance set out in the ADB's Financial Due Diligence Note (2009) and Note on Preparation and Presentation of Cost Estimates (2008, revised 2010) and will:

a) prepare projections of future incremental costs, assess whether the IAs will have funding to cover long-term costs as needed to ensure investment program sustainability, and identify actions needed to ensure investment program financial sustainability as conditions.

b) prepare a disbursement schedule including S-curve for projections of contract awards and disbursements; and standard cost estimates tables (by expenditure category, by financier, by Output, and by Year).

(iii) Prepare an investment program financing plan taking to account of any prospective co-financing and assess veracity of proposed counterpart funding.

(iv) Co-develop with the IAs projected cash flow statements for a ten-year period including projected revenue, costs.

(v) Provide costing and financial forecasting data to support assessment of economic viability.

(vi) Assist in developing financial covenants, if necessary – In particular, actions needed to ensure project sustainability should be identified covering operating performance, liquidity and debt serviceability.

(vii) The consultant must ascertain what entity, units or departments are to be the prime focuses of the assessment. This could be the EA, and/or IAs and/or a PMU.

(viii) Assess relevant previous experience and any past analysis conducted for the EA/IAs and assess how much reliance can be placed on the financial management systems by reference to:

a) the Country Program Strategy (CPS) which will include the information on status of Project Financial Management (PFM) systems and capacity building initiatives.

b) Financial management performance on recent relevant ADB projects, eg, with same EA/IA or in the same Sector.

c) Analysis of historical financial performance of EA with other donor financed projects (eg, World Bank, DFID).

d) Any other country-wide assessments, such as Study of Accounting and Auditing Practices or PEFA Assessments or assessments done by other MDBs.

(ix) Using the Financial Management Assessment Questionnaire (FMAQ) collect information to assess the strengths and weaknesses of the financial management systems and controls. This should be achieved through interviews, obtaining copies of relevant documentation and limited walk through testing.

(x) The assessment should include a review of the quality of Internal Audit (if any), staffing, fund flows mechanism, budgetary framework, financial accounting and reporting, management information systems, and detailed internal control activities (over payments, payroll, maintenance of bank balances, imprest accounts, advances, fixed assets, completeness of liabilities, etc.) The assessment should also consider the external auditing arrangements in place.

(xi) Obtain copies of key documents as relevant, exercising professional judgment (including sample bank reconciliation statement, extracts from fixed assets register, chart of accounts, organizational chart, policy documents etc.)

(xii) Understand the key risk to the proposed project and for the entity itself. Based on those risks, determine which existing key controls are already in place to mitigate these risks. Not only understand and document these key controls, but also test check compliance with the stated regulations of the entity in the major areas of ADB's expected expenditure, on a sample basis. Consultant's working papers should include all relevant evidence and information to support this, if required later.

(xiii) Obtain audited financial statements prepared by the IAs on an entity-level and/or for previous similar projects and assess (a) whether these are in compliance with (national accounting standards or Cash Basis International Public Sector Accounting Standards or IFRS or relevant accounting standards or framework as appropriate), (b) whether these are in compliance with relevant auditing standards, (c) identify any gaps which should be highlighted and addressed.

(xiv) Obtain the chart of accounts, and ensure that eligible expenditure categories and investment plan as envisaged for the loan agreement can be mapped into the IAs original chart of accounts.

(xv) In case of Supreme Audit Institutions, following the ADB template, prepare a draft statement of Audit Needs to clarify ADB's audit requirements.

(xvi) Draft the Financial Management Assessment Report using the ADB template given on page 31 of 96 of the Knowledge Addendum of ADB's Financial Management and Analysis of Projects, 2005. Annexure to the Report should include: (a) the financial management assessment questionnaire and its responses; (b) template financial statements which are based on the entities chart of accounts, take into account requirements of relevant national accounting standards and eligible expenditure categories; (c) details of the organizational structure as part of the final report; and (d) audit TORs.

(xvii) Prepare a Risk Analysis summary. Identifying risks arising from material deficiencies and propose practical recommendations for improving financial management functions and/or staffing for financial operations that are needed to mitigate risk.

(xviii) Provide relevant detail information to enable completion of: (a) the Financial Management section of the Risk Assessment Management Plan; (b) the accounting and auditing arrangements, and the disbursement arrangements of the Facility Administration Manual; and (c) the Governance Section of the Report and Recommendation to the President.

(xix) Assist the Team Leader, and other involved consultants, and where necessary, to explain to the borrower the financial management assessment, the financial evaluation and the basis and compilation of financial forecasts and analyses etc. with justification for relevant proposed financial risk mitigation measures.

(xx) Support the international Economist and Financial Management Specialist with gathering necessary socio-economic data for the economic analysis.

7. Procurement Specialist

(i) Undertaking a procurement assessment of the EA, including the existing procurement systems of the government. The assessment will identify if there are any capacity, procedural and organizational constraints that may affect effective program implementation; and recommend an action plan with the EA to address these constraints.

(ii) Assessing the procurement risk and facilitating appropriate review and supervision processes and thresholds that will mitigate those risks.

(iii) Preparing a procurement plan for each tranche of the investment program.

(iv) Reviewing existing procurement documents and advising on the preparation of planned procurement documents and materials for each work packages under the investment program, in line with the requirements of the government, and for ADB financing.

(v) Reviewing the contract packages and documents for advance action subprojects and assist the EA and IAs with improving them, if necessary, to meet ADB requirements.

(vi) Assisting the government and ADB on advance contracting actions to appoint the PMDC and Project 1 contractors.

(vii) Advising ADB and the government on procurement procedures for engaging a turnkey (“design and build” or “engineering, procurement and construction”) contractor to implement specialized tunneling civil works under Project 2 including schedules, costs, specialist requirements, and any associated risks and how to manage them.

(viii) Prepare the terms of reference for the procurement team of the Program Design and Management Consultant who will be responsible to managing procurement of Projects 2 and 3.

(ix) Undertaking seminars to the government on the relevant guidelines on procurement and engagement of contractors and consultants under ADB guidelines.

(x) Preparing draft and final reports detailing the above tasks and outputs.

8. Communications Specialists

Phase 1: Stakeholder Analysis and Communication-Based Assessment

(i) The specialists will undertake a diagnostic of the overall communication needs, both during project design and into implementation. This would include assessing communication needs of project-affected people within the project areas, civil society organizations (CSOs), non-government organizations, local and central government stakeholders, and more broadly, other stakeholders within the scope of the investment program.

(ii) The specialists will review the current status of the communication components of the investment program. The specialists will also undertake a broader diagnostic of the overall communication and information environment relevant to the investment program; assess any gaps in understanding or communication among all stakeholders. The specialists are expected to incorporate the findings of their analysis into the development of a communication program for the investment program. During this work, the specialists are expected to work closely with government staff and the PPTA Safeguards and Social Development Specialist. Some of the major elements of the Communication-Based Assessment will include, amongst others:

a. Reviewing and evaluating the existing and planned communication activities of the government in relation to this investment program, and recommending additional activities, if any.
b. Mapping stakeholders; their positions on the project; their communication requirements (especially those of the project-affected people); gauging stakeholder's level of understanding; identifying their interests and their level of influence.
c. Assessing the existing communication dynamics including, but not limited to: how the stakeholders receive and process information; important media outlets; traditional forms of information dissemination practices; new media and technology; key opinion leaders and social interaction, etc.
d. Analyzing the media and communication channels that will be critical to sharing information, enabling feedback and participation, building consensus and community mobilization and otherwise supporting the project objectives. Identifying strategic approaches and materials for engaging stakeholders through these various communication and media channels.
e. Evaluating the communication capacity of the relevant institutions – both government and non-government – that are involved in the implementation and/or managing the implementation of the communication program and identify priority areas for capacity building.

Phase 2: Development of a Strategic Communication Program (SCP).

(i) Based on the assessment completed in Phase 1, the consultant will develop a SCP for the investment program which will comprise of, but not be limited to, the following major elements:

a. A Communication Strategy that will set a vision, identify challenges and risks, and elaborate a plan of action to achieve the communication objectives contributing to the successful implementation of the investment program;

b. A Communication Action Plan that will have specific communication objectives, internal and external audiences, messages, communication channels, type of media, frequency, evaluation, etc.;
c. A Communications Monitoring and Evaluation System that will include opinion research, tracking system, media monitoring, focus groups, and evaluation of major communication activities identified and listed in the Communication Action Plan.
d. A Capacity-Building and Knowledge Management Plan will describe the types of skills training, institutional arrangements, knowledge creation and sharing activities required to strengthen the capacity of key stakeholders, including key government agencies, to design and manage the implementation of the SCP.

(ii) The SCP will be developed in coordination with the implementing authorities, other relevant government agencies, and ADB. It should include the development of strategies that will assist, amongst others: (i) the preparation of the investment program (ii) effective sharing of information and collaboration between government and non-government organizations; (iii) building of awareness and mobilizing of communities; and (iv) improving the design of the investment program to incorporate agreed stakeholder recommendations. The specialists will also develop a coordinating mechanism for the communication work among the different organizations involved in the investment program and ensure that materials needed for the implementation of the communication program are produced among the different entities.

(iii) The specialists, working with the appropriate government agencies, will develop the Stakeholder Communication Strategy for the investment program's Facility Administration Manual. This will include preparing the relevant terms of reference for the Program Design and Management Consultants that will assist the government with implementing the investment program and preparing its subsequent tranches.

Phase 3: Initiating the implementation of the SCP and effective handover to the PMDC specialists who will mobilize prior to the beginning of construction activities.

APPENDIX 2

PPTA WORK PROGRAM

Water Resources Development Investment (WRDIP)
Project Preparatory Technical Assistance (PPTA)

Water Resources Development Investment Program - Project Preparatory Technical Assistance
WORK SCHEDULE AND PLANNING FOR DELIVERABLES

No.	Description of Activities (by others shown in *italics*)	2014 Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	2015 Jan	Feb	Mar	Apr	May	June
A. PROJECT MANAGEMENT																
	Mobilise, establish PPTA office	◆ *April 23 - Mobilization*														
	Kick-off meetings with key organisations (MIWRM, MCB, DWC, NPD, CEA, IWMI)	■														
	Collection/review of existing documents/reports/information/data etc.	■	■													
	Stakeholders' Meetings		◆ *May 7 - Inception Meeting*		◆ *July 21 - Interim Meeting*											
B. TECHNICAL ASSESSMENTS																
	Collection/review of WRDIP related data, documents, feasibility studies, maps, etc.		▒	▒												
	Sector analysis and assessment with identification of development priorities		■		■ *Draft Sector Assessment*											
	Water balance assessment of the Mahaweli System (including water availability and climate change)		■		■ *Draft Water Balance Assessment and Draft Climate Change Vulnerability Assessment*											
	Technical review of project feasibility studies for MLBCR, KMTC, UEC and NWPC		■	■	■	■	■	■	■							
	Technical review of irrigation system designs, engineering and specifications		■	■	■	■	■	■	■							
	Assessment of tunnel construction methods and contracting		▒	■	▒	■	■	■	■							
	Preparation of the consultancy package for tunnel feasibility designs (KMTC and UEC)				■	■	■									
	Analysis and updating of project estimates and implementation schedules				▒	▒	▒	▒								
	Design of the ISEWP and SIWRM consultancy packages including detailed ToR and costs				■	■	▒	▒								
C. SAFEGUARD ASSESSMENTS																
	Initial review and updating of the Initial Environmental Examination (IEE) for MLBCR		■	■	■	■ *Draft IEE submitted to ADB*										
	Initial review and updating of the Environmental Impact Assessments (EIAs) for NWPC and KMTC-UEC		■	■	■	■ *Draft EIAs submitted to ADB*										
	Revision and translation of IEE for MLBCR by the MIWRM					▒ *Revised Draft IEE submitted to CEA*										
	Revision and translation of EIAs for NWPC and KMTC-UEC by the MIWRM				▒	▒	▒	▒ *Revised Draft EIAs submitted to CEA*								
	Posting of Draft EIAs to ADB Website							◆ ◇ *120-day disclosure limit before Board Approval*								
	Final review and approval of IEE for MLBCR						▒	▒	▒ *Final Approval of IEE by CEA*							
	Final review and approval of EIAs for NWPC and KMTC-UEC							▒	▒	▒	▒ *Final Approval of EIAs by CEA*					
	Socio-economic surveys (for RPs/PSA/SPRSS)		■	■	■	■	■									
	Preparation of Resettlement Plans for (a) NWPC, and (b) KMTC-UEC-MLBCR				■	■	■									
	Preparation of Resettlement Framework		■	■												
	Revision and translation of RF, RIP and EARF by the MIWRM			▒	▒	▒	▒	▒								
	Preparation of Poverty and Social Assessment					■	■									
	Preparation of the Environmental Assessment Review Framework				■	■										
	Stakeholder Analysis and Communications-Based Assessment				■	■	■									
	Preparation of Strategic Communications Program				■	■	■	■	■							
D. FINANCIAL AND ECONOMIC APPRAISAL																
	Collection/review of relevant agro-economic and EA/IA financial management data and reports	■	▒	▒	▒	▒										
	Econometric analysis of proposed improvements in irrigated agriculture		▒	▒	▒	▒										
	Preparation of Financial Management Assessment Report				■	■	■									
	Preparation of final project cost estimates				▒	■	■	■	■							
	Preparation of detailed Economic and Financial Analysis Report		▒		■		■	■	■							
	Preparation of an investment program financing plan						■	■	■							
E. PROJECT PACKAGING																
	Review of available contract packages and procurement documents		■	■												
	Preparation of Procurement Capacity Assessment Report		■		■	■										
	Preparation of bid documents for advance action civil works packages by MIWRM			▒	▒	▒	▒	▒	▒							
	Preparation of Procurement Plans for each project (tranche)		■	■	■		■	■	■							
	Preparation of the ToR for the Program Management and Design Consultancy (PMDC)		■	■	■	■										
	Seminars for MIWRM about relevant guidelines on ADB procurement requirements			▒	▒											
F. IMPLEMENTATION ACTIVITIES																
	Recruitment of Program Design and Management Consultant					▒	▒	▒	▒	▒	▒					
	Bidding for advanced packages								▒	▒	▒	▒	▒	▒		
	Contract award										▒	▒	▒	▒	▒	▒
	Implementation of the Resettlement Plans										▒	▒	▒	▒	▒	▒
	Mobilzation to site											▒	▒	▒	▒	▒
	Initiation of construction activities												▒	▒	▒	▒
ADB MISSIONS AND KEY DATES (tentative)																
	Inception Mission	■	■													
	Interim Mission				■											
	Review Mission							■								
	Fact Finding Mission								■							
	Loan Negotiations										■		■			
	ADB Loan Approval													■		
	Loan Contract Signing														■	
	Loan Effectiveness															■
PPTA OUTPUTS AND REPORTS																
	Inception Report		◆													
	PMDC Terms of Reference					◆										
	Draft Interim PPTA Report				◆											
	Final Interim PPTA Report					◆										
	Draft Final PPTA Report								◆							
	Draft RRP Report								◆							
	Final PPTA Report									◆						
	Final RRP Report									◆						

LEGEND ■ **Full-time assignment** ▒ **Intermittent**

APPENDIX 3

SECTOR ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 3

SECTOR ASSESSMENT

NATURAL RESOURCES AND AGRICULTURE

DECEMBER 2014

ABBREVIATIONS

ACE	–	annual capita endowment
ADB	–	Asian Development Bank
CARE	–	Care Affected Regions Emergency project
CDB	–	Chinese Development Bank
CP	–	Concept Paper
CECB	–	Central Engineering Consultancy Bureau
CGIAR	–	Consultative Group on International Agricultural Research
DAC	–	Divisional Agriculture Committee
DAD	–	Department of Agrarian Development
DMC	–	Disaster Management Centre
DOA	–	Department of Agriculture
DZ	–	dry zone
EDBI	–	Export Development Bank of Iran
EIA	–	Environment Impact Assessment
FAO	–	Food and Agriculture Organization
FO	–	Farmer Organization
GDP	–	gross domestic product
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
DOI	–	Irrigation Department
IFAD	–	International Fund for Agriculture Development
IMT	–	Irrigation Management Transfer
ISEWP	–	improving system efficiencies and water productivity
IWMI	–	International Water Management Institute
JICA	–	Japan International Cooperation Agency
KFAED	–	Kuwait Fund for Arab Economic Development
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MOA	–	Ministry of Agriculture
MASL	–	Mahaweli Authority of Sri Lanka
MCB	–	Mahaweli Consultancy Bureau
MDM	–	Ministry of Disaster Management
MDP	–	Mahaweli Development Program
MERE	–	Ministry of Environment and Renewable Energy
MFF	–	multitranche financing facility
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MOED	–	Ministry of Economic Development
MPE	–	Ministry of Power and Electricity
MRB	–	Mahaweli River Basin
MT	–	metric ton
MUDSAD	–	Ministry of Urban Development and Sacred Area Development
MWSD	–	Ministry of Water Supply and Drainage
NCPCP	–	North Central Province Canal Program
NEM	–	North East Monsoon
NWA	–	National Water Authority
NWC	–	National Water Council
NWS&DB	–	National Water Supply and Drainage Board
NWPC	–	North Western Province Canal
O&M	–	Operation and Maintenance
OFID	–	OPEC Fund for International Development

PC	–	Provincial Council
PDA	–	project design advance
PIM	–	Participatory Irrigation Management
PMC	–	Project Management Committee
PMDC	–	program management and design consultant
PPTA	–	project preparatory technical assistance
SFD	–	Saudi Fund for Development
SIWRM	–	strengthening integrated water resources management
SLLRDC	–	Sri Lanka Land Reclamation and Drainage Corporation
SLPI	–	Sri Lanka Prosperity Index
SOP	–	Seasonal Operational Plan
SRI	–	System of Rice Intensification
SWM	–	South West Monsoon
UEC	–	Upper Elahera Canal
WMP	–	Water Management Panel
WMS	–	Water Management Secretariat
WRB	–	Water Resources Board
WTP	–	willingness to pay
WZ	–	wet zone

WEIGHTS AND MEASURES

ACE	–	annual per capita endowment
ha	–	ha
GW	–	gigawatt
Km	–	kilometer
Km^2	–	square kilometer
km^3	–	cubic kilometer
MCM	–	million cubic meters
mm	–	millimeter
m^3	–	cubic meter
MW	–	megawatt

CONTENTS

TABLES

I. INTRODUCTION

A. Forward

1. In Sri Lanka agriculture and natural resources[1] are intrinsically linked as most of the productive agriculture lands are located in the 'dry' zone of scarce water resources in the Northern provinces. Irrigation therefore plays a critical role in ensuring food security for the predominately rural population of the region and nationally.

2. Agriculture also plays an important role in the Sri Lankan economy with 80% of the population being rural of which 70% rely on agriculture for their livelihoods. The sector as a whole accounts for more than 10% of GDP, 30% of employment and 25% of export revenue. However, the contribution to GDP has declined in recent years, and productivity needs to increase to keep pace with rising demand for domestic consumption and to achieve national goals of food self-sufficiency and poverty reduction.

3. While Sri Lanka is a relatively water rich country, with more than 2,600 m^3 per capita and demand to supply ratio of 25%, the challenge is the difference between spatial and temporal distribution of water supply and demand, that is between a 'wet zone' of high availability and low demand, and a 'dry' zone of low availability and high demand. This is not a new problem as evident from the long history of building dams (minor tanks) and transfer canals. Today's challenge is to develop the potential of untapped water resources to improve livelihoods and living conditions in water scarce areas in the interests of inclusive growth and national development.

4. This sector assessment presents a synopsis of the sector, the key sector indicators, and summarizes performance to date and the proposed national development strategies and projects for the future.

B. Objectives

5. The purpose of this report is to present a summary of the assessment of the agriculture and natural resources sector. The overall objective of the program is to improve the productivity of water both in absolute terms (nationally) and per unit volume at farm level. The proposed investment program is focused on water transfers and enhancing the supply of water primarily for irrigated agriculture and drinking water supplies and the improvement of water use efficiency (WUE) within the project irrigation systems, as well as the strengthening of river basin integrated water resources management (IWRM). Therefore the emphasis is on irrigated agriculture and water and irrigation development and management.

C. Document Overview

6. The report is presented in the following sections:

- Section II – Water Resources and Agriculture Assessment; presenting a review of the resources and key indicators for water resources and agriculture.

[1] As per ADB terminology the sector subsectors include agriculture, irrigation and drainage, flood protection and water-based natural resources management

- Section III – Current Sector Organization and Performance; reviews the organizational, policy and legislative frameworks and current sector performance.
- Section IV – National Development Strategies; outlines current development plans and strategies to improve sector performance for achieving national development goals.
- Section V – Sector Investment Program; summarizes current investment programs, ADB's experience in Sri Lanka, lessons learnt and proposed programs in the sector.

D. Administrative Setting

7. For the purposes of administration there are nine provinces in Sri Lanka: Northern, North Western, North Central, Eastern, Central, Western, Sabaragamuwa, Uva and Southern (refer to **Figure 1**), each administered by a Provincial Secretary. There are 25 districts within these provinces, each administered under a District Secretary appointed by the central government, for coordinating communications and government activities, including development projects at district and divisional level (a sub-unit of districts of which there are 256).

Figure 1: Administrative Boundaries of Sri Lanka

Source: MCB, 2014

II. RESOURCES ASSESSMENT

8. This section presents an outline of the sector resources (water resources and agriculture), key indicators of availability and performance, and issues to be addressed in sector management and development.

A. Water Resources

9. The principal drivers of renewable water resource availability, both spatially and temporally, are the seasonal monsoonal rains and topographic relief. There are two monsoon periods consisting of the North-East monsoon (NEM) from December to February (Maha), and the South-West monsoon (SWM) from May to September (Yala), as well as two inter-monsoonal periods including March to April (first inter-monsoon (IM1)) and October to November (second inter-monsoon (IM2)).

10. The associated rainfall patterns and the high mountain relief in the center of the island, divide the country into three principal climatic zones: (i) the wet zone (WZ) of the lower southwest, which is about a quarter of the total land area; (ii) the dry zone (DZ) of the north and east, as well as (iii) the intermediate zone between the wet and dry zones (refer to **Figure 2**).

11. While the national mean annual rainfall is approximately 1,860 mm, this varies from 2,350 mm[2] in the wet zone to 1,450 mm in the dry zone; in the dry zone districts in the north[3] this average is about 1,200 mm. While the monsoonal winds predominately bring rain specifically to the SW and NE parts of the country, the inter-monsoonal rains are generally more widespread (refer to **Table 1**).

Table 1: Mean Annual Rainfall

Season	mm	%
IM1	268	14%
SWM	556	30%
IM2	557	30%
NEM	479	26%
Total	**1,860**	

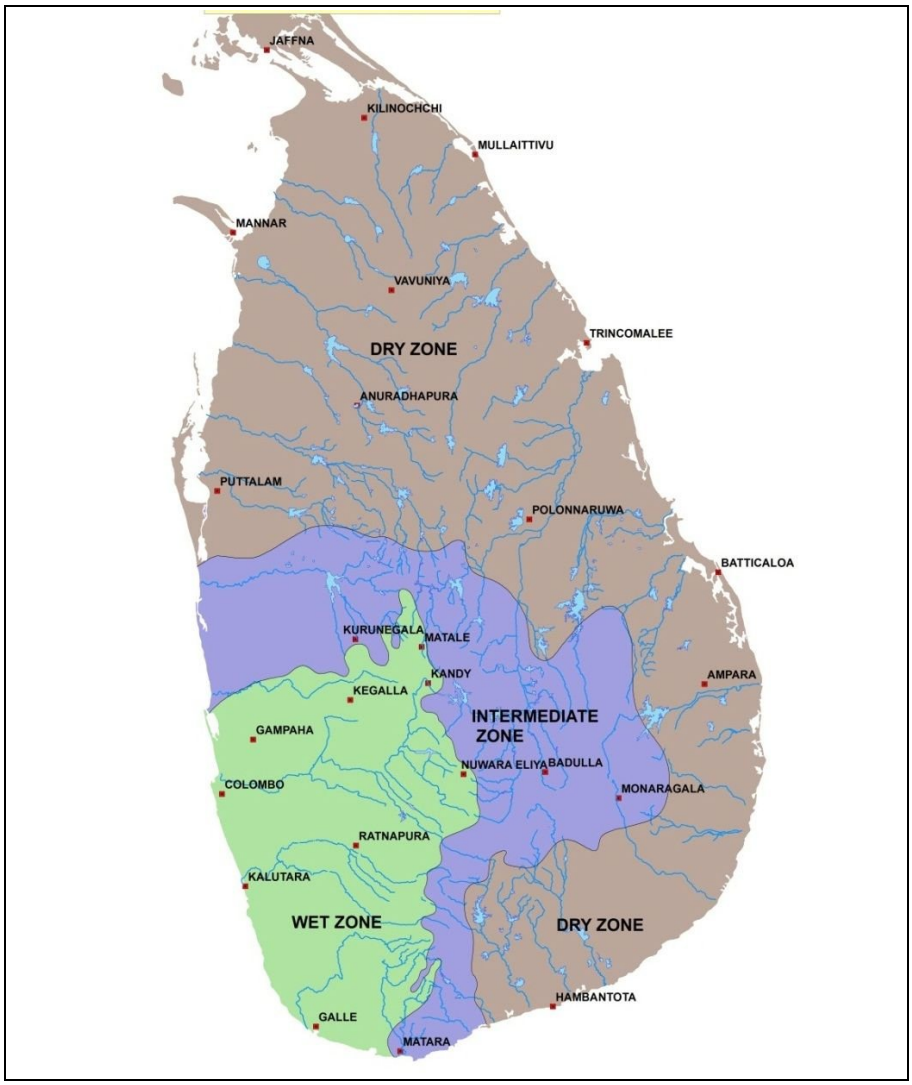
Source: Ministry of Environment[4], 2011

1. Water Availability

12. **Surface Water Resources.** There are 103 river basins mostly radiating from the central highlands to the coast, the largest of which is the Mahaweli Ganga with a catchment area of 10,300 km^2. The total annual surface water resources are approximately 52 km^3, of which 56% and 44% occur within the Maha and Yala seasons, respectively. About 60% of the annual river flow originates in the upper catchment wet zone (25% of the land area), which has significant implications on water availability for consumptive use in the lower intermediate and dry zones.

[2] IWMI. 1999. *Water Scarcity Variations within a Country: A Case Study of Sri Lanka*. Research Report 32, Sri Lanka.
[3] These are the districts (Anurdhapura, Jaffna, Killinochchi, Kurunegala, Mannar, Mullaitivu, Puttalam, Trincomalle and Vuvaniya) within which the WRDIP and NCPC irrigation systems are located.
[4] Sri Lanka's Second National Communication on Climate Change, 2011. Ministry of Environment, Sri Lanka

Figure 2: Hydrological Zones

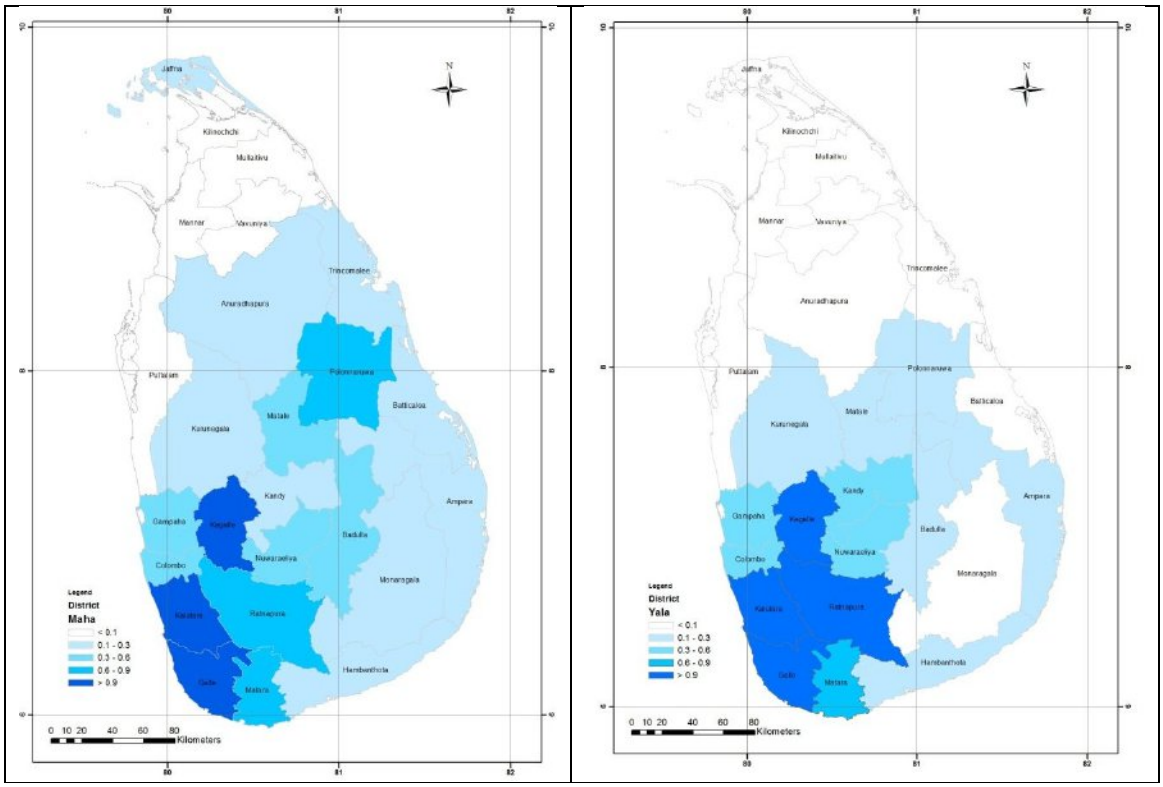


Source: MCB, 2014

13. **Seasonal water resources. Figure 3** shows the temporal (as well as spatial) variability of water resource availability. It is derived from the IWMI Research Report (No. 32) that shows the distribution of water resources, expressed as depth (m) per district for the Maha and Yala seasons. A key point to note is the higher and more extensive water availability within the dry zone districts during Maha (by comparison with Yala season), as well as the low water availability within the northern districts in both seasons.

14. The WRDIP aims to develop water infrastructure for the transfer of water from wet zone, principally districts of the Central Province to Northern provinces (North Western, North Central and Northern) of the dry zone. The North Western Province (NWP) includes the districts of Puttalam and Kurunegal and North Central Province (NCP) the districts of Anuradhapura and Polonnaruwa. While the Northern Province includes the districts of Mannar, Vavuniya, Mullativu, Kilinochichi and Jaffna.

Figure 3: Seasonal Water Resource (m)



Source: IWMI Research Report No. 32

15. **Groundwater.** There are a number of regional and localized aquifer systems within the country, of which the most well-developed for water use are the karstic and coastal confined aquifers of the Northern Province. There are also a number of alluvial aquifers in the lower reaches of the major river basins. In the hard rock areas of the metamorphic complex that covers 90% of the country deep regional aquifers are rare, and groundwater is associated with special localized geological conditions. Total annual groundwater is estimated to be of the order of 7.8 km^3 (refer to **Table 2**).

16. Groundwater quality is variable between aquifers and locations. It is estimated that about 40% of tubewells constructed during the 20th century have been abandoned due to high levels of iron and manganese, and on the Jaffna peninsula to nitrate levels of more than 200 milligrams per liter.[5] High concentrations (more than 3 ppm) of fluorides are also reported in the eastern and north central dry zone.

17. Also over-exploitation of aquifers near the coast in areas such as Puttalam, Mannar, Paranthan, Kilinochichi and Mullaitivu has resulted in seawater intrusion and salinization of water supplies. A more widespread problem is hardness of water with more than 850 ppm occurring in the northern sedimentary formations.

[5] MIWRM, 2010. Sri Lanka Water Development Report.

18. **Total Renewable Water Resources.** Total average annual renewable water resources are nearly 53 km^3, which is inclusive of nearly 8 km^3 groundwater of which 7 km^3 is derived directly from surface water recharge, hence referred to as overlap between and therefore not included in the calculation of total renewable water resources as shown in **Table 2**. The 75 percentile renewable resources are estimated at 41 km^3.

Table 2: Renewable Water Resources[6]

Item	Total (km^3)
Surface Water	52.0
Groundwater	7.8
Overlap [7]	7.0
Total	**52.8**

Source: FAO Aquastat

19. **Storage.**[8] There is a long and proud history of reservoir construction in Sri Lanka, traditionally referred to as *tanks*, going back several millenniums. In the past 100 years there has been an active program for rehabilitation of many of these tanks, and in more recent decades construction of a number of large dams for hydropower and water supply for irrigation and municipal use.

20. There are estimated to be nearly 30,000 reservoirs[9] and tanks nationwide with a combined storage volume of 8.76 km^3, principally for the supply of irrigation water. The vast majority (98%) are classified as minor tanks with a combined storage volume 1.4 km^3. There are 517 major and medium reservoirs with storage volume of 7.3 km^3, of which 129 are classified as large dams with 7.2 km^3 of storage (refer to **Table 3**). This latter group of dams is operated by five organizations, with the Department of Irrigation (DOI) and Mahaweli Authority of Sri Lanka (MASL) responsible for 94 and 13, respectively.

Table 3: Summary of Large Dams[10]

Operator	No.	Storage (MCM)
Irrigation Department	94	4,343.9
MASL	13	2,667.5
NWS&DB	2	26.7
Ceylon Electricity Board	8	46.2
Provincial Council	2	132.3
Total	**129**	**7,216.5**

Source: Irrigation Department, 2014

[6] FAO Aquasat Country Water Resource Summary. It should be noted that estimates of average annual renewable resources vary slight between sources but are of similar order (approx. 52 km^3 per annum).
[7] Overlap between groundwater and surface water
[8] MIWRM. 2014. *Irrigation Knowledge*. Irrigation Department, MIWRM, Sri Lanka.
[9] ibid
[10] As reported in MIWRM publication, Irrigation Knowledge Centre, 2014, a large dam is greater than 15 m in height, and/or 5 to 15 m in height impounding more than 3 MCM, and/or rating as 'highly hazardous' depending on the location, age, peculiarity of structures and foundation.

21. New dams under construction include the Deduru Oya (75 MCM), Gurugal Oya (0.3 MCM), and Mallipotha (0.9 MCM) for the DOI,[11] and Moragahakanda (570 MCM) and Kalu Ganga (266 MCM) for the MASL, as part of the NCPCP. The Moragahakanda Reservoir also includes a 20 MW hydropower station.

2. Irrigation Development

22. There are more than 30,000 irrigation systems with a combined irrigated area of 717,000 ha[12] as summarized in **Table 4**. The major and medium systems are those defined as those with (i) irrigated areas of greater than 400 ha and (ii) 80 to 400 ha, respectively, which constitute only 2% of the schemes, but cover 58% of the total irrigated area. The minor schemes are those schemes of less than 80 ha (98% of schemes) and 42% of the total irrigated area.

Table 4: Irrigation System Typology[13]

System	No.	Area (ha)
Major and Medium	548	422,723
Minor	30,521	294,025
Total	**31,069**	**716,748**

Source: Department of Irrigation, 2014

23. The operation and maintenance (O&M) of the system headworks and main canals is shared between different organizations (as discussed in Section III), with the DOI, MASL and Provincial Councils (PCs) responsible for major and medium systems, and PCs and the Department of Agrarian Development (DAD) supporting minor systems. In all systems Farmer Organization operates and maintains the tertiary canal system, including distributary and field canals.

3. Hydropower

24. Until recently hydropower was a major contributor to energy production, producing about 50% of the annual national requirements. There are 16 hydropower stations with a combined average annual power production potential of about 1,207 MW[14] and two more are under construction (Broadlands and Moragahakanda) as summarized in **Table 5**. In addition, there are also 85 small hydropower stations operated under Public Private Partnership (PPP) arrangement with installed capacity of 175 MW. Total installed hydropower generation capacity is about 44% of the total installed capacity (inclusive of thermal and wind) of 3,141 MW. In 2011 hydropower generated 4,600 GWh from both CEB and PPP stations, which was 40% of total national generation (11,528 GWh), compared to thermal stations (18) which generated 59% of the total.

[11] These dams are outside the WRDIP project area
[12] MIWRM estimate
[13] There are considerable variations in reported irrigated areas between sources and unfortunately there is no complete and comprehensive summary of systems by type. Therefore, the numbers presented in this report are a best estimate based on currently known numbers and areas as reported by the principal institutions responsible for system O&M; Irrigation Department, MASL and Department of Agrarian Development
[14] CEB, 2011. Statistical Digest 2011. Ceylon Electricity Board (CEB).

25. As discussed in Section III the contribution of hydropower to the country's energy needs has been declining as demand for electricity rises, and is predicted to continue to do so in the future. As the majority of the hydropower potential has been developed, and future generation capacity will come from an expansion of other energy sources, principally increased thermal power capacity.

Table 5: Hydropower Stations

Reservoir	Operator	Installed Capacity (MW)	Firm Energy (GWh/yr)	Rated Head (m)	Total Storage (MCM)
1. Kotmale	MASL	134	270	201	173
2. Ukuwela	MASL	40	164	78	4
3. Victoria	MASL	210	446	190	721
4. Randenigala	MASL	126	304	78	861
5. Rantambe	MASL	49	174	32	7
6. Bowatenna	MASL	40	49	55	52
7. Canyon	CEB	100	-	578	-
8. Castlerigh	CEB	50	-	227	48
9. Moussakelle	CEB	30	-	204	124
10. Norton	CEB	24	-	468	-
11. Polpitiya	CEB	25	-	259	-
12. Upper Kotmale	CEB	112	-		
13. Kukule ganga	CEB				
14. Samanalawewa					278
Total		**940**			**2,268**

Sources: MASL, DOI and CEB, 2014

4. Flood Risk

26. Fifteen of the 103 river basins are assessed as high flood risk due to their large catchment areas (greater than 1,000 km^2), river length (greater than 100 km^2), and recent land use changes, due to deforestation and/or high levels of development. In recent times severe flood events were recorded in 2003, 2006, 2008, 2010 and 2012. Between 2010 and 2012 the cumulative cost of flooding has been estimated at SLRs 111,534 million[15] ($860 million) of which 80% was a result of damage to infrastructure, mainly roads. Floods have the single greatest impact on people, accounting for 46% of impacted persons over the period from 1974 to 2012 (notably drought is second accounting for 42%).[16]

5. Water Demand

27. Total annual withdrawals for consumptive use are approximately 13 km^3 of which 90% are for agriculture and 5% each for municipal and industrial use (refer to **Table 6**).

28. Agriculture is the major water user in Sri Lanka, primarily for irrigation. There are estimated to be about 30,000 irrigation systems in the country with a total irrigable extent of

[15] Mahinda Chintana, 2012.
[16] Mahinda Chintana, 2012 Chapter 5.

717,000 ha[17]. As outlined above, the majority of systems (98%) are classified as minor systems of less than 80 ha, which accounts for 42% of the total irrigated area, while there are 548 major and medium systems (2%), which account for nearly 60% of the irrigated area.

29. Municipal drinking water and industrial water are estimated to be about 0.8 km^3 per annum or 6% each of total withdrawals. And demand is predicted to further increase with population growth, improved water reticulation and growth of industry.

Table 6: Water Withdrawals[18]

Sector	Volume (km^3)	%
Agriculture	11.310	87
Municipal	0.805	6
Industrial	0.831	7
Total	**12.950**	

Sources: MIWRM, 2014

6. Water Resources Indicators

30. There are several indicators that provide relevant information about the status of national water resources availability and use. **Table 7** lists three indicators relevant to this assessment:

- The national Annual per Capita Endowment (ACE) is nearly 2,600 m^3, which is well above the threshold of 1,700 m^3 for water 'scarcity'. However, there is considerable spatial variation. While it is more than 2,900 m^3 in the wet zone within which the upper Mahaweli Ganga is located (the principal water source for the WRDIP) and about 1,200 m^3 in the dry zone to the north[19] where the WRDIP irrigation systems are located (and within which most of the irrigated lands are located). This latter value is well below the threshold of 1,700 m^3 for moderate scarcity,[20] and based on projected population growth could be less than 1,000 m^3 (moderate to severe) by 2025. The situation in the northern dry zone is even more severe, if the dependable seasonal rainfall[21] is considered as the criteria for water availability. In which case the ACE is less than 670 m^3, of which 540 m^3 (80%) occurs in the Maha season. The Yala season is 'usually' severely water short with less than 200 m^3 per capita.
- Withdrawals per capita: the withdrawals per capita nationally are 639 m^3, or only a quarter of water availability.
- Withdrawal supply ratio: the ratio of withdrawals to annual renewable water resources nationally is 24%, but within the northern dry zone, (as outlined above) this increases

[17] MIWRM. 2014. *Irrigation Knowledge*. Irrigation Department, Ministry of Irrigation and Water Resources, Sri Lanka.
[18] FAO, Aquastat Country Summary
[19] Within the districts of Jaffna, Kilinochchi, Mullaitivu, Vavuniya, Mannar, Trincomalee, Anuradhapura, Puttalam and Kurunegala.
[20] Falkenmark indicators of scarcity are; little or none > 1,700 m^3, moderate 1,700 to 1,000 m^3, medium to severe 1,000 to 500 m^3 and severe < 500 m^3.
[21] Dependable seasonal rainfall is defined rainfall exceeding 75% probability.

to more than 60%. And is more than 80% in the Yala season and without the provision of additional water from transfer or desalination could increase to 100% by 2025[22].

- Storage ratio: the ratio of storage volume per capita is about 360 m^3 per capita, however most of the storage, by volume, is located in the wet zone, particularly the large dams on the Mahaweli Ganga. Within the northern dry zone the ratio, it is of the order of 300 m^3 per capita.[23]

Table 7: Water Indicators

Indicator	Unit	Sri Lanka		Global	India	Mauritius	Indonesia	Jordan
		National	Nth DZ					
Annual endowment per Capita	m^3	2,601	1,200	6,000	1,582	2,129	8,504	156
Withdrawals per Capita	m^3	639						
Withdrawal Supply Ratio	%	24	60		40	26	5	99
Storage Ratio	m^3	356	300	1,050	191	72	97	46

Nth DZ = northern dry zone
Sources: Sri Lanka; Present Study, 2014, global and other countries FAO Aquastat

31. The above table also shows the relative water situation of Sri Lanka compared to global values and other countries, including neighboring (India), other island states (Mauritius and Indonesia) and arid zone (Jordan). While it is significantly below the global average of 6,000 m^3 per capita, the annual water endowment and withdrawal ratio are similar to neighboring countries and small island states, and well above arid zone countries.

B. Agriculture

32. The total cultivable area is of the order of 2.18 million ha[24] or about 33% of the total country land area, of which approximately 1 million ha (2.38 million acres) are cultivated seasonally with paddy, other field crops and vegetables, and of which approximately 75% are irrigated.

33. **Cropped Area.** The cropped area varies between the Maha and Yala seasons, and between years. The maximum cropped area occurs during the Maha season, and is of the order of 1 million ha and 600,000 ha in Yala season as summarized nationally and for the 'northern' dry zone in **Table 8** paddy rice accounts for 74% of cropped area and other field crops (OFC), principally maize, green chili, green gram, cow pea, black gram and groundnuts, and vegetables are 16% and 10% of the total, respectively. In some districts especially dependent on water availability, there is also inter-seasonal cropping, between the Maha and Yala seasons, of short duration vegetable crops including cow pea, green gram, black gram, onion, kurrakan and maize, though the areas are relatives small (for example 8,700 ha in 2013).

[22] IWMI Report 32. Water Scarcity Variations within a Country: A Case Study of Sri Lanka.1999. Based on 'scenario 1' prediction and dependable water availability.
[23] As calculated from information provided by the Irrigation Dept. MIWRM, Sri Lanka, March 2014.
[24] Agriculture areas at farm, district and national levels are generally reported in acres, 2.38 acres equals one hectare.

34. The annual cropped area within the 'northern dry zone' (as defined above) is about 637,000 ha (37% of the national total) with a cropping intensity of a just over 150%. The cropping pattern is similar to the national trend, which is dominated by paddy production (of more than 70% of total crop) in both the Maha and Yala seasons.

Table 8: Annual Cropped Area (ha)[25]

Nationally	Maha	%	Yala	%	Total	%
Paddy	774,120	72	502,870	74	1,276,990	74
OFC	189,032	18	84,913	13	273,945	16
Vegetables	95,026	9	71,065	11	166,090	10
Sugar[26]	17,000	2	17,000	3	17,000	1
Total	**1,075,178**	**62**	**675,848**	**38**	**1,734,025**	

Dry Zone	Maha	%	Yala	%	Total	%
Paddy	302,120	72	161,675	74	463,795	73
OFC	93,311	22	41,354	19	134,665	21
Vegetables	23,268	6	15,489	7	38,757	6
Total	**418,699**	**66**	**218,518**	**34**	**637,217**	

Source: Department of Census and Statistics, 2014

35. **Figure 4** shows the trend in planted area of paddy over the period 2005-2013. While there are annual variations, the total area increased from 800,000 to 900,000 ha in the period 2005-2007, to more than 1 million ha after 2010. Much of this increase has been in the Maha season.

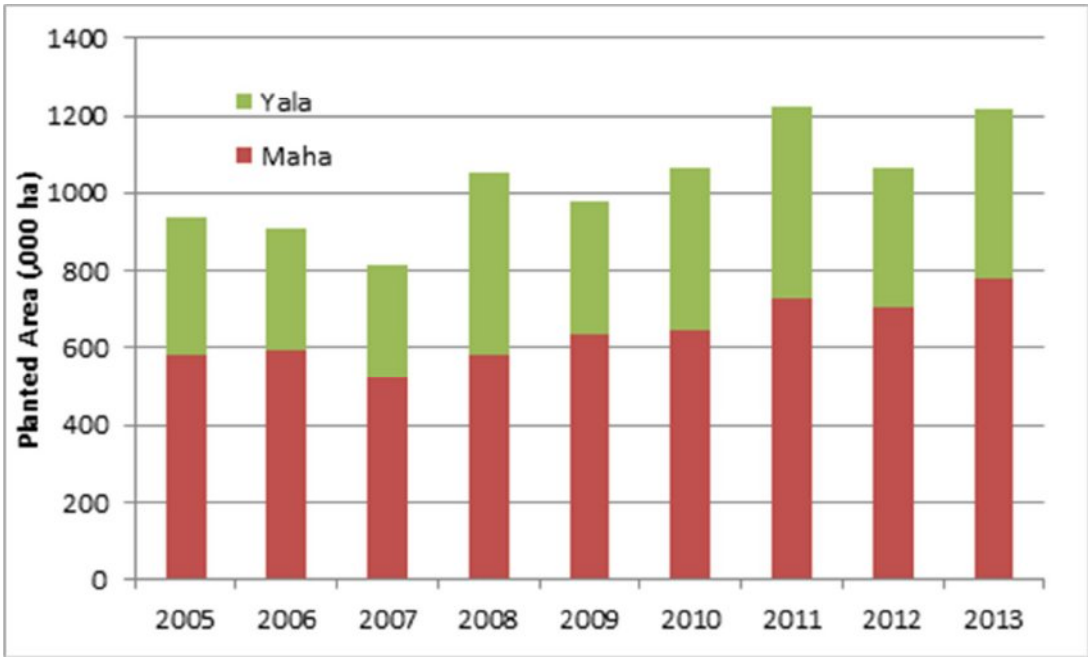
36. **Figure 5** also presents the planted area by water source, irrigation systems, major and minor, and rainfed. It tends to indicate that much of the increase in area has been within the major (and medium) irrigation systems.

37. **Figure 6** shows the trend in planted area of the principal other field crops over the period 2001 to 2013. The total annual area trebled over this period to more than 200,000 ha (out of the total area for all OFCs of 285,000 ha), with the area of maize increasing from less than 30,000 ha to 100,000 ha.

[25] Socio Economics and Planning Centre, Department of Agriculture, Ministry of Agriculture, Crop Forecasts for Maha 2013/14 and Yala 2013 (targeted areas)

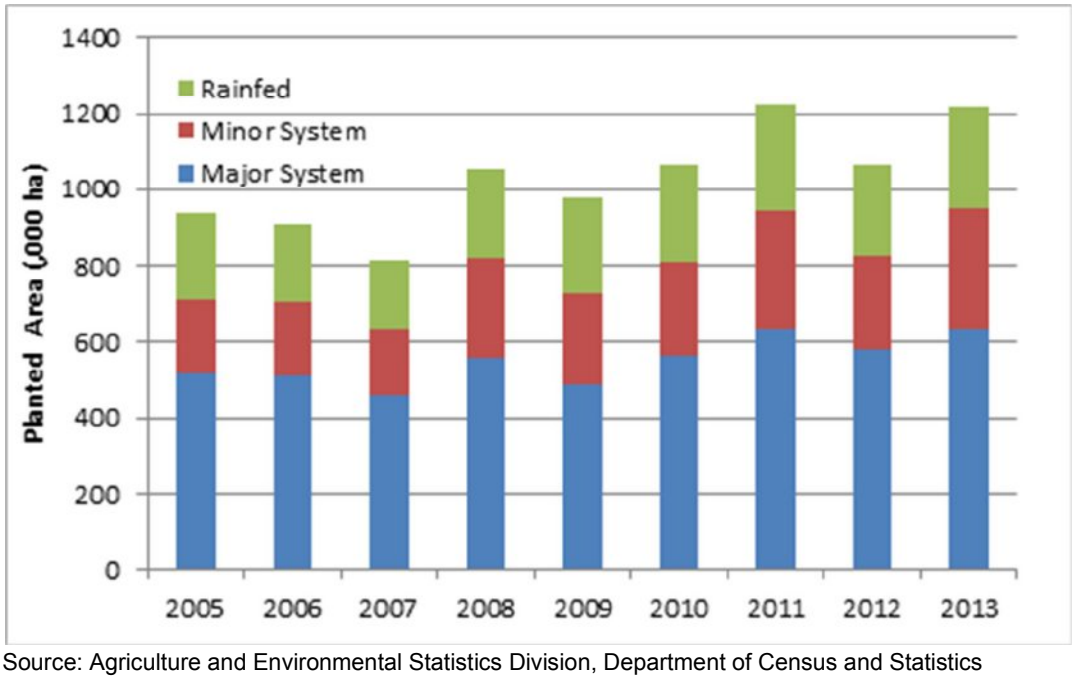
[26] The area of sugarcane in 2005 as 16,910 hectares.

Figure 4: Seasonal Paddy Area (2005-2013)



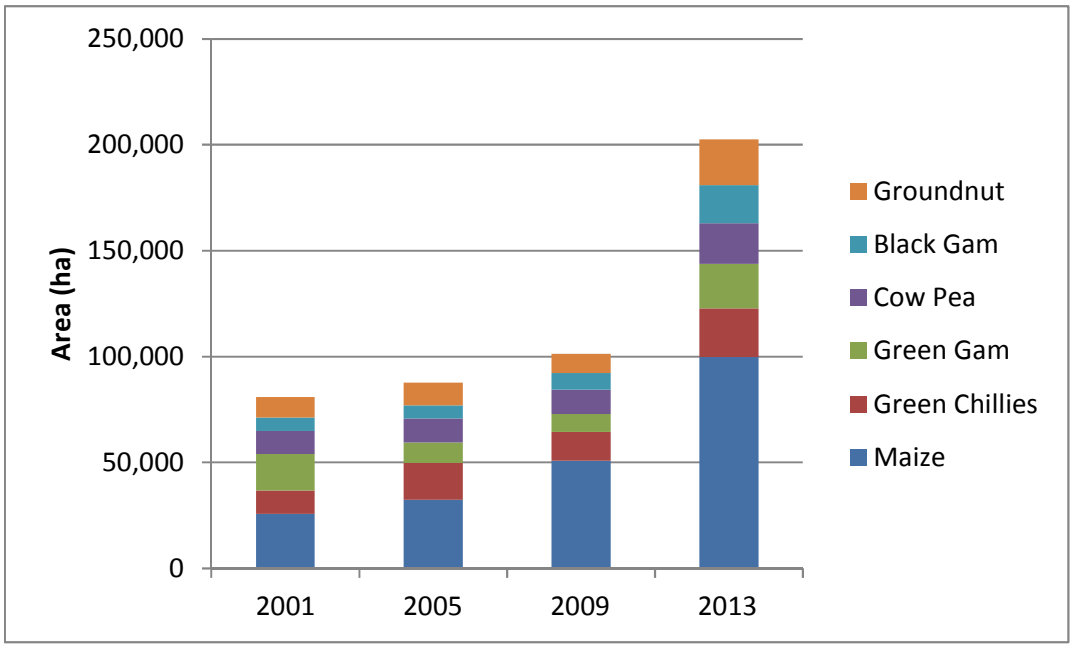
Source: Agriculture and Environmental Statistics Division, Department of Census and Statistics

Figure 5: Paddy Planted Area by System (2005-2013)



Source: Agriculture and Environmental Statistics Division, Department of Census and Statistics

Figure 6: OFC Area (2001-2013)



Source: Agriculture and Environmental Statistics Division, Department of Census and Statistics

38. **Cropping Intensities.** Cropping intensity in Maha is reportedly close to 100% in normal rainfall years; therefore, overall cropping intensity nationally is of the order of 150%. However, there is considerable variation between districts due to rainfall and irrigation water availability. In the Northern provinces for areas supplied from minor tanks cropping intensity is typically less than 100% and for those supplied from major tanks of the order of 130%.[27] For the major irrigation systems under command of the Mahaweli Scheme it is typically of the order of 180% to 200%.

39. **Irrigated and Rainfed Areas.** The cropped area under irrigation, from main schemes and major and minor tanks is approximately 717,000 ha or 72% of the cultivated area of approximately one million ha with the balance being rainfed.

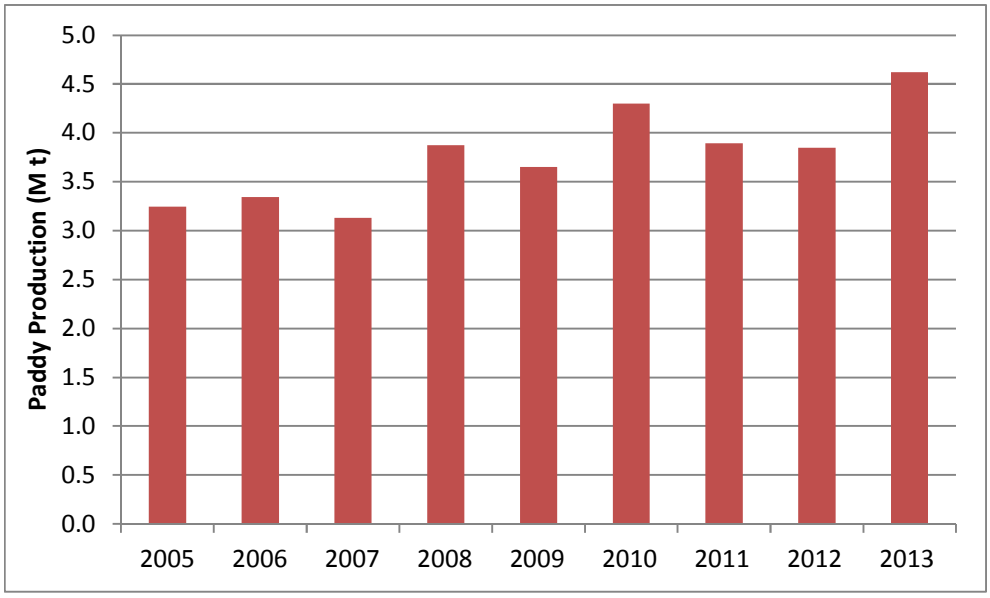
40. Rice Production. Annual paddy production is of the order of 4.4 million tons of which approximately 60% and 40% are produced during the Maha and Yala seasons, respectively. After accounting for wastage, seed requirements and milling this equates to about 2.6 million tons. One of the main goals of current policies and strategies is national self-sufficiency in rice, which for the current population would require an annual rice production of 2.3 million tons.

41. **Figure 7** shows the total annual paddy production, from irrigated and rainfed, over the period from 2005 to 2013. Over this period production increases from 3.3 (2007) to 4.6 million tons (2013).

[27] MCB NCP Prefeasibility Study

42. **Food Imports.** In 2012 Sri Lanka was technically self-sufficient in rice, with imports of about 28,000 tons matching exports, and with projections of exports rising to 500,000 tons by 2020.[28] In the same year, approximately 320,000 tons of OFCs and vegetables were imported, mostly onions and potatoes (80%). However the national development goal is for self-sufficiency in OFCs and vegetables by 2020.

Figure 7: Paddy Production 2005-2013



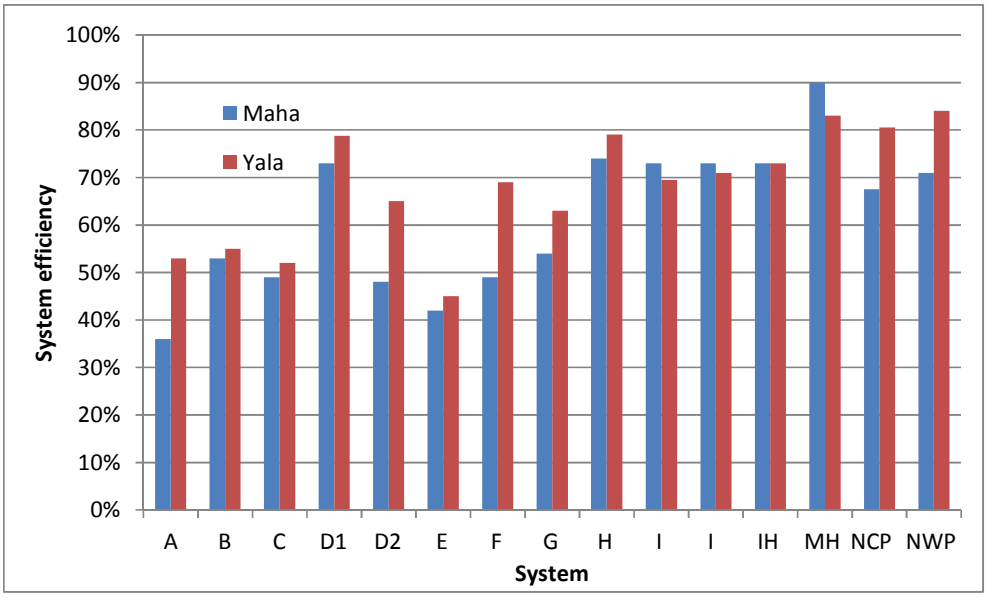
Source: Agriculture and Environmental Statistics Division, Department of Census and Statistics

43. **Water Productivity.** The water productivity of paddy varies between systems, locations, and seasons and is dependent of yield and gross water applications. In the Mahaweli systems[29] over the period from 2003 to 2011 cropping intensity averaged close to 180%. Paddy production over this period averaged 5.4 tons per hectare (t/ha) with similar yields in both the Maha and Yala seasons. Water productivity overall (for paddy) was 0.33 kilograms per cubic meter (kg/m^3) and 0.37 and 0.29 kg/m^3 for the Maha and Yala seasons, respectively. Based on a farm gate price of about $300 per ton (about SLRs 40 per kilogram), this is a productivity of $0.10/$m^3$. Within the northern dry zone districts (as defined above) it is estimated[30] for the 2012-13 Maha and Yala season that overall cropping intensity was about 130% and paddy yields on average 3.7 t/ha. Based on 'typical' crop water requirements and irrigation efficiencies, the average water productivity is about 0.20 kg/m^3, but ranges from 0.15 to 0.25 kg/m^3 in the Yala and Maha seasons, respectively. At the above farm gate prices this is an equivalent productivity of $0.06/$m^3$. However it should also be borne in mind that within the districts there is variation in yields and irrigation water requirements between irrigated and rainfed crops, and between major and minor irrigation systems.

[28] Mahinda Chintana (pg 89)
[29] MASL Statistical Handbook 2010/2011
[30] Department of Census and Statistics, District crop estimates for 2012-2013 seasons.

44. **System Efficiencies**. For typical cascade systems common in Sri Lanka water is reused (recirculated) within the systems, so the system efficiency is higher than for individual sub-systems. System efficiencies vary widely due to differences in the system layout, water availability, cropping intensity and operation. For the systems within the MDP area, system (cascade) efficiencies range from less than 40% (System A in Maha season) to more than 80% (System MH) (refer to **Figure 8**).

Figure 8: System Irrigation Efficiencies



Source: MCB, 2014

III. CURRENT ORGANISATION AND PERFORMANCE

45. This section sets out the overall sector framework in terms of institutional, policy and regulatory aspects of sector management and current levels of performance.

A. Institutional Framework

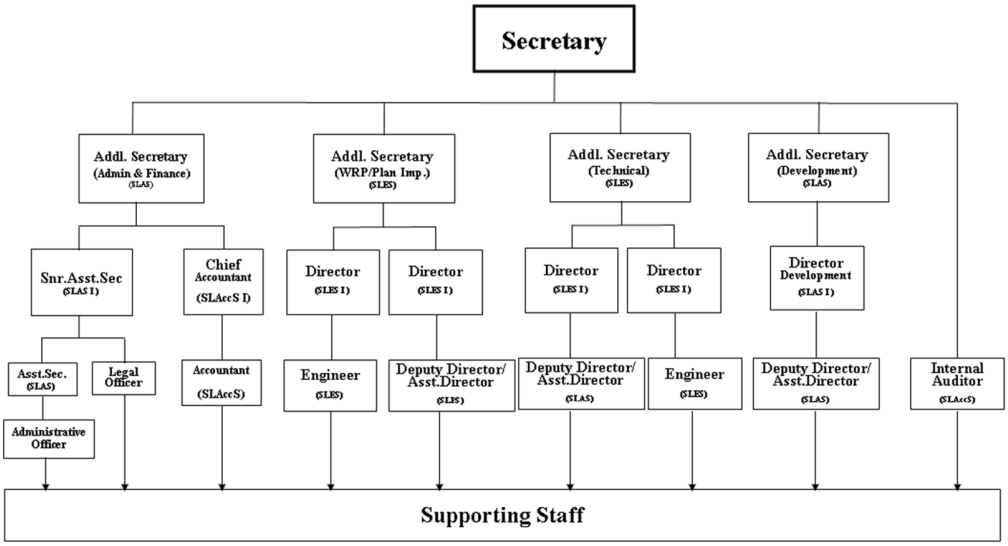
1. Institutions

46. **Current Situation.** The institutional landscape includes numerous organizations with mandates and responsibilities in the development and management of the water resources and agricultural sectors. At the national, provincial and district levels there is somewhere of the order of 40 government agencies with varying degrees of involvement in the sector.[31] The principal institutions are listed below with an outline of their structure and activities.

47. The principal ministries with mandates and activities in the sectors include: the Ministry of Irrigation and Water Resources Management (MIWRM), Ministry of Environment and Renewable Energy (MERE), Ministry of Agriculture (MOA), Ministry Power and Energy (MPE), Ministry of Land and Land Development (MLLD) and Ministry of Disaster Management (MDM). In addition, there are a number of other ministries and agencies with specific sub-sector and/or area responsibilities.

48. **Ministry of Irrigation and Water Resources Management.** The MIWRM is principally responsible for water resources development for multi-sector uses, including agriculture, energy, flood protection and domestic water supply, and for the on-going management of major dams and major and medium irrigation schemes which water courses pass across administrative boundaries of provincial councils (i.e. inter provincial river basins). **Figure 9** shows the MIWRM overall organizational structure.

Figure 9: MIWRM Organogram



[31] Samad, 2004. Water Institutional reforms in Sri Lanka, Water Policy 7 (2005) 125-140. International Water Management Institute, Colombo.

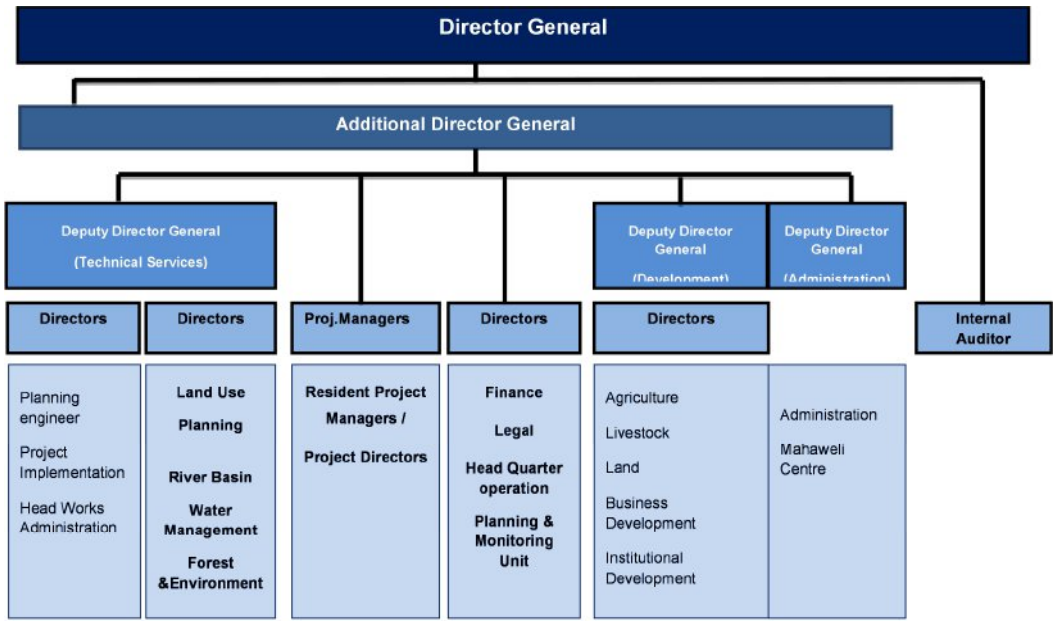
49. The MIWRM affiliated boards and institutes include:

(i) **Water Resource Board (WRB).** The main role of the WRB is collection of data and information for advisory purposes including hydrogeological investigation and groundwater development projects.

(ii) **Mahaweli Authority Sri Lanka (MASL).** The MASL was established in 1979 with the mandate to implement the Mahaweli Development Program, which included the development of dams and reservoirs for hydropower and irrigation water supply, and construction of canal irrigation systems. Current activities include the planning and management of the Mahaweli Scheme, including the planning and management of multi-sector water allocations. This is carried out by the Water Management Secretariat, via a Seasonal Operational Plan, which is prepared in consultation with stakeholders; farmers, irrigation system managers (from both DOI and MASL), and hydropower station and drinking water supply system operators. The plan is implemented through weekly water management planning meetings (referred to as the Water Panel Meeting), comprising representatives from farmers, DOI, MASL, CEB, National Water Supply and Drainage Board (NWS&DB), WRB and Divisional and Provincial Secretariats. The Mahaweli Scheme currently supplies an irrigated area of about 161,000 ha of which about 60% are under direct MASL management, and the balance of which are under DOI management, as discussed in the following section.

The MASL as of April 2014 had a total staff of more 4,400 of which 15% (522) were technical, including specialists in engineering, planning and agronomy. It comprises of a technical directorate responsible for project planning and water resources management and development directorate (refer to **Figure 10**).

Figure 10: MASL Organogram



(iii) **Department of Irrigation (DOI).** The DOI was formed 114 years ago, since which time its responsibilities and activities have evolved to planning, research, development and regulation of water resources nationally, including irrigation, hydropower, flood control and drainage. One of its main functions is the O&M of the major and medium tanks and irrigation systems that cross district boundaries and are outside the Mahaweli Development Program as outlined below. There are approximately 352 systems under the DOI with a combined irrigated area of approximately 284,000 ha, with the larger systems (72) managed by the Water Management Division (WRD) and balance of systems (280) by the Irrigation Management Division (IMD).

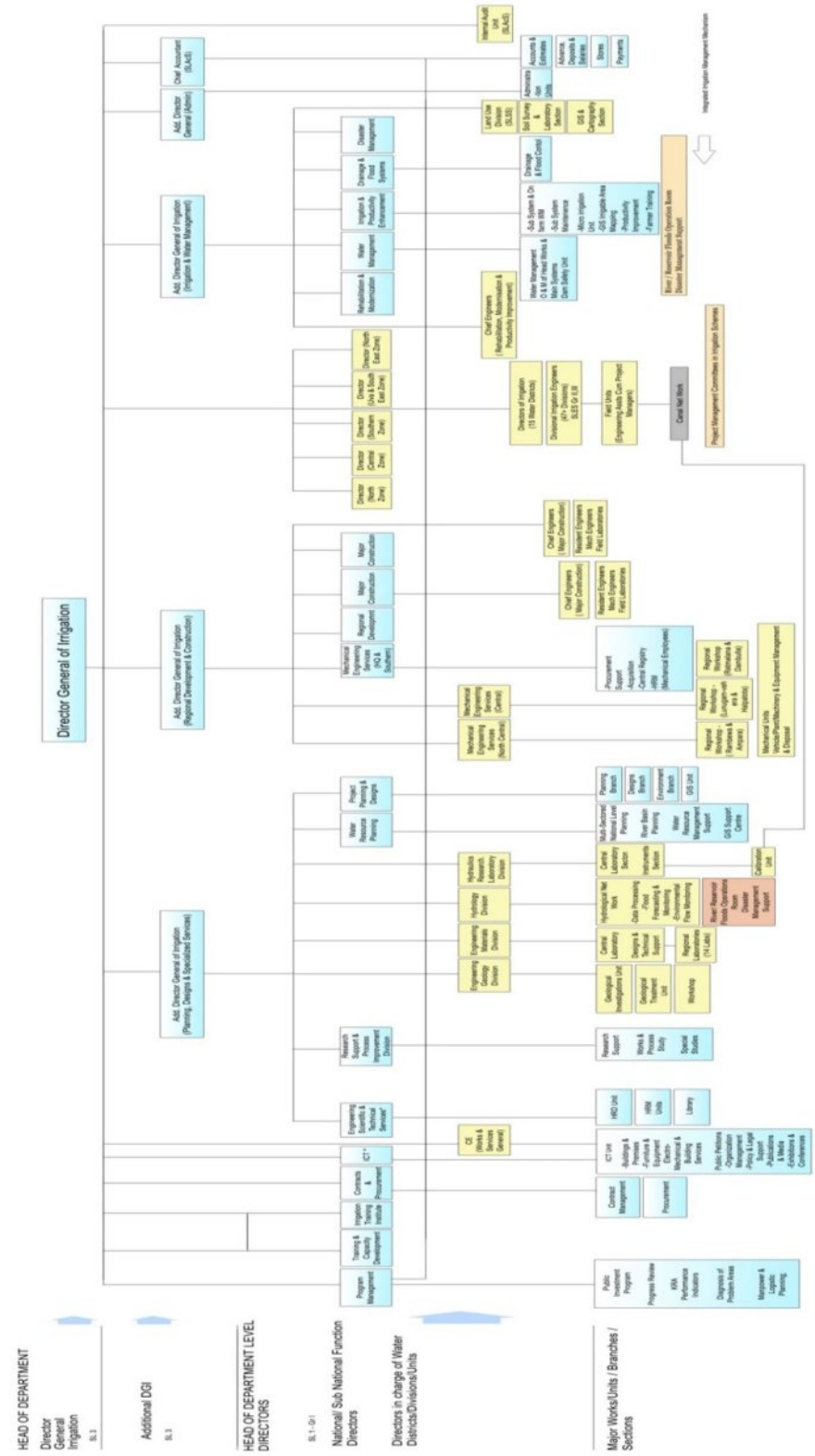
As of 2013 the Department had a staff of about 4,000 of which more than 1,000 are technical staff specialists in disciplines of engineering, hydrology, geotechnical, irrigation planning and management and surveying. There are 14 Range offices with Director, Chief Resident Engineer and 48 Divisional Irrigation Engineer offices. **Figure 11** shows the DOI organizational structure, which includes three technical directorates; Irrigation and Water Management responsible for system operation and maintenance; Regional Development and Construction and Planning; and Design and Specialist Services. In 2013 annual recurrent expenditure was SLRs 1.44 billion and capital expenditure SLRs 6.72 billion of which about SLRs 1.6 billion was for rehabilitation of capital assets. Assuming that the majority the rehabilitation costs are for irrigation systems this is an equivalent area rate of about $30/ha (based on an irrigated area of 284,000 ha).

(iv) **Central Engineering Consultancy Bureau (CECB).** The CECB is a statutory body established under the State Industrial Corporations Act No. 49 of 1957, giving special attention toward providing multi-disciplinary consultancy services for state sector development projects. Specific functions of the CECB include providing technical support, training and research services to multi-purpose engineering projects, including those for flood protection, water supply and irrigation.

50. **Ministry of Agriculture (MOA).** The Department of Agriculture (DOA) function within the MOA is the promotion of agricultural productivity and production of food crops for the purpose of enhancing the income and living condition of farming communities and making food available at affordable prices to the consumer. The major functions of the DOA include research, extension, production of seed and planting material, regulatory services related to plant quarantine, soil conservation and pesticides.

51. **Department of Agrarian Development (DAD).** The DAD was established in 1958 with a broad mandate for the provision of services and support to the agriculture sector, and while initially part of the MOA it is now an institution of the Ministry of Economic Development (MOED). Its activities include the restoration, operation and maintenance of minor (village) tanks and irrigation works, of which there are more than 29,000 nationally with a combined irrigated area of more than 290,000 ha. The DAD has more than 12,000 staff of which about 9,500 are field staff.

Figure 11: Organogram of the Department of Irrigation



Source: DOI, 2014

52. **Ministry of Power and Energy (MPE).** The Ministry's primary role is the planning and management of the power sector. The CEB is an affiliated institution which was formed in 1969 responsible for electricity generation, transmission, distribution and retailing. The CEB operates 24 power stations[32] with a total installed capacity of 2,058 MW: 16 hydropower plants with an installed capacity of 1,207 MW, 7 thermal plants of 848 MW, and 1 wind station of 3 MW. The total combined annual production is about 11,500 GWh. In addition to the CEB there are a number of private generation companies that supply power to the national grid. Decisions on water allocation and releases of hydropower stations operated by MASL (as shown in **Table 5**) are jointly taken by the water panel of the MASL Water Management Secretariat (as described in section 36 (iii)).

53. **Ministry of Water Supply and Drainage (MWSD).** The Ministry's mission statement is: *to facilitate stakeholders to serve the nation by providing safe drinking water and adequate sanitation facilities, ensuring protection of water sources and environmental equality.* It facilitates and coordinates sector activities with the National Water Supply and Drainage Board (NWSDB) in order to achieve the mission objectives and government development goals.

54. **National Water Supply and Drainage Board (NWSDB)**. The NWSDB works under the MWSD and is the principal authority providing safe drinking water and facilitating the provision of sanitation in Sri Lanka. It presently operates 312 water supply schemes, supplying 39% of the population, and in addition, 12% of the population is supplied from hand pump tube wells. It is also operates and maintains sewerage schemes in Colombo, Hantane, Koggala, Hikkaduwa and Kataragama.

55. **Ministry of Urban Development and Sacred Area Development (MUDSAD).** The Rural Water Supply and Sanitation Division (RWSSD) of the MUDSAD is the national agency responsible for the development of the rural water supply and sanitation sector.

56. **Ministry of Environment and Renewable Energy (MERE).** The stated mission of the Ministry is the provision of leadership for the management of the environment and natural resources for sustainable development. The water and agriculture sector relevant divisions include the Climate Change Secretariat, Natural Resources Management, Sustainable Development and Sustainable Environment responsible for development of mitigation and adaptation strategies for impact management, while the Department of Meteorology is responsible for climate observation and reporting.

57. **Ministry of Disaster Management (MDM).** The MDM organizations relevant to the sectors include:

(i) **Department of Meteorology.** The main functions are (a) the provision of meteorological and climatological services, (b) provision of early warning services with to meteorological hazards and tsunamis, and (c) technical activities on climate change.

(ii) **Disaster Management Centre (DMC).** The Centre was established under the National Council for Disaster Management in accordance with the Sri Lanka

[32] CEB Annual Report 2011

Disaster Management Act No. 13 of 2005, and fits within the MDM. It functions as a coordinating body between other institutions for the planning and management of disaster forecasting, preparedness and mitigation.

58. **Ministry of Land and Land Development**. The Ministry mission statement is "*Effective and Efficient Management of the Land Resource while contributing to the Socio – Economic Development of the Country, at the Maximum Level".* As such, it has overall responsibility for national land and land use policies, management and development of state lands including distribution to landless people and allocations for development projects, as well as management of land registration.

59. **Sri Lanka Land Reclamation and Drainage Corporation (SLLRDC).** The corporation is engaged in water related engineering design and construction, including drainage and hydraulic structures.

60. **Provincial Councils (PC).** The Provincial Councils were set up in 1987[33] and are legislative bodies of the nine provinces. They have power over a variety of matters including agriculture, education, health, housing, local government, planning, road transport and social services. The PCs are active in supporting irrigation systems, of which water course does not cross the administrative boundary of the provincial council (i.e. intra provincial river basins) including major and medium systems (about 100 in total with an irrigated area of more than 39,000 ha) mostly in the Northern and Eastern Provinces, as well as support to some minor tanks for maintenance works.

61. **Farmer Organizations (FOs).** Established in 1979 under the Agrarian Services Act (discussed below), the FOs are legally registered entities with functions of representation of members, coordination with the DAD and the O&M of the sub-systems that are part of the canal irrigation systems, from distributary canal to field including drainage canals. This includes power for levying water fees and management of maintenance activities. As discussed below while the intention of the Act was for the FOs to take up full responsibility for both financial and physical aspects of sub-system O&M, the reality is they are still dependent on government agencies for significant support both technical and financial.[34] The organizations are typically comprised; president, secretary and treasurer, and water controller(s), the latter being responsible for overseeing canal operations. As outlined during field visits, the executive members (president, secretary and treasurer) are elected or selected by members, annually or biannually, and the water controller appointed. Dependent on irrigated area, one or more water controller may be appointed, with the position in some cases being voluntary and in other with remuneration in crop (paddy) yield.

62. In addition to management of the tertiary system, as described above, the FOs also participate in irrigation planning and management at higher levels. They are represented on the Project Management Committee (PMC), which is responsible for the system management including preparation of the Seasonal Operation Plan (SOP). The PMC chairman and secretary

[33] 13th Amendment to the Constitution and the Provincial Councils Act. No. 42 of 1987

[34] IWMI 1999. An Assessment of Participatory Irrigation Management of Irrigation Schemes in Sri Lanka; Partial Reforms, Partial Benefits. Report No. 34, International Water Management Institute, Colombo

are automatically FO representatives, and with other members drawn from relevant government agencies, including the resident engineer(s) from DOI and/or MASL and DAD.

63. FOs are also represented on the Divisional Agriculture Committee (DAC) which is responsible for the Divisional sector planning and management, inclusive of irrigation systems. The DAC is chaired by the Divisional Secretariat, and in addition to FO representatives has members from government agencies including DOI, MOA and DAD.

64. The District Agriculture Committee responsible for district agriculture planning and management includes FO representatives along with representatives from government agencies.

2. Irrigation Management

65. The management of irrigation systems is shared between several agencies. This has come about through water development programs, in particular the Mahaweli Development Program, as well as government initiatives in the 1980-90s to decentralize system O&M.

66. The O&M of major and medium irrigation systems of inter-provincial river basins is shared within the MIWRM, through its two affiliated institutions, the DOI and MASL. Provincial councils are responsible for irrigation systems of intra province river basins. While the major and medium irrigation systems make up less that 2% of the total irrigation systems by number (approximately 548), they have nearly 60% of the area (422,723 ha). The average system is about 800 ha however there are a small number of large systems greater than 10,000 ha. MIWRM activities include preparation of seasonal operational and water management plans and system O&M down to distributary canals (inclusive of tanks). As evident from the PPTA field visits there are varying levels of adequacy of maintenance between and within systems, with some systems well maintained, particularly the larger systems, and others with a backlog of works and repairs.

Table 9: Irrigation System Management by Agency

Systems	No.	Area (ha)
Major and Medium		
Irrigation Department	**352**	**284,000**
MASL	100	99,301
Provincial Council	96	39,422
Subtotal	**548**	**422,723**
Minor		
Tank	14,204	
Anicut	13,850	
Waterway	2,467	
Subtotal	**30,521**	**294,025**
Total	**31,069**	**716,748**

Sources; DOI major and medium systems, DAD minor systems

67. **Irrigation Department.** The DOI is responsible for O&M of 352 systems with a total irrigated area of 284,000 ha. This is shared between two divisions: (i) the WMD manages large and medium tanks systems, of which there are 72 with an irrigated area of about 199,000 ha; and (ii) the IMD that has the balance of smaller systems and tanks (280) with an irrigated area of 85,334 ha.

68. **Mahaweli Authority Sri Lanka (MASL).** The MASL is responsible for the major and medium systems supplied water from the Mahaweli Scheme, including those within the Mahaweli River Basin and adjacent river basins to which water is transferred (refer to **Table 10**). Currently there are six 'systems' (as defined by the MASL) managed by the MASL servicing about 100 major and medium tanks system with a total irrigated area close to 100,000 ha, with the balance of the systems (8) managed by the DOI. The Water Management Secretariat is responsible for the planning and management of water allocations within the systems, for not only irrigation but also hydropower and drinking water supplies.

Table 10: Mahaweli Scheme Summary

System	Area (ha)	Institution
A	7,050	DOI
B	18,196	MASL
C	22,801	MASL
D	36,561	DOI
E	7,290	DOI
G	5,625	MASL
H	32,023	MASL
IH	4,907	DOI
L	19,995	MASL
MH	4,210	DOI
UW	662	MASL
Mapakada	550	DOI
Dambarawa	610	DOI
Sorabora	810	DOI
Total	**161,290**	
DOI	67,613	42%
MASL	99,302	62%

Source: MCB Water Balance Study Report, October 2013

69. **Minor Tanks.** There are more than 30,000 minor systems with a combined command area of 294,000 ha. About half of minor systems are part of tank cascades and the balance supplied from Anicut and open water ways.

70. **DAD.** The DAD is the principal technical agricultural services organization, responsible for administering services and subsidies to the agriculture sector nationwide. It is also responsible for supporting planning and operation and maintenance of minor systems. This is organized through Agriculture Service Committees, of which there are 559 nationally. The

Committee with farmer and official representatives is responsible for the system agriculture and irrigation O&M planning which is done on a seasonal basis. DAD has about 9,500 field officers providing agriculture services support.

71. **PCs.** The Provincial Councils are responsible for the operation and maintenance of a number of medium systems and number of minor tanks, mainly in the northern provinces, and also provided assistance to minor systems for maintenance works from time to time.

72. **FOs.** The FOs are responsible for sub-system operation that is from distributary canal to field. The DOI contributes to O&M costs with a budget allocation of about SLRs 100 per ha per season.[35] Farmer members contribute voluntary labor for maintenance activities, cost (typically SLRs 150 per season per person) and/or conscripted farm labor for maintenance activities in proportion to their farm area. The water controller is in some systems a paid position (either in cash or crop) and in others voluntary.

73. **Seasonal Operation Plan.** The major and medium systems are managed by preparation of a SOP, developed between the DOI, FOs and other interested government agencies and stakeholders, including DAD, DOA and local credit providers. The purposes of the SOP are to plan for the seasonal water allocations and related issues in order to supply the planned cropped areas, and as such, optimally match available water resources to irrigated areas and crops. The planning sequence entails (i) determination of seasonal water availability principally from resources storage at the start of the season (prepared by the DOI), planned crops and irrigated areas (prepared by FOs); (ii) holding of pre-season meeting(s) between stakeholders to agree on allocation levels, and where necessary make decisions on seasonal irrigable area when water availability is low; and (iii) formalization of the SOP. The Plan provides a baseline and benchmark for water allocations, and which the stakeholders meet weekly to discuss and amend as necessary.

74. Private sector contributions to the plan are reported[36] as lending agencies, principally bank advancing credit to farmers and farmer representative.

3. Institutional Reform

75. **Institutional Reform.** [37] The institutional framework is somewhat fragmented with responsibilities shared between numerous agencies. Samad (2004) attributes this to an *ad hoc* evolution of institutions, particularly in the water sector, in response to sectoral needs at various levels and times. And while there are inter-ministerial bodies (such as the Central Coordination Committee on Irrigation Management and the Steering Committee on Water Supply and Sanitation) for sector coordination, they have been of limited effectiveness.

76. Nevertheless, there have been attempts since the 1990s to reform the sector and move towards more efficient and holistic management of water resources, and particularly in regards to an IWRM approach. Consequently, a national water sector apex body was established in

[35] Consultant field observation May 2014.
[36] From field visit discussions May 2014
[37] Samad, 2004. *Water institutional reforms in Sri Lanka*. Water Policy 7 (2005). International Water Management Institute.

1996 in the form of the National Water Council. It was to be replaced at a later stage by a full-fledge policy and regulatory authority in the form of the National Water Authority (NWA). The reform efforts culminated in 2000 with the cabinet approval of a National Water Policy. However, the lack of public consultation and debate during the policy preparation triggered public criticism and mass rallies soon after the approval and the National Water Act that was to provide the legal basis for the NWA was subsequently not submitted for parliament's approval.

77. A current World Bank project[38] is looking at renewing interest in IWRM[39], with the preparation of reports on (i) National Water Use Plan, (ii) Updated Mahaweli Water Resources Development Plan, and (iii) Integrated Water Resources Plan for the Mundeni River Basin.

78. The findings of work on the National Water Use Plan to date are presented in three reports[40], an initial assessment report presenting a description of the water resources sector, resources, demand, management and key issues facing the sector. The second report is titled the 'Strategic Planning Framework' and identified key issues through stakeholder consultation as; under-utilization of water resources (opportunity), water shortages for existing cultivation, deterioration of irrigation systems and lack of potable water supply. Inter-basin water transfer was identified as the strategic approach to addressing the under-utilization of water within water rich basins and water shortages within water scarce basins. This is principally from the Mahaweli Ganga to the basins to the north and south. A number of development options and scenarios were identified, with combinations of transfers with and without construction of additional storage, and for which there are a number of variants (options for storage and transfer). And while information requirements are identified for further evaluation of the scenarios there is no conclusive analysis of the scenarios and recommended scenario(s). Based on this conclusion it is assumed that a further volume is pending presenting the actual strategy.

79. In addition to the above reports, a third report 'National Water Use Planning Model'[41] presents the approach to and findings of development of water resource models (3 models). The purpose of the modelling is to support development of a decision support system for water resources planning and management at national and basin river levels. The approach was to be based on development of three models: (i) a national model (with two sub-models with the country divided between north and south models), (ii) Mahaweli basin model, and (iii) Mundeni Aru basin model, with the latter two being at a higher level of detail than the national model. The approach is based on use of Mike II software as described in Volume 1 of the modelling report, along with the data sources and model organization. The application of the model and use in the decision support system are to be presented in Volume 2.

[38] World Bank Dam Safety and Water Resources Planning Project, Component 3, The other technical component are Dam Safety and Operational Efficiency Improvement (component 1) and Hydrometerogical Information System Improvement (component 2)
[39] Project component 3
[40] Based on review of three project reports; Initial Assessment Report, Volume 1, 2010, Strategic Planning Framework Report, 2011 and Modelling Report National Model Volume, all by SMEC Int Ltd.
[41] Modelling Report National Model Volume 1 Model Establishment and Calibration, 2012. Prepared by SMEC Int Ltd

80. The primary purpose of the Updated Mahaweli Water Resources Development Plan[42] is to provide an assessment and/or confirmation of the future development goals and approach for the greater Mahaweli scheme (MDP). Much of the introduction section of the report reiterate information on national statistics, development goals and generic stakeholder key issues presented in the above mentioned National Water Use planning report. However the latter section on development options and scenarios for development and trans-basin water transfers to the north is of interest to the WRDIP. In particular the transfer of water to the Huruluwewa and further north to the NCP for which four options are identified (routes 6, 7, 8 and 11). As per the National Water Use Plan a range of scenario types are identified along with variants (specific options within scenarios), however there is no analysis or comparison of scenarios and more importantly no recommendation on scenarios preference(s). Thus the findings are somewhat inconclusive and suggest that further work is pending.

B. Policy Framework

81. In Sri Lanka there is not an exclusive and formally approved water policy. Water related policy statements are made in official planning documents such as the national investment program and institutional mission statements.

82. **Water Policy Background.** The current state of water sector policy is largely a legacy of failed policy reform attempts in the 1980s and 1990s. The 1980's attempts to 'modernize' the sector included proposals for legal water rights (sector bulk water allocations) and the collection of irrigation fees for O&M cost recovery. The latter marked a significant shift in policy away from the provision of water free of charge. It applied to major government irrigation systems and was initially successful; however, ultimately it failed due to a perceived lack of promised improvements in service delivery and also to politicization of the issue of water entitlements (Samad, 2005).[43]

83. In 1988 in conjunction with irrigation fees, a participatory irrigational management (PIM) policy was promoted[44] for the transfer of O&M responsibilities of minor irrigation systems to farmers, with the medium and major irrigation systems coming under joint management of FOs and irrigation agencies. With the FOs responsible for system O&M at the tertiary system (distribution canal and lower) and the government responsible for the O&M of the headworks and main and secondary canals. One of the government's main interests in the transfer at the subsystem level was the potential reduction in public expenditures for O&M. The impacts of the PIM program were reportedly mixed,[45] as the failure of the cost recovery program has meant the government continues to finance O&M, albeit at lower than required levels. The FOs have also failed to develop to the envisaged extent necessary to take over system O&M to improve irrigation service performance.

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[42] Strategic Planning Framework, Updated Mahaweli Development Program, 2011. Prepared by SMEC Int Ltd.
[43] Samad. 2005. *Water Institutional Reforms in Sri Lanka*. IWMI, Colombo.
[44] This included a program labelled as "Participatory Irrigation System Management" implemented in a number of major and medium schemes under three government-sponsored programs: Integrated Management of Irrigation Schemes (INMAS), Management of Irrigation Systems (MANIS) program, and in the systems under the Mahaweli Development Project. Prepared by SMEC International Ltd.
[45] Samad et al. 1999. *Assessment of the Impact of Participatory Irrigation Management in Sri Lanka: Partial Reforms, Partial Benefits*. IWMI Research Report 34, Colombo.

84. In the 1990s an action plan was initiated for water policy (and institutional) reforms with donor assistance (ADB, and USAID[46]), to address critical factors for water resources development and management. A Water Resources Secretariat (WRS) was set up for the formulation the national water policy. The proposed policy adopted modern holistic principles for water resources management and development. The reform program also included a new organizational setup, most notably the formation of a national apex organization, the National Water Resources Authority (NWRA) as discussed above.

85. However while the proposed reforms offered an opportunity for significant policy and institutional rationalization, they ultimately failed to gain public, and more importantly political support after widespread media attention and debate, and were ultimately withdrawal by Government.

86. **Progress on IWRM.** To date there has been limited traction in the development of policies and institutional reforms for IWRM. The World Bank, through the Dam Safety and Water Resource Planning Project (DSWRPP)[47] has currently taken the lead in supporting the government's efforts with the sector's policy and reform process, promoting nationwide integrated water resource planning within the river basin framework, as well as addressing some of the urgent backlog of deferred maintenance on medium and large reservoirs. And as mentioned previously to this end a National Water Use Master Plan and an Updated Mahaweli Water Resources Development Plan are currently being prepared. The plans (draft) indicate that initial focus has principally been to address priority infrastructure needs for improved water availability and that addressing reforms to the water institutions, legal framework and water resources planning and management procedures will be addressed in later programs- these will be required for strengthening of IWRM.

87. **Drought Management.** Water use is prioritized under drought conditions, with drinking water supply assigned highest priority[48], followed by current irrigation demand (for planted crops), and with other uses ranked lower. Within the northern dry zone, meteorological droughts usually occur during the inter-monsoonal and Yala seasons. The management of water deliveries for irrigation is split between those systems managed by the MASL and those managed by the DOI[49]. Water allocations and reservoir operation is managed by the Water Management Panel (WMP), which is charged with the responsibility of achieving the optimum benefits from both irrigation and hydropower generation within the Mahaweli scheme. In addition to the MASL Water Management Secretariat (WMS), with other key stakeholders are represented including Irrigation Department, Ceylon Electricity Board, Department of Agrarian Development and Farmer Organisations. The WMP prepares and monitors the SOP, and during droughts the prioritizing of reservoir operation and water allocations according to pre-defined operational rule. For other medium and major irrigation systems the DOI, in collaboration with

[46] The USAID Irrigation Support Project for Asia and the Near East (1990)
[47] DSWRPP. Dam Safety Water Resources Planning Project, Multi-sector Water Resources Planning Component. *National Water Use Master Plan* (draft report) and *Updated Mahaweli Water Resources Development Plan* (draft report) (Nov. 2013).
[48] Essentially by default as drinking water supplies are generally maintained during drought conditions, while other uses are restricted.
[49] As reported in discussion with the WMS and Irrigation Department during the PPTA mission.

other stakeholders (DOA, DAD, and FOs) coordinated and facilitates the preparation of the SOP. This takes into consideration the volume(s) of storage available pre-season and the probability/possibility of rainfall during the season. The plan's key output is an agreed seasonal irrigated area and cropping pattern, based on the estimated water availability. In drought conditions and low water availability, the irrigated area is restricted and low water demand crops preferred. As with the MASL, the SOP is monitored and updated according to revised water availability estimates.

C. Legislative Framework

88. While there is no dedicated comprehensive national water legislation, there over 50 laws related to the various aspects of water and agriculture.[50] The most relevant to the WRDIP include:

(i) Irrigation Ordinance (No. 32) first enacted in 1856 to legalizing customary irrigation practices and the conditions of water extraction especially for paddy. Over the years the Ordinance has been amended to keep pace with changing social and economic conditions. The 1947 amendment sets out the regulations for the development and management of government irrigation schemes and systems, including the rating of irrigation lands. The 1994 amendment gives substantial authority to FOs over irrigation, including obtaining bank loans, delivery of water to farmers, and engaging in supplying farm inputs and marketing of farm produce.

(ii) State Ordinance (No. 8, Part IX) of 1947 defines public and private water and specifies the water uses for which no permit is required. It also provides for regulation and control of public water and streams through a permit system and establishes the States formal rights to use, manage and control public water.

(iii) Electricity Act (No. 19) of 1950 and amendments provides for the licensing of electricity generation installations, which confer all necessary rights for generation including the right to use of water.

(iv) Water Resources Board Act (No. 29) of 1964 sets out the structure and duties of the Board, to advise the MIWRM on water resources management issues and to coordinate the activities of departments related to the water sector. The Board is composed of five members nominated by the Minister with expertise in water resources.

(v) National Water Supply and Drainage Board (NWSDB) Act (No. 2) of 1974 establishes the Board as an "autonomous body", with the statutory functions to provide water supply for domestic and industrial purposes and to operate sewerage systems.

(vi) Mahaweli Authority Act of Sri Lanka (No 23) (1979) established the MASL and defined its structure and duties, which were principally the implementation and management of the Mahaweli Ganga Development Scheme.

[50] Samad. 2004. *Water Institutional Reforms in Sri Lanka*. Water Policy 7, IWMI, Colombo.

(vii) Agrarian Services Act of 1979 established the regulations governing the land tenure systems of paddy land and management of irrigation systems. The latter function was subsequently transferred to PCs. The Act provides recognition of FOs, stipulates their responsibilities, including levying of water fees and confers the authority on the DAD to support FO activities.

(viii) Constitution Amendment (13th) of 1987 established the decentralization of irrigation systems that were split between central and provincial governments: the central government administering schemes larger than 400 ha and inter-provincial rivers through the DOI and MASL; medium sized schemes of 80 to 400 ha administered by PCs; and minor schemes less than 80 ha maintained by FOs with technical guidance from the provincial offices of DOI and DAD.

(ix) Agrarian Development Act (2000): the Act set up community level FOs with statutory power to regulate water within their respective areas in the use for agriculture (for example, water rights among different farmers and timing of release of water for cultivation).

89. **Legislative Shortfalls.** The multiple and fragmented legislation that exists has created challenges for the proper regulation of water uses and development. The main challenge is the ambiguity of water rights and rights of water use, which can lead to competing and conflicting demands on limited water resources. The transfer of a number of water related functions to the PCs occurred with the 13th amendment to the Constitution; however, there are no provincial legislation related to water.

90. In summary, the current legislative framework requires a major overall to fully meet future water management needs. This should include robust legislation such as for enabling multi-sectoral water allocations, regulating groundwater abstractions, and establishing specific provisions to safeguard and quantify environmental water needs.

91. However, as highlighted by previous reform attempts this is a sensitive issue which requires careful assessment and planning to have any chance of initiating improvements. The WRDIP will contribute to finding a way forward through the strengthening of integrated water resources management policies and processes, and as such be complementary to the current World Bank project.

D. Sector Performance

92. **Water Resources Management.** Currently, there are around 40 national and provincial agencies responsible for one or more aspects of water management. This multiplicity of agencies operating in the water management sector, more or less independently of each other, has resulted in distortions and inefficiencies in water management including: (i) no reliable and impartial mechanisms to allocate bulk water between sectors, which leads to inequity in allocation between the sectors; (ii) water for environmental and social needs is not safeguarded over other uses; (iii) water supplies for existing water users are threatened by the lack of control on new water use development; and (iv) a lack of flexibility of water allocation to allow voluntary transfers between users, which could increase overall water productivity.

93. In the irrigation sector, the current policy and institutional issues that affect the sector performance include: (i) many agencies (particularly the overlap in responsibilities between the DOI, DAD and Provincial Councils) involved in the construction and O&M of irrigation schemes, which is causing duplication and inefficient use of manpower and institutional resources; (ii) current irrigation system management, either farmers' led or jointly managed, has been partly successful and needs improvement for which adequate assessment is required to identify and address shortcomings or gaps; (iii) despite the ongoing reforms in the name of PIM/Irrigation Management Transfer (IMT), the O&M of irrigation systems is still being largely financed by the government, but these budget allocations are decreasing and therefore, the level and quality of O&M is on the decline; and (iv) a lack of incentives to attract private sector participation in irrigation investments.

94. Previous attempts at sector reform in the 1990s stalled; however, lessons can be learnt from this experience which will help shape future approaches to rationalize and improve water sector management. These include the appropriate reform design and implementation principles such as institutional sequencing and packing, ie, the timing and scale of reforms. Of particular importance is the issue of water rights, which in previous reform attempts was construed by opponents as a move toward privatization of water resources and consequently was high politicized. An important lesson learnt was the need for meaningful stakeholder participation and buy-in to the reform process, and appreciation of the need for and benefits of the process.

95. **Irrigation Management.** The sub-sector is characterized by relatively high application rates (or water issue rates), typically with the equivalent to duties of 50 ha per MCM or 20,000 m^3 per hectare, and in some older systems more than double this value. While some of the irrigation losses are recycled within the cascade system of tanks and command areas, much is can be lost to surface and groundwater drainage. And as indicated in **Figure 8** system efficiencies are highly variable between systems. However, there is potential to substantially improve the efficiency of water conveyance and application in the older and less well maintained systems, through improvements in irrigation infrastructure, to reduce losses to percolation and to improve on-farm irrigation methods and management, through land levelling and more water efficient cultivation methods, such as SRI (System for Rice Intensification) and alternate wetting and drying. There is also potential for improvements in the planning and management of system O&M, through better irrigation scheduling, monitoring,[51] and evaluation of water issues.

96. **Irrigated Agriculture.** The sub-sector plays a major role in achieving and maintaining food self-sufficiency, with 75% of paddy production under irrigated lands, and accounts for the vast majority of annual production. While the country has attained rice self-sufficiency, demand is rising and there is some way to go to attain self-sufficiency in other field crops and vegetable production.

97. Paddy production in 2012 was 4.5 million tons and to meet projected demand needs increase to more than 8 million tons by 2020. Nationally, yields are in the range of 3 to 5 tons per ha, which is below a genetic potential of 6 to 7 tons per ha.

[51] As observed during site inspection in May 2014, the DOI is establishing a system to monitor water distribution from Huruluwewa.

98. Nationally water productivity is relatively low at 0.3 to 0.4 kg per m^3 or lower[52] due in part to the relatively high application rates and in part to the medium-level yields. With higher irrigation efficiencies and increases in yields closer to potential values, water use efficiency could increase to 0.5 to 0.6 kg/m^3 or higher and be comparable with expected levels for well managed irrigation systems.[53]

99. There is potential to attain improvements through improved irrigation system performance, both conveyance and management and improved paddy yields. In addition there is potential to increase the returns to water (\$/m^3) through diversification to other higher value field crops and vegetables.

100. While cascade systems from an efficiency perspective inherently benefit from recycling of return flows, application rates are nevertheless high and as such indicative of potential for improvements to reduce losses, to percolation and drainage, and improvements in irrigation scheduling.

101. While current cropping regimes are dominated by paddy production, there is also potential to improve farm incomes and water productivity (\$/m^3) through diversification to field crops and vegetables, particularly during the Yala season. These crops generally have lower irrigation demands and higher returns per unit area. Based on current yields and returns productivity levels are typically two to three times higher than for paddy.

102. **Cropping Intensity.** In the dry zone cropping intensities are constrained by water availability, being in the major and medium systems on average about 160% and in the minor systems about 130%, and some years drop to less than 100% (due to water availability being limited by available storage volumes). With planned infrastructure developments for water transfers, cropping intensity is projected to increase to 180% in major and medium systems and 160% in minor systems.

103. **Cropping Patterns.** Nationally field crop production is dominated by paddy, which accounts for 80% of annual cropped area, and with OFCs and vegetables each at 10%. While recent agriculture and national policy has focused on paddy self-sufficiency for reasons of food security and poverty alleviation, there is potential with improved water availability for diversification in the Yala season to higher value crops. This move requires technical and marketing support for farmers to confidently and profitably invest in new crops. In particular improved infrastructure for post- harvest handling, processing and storage, transport and access to markets, particularly in the major demand centers and for export.

104. **Drinking Water Supply and Sanitation.** Access to clean water and sanitation facilities is a national priority, with access to safe drinking water increasing from 75% to 88% of the population between 2005 and 2012. Approximately 90% of households have access to sanitation facilities. The national development goals are to increase the coverage safe water

[52] Mahaweli Hand Book 2008- 2009, Mahaweli Authority of Sri Lanka.
[53] IWMI. 2007. *Water for Food Water for Life. A Comprehensive Assessment of Water Management in Agriculture*. Colombo shows that water productivity of 0.5 to 1.0 kg/m^3 should be attainable at 5-6 tons/ha.

access to 95% of the population by 2020 along with the expansion of the reticulated water supply from 44% (2012) to 51%, and access to sanitation facilities to 95% of the population.

105. **Hydropower.** Annual demand for electricity is predicted to increase from the current level of 12,000 GWh to more than 20,000 GWh by 2020.[54] As the hydropower production capacity has largely been developed, new thermal plants (coal and gas) are being constructed to meet future energy demands. The thermal plants are used to meet base demand and it is planned to utilize some of the hydropower stations for peaking.[55] This change in operation mode of hydropower stations in some cases impacts on river flows and downstream water users, potentially resulting in higher water losses to the sea and lower water availability for consumptive use.

106. **Natural Disaster Management.** Flooding and drought have the greatest impact on the population (of all natural disasters). Both occur relatively frequently, with eight events over the past twelve years. As discussed in Section II.A.4, severe floods events occurred in five years in the period between 2003 and 2012, and in the 2010-2012 accounted for an estimated cost of damages $860 million. In the period between 2006 to 2012, droughts occurred in 2006, 2007, 2009 and 2012 (the more severe) and cumulatively affected about 500,000 households.

[54] At predicted growth rate in demand of 5-7% per annum (Mahinda Chintana, 2013).
[55] Discussion with MCB and CEB

IV. NATIONAL DEVELOPMENT GOALS AND STRATEGIES

107. National development goals and strategies are presented in a number of places, including the Millennium Development Goals, national development plans, and more specific plans for the 'dry zone' and the Mahaweli Development Program as summarized and discussed in this section.

108. **Millennium Development Goals (MDG).** The MDGs include target goals for the eradication of extreme poverty and hunger, and to ensure environmentally sustainable development. The goals for Sri Lanka to 2016 include eradication of hunger and hard core poverty, reduction of malnutrition in children to 12 to 15%, and increasing access to clean water in urban areas to 90%.

109. **Development Goals.** The national development goals and strategies of the country are set out in the Mahinda Chintana,[5657] the national planning document prepared by the MFP. The overall goal is to promote inclusive growth with the objective of increasing per capita income to $4,000 by 2016. This will be achieved through a multi-sector investment and inclusive growth strategy including investments in agriculture, water, transport, education, communications and manufacturing sectors. The strategic investment directions and strategies include:

(i) **Agriculture:** achieving sustained improvement in farm production through increased productivity and competitiveness. This will be achieved by development of improved seed and plant materials, post-harvest facilities, micro-financing, improved technologies, extension services and by increasing WUE. The target for paddy production is to increase annual production from 4.5 million tons in 2012 to 8.2 million tons by 2020,[58] which will more than meet projected domestic demand. For other field crops the target is to attain self-sufficient by 2020.[59]

(ii) **Irrigation:** construction of new reservoirs to harvest run-off water and increase irrigation productivity and WUE through improved water management in order to meet rising water demand. The national goals to 2016 include increasing: (i) average cropping intensity to 160% (from 147% in 2011); (ii) paddy rice yield to 6.5 T/ha (from 5.5 T/ha in 2011); and (iii) paddy rice water productivity to 1.3 kg/m^3.

(iii) **Water Supply:** prioritize enhancement of safe water supplies to districts where coverage is below national urban and rural averages. Goals include an increase to 89% by 2016 (from 83% in 2011) through rehabilitation of supply networks to reduce losses and strengthening of water institutes with capacity building and technical support.

(iv) **Power and Energy:** to ensure reliable and affordable energy supplies through increased electricity capacities, and on the demand side promotion of energy efficiency.

[56] Mahinda Chintana – Public Investment Strategy 2014-2016, Ministry of Finance and Planning, Sri Lanka.
[57] The plan is also referred to as the 'Second Five Year Development Framework 2011-2016'.
[58] This is inclusive of projected paddy exports of about 0.5 million tons
[59] As per the Mahinda Chintana (page 91) currently field imports are approximately 40% of domestic demand

110. **Dry Zone Development.** The Department of National Planning of the MFP has formulated a plan for water resources development in the dry zone[60] that follows-on from and is complementary to the Mahinda Chintana. In the dry zone of the Northern provinces[61] the policy direction is for the improvement of water availability for irrigated agriculture and improvement of water use productivity and efficiency. In line with the national water policy, water availability will be improved through the construction of reservoirs and transfer canals to the north and through improvements in WUE. The plan's goals by 2020 are to increase irrigated from 745,000 to 800,000 ha, cropping intensities from 157% to 165%, paddy productivity 5.5 to 7.0 T/ha, and access to safe water from 84% to 100%; and decrease paddy water use from 16,800 to 11,300 m^3/ha (a 35% reduction).

111. This plan forms the basis and rationale for the promotion of the current NCPC project of which the WRDIP forms the first phase with construction of the main transfer canals (KMTC and UEC) and development of the NWPC and rehabilitation of the MLBC.

112. **Updated Mahaweli Water Resources Development Plan (UMDP).** While work has been on-going with the Mahaweli Scheme since the 1960s, an updated plan[62] is being formulated under the World Bank sponsored National Water Use Plan as discussed above. The objective of which is to present future scheme development options, that meet future water demand and supply in the Mahaweli Basin and adjoining river basins in the North Central and Northern Provinces. The plan principles are consistent with the national development policies for improving water availability and with the dry zone development plan of water transfers to the north to enhance irrigated agriculture performance and improved drinking water supplies.

[60] Development of Water Resources in the Dry Zone Area, Department of National Planning, Ministry of Finance and Planning, Sri Lanka
[61] The northern provinces are Northern Province, North Central Province and North West Province
[62] SMEC, 2013. Updated Mahaweli Water Resources Development Plan.

V. SECTOR INVESTMENT PROGRAM

A. Sector Road Map

113. The Mahinda Chintana sets out the investment program for 2014-16 and lists proposed major development projects by sector and funding source. **Table 11** lists a summary of the projects related to the water and agriculture sector, of which there are 139 with a combined cost of SLRs. 874 billion or $6.7 billion. About half of the projects are related to improving drinking water supply and 40% to on-going and new irrigation projects.

114. **Agriculture.** There are a total of 17 agricultural investment projects – 15 ongoing and 2 new – with a total cost of SLRs. 41.33 billion or $318 million (**Table 11**). The largest, by far, is the fertilizer subsidy program at SLRs. 38 billion, accounting for 92% of total cost. The program also includes on-going projects for increasing production of field crops, big onion production, promotion of rice exports though establishing rice export zones and a seed production and purchasing program.

Table 11: Water and Agricultural Sector Projects in the Mahinda Chintana

Sector – Sub-sector	Projects (no.)	Costs (SLRs. billion)	Costs ($ million)
Agriculture	17	41	317
Irrigation	36	361	2,779
Water Supply	85	471	3,625
Power & Energy	1	0.61	4.69
Total	**139**	**874**	**6,726**

Source: Mahinda Chintana, MFP, 2010

115. **Irrigation.** There are a total of 36 irrigation projects – 27 ongoing and 9 new– at a total cost of SLRs. 361 billion or $2.8 billion. The cost of new project is SLRs. 128 billion ($985 million) or 35% of total cost. The on-going projects include completion of construction of the Moragahakanda and Kalu Ganga Dams and headworks, construction of the Uma Oya Project for diversion of 145 MCM from the Uma Oya to the Kiridi Oya Basin, rehabilitation of the Mahaweli System B, construction of reservoirs (15), and rehabilitation of irrigation systems. The new projects include construction of the Mahaweli System B Right Bank (SLRs 38,500 million (2014-18)), implementation of the World Bank sponsored dam safety program (SLRs 44,822 million (2015-18)), floods and drought mitigation/climate resilience program for the protection of 135,000 ha (SLRs 11,300 million (2015-18)), Minipe Anicut raising project (SLRs 2,000 million (2015-18)) and study of development of minor tank systems (30,000 ha) under command of the NCP (SLRs 270 million (2015-16)).

116. **NCP Canal Program.** The national strategy identifies the North Central Province Canal Program as a high priority. The program is an extension of the MDP with the transfer of water from the Mahaweli River Basin to the Northern provinces for supply of drinking and irrigation water. Under the program the target area is approximately 80,000 ha with about 255,000

beneficiary households, and in addition 160 MCM of water will be supplied for drinking water. Total cost is estimated at SLRs. 187 billion ($1.5 million).[63]

117. **Water Supply.** There are 85 water supply projects, 19 on-going and 66 new, with a total cost of SLRs 471 billion ($3,625 million). The number of projects and total investment reflects the national priority for improving access to safe drinking water.

118. **Power.** To meet rising demand for electricity it is planned to increase installed capacity by 3,300 MW by 2020, for which 231 MW will be from hydropower (Uma Oya, Broadlands and Gingana projects) but the majority of the balance from thermal (2,200 MW).

B. Strategic Context

119. ADB's strategic sector objectives as presented in the Country Partnership Strategy 2012-2016 are aligned with the government's principal development objectives of economic growth and reduction of poverty. This includes assisting the government to address major constraints for sustaining inclusive economic growth with infrastructure development support that improves connectivity and service delivery to lagging regions.

120. It is also consistent with ADB's strategic and sector goals as articulated in (i) 'Strategy 2020'; (ii) "Water for All" policy, [64] and (iii) Water Operational Plan 2011-2020[65] which include the objectives of reducing the water demand-supply gap in water scarce areas, fostering IWRM, improving water governance and delivery of services, and improving resilience to climate change.

121. The ADB Strategy 2020 established three strategic agendas to guide its work up to 2020: (i) inclusive economic growth, (ii) environmentally sustainable growth, and (iii) regional integration. Water is common to each of these; in fact, it is central to their attainment. It is also integral to the Strategy's five drivers of change: (i) private sector development and private sector operations, (ii) good governance and capacity development, (iii) gender equity, (iv) knowledge solutions, and (v) partnerships. The Strategy focuses ADB's operations into five core areas that best support its agenda and reflect ADB's comparative advantages. One core area is infrastructure, where water management and irrigation are key elements.

122. The ADB Water Policy (Water for All) has seven key elements: (i) promoting a national focus on institutional reform; (ii) fostering integrated river basin management (IRBM); (iii) improving and expanding service delivery; (iv) fostering conservation; (v) promoting regional cooperation; (vi) facilitating the exchange of information and experiences, including public-private-civil society partnerships, and (vii) improving governance and promoting decentralization. The policy recognizes that shrinking annual per capita water endowments are leading to water stress and that remedies include (i) increasing irrigation efficiency (water consumption/withdrawal); (ii) reversing the degradation of water resources, by agricultural, industrial, and municipal effluents; and (iii) improving the allocation and management of available resources at the river basin level.

[63] The total cost excludes the Minipe Anicut (SLRs 2 billion) and Mahaweli System B right bank identified in the irrigation investment programme.
[64] ADB.2003. Water for All – The Water Policy for the Asian Development Bank. Manila
[65] ADB. 2011. Water Operational Plan 2011-2020. Manila

C. ADB Sector Experience

123. The ADB has had mixed results from its sector experience over the past twenty years.[6667] In the 1990s it initiated a move to support sector reforms in-line with its policies to encourage a more holistic approach to water resources management and development. It was also a decade in which water sector reforms were promoted in the region in the interests of providing better service to water users, especially the poor.

124. In 1992 the Comprehensive Water Resources Management Project (CWRM) set out to assess institutional capacity, develop a single overarching policy and law governing water resources and establish a single 'apex body' (subsequently called the National Water Authority (NWA)) for coordinating water related activities. With the guideline principle that water resources management be holistic and efficient, and in line with the principles of IWRM and water as an economic good. Along with the move to more integrated and sustainable water resources management, the policy also introduced a number of new unfamiliar approaches, such water entitlements and water tariffs for demand management.

125. In 2001 the Water Resources Management Project (WRMP) was established to finance infrastructure construction and follow-up on with support of the 'apex body' formed under the CWRMP. Both projects were plagued by controversy, largely due to a politicization of the issues related to water entitlements and intense media interest, and the 'apex body' was never formed, and ultimately the policy development process collapsed.[68]

126. The WRMP included two components: Part A establishment of the NWA (as mentioned above) and its operational links to other water agencies, and was to include the institutional resources and infrastructure, water database, and development of three pilot river basin plans, as well as institutional capacity building and strengthening, and Part B was the construction component with construction of the Kelani Conservation Barrage to restore the capacity of water supply intake for Greater Colombo and installation of six measurement weirs in 'critical' rivers. Part C was added in September 2004 to help draft a reviewed NWRA policy but was subsequently (2005) suspended along with Part A. The project struggled to make progress with only 11% of the budget implemented before closure[69] and with the project ultimately being rated as 'unsuccessful'. As mentioned earlier the principal problem arose from sensitivities and public protests to the implementation of Part A. The lessons learnt stated that "reform requires extended periods of stakeholder consultation, public awareness campaign and political consensus creation – activities that are to a large extent political."[70]

[66] In addition in 1977 ADB funded the Kirindi Oya Irrigation and Resettlement Project (KOISP) in the Southeast dry zone which was the first irrigation project funded by ADB

[67] Specific lessons learnt from ADB and World Bank projects are presented below in Section E.

[68] ODI, 2008. Swings and Roundabouts. A Narrative of Water Policy Development in Sri Lanka, Working Paper No.26. Overseas Development Institute, London.

[69] Actual expenditure was $3.15 million out of a budget of $28.2 million (ADB Project Validation Report 2008)

[70] ADB Project Validation Report (PCV: SRI 2008-15) 2008

127. However, despite this setback ADB has been more successful with supporting infrastructure development and climate adaptation projects. The Improving Community Based Rural Water Supply and Sanitation in Post-Conflict Areas of Jaffna and Kilinochchi (2011)[71] aims to reduce poverty and improve quality of life in rural communities in the Jaffna and Kilinochchi districts through improved water supply and sanitation services.

128. The ADB Conflict Affected Regions Emergency (CARE) project includes support for improvement of irrigation systems in the North and North Central Provinces, in addition to other transport, electricity and water supply infrastructure. Under the project a rehabilitation works have been carried out on about 150 small and medium size tanks systems with an irrigated area of about 15,000 ha.

D. External Assistance

129. There are a number of international banks and development agencies with activities in the sector as outlined below and summarized in **Table 12**.

130. The **World Bank** country partnership strategy (CPS) (2013-2016) focuses on three areas: (i) facilitating sustained private and public investment; (ii) supporting the structural shifts in the economy; and (iii) improving living standards and social inclusion, as per the National Development Strategy. To this end the World Bank has two current projects in the water sector these include:

- Dam Safety and Water Resources Development Project ($72 million) (2008-2015),[72] the project's development objectives are to (i) to establish long-term sustainable arrangements for the operation and maintenance of large dams, and (ii) improve water resources planning. For the first objective the programme includes enhancing public safety on 32 high risk dams and sustainably improving operational efficiency on 80 other dams. For the second objective activities include strengthening, institutionally and materially, the hydrometeorological network and strengthening of institutional capacity for integrated and multi-sectoral water resources planning, with preparation of key planning documents, including National Water Use Plan, Updating of the Mahaweli Development Plan, and preparation of an IWRM plan for the Mundeni River Basin. The project implementing agency is the MIWRM.

- Improving Climate Resilience ($110 million) (2014-2019);[73] the purpose of the project is to reduce vulnerability of the public and assets to climate risk and improvement of the government's capacity to effectively respond to disasters. The project components include; (i) development of basin investment plans based on modeling of the climate risks, for the identification of $1 billion of investments, and (ii) increasing the climate resilience of infrastructure including flood mitigation, transport continuity and school protection. The MIWRM is also the implementation agency.

[71] Project No. 44082-012
[72] Project No. P093132
[73] Project No. P146314

131. The **Japan International Cooperation Agency** (JICA) has been active in Sri Lanka for more than fifty years. In-line with national development objectives priority areas are to (i) improve living conditions of the former conflicted population in the North and East, including the restoration of infrastructure, (ii) assist to accelerate economic growth, (iii) support poverty alleviation and regional development, and (iv) support disaster management and climate change. JICA are planning to support the Poor Economic Advancement Community Enhancement (PEACE) project for the improvement of farming systems under the command of minor cascade irrigation systems in the North Central Province. The project is currently in preparation with the planned objectives of preparation of a plan for minor cascade system improvements, infrastructure rehabilitation and improvements, and value chain improvements. The project area will benefit from the water transfers from the NCPC (on completion of Phase 2), and therefore is complementary to the WRDIP, by further improving the utilization and productivity of water transferred from the Mahaweli Ganga.

132. The **Chinese Development Bank** (CDB) is currently active with funding projects in the transport (roads) and water sectors, including the construction of Moragahakanda Reservoir. The reservoir provides additional storage within the Mahaweli scheme and feeds the UEC for transfers to the north.

133. The **Saudi Fund for Development** (SFD) is also contributing to the transport and water sectors, including the co-financing of the Kalu Ganga Reservoir. The reservoir will increase scheme storage and transfers onto the Moragahakanda Reservoir.

134. The **Kuwait Fund for Arab Economic Development** (KFAED) is also co-financing the Kalu Ganga Reservoir. In addition it is also funding more than ten other development projects in Sri Lanka, including the Hambantota Irrigation Rehabilitation Project (HIRP).

135. The **OPEC Fund for International Development** (OFID) is also co-financing (along with the KFAED) the Kalu Ganga Reservoir as part of its general mandate for promotion of cooperation between OPEC and developing countries.[74]

136. The **Export Development Bank of Iran** (EDBI) is providing funding for the Uma Oya Project for hydropower generation, as well as the provision water for drinking supplies, industry and irrigation. It is also funding development in the electricity, housing and transport sectors.

137. The **International Fund for Agriculture Development** (IFAD) is currently supporting three projects in the agriculture and irrigation sector; the Iranamadu Irrigation Development Project in Killinochchi Province in the north, the Agribusiness Development Program, and the Smallholder Plantation Entrepreneurship Development Programme in the Central Province.

138. The **International Water Management Institute** (IWMI) is headquartered in Colombo and is part of the CGIAR group of agricultural research organisations, with a specific mandate for irrigation and water management. While not a funding agency, the organization has

[74] OPEC is providing assistance to achieving Sri Lanka's MDG with assistance to 12 public sector projects and 3 private sector projects

considerable regional and national experience with research of irrigation related issues, and a number of projects on the subject in Sri Lanka.

Table 12: Major Development Partners

Development Partner	Project Name	Duration	($ million)
World Bank	Dam Safety and Water Resources Planning	2008 – 2015	65
	Dam Safety extension Project	2014 – 2018	83
	Climate Resilience Project	2014 – 2018	110
China Development Bank (CDB)	Moragahakanda Reservoir	2007 – 2016	558
Kuwait fund for Arab Economic Development (KFAED), Saudi Fund for Development (SFD), OPEC fund for International Development (OFID),	Kaluganga Reservoir	2014 – 2018	270
Export Development Bank of Iran (EDBI)	Uma Oya Multipurpose Development Project	2008 – 2016	450
Japan International Co-operation Agency (JICA)	Poor Economic Advancement and Community Enhancement (PEACE) Project	2006 – 2013	40
Asian Development Bank (ADB)	Water Resources Development Investment Program (WRDIP)	2015 – 2024	650
	Conflict Affected Regions Emergency (CARE)	2010 – 2015	150
International Fund for Agricultural Development (IFAD)	Iranamadu Irrigation Development Project	2012 – 2017	29

Source: MIWRM, 2014

E. Lessons Learned

139. As mentioned in earlier sections, ADB has been active in the sector a number of years. And through this engagement in this and other sectors learnt a number of lessons in the formulation and implementation of investment programs and projects.

140. As identified in the validation report for the CPS (2012-2016)[75] the key lessons were: *"(i) government ownership to facilitate sector reforms in a sequenced manner; (ii) reliable funding for maintenance of infrastructure projects; (iii) partnerships with the government and development partners as key to effective implementation; and (iv) recognizing institutional capacity limitations."* In addition further lessons were: (i) policy dialogue should be conducted in a phased manner with broad stakeholder consultation; (ii) capacity building requires more

[75] ADB, Country Partnership Strategy 2012-2016

focused intervention, better preparatory work for technical assistance (TA), and stakeholder consultation; and (iii) for ensuring sustainability, policy-level commitment for enhanced funding is required.

141. To improve the overall program effectiveness, efficiency, and sustainability, the report also recommended: "*(i) pursue policy dialogue and reforms through a detailed pragmatic, consensus-driven approach, involving rigor, candidness, and transparency; (ii) continue the focus on conflict-affected areas and strive to improve the quality of life by empowering local bodies through decentralization; (iii) encourage public–private partnerships in infrastructure development and education by creating an incentive structure and an enabling environment; (iv) engage the major stakeholders and beneficiaries in capacity building initiatives; (v) give more emphasis to secondary and technical and vocational education; (vi) provide more effective technical support for managing for development results across government ministries; and (vii) ensure cost recovery mechanisms are in place, backed by political commitment."*

142. Most of the above lessons are relevant to the agriculture and natural resources sector projects and to the planned WRDIP. In addition, these lessons are also reflected in the lessons learnt from past investment projects. In particular those associated with the attempted sector reforms in the 1990s and early 2000s.

143. The completion report for the Water Resources Management Project[76] provides a number of valuable lessons about the approach to and rate of implementation of sector reform. These included: (i) reform process should not to be overly ambitious in terms of the scale and extent of the process and to provide sufficient resources to manage the socio-political process, (ii) project objectives should not mix sector reform processes, policies and institutional with infrastructure development in selected geographical locations, (iii) stagger policy development so arrangements on contentious issues can be better managed, and to initially only develop the essential element policy and institutional reform, and (iv) the need for effective stakeholder consultation to support the reform process.

144. The earlier Institutional Strengthening for Comprehensive Water Resources Management project[77] in the 1990s established and supported development of national water policy and formation of the National Water Resources Council (NWRC) and Water Resources Secretariat. Key lessons learnt through implementation were the need for political leadership in implementation of water resources policy, broad base stakeholder representation in the NWRC and the need for a neutral ministry for water resource management functions to ensure political acceptance of water resource policy.

145. The World Bank was a major contributor to the MDP with six credits of a total of $450 million between 1970 and 1998. These included a $90 million loan for the development of System C with an irrigated area of about 24,000 ha for settlement of new farmers. Overall the project was rated as highly unsatisfactory[78] due to a number of problems. The project performance reassessment noted a number of key lessons including: "(*i) rushing technical and economic*

[76] ADB, 2007. Completion Report. Sri Lanka: Water Resources Management Project. ADB, Manila.
[77] ADB, 2001. TA Report http://www.adb.org/sites/default/files/projdocs/2001/in280_01.pdf
[78] World Bank, 2004. Project Performance Reassessment Report. Third Mahaweli Development Project.

feasibility studies or paying insufficient attention to the findings is likely to result in an unsatisfactory outcome, (ii) settlement programs that do not select candidates with previous farming experience and which do not provide settlers with full title to their land are not likely to prosper, and (iii) using repeated interviews with a small number of households, supplemented by interviews with local leaders and community groups is an effective low cost technique for tracking the performance of rural development projects."

146. The Major Irrigation Rehabilitation Project[79] in the early 1990s sought to improve seven tanks systems in the drier areas of the country, and in particular solve the problems of recurrent operation and maintenance. While the infrastructure elements of the project were successfully implemented, the cost recovery for O&M was reported as '*dismal'* and to overcome this the emphasis should be on farmer participation in O&M activities rather than solely on cost recovery.

147. The National Irrigation Rehabilitation Project[80] (1991-1998) main objectives were to stabilize and increase agricultural production and incomes, and to raise the standard of living of project beneficiaries through rehabilitation and improved O&M of existing irrigation schemes. Also with a sub-objective of creating viable FOs for the system on-going O&M. While the project reportedly achieved planned physical works, there was doubt over the sustainability of the FOs. And the main lessons learnt from the project were: *"(i) without upfront commitments on agriculture sector policy and related institutional reforms, it is difficult to achieve successful irrigation projects; (ii) a situation of low productivity and profitability of irrigated farming systems inhibit the development of viable FOs, and establishment of beneficiary-driven, sustainable O&M arrangement in the irrigation sector; (iii) forming FOs and carrying out rehabilitation at the same time do not work well; before starting rehabilitation works, it is essential to maintain for at least a year, an effective institutional support; (iv) improvements to one scheme affects hydrology and water availability at other downstream schemes in tank cascade systems; this factor needs to be adequately addressed in scheme selection, planning and design of future irrigation rehabilitation projects; (v) it is essential to develop and enforce pragmatic civil work specifications, and contract packaging, administration and quality assurance systems suitable for rehabilitation to ensure sustainability of the rehabilitated schemes; (vi) in line with point (v) above and to assure the achievement of good quality standards, consideration should be given for a pre-qualification system of contractors for larger civil works of similar projects in the future; (vii) the establishment of a maintenance fund to cover O&M costs with actual support from farmers has proved to be one of the possible solutions to the problem of project sustainability; (viii) UN agencies and international NGOs such as ICRC can make valuable contributions in implementing project activities in areas with civil security concerns; and (ix) for national projects involving provinces, project implementation authority and responsibility should be devolved to provinces to the extent possible to ensure efficiency and effectiveness*".

[79] World Bank, 1995. Completion Report. Major Irrigation Rehabilitation Project.
[80] World Bank, 1999. Implementation Completion Report. National Irrigation Rehabilitation Project – Sri Lanka

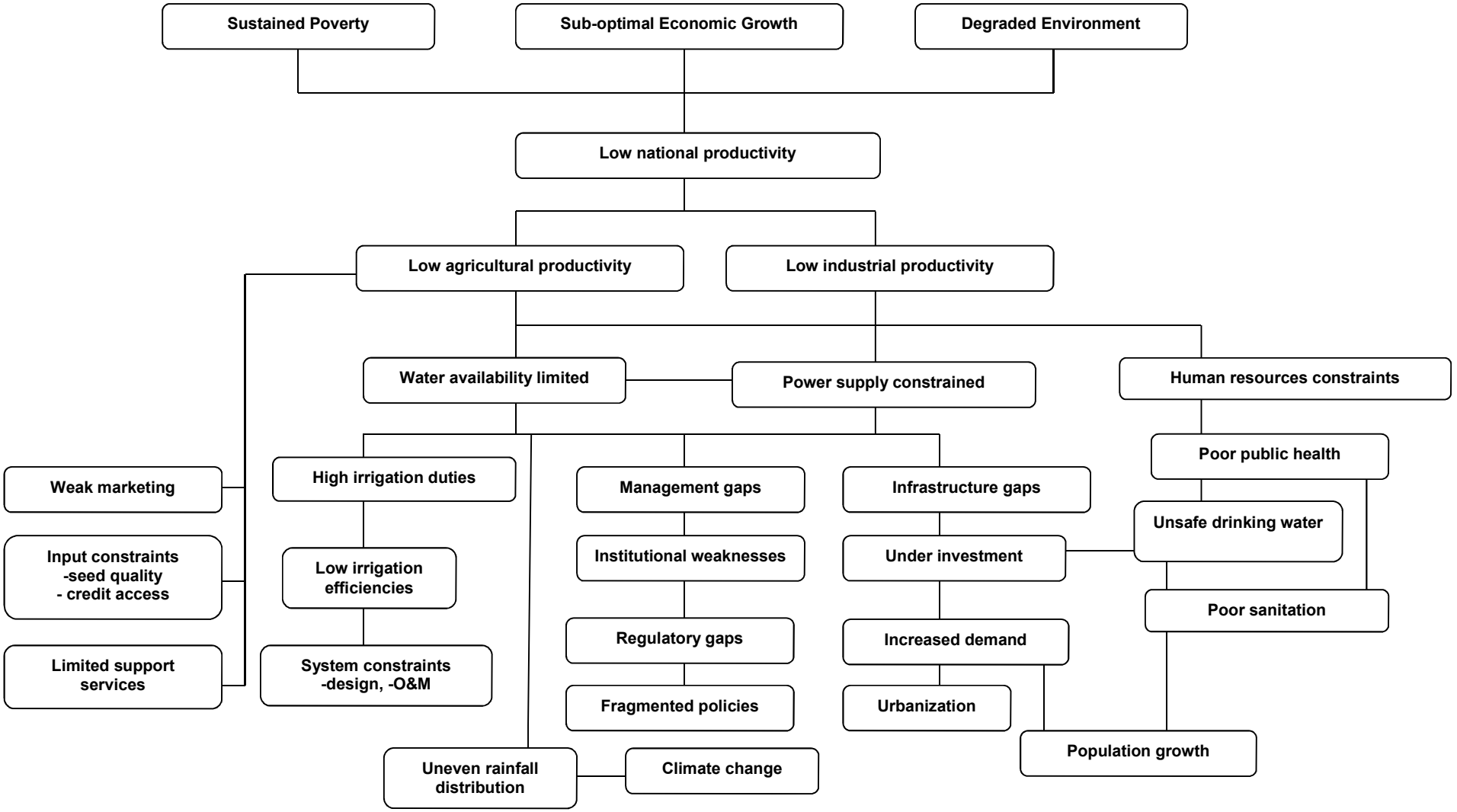
148. The Village Irrigation Rehabilitation Project[81] had a similar objective to the Modern Irrigation Rehabilitation Project of improving agricultural production through rehabilitation and improvement of irrigation system infrastructure and management. It also had similar lessons of physical works being completed but due to limited institutional capacity and resources limited success with the improving system O&M management, particularly in the formulation and implementation of water management plans, and in training of FOs.

149. The North East Irrigated Agriculture Project[82] included components for irrigation system rehabilitation and community capacity building and small scale reconstruction. While the project was implemented through a number of difficulties associated with the local and time (1999-2005), the outcome was rated as "*satisfactory".* The cited lessons included: *"(i) Delivering assistance directly to communities and forming strategic alliances between key stakeholders are critical determinants of project success in conflict affected situations, (ii) Anchoring a project at the provincial level in Sri Lanka increases ownership at the local level and facilitates project implementation, (iii) Selecting villages in poorer areas and activities targeted to poor and landless people, ensure benefits of irrigation-led projects reach communities and families most in need of assistance, and (iv) Livelihood support to women's groups can make a project more inclusive and has tremendous potential for alleviating poverty."*

150. The above projects exhibit similar findings in term of implementation experience; those associated with sector reform highlighted the need to consider socio-political issues and leadership, as well as a progressive reform process to gain stakeholder acceptance of the need for and benefits of sector policy and institutional reform. The irrigation rehabilitation projects have largely been rated as successful in terms of infrastructure works, but less so in developing local capacity to sustainably operate and maintain these systems. The latter effect is attributed to the need to assign sufficient resources for the strengthening of FOs and to develop alternative mechanisms for farmer contribution to O&M funding and support, such as contribute in kind.

[81] World Bank, 1992. Project Completion Report, Village Irrigation Rehabilitation Project, Sri Lanka.
[82] World Bank 2005. Project Completion Report. North-East Irrigated Agriculture Project.

Annex 1: Sector Problem Tree



Annex 2: Sector Results Framework Natural (Water) Resources and Agriculture, 2012-2016)

Country Sector Outcomes		Country Sector Outputs		ADB Sector Operations	
Sector Outcomes with ADB Contribution	**Indicators with Targets and Baselines**	**Sector Outputs with ADB Contribution**	**Indicators with Incremental Targets**	**Planned and Ongoing ADB Interventions**	**Main Outputs Expected from ADB Interventions**
Increased water availability for agriculture sector and drinking water sub-sector. Increase agriculture productivity	Urban water supply Baseline 2012: 65% 2020: 90% Cropping Intensity Average: Baseline 2012: 147% Government target 2020: 160% Major systems: Baseline 2012: 170% Target 2020: 180% Paddy production: Baseline 2012: 3.84 million MT Target 2020 : 8.20 M MT Other Food Crops production Baseline 2012: 0.53 million MT Target 2020: 1.156 M MT Fruit& Vegetable Production Baseline 2012: 1.65 million MT Target 2020: 2.31 MMT Water use efficiency Baseline 2012:6,500 – 9,000 m^3/ha Target 2020: 4,000 – 5,200 m^3/ha Non-revenue water: Baseline 2012: 29% Target 2012: 20%	Transfer of water from 'wet' zone to 'dry' zone water to irrigated lands, to improve water availability for increased cropping intensities. Increase agricultural productivity within existing irrigation system, by improving water distribution within the systems through improved conveyance systems and system operation. Improve inter-sectoral river basin and integrated water resource planning and management	Inter-basin water transfers of 1,000 MCM per annum from wet to dry zone northern Provinces. In Stage 1 approximately 30,000 ha to be provided with a reliable water supply. And in Stage II this will be extended out to about 80,000 ha, and with increase in cropping intensity from 137% to 180%. Prepare guidelines for a program for the increase in conveyance and distribution efficiencies by 10% Prepare guidelines for the strengthening of IWRM activities nationally.	**Planned key activity areas:** Water resource infrastructure development (90%) ●Introduction of water saving irrigation technologies and agriculture support services (5%) ●capacity building for IWRM and IMT (5%) **Pipeline projects with cost estimate:** PPTA: Preparing the Water Resources Investment Program (WRIP) ($600,000) 2012. MFF: Water Resource Investment Program ($675 million) Tr. 1 $189 million - 2015 Tr. 2 $287 million - 2016 Tr. 3 $199 million - 2018 **On-going projects with approved cost:** Jaffna-Kilinochchi Water Supply and Sanitation ($90 million)	**Planned key activity areas**: Increased water supply (900 MCM) to approx. 80,000 ha and about 255,000 beneficiary households. Increase drinking water supplies (160 MCM) to about 820,000 beneficiaries. **Pipeline projects**: Construction of new (160 km) and rehabilitate canals (75 km). Water use efficiency program for selected minor tank irrigation systems. Guidelines and program for strengthening and development of IWRM. **On-going projects**: Improved water supply infrastructure Improved sanitation infrastructure Strengthened water resource protection and management Project management and implementation system is operational

ha = hectare; IMT = irrigation management transfer; IWRM = integrated water resource management, MFF = multi tranche financing facility; MT = metric tons; PPTA = project preparatory technical assistance; WUAs = water users association. Source ADB; Mahinda Chintana, Government of Sri Lanka, 2010.

APPENDIX 4

WATER BALANCE ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 4

WATER BALANCE ASSESSMENT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
CP	–	Concept Paper
ID	–	Irrigation Department
EIA	–	Environment impact assessment
ETo	–	Reference Evapotranspiration
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MASL	–	Mahaweli Authority of Sri Lanka
MCB	–	Mahaweli Consultancy Bureau
MDP	–	Mahaweli Development Program
MRB	–	Mahaweli River Basin
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
NCPC	–	North Central Province Canal
NCPCP	–	North Central Province Canal Program
NWPC	–	North Western Province Canal
PDA	–	project design advance
PMDC	–	program management and design consultant
PPTA	–	project preparatory technical assistance
SIWRM	–	strengthening integrated water resources management
SLPI	–	Sri Lanka Prosperity Index
UEC	–	Upper Elahera Canal
WRDIP		Water Resources Development Investment Program
WTP	–	willingness to pay

WEIGHTS AND MEASURES

ACE	–	annual per capita endowment
ha	–	Hectares
km	–	Kilometer
MCM	–	million cubic meters
mm	–	Millimeter
m^3	–	cubic meter
MW	–	Megawatt

CONTENTS

I. OVERVIEW

1. The Water Resources Development Investment Program (WRDIP) will contribute to the implementation of major water infrastructure under the Mahaweli Development Program (MDP) for the transfer of water from the water rich central 'wet' zone to the 'dry' zones in the North Central and North Western Provinces for agriculture and domestic water consumption. The investment program includes three projects: (i) the Kalu Ganga – Moragahakanda Transfer Canal (KMTC) and Upper Elahera Canal (UEC); (ii) the North Western Province Canal (NWPC); and (iii) the Minipe Left Bank Canal Rehabilitation (MLBCR) with an expected annual water supply of more than 700 MCM from the Mahaweli Ganga to the target systems.[1] The Program is the first of two phases that will permit the transfer of Mahaweli water northwards to the proposed North Central Province Canal Program (NCPCP). The WRDIP projects are also part of the larger MDP, with existing consumptive (agriculture and domestic) and non-consumptive (hydropower) water uses and planned further uses.

2. The reliability of water availability from the Mahaweli River Basin for the investment program is essential to assess under both current and future water demand conditions to determine supply reliability and impact of the projects on other existing and planned water uses within the MDP. It is also potentially sensitive to climate change impacts, particularly in terms of impacts on water demand due to predicted temperature increases and changes to rainfall patterns (refer to the Climate Risk and Vulnerability Assessment[2]). The results of this water balance assessment confirm that the water supply requirements for consumptive and non-consumptive uses are consistent with the planned climate-resilient development of the WRDIP.

3. This review is based principally on reports prepared by the Mahaweli Consultancy Bureau (MCB) for the Ministry of Irrigation and Water Resources Management (MIWRM, the executing agency) on the water balance for the MDP, and results of the Water Balance Model Study[3] for the MDP and NCPCP, which is included herein for reference as **Annex 3**. The model is the key tool for the planning and management of the NCPCP.

4. This assessment is presented in the following sections:

- Mahaweli Development Program; presents an overview of the MDP and planning for the NCPCP
- Water Balance Model; presents a description of the Water Balance Model, input parameters, simulation scenarios and findings.
- WRDIP Assessment; presents the assessment of current and future water availability

[1] There are also locally generated (from local recharge) resources supplied to the systems.
[2] See Appendix 5 Climate Risk and Vulnerability Assessment of the PPTA Final Report and the RRP Supplementary Appendix 4 Project Climate Risk Assessment and Management Reporting.
[3] Appendix 1: Water Balance Study of NCP Canal Project, Final Report of Randenigala – Kalu Ganga Project. 2014. Mahaweli Consultancy Bureau for Ministry of Irrigation and Water Resources. Colombo

II. MAHAWELI DEVELOPMENT PROGRAM

5. This section presents an overview of the MDP, its background, current status and plans for completion with the implementation of the WRDIP as part of the overall NCPCP.

A. Project Background

6. The MDP was formulated by the United Nations Development Program (UNDP) and Sri Lankan experts in 1968 as a multi-purpose agriculture project for development of large-scale irrigation systems, development of hydropower production and other infrastructure facilities in the Mahaweli River Basin and adjacent five river basins in the NCP, Northern Province (NP) and Eastern Province (EP). The project implementation period was conceived to span 30 years.

7. The original scope included twelve distinct systems identified under the Mahaweli Master Plan (1968) for development in the NCP, NP and EP and the corresponding benefit areas are given in **Table 1**. The plan foresaw the total development of 364,000 ha of which 254,000 ha was to be new area and the balance 110,000 ha supply to existing area. To support this development and the need for power production, the construction of 15 dams was planned of which 12 were to have hydropower plants with a combined installed capacity of 460 MW.

Table 1: Mahaweli Proposed Irrigable Areas

Mahaweli System	Planned Extent of Irrigable Area (ha)			Developed Area (ha)
	Existing	New	Total	
A	5,668	29,636	35,304	7,050
B	2,632	41,741	44,373	18,196
C	1,336	29,798	31,134	22,801
D1	20,729	11,417	32,146	26,520
D2	7,368	3,684	11,052	10,480
E	4,211	4,049	8,260	7,290
F	202	3,320	3,522	
G	1,943	2,510	4,453	5,025
H	16,478	23,036	39,514	32,023
I	21,134	35,547	56,681	4,907
J	2,874	19,919	22,793	
K	13,198	7,854	21,052	
L	8,057	30,972	39,029	19,995
M	4,453	10,081	14,534	4,210
Others*				2,632
Total	**110,283**	**253,564**	**363,847**	**161,129**

Source: MCB, 2014 (*) UW, Mapakada, Dambarawa, Sorabora

8. The existing Systems E and G, and the proposed System K, were to be fed from diversion canals, while all the other systems are fed from augmenting existing reservoirs and from proposed reservoirs.

9. However, the actual area currently developed and augmented from the Mahaweli Ganga is about 161,000 hectares as discussed in the following sections.

B. Mahaweli Development Program Achievements

10. Harnessing the water resources in the Mahaweli Ganga and adjoining basins required a series of regulating reservoirs and an intricate network of conveyance systems incorporating powerhouses to maximize the project benefits.

11. The government commenced project implementation in 1970 with construction of the Polgolla Diversion encompassing the barrage, tunnel, Ukuwela power house, followed by Bowatenna Reservoir across the Amban Ganga including a power house and Lenadora Tunnel to divert water to Kala Oya, part of Malwatu Oya, Yan Oya and Amban Ganga Basins, supplying Systems H, IH, MH, G and D, covering a total benefit area of about 83,000 ha.

12. As a consequence of other developments having taken place during the last three decades, some of the land originally identified for development had been reduced in the service areas of some systems, while the demands in others have increased. The land available for development in System A has reduced considerably due to the demarcation of major portions of it for forest and wildlife reserves.

13. In order to respond to increasing demands for the agriculture and power and to realize project benefits in a shorter period of 6 years, the government decided in 1977 to accelerate the implementation. It set targets of: (i) achieving self-sufficiency in rice by the mid-1980s; (ii) meeting the energy requirements for mid-1990s with hydropower in the Mahaweli cascade; and (iii) promoting employment generation to reduce poverty.

14. The Accelerated Mahaweli Development Program (AMDP) gave priority to: (i) construction of a series of reservoirs along the Mahaweli River comprising Kotmale, Victoria, Randenigala and Rantembe; (ii) completion of Systems H, IH and MH, including construction of Dambulu Oya Reservoir and enlarging Kalawewa Reservoir; (iii) improving irrigation infrastructure in Systems D and G; and (iv) completion of irrigation infrastructure in Systems B, C, and E, including construction of the new reservoirs Ulhitiya, Ratkinda, and Maduru Oya. By the mid-1990s when the AMDP concluded, the benefits achieved included 145,000 ha of irrigated land and the establishment of 660 MW of hydropower generation capacity, contributing substantially to the national gross domestic product.

15. Remaining works in the balance of the systems could not commence due to civil disturbances in the country, especially the northern and eastern provinces from 1983 to 2009. The total benefits realized from the agriculture sector is about 40% of those originally envisaged under MDP.

16. The total irrigated area is currently about 161,000 ha in 14 systems of which 6 are managed by the MASL with 62% of the irrigated area, and the balance of 8 are managed by the Irrigation Department (ID) (refer to **Table 2**). The total installed hydropower capacity, with the addition of the Upper Kotmale hydropower project (HPP) of 150 MW, was increased to 810 MW as shown in **Table 3**. In addition, a further three power stations are under construction: Upper Uma Oya (150 MW), Morangakanda (25 MW), and Morogalla (27 MW) for a combined installed capacity of 202 MW.

Table 2: Mahaweli Scheme Summary

System	Area (ha)	Institution
A	7,050	ID
B	18,196	MASL
C	22,801	MASL
D	36,561	ID
E	7,290	ID
G	5,625	MASL
H	32,023	MASL
IH	4,907	ID
MH	4,210	ID

Source: MCB Water Balance Study Report, October 2013

Table 3: Planned and Installed Power Generation Capacities

Hydropower Station	Installed Capacity (MW)	
	Planned	Achieved
1. Ukuwela	34	38
2. Victoria	80	210
3. Kotmale	102	201
4. Randenigala	100	122
5. Rantebe	-	49
6. Bowatenna	11	40
7. Moragahakanda[1]	40	25
8. Upper Uma Oya[1]	25	150
9. Lower Uma Oya[2]	29	
10. Taldena	13	
11. Pallewela	10	
12. Haslaka Oya[2]	11	
13. Heen Ganga[2]	6	
14. Upper Kotmale		150
15. Moragolla[1]		27
Total	**461**	**810**

[1] Under construction

[2] Proposed under NCPCP Phase 2

Source: MIWRM, 2014

C. North Central Province Canal Program

17. The overall purpose of the NCPCP is to develop and implement the balance of the MDP, principally[4] for the completion of the water transfer to the Northern provinces for irrigation and drinking water supplies. A general overview of the NCPCP is presented below

1. Past Studies

18. The original NCPCP encompassed the transfer of Mahaweli water to the NCP and NP, through a canal taking off from the Moragahakanda Reservoir built across Amban Ganga and augmented from the Bowatenna Reservoir. However, work was suspended in late 1970s due to limitations in financial resources. Subsequently, several consultants conducted studies towards the revival of the NCPCP and proposed alternative solutions, but they had not been considered for implementation due to financial constraints and the civil disturbances that prevailed from 1983 to 2009.

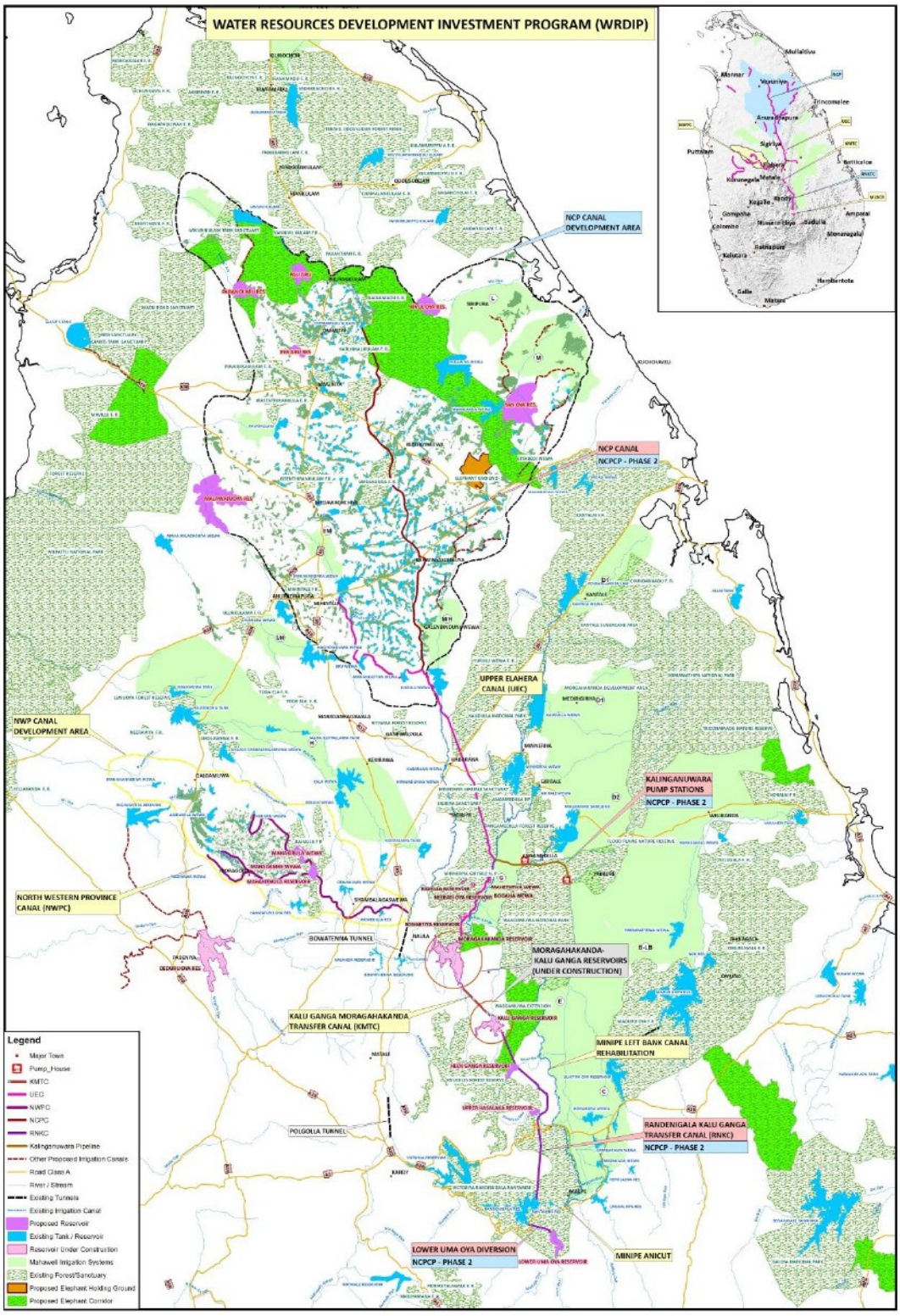
19. The previous studies reviewed the options with a focus on the optimum use of available water resources in the Mahaweli Basin and the feasible transfer routes from Mahaweli to Amban Ganga basin for augmenting the NCPC. These studies included:

- UNDP Master Plan Study (1968) proposed works included: works on the Minipe Anicut and Minipe LB Canal, the Angamedilla to Kaudulla and Kantalae Angamedilla pump stations and NCPC and NCP irrigation systems.
- ELECTROWATT – Trans-basin Diversion Study (1980) proposed works included: Minipe Anicut - Minipe LB new parallel canal - Hettipola Pump Station - Kalu Ganga - Elehera - NCPC - NCP Target Area.
- JICA Transbasin Study (1989) proposed works included: Minipe Anicut - Minipe LB New Parallel Canal - Minneriya Tank - Minneriya Pump Station - NCPC - NCP Target Area.

20. Consequently to the above studies a contract for the construction of Moragahakanda Reservoir was awarded in the second quarter of 2012 and presently the work is in progress. The construction of irrigation infrastructure facilities at the Kalu Ganga Reservoir is in progress and the contract for construction of headworks has been scheduled to commence in mid-2014.

[4] There are also plans and projects for water transfer to the south from the Upper Uma Oya to the Karindi Oya, though the volumes and areas are relatively small by comparison with the NCPCP, the average annual volume is approximately 150 MCM.

Figure 1: General Layout of the NCPCP



Source: MCB, 2014

2. NCP Canal Project Pre-feasibility Study

21. Under the government policy framework of the "Mahinda Chintana - Vision for Future"[5] the NCPCP of the MDP is a high priority project to be under taken for development. The NCPCP had been conceived to cater for the increasing water demands in the dry zone areas and to address the urgent need for socio-economic development in the rural sector. In the post-civil disturbance era, the government has given high priority for development of balance water resources of Mahaweli for domestic and agriculture consumption in the NCP, NP, EP and NWP, and identified the development of the NCPCP encompassing Upper Mi Oya and Hakwatuna Oya Basins as the best options to resolve multiple complex socio-economic issues in the above provinces.

22. In 2010, the Secretary of MIWRM entrusted the pre-feasibility study of the NCPCP to the Mahaweli Consultancy Bureau (Pvt) Ltd (MCB).[6] The main objective of the study was to assess the availability of water resources in the Mahaweli Basin, Amban Ganga Basin and in the target project areas. And to propose the best diversion routes to optimize diversion quantities for the development of areas in the NWP (Upper Mi Oya Basin), NCP and NP with minimum impacts on the existing systems and environment in conformity with the Mahinda Chinthana.

23. The NCPCP Pre-feasibility Study[7] identified the need for further studies to develop seven major irrigation infrastructure facilities listed below as sub-projects to facilitate phased development:

(i) Modification to the configuration of Moragahakanda and Kalu Ganga Reservoirs to accommodate the NCPCP

(ii) Diversion of Mahaweli water through the Randenigala – Kalu Ganga transfer canal including supplementary inflows from Lower Uma Oya, Hasalaka Oya and Heen Ganga Reservoirs

(iii) Development of irrigation infrastructure facilities in System B - Maduru Oya RB

(iv) Heightening of the Minipe Anicut and rehabilitation of the Minipe LB Canal

(v) Provision of water for development of NWP area

(vi) Provision of water to revive the Kantale sugar industry

(vii) Pumping Mahaweli water at Kalinganuwara on the lower Mahaweli Ganga.

24. The study proposed staged implementation of the NCPCP with due consideration to the magnitude of the infrastructure development involved, socio-economic constraints, required investments, and achieving benefits during project implementation. **Table 4** provides a summary of the proposed stages and the timeframes for sequential implementation of the development program.

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[5] Government of Sri Lanka, Department of National Planning, Ministry of Finance and Planning. 2010. *Mahinda Chinatana – Vision for the Future: The Development Policy Framework of the Government of Sri Lanka.* Colombo.

[6] Through a contract signed (Contract No TS/NCP/P-FS/88 December 2010) between MCB and the Mahaweli Authority of Sri Lanka (MASL)

[7] MCB. 2012. *Pre-feasibility Study for the Implementation of North Central Province (NCP) Canal*. Colombo.

Table 4: Study Development Stages[8]

Timeframe	Stage No.	Proposed Development
2014 – 2017	Stage I	• Kalu Ganga – Moragahakanda Transfer Canal • Upper Elahera Canal • Lower Uma Oya Hydro Power Project • 9,000 ha in NWP • 10,500 ha in NCP • 5,120 ha in Kantale • Heen Ganga hydro power project
2018 – 2022	Stage II	• Hasalaka Oya hydro power project • Angamedilla Pump Station • 24,500 ha in NCP
2023 – 2027	Stage III	• Randenigala - Kalu Ganga Diversion Canal • Kalinganuwara Pump station • 18,000 ha in NCP • 2,000 ha NWP • 1,456 ha Kantale

Source: MIWRM, 2014

3. Randenigala – Kalu Ganga Diversion Study

25. In 2012 the MIWRM assigned the finalization of the water balance study for the NCPCP and project layout for the Randenigala- Kalu Ganga transfer route to the MCB.[9]

26. Having considered the ongoing work, magnitude, complexity and time allocation for the project, the MCB submitted to the MIWRM a revised work program with detailed clarifications and an amended scope of work.[10] The MIWRM concurred the amended scope of work and the extension of the period of the assignment as given below (along with current status of relevant elements):

- Finalize the Water Balance Study; finalized and published in October 2013.
- Conduct a geophysical survey along the transfer route and dam sites; on-going and partially completed as part of the detailed design for the NCPCP.
- Submit water quality reports at the following locations: Kalinganuwara and Minipe Anicut in the Mahaweli River Basin, and Parakramasamudra, Minneriya Tank and Angamedilla Anicut in Amban Ganga Basin; completed.
- Prepare a report on sediment management of the Lower Uma Oya, Randenigala, Rantambe, and Minipe Complex; completed.
- Conduct a socio-economic and inundation surveys for the project components; completed for Kalu Ganga and Moragahakanda reservoirs.

[8] It should be noted that the definition of stages and phases discussed in the Pre-feasibility study differs from that subsequently adopted for the proposed ADB funded project which is presented as two phases.
[9] By the letter 02/02/87/RKTC, dated 26 December 2012
[10] By the letter MCB/ENG/FS/Randenigala/93, dated 15 November 2012

- Prepare and submit required documents to the client for initiating EIA and archeological impact assessments.
- Update the recommendations given in the NCPCP Pre-feasibility Study and establish an optimum layout for the configuration for the Randenigala – Kalu Ganga transfer route and associated hydropower reservoirs.
- Update the financial and economic analysis conducted for Pre-feasibility Study of the NCPCP.
- Prepare TORs to undertake detail designs relevant to project components for feasibility stage designs.

27. This recent study for the Randenigala – Kalu Ganga Project represents the most recent and comprehensive updating of the NCPCP, particularly in terms of the projects proposed for Phase 2 (refer to **Annex 3**).

III. WATER BALANCE ASSESSMENT

A. 2013 Water Balance Study

28. The study approach and results[11] are presented in the Water Balance Study Report of October 2013.[12] The purpose of the study was to assess water availability within the Mahaweli River Basin, including the Amban Ganga, and to formulate an agricultural development plan for the adjacent water scare areas in the northern and eastern provinces.

29. The WRDIP forms part of the NCPCP and the projects in the Program are covered in the Water Balance Study as listed in **Table 5**. The 2013 study included an assessment of estimated water demands for all command areas (current and future) and water availability in the system to reliably meet this demand. Therefore, the study findings provide the basis for assessment of project water availability and impact on future planned development in the Mahaweli scheme.

30. The 2013 study utilized the Mahaweli Water Balance Model to evaluate a number of scenarios for incrementally expanding scheme development over a number of stages. The Mahaweli scheme is a complex system with multiple water sources, storage sites and transfer routes for water supply. In terms of water demand there are a large number of command areas with varying levels of internally-generated water resources. The numerical model was used to optimise supply and demand scenarios, within a set of operating rules for hydropower generation, and irrigation and drinking water supply allocation rules.

31. The overall MDP development envisioned an expansion in irrigated area from about 146,000 to 230,000 ha, an increase in cropping intensity from about 140% to 180%,[13] and diversification to cash crops (from paddy) in the Yala season in major and minor tanks.

32. As presented in the previous section, the initial proposal for the full development of the MDP included additional reservoirs, hydropower stations, transfer canals, as well as pumping stations at Kalinga Nuwara and Angamedilla on the Mahaweli and Amban Ganga, respectively. The proposed development plan was for implementation in three stages with; Stage 1 (2018-2022), Stage 2 (2023-2027) and Stage 3 (2028-2032); however, this has now been superseded by the current ADB two phase approach as discussed in Section IV.

B. 2013 Water Balance Models

33. The water balance model Acres Reservoir Simulation Program (ARSP) was developed by the Canadian consulting firm Acres International in the 1980s as part of the original scheme development and is commonly referred to as the 'Acres model.' It is a custom-built mass balance mathematical model for simulating the scheme's operation over a 40 year timeframe (1971-2010), which integrates reservoir operations, hydropower generation and water issues for optimisation of water management.

[11] The model was subsequently applied for assessment of water availability for the proposed ADB funded projects.
[12] MCB. 2013. *Water Balance Study Report*. Contract No. MIWRM/AGR/Consult/2011/22. Colombo.
[13] However cropping intensities vary between individual systems.

34. The irrigation demand series for the irrigation systems included in NCPCP have been computed using Acres' Irrigation Demand Model (AIDM) for the cropping patterns selected; the irrigation demand time series computed are an input to ARSP. The paddy-paddy cropping pattern has generally been used in computing the irrigation demand series, as the basis for determining infrastructure design duties, but with the understanding that this is the likely upper limit of demand and with crop diversification water demand will be lower. The feasibility studies prepared by the MCB assumed a gradual increase in other field crops once irrigation water supplies were more secure. For example, a likely cropping pattern for such a future scenario would be bananas 20%, green gram 22%, groundnut, and chillies 17% each, and vegetable and onions 12% each in 20% of the irrigated lands in Yala[14] crop under major to medium reservoirs,[15] and that of 80% under minor reservoirs.

35. The Water Management Secretariat (WMS) of the MASL utilizes the model for planning and management of the scheme including in the preparation of Seasonal Operational Plans (SOPs) and in day-to-day management of reservoirs and water issues (allocations) for hydropower and irrigation. It was utilized by the MCB for the 2013 Water Balance Study, and the present assessment of the WRDIP, to evaluate various development options, corresponding water supply and demand issues, and to test development scenarios, according to operational rules and supply reliability constraints as outlined in the following sections.

1. Methodology

36. The purpose of the modelling is to optimise water distribution within the Mahaweli Scheme, both for in basin and transfer basins, for hydropower production and for irrigation and drinking water supplies. The optimisation objectives are to sustain hydropower generation at predetermined levels, based on long-term production levels, reliably meet prescribed drinking water supply levels, and to maximise the irrigable area within supply reliability criteria.

37. The approach is based on a volumetric water balance between water demand, for both consumptive and non-consumptive uses, and water supply, both from the Mahaweli River Basin and within the irrigation command areas (tank cascades). The modelled period is based on climatic and hydrological information for the 40 year period 1970 to 2010. The analysis is based on monthly values over this period, with a results matrix of 12 by 40.

38. Irrigation demand is calculated for each cascade system within the scheme's present and planned system areas based on crop water requirements, both pre-season and during the season, system efficiency, and effective rainfall. Drinking water supplies were calculated for a number of communities within the extended scheme area based on current and projected demands to 2030. Hydropower requirements are based on the minimum impact on current production levels, which are on average 1,874 GWh per annum, and taking into consideration the planned change in operation mode from base to peak production.

[14] In Sri Lanka there are two principal cultivation seasons; Yala from May to September and Maha from December to February which coincide with the South West and North East Monsoons, respectively.

[15] Reservoir systems are referred to as cascade irrigation systems, with either major, medium and or minor reservoirs (referred to as tanks). The cascade refers to the hydraulic inter-linkage of a sequence of tanks and irrigation command areas, which in effect recycle water within the system from tank to farm to tank down the system in essence forming a hydraulic cascade.

39. For the purpose of analysis the Scheme is organised hydraulically with key features assigned as input and output parameters. The key hydraulic features are: river and canal reaches with inflow and outflow nodes, storage reservoirs with inflows and outflows (releases and spills), power plant points, irrigation demand points and pumping stations.

2. Inputs

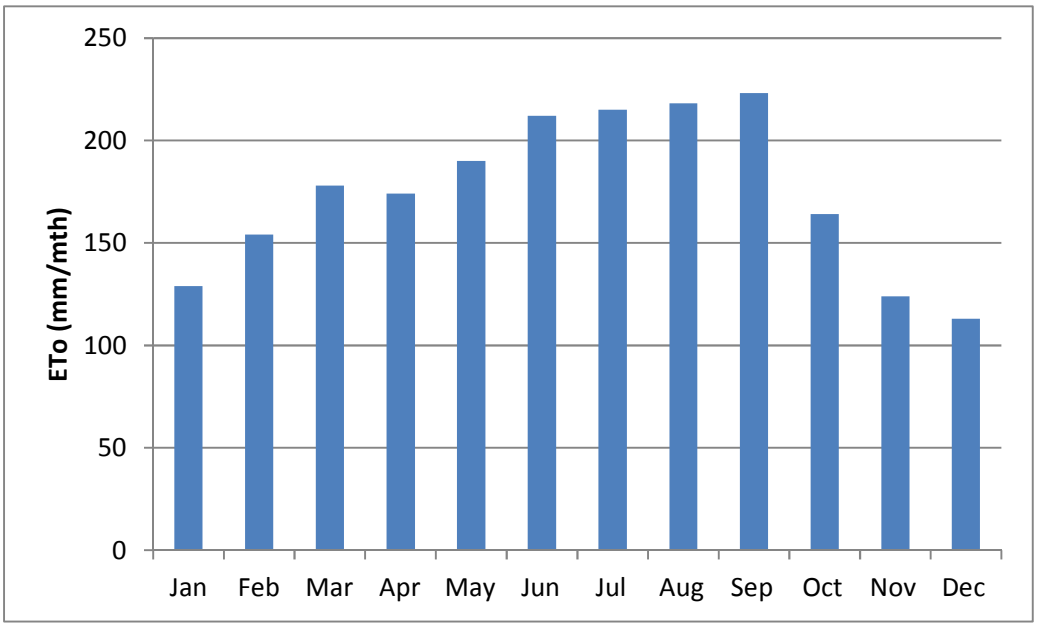
40. The inputs parameters include those for determination of irrigation water demand and water supply from river flows and storage reservoirs.

41. The irrigation water demand parameters are:

- Reference evapotranspiration (ETo): mean monthly value over the model period for two stations representative of the system areas (both located within the dry zone). Average annual ETo is 2,094 mm, with a peak during the Yala season of about 215 mm per month and low of about 110 mm per month during the Maha season (refer to **Figure 2**).
- Crop information: crop type (paddy (for both short and long-term varieties rotation), sugarcane, chillies, soya beans/cow pea and field crops), stages and coefficients.
- Rainfall: monthly rainfall over the model period from more than 100 stations.
- Pre-season irrigation: for paddy the pre-season irrigation depth is 100 mm
- Irrigation efficiency: the irrigation efficiency was determined as the cascade system efficiency, that is the overall efficiency from the point of issue to the last point with the system and is inclusive of recycling within the system. For existing systems this was determined from previous season records of water issues. Efficiency values differ between the two growing seasons, Maha and Yala, due to differences in cropping intensity (efficiency increases with intensity due to greater recycling) and effective rainfall. **Figure 3** shows the average seasonal efficiency for the Mahaweli systems, which vary widely between systems from less than 40% to 90%.[16]

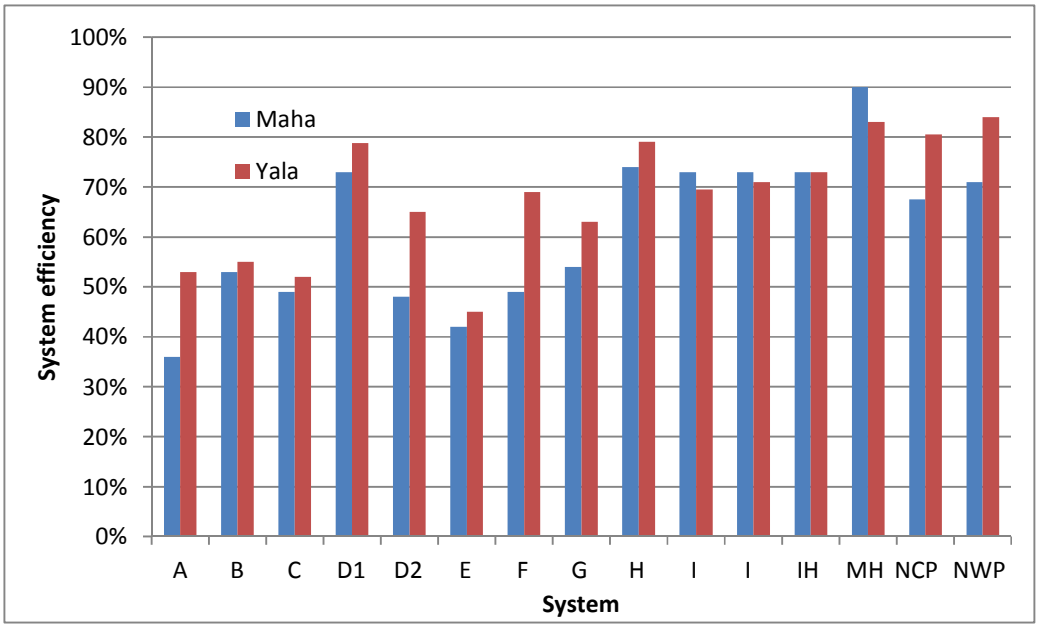
[16] The irrigation efficiencies for the NWP are 71% and 84% for Maha and Yala seasons, respectively, Irrigation efficiencies are predicted to increase as a result of the investment program, by 5% in Maha and 10% in Yala season, as per Cases B and C in the Water Balance Study Table 3.5.

Figure 2: Mean Monthly Reference Evapotranspiration



Source: MCB, 2014

Figure 3: System Irrigation Efficiencies



Source: MCB, 2014

42. Water availability from the Mahaweli Basin (inclusive the Amban Ganga) is based on historical flow records over the model period as measured at a number of gauging stations and from dam reservoir records.

3. Optimization Criteria

43. As mentioned above the objective was to optimize options for the development of the balance of the available water resources within the Mahaweli Basin. This was achieved within three development stages and supply criteria.

44. To cater for changes in irrigation efficiency and crops, the water balance study adopted three 'cases' (A to C) over the three development stages (2012-17, 2018-22 and 2023-32, respectively). The cases assume that water demand per unit area will decline over time due to improved system efficiencies (due to improved; conveyance efficiency, field application efficiencies and irrigation management) and lower crop water demand due to changes in paddy and crop varieties, and planting times (in the case of paddy resulting in shorter duration crops and hence lower water demand). The study also acknowledged that total water demand could also be reduced with diversifying to field crops with lower water demands than paddy. The three cases were:

- Case A; is the 'present case' (without project) that is, current irrigation efficiencies and cropping patterns including ratio of long-term, medium-term and short-term[17] paddy (ratio of 1/3 long-term to 2/3 medium-term in Maha season and ratio of 2/3 medium-term to 1/3 short term in Yala season).
- Case B; improved irrigation efficiencies (with increases of 5% and 10% in the Maha and Yala seasons respectively) and bringing forward planting dates due to improved water supply reliability.[18] (This is the "with- project" alternative.)
- Case C; in addition to (above) improved irrigation efficiency, the ratio of paddy varieties are changed to further reduce water demand (ratio of 1/3 short-term to 2/3 medium-term in Maha season and ratio of 1/3 medium-term to 2/3 short term in Yala season).

45. **Supply Reliability.** In the preparation of the Seasonal Operational Plans (SOP) for the Maha and Yala seasons, the WMS uses a Reliability Criterion in assessing the irrigation deficits of individual systems in the simulated system performance. The water balance study adopted the same three criterion, which are:

- *Irrigation failure* occurs when the supply deficit exceeds 5% of Yala seasonal demand. It should not exceed 20% occurrence (over the modelled period).
- *Significant failure* occurs when the supply deficit exceeds 10% of Yala seasonal demand. It should not exceed 10% occurrence (over the modelled period).
- *Total failure* occurs when the supply deficit exceeds 20% of Yala seasonal demand. It should not exceed 5% occurrence (over the modelled period).

[17] Short, medium and long terms are crops of 90, 105 and 135 days duration respectively.
[18] In Maha season shifting start of planting from 01 Nov to 15 Oct, and in Yala season from 15 May to 01 May.

46. An *irrigation failure* is assumed to be effectively managed by 'tightening up' on water deliveries with no significant losses. While managing *significant and total failures* requires water supply restrictions and restricting serviced areas, and would adversely impact on overall agricultural production.

47. The reliability criteria are in essence multiple supply criteria, with the respective levels being at the 95, 90 and 80 percentile levels, respectively. Typically, irrigation schemes are designed for supply reliabilities of greater than 80%, so the criteria are within accepted design and economic norms.

48. **Rationing rules.** The model analysis is based on the existing allocation rules under rationing conditions (low flow periods) between system based on priority uses, with the ancient riparian systems on the Mahaweli and Amban Ganga assigned highest priority (Systems E, C, D1 and D2), and the newer systems assigned lower priority. Within this rule the full scheme (all systems and cascades) has to meet the above supply reliability levels. The results are presented in **Annex 2**, for the two relevant modelled scenarios:

(i) **A2A** equivalent to Phase 1 of the WRDIP
(ii) **A10A** equivalent to Phase 2 (as described in this report)

49. **Rule curves.** The scheme reservoirs and irrigation tanks are operated according to pre-defined rule curves for monthly water levels, anticipated rainfall, and storage volumes which were adopted in the water balance study. As mentioned above, maintenance of current hydropower generation was one of the optimization conditions.[19]

4. Outputs

50. The model results formed the basis of the determination of water availability for development of the NCPCP including for the proposed increases in cropping intensities and irrigated areas. The results are presented for the series of development scenarios (12)[20] and development stages (3).[21] The outputs include withdrawals and spill volumes for key diversion points, all irrigation systems, and energy generation for hydropower stations.

51. The results helped provide a basis for the selection the WRDIP projects based on logical water management and financial constraints, referred to below as Phase 1 and subsequent developments in Phase 2. As indicated below, at full development the irrigated area both fully

[19] One of the principal objectives, (for the model) is to maintain or at least minimize impacts of the NCPC allocation on annual power generation. Whether the power production is peaking or base, does not significantly impact on the model (which is based on month time steps).

[20] The 12 scenarios include the base case (scenario A1A), Stage 1 scenarios (A2A to A5A), Stage II scenario (A6A) and Stage III scenarios (A7A to A11A and A14A). The scenarios are based on the progressive development of water infrastructure, and improvements in irrigation efficiency and changes in crops (Cases A to C). The results for the scenarios are presented in Table 4-1 of the Water Balance Study (Simulations) of the Appendix 1: Water Balance Study of NCP Canal Project (October 2013).

[21] The Water Balance model assumed three development stages based on progressive of water storage and transfer infrastructure with; Stage 1 including construction of KMTC and UEC, Stage II including construction of the Hasalaka and Heen Ganga stretch of the Randenigala Kalu Ganga Transfer Canal (RKTC) and diversion of Hasalaka power flows to the Kalu Ganga, pump station at Angamedilla and NCPC to Kahatagasdigiliya, and Stage III including completion of the RKTC and NCPC.

and partially supplied from the Mahaweli Scheme will be in the order of 233,000 ha with an average cropping intensity of 1.9 and annual diversion of 4,300 MCM (up from 3,200 MCM).

52. The modelling approach is based on maintaining current hydropower production levels and supply reliability to existing systems and proposed extensions to the north (NCP and NWP) and east (System B Right Bank). The approach provides a sound quantitative analysis of water demand and supply to determine the reliably allocable water resources for multipurpose use (hydropower, irrigation and drinking water supply) to support full scheme development. From the review of the Water Balance Study and Water Model, the approach appears to be well founded on existing water availability and demand, and robust in terms of determining water availability for future development, for not only the proposed WRDIP but also for other proposed developments including the NCP, System B Right Bank, System D1 Kantale and increased cropping intensities within existing systems, as well as drinking water supplies.

IV. WATER RESOURCE DEVELOPMENT INVESTMENT PROGRAM

53. This section presents an overview of the MDP as proposed under the NCPCP and NWPC programs, and secondly those elements to be developed under the WRDIP.

A. Scheme Summary

54. The proposed development program entails the construction of additional storage and conveyance canals for the transfer of water from the Mahaweli Ganga and Amban Ganga to irrigation systems and for drinking water supply to the Northern provinces. This will be initially achieved through water transfer at Pologolla and via the UEC, extended with transfer via the Randenigala – Kalu Ganga Transfer Canal (RKTC) and pumping of water at Kalinga Nuwara (to compensate for diversion in the upper Amban Ganga). It is a complex system and a large development program which requires sequenced implementation to ensure sustained water supply for hydropower generation and to existing systems. **Table 5** lists the proposed implementation schedule in two phases, with Phase 1 development financed under the WRDIP, and Phase 2 under future funding.

55. In addition to the implementation of Phases 1 and 2 for development of the scheme, the 'balance' of systems including Systems A, C, D2 G and H will have minor changes in water supply levels due to changes in cropping intensities and improvements in WUE.

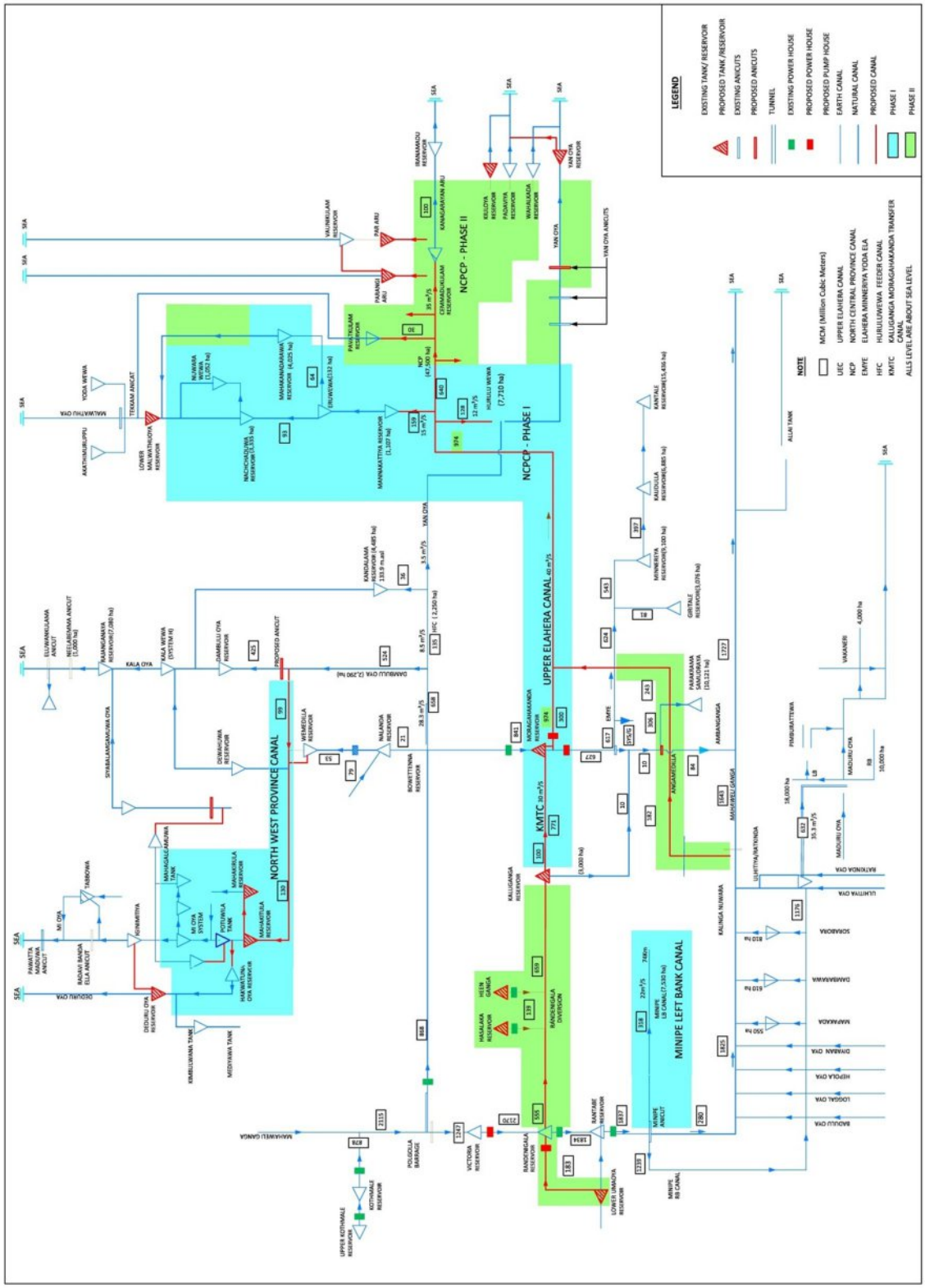
56. **Figure 4** presents the schematic layout of the Mahaweli Scheme at full development with the completion of proposed works under the NCPCP and NWPC. It shows those the two phases shaded by principal works and systems in which addition scheme water is to be delivered.

Table 5: Development Sequence for Phases 1 and 2

Phase	Infrastructure	Systems Area (added)
Phase 1	• Upper Elahera Canal and Kaluganga-Moragahakanda Transfer Canal. • NWPC Stage 1 Canal and Reservoirs • Minipe Left Bank Canal Rehabilitation	• D1: 1,420 ha Kaudulla • MH: 4,210 ha • IH: 4,907 ha • I: 3,264 ha • NWPC: 11,420 ha
Phase 2	• Lower Uma Oya Dam and Canal • Randenigala - Kaluganga Transfer Canal • Kalinganuwara Pump Station • North Central Province Canal	• B: Maduru Oya RB 10,000 ha • D1: Kantale sugar 6,576 ha • I: expanded to 5,264 ha • MH: expanded to 7,710 ha • NCP: added at 47,500 ha • NWP: expanded to12,420 ha

Source: MIWRM 2014

Figure 4: Mahaweli Development Program Schematic showing Phases 1 and 2



Source: MCB, 2014

57. **Table 6** presents a summary of the system areas supplied, fully and partially, from the Mahaweli Scheme currently and in the future, as well as the current and planned cropping intensities (CI, %). The total scheme irrigated area is currently approximately 146,000 ha, and with Phase 1 this will be extended out to 162,000 ha with the addition of areas in NWPC, the compensation area (1,420 ha) to be developed downstream of the Moragahakanda Reservoir (System D1), and addition of System I (3,264 ha). With the completion of Phase 2 the scheme area will increase to 232,500 ha, with the addition of the NCP minor and major tank cascades (47,500 ha), extension of the NWPC (1,000 ha), extension of System I (to 5,264 ha), addition of System B Right Bank Canal (10,000 ha), addition of the Kantale sugar estate in System D1 (6,576 ha), and expansion of System MH by 3,500 ha.

Table 6: Irrigation Systems by Phase

Irrigation System	Current		Phase 1		Phase 2	
	Area (ha)	CI (%)	Area (ha)	CI (%)	Area (ha)	CI (%)
A	7,050	2.00	7,050	2.00	7,050	2.00
B	18,500	1.78	18,500	1.80	28,500	1.80
C	22,800	1.88	22,800	2.00	22,800	2.00
D1	26,520	1.91	27,940	1.91	34,516	2.00
D2	10,480	1.99	10,480	2.00	10,480	2.00
E	7,530	1.95	7,530	2.00	7,530	2.00
F	3,000	2.00	3,000	2.00	3,000	2.00
G	6,210	1.85	6,210	2.00	6,210	2.00
H	34,545	1.89	34,545	1.89	34,545	1.89
I			3,264	1.80	5,264	1.80
IH	4,907	1.67	4,907	1.83	4,907	1.83
MH	4,210	1.53	4,210	1.80	7,710	1.80
NCP					47,500	1.80
NWP			11,492	1.80	12,492	1.80
Total	**145,752**	**1.88***	**161,928**	**1.91***	**232,504**	**1.89***

Source: MCB, 2013 (derived from Water Balance Study Report) (*) Cropping intensities for the area under direct scheme command, that is as supplied with water (partially or fully) from the Mahaweli Ganga (which differs from that reported below, which include areas not under command for the purpose of determination of project benefits).

58. It should be noted that **Table 6** refers to the MDP as a whole, current and future, inclusive of all systems (including those not part of the WRDIP). The subsequent tables (7, 8 and 9) refer only to systems within the MDP which are part of the WRDIP. For the WRDIP for the determination of benefits the approach looks at the current CIs (with and without MDP supply) and the change in CI in the future under Phase 1 and Phase 2. The systems of interest for the WRDIP are Systems E, I, IH, MH, NWP and D1 Kadulla for Phase 1, as per **Tables 7** and **8**, and NCP plus increase in areas Systems I, and MH for Phase 2 as per **Table 9**.

59. The other systems within the MDP do not directly benefit from the WRDIP investments; any changes in CIs for these systems are a result of general trends in crop and water management which are not directly attributable to the WRDIP.

60. **Annex 2** presents a more comprehensive summary of the systems and sub-systems (cascades) for both the current situation and future Phase 2 of the NCPCP. In addition to the above information, it also shows current cropping intensities for the system areas not currently supplied from the Mahaweli Scheme. The current cropping intensity inclusive of these areas is about 1.42, and will increase to 1.51 and 1.89 under WRDIP and NCPCP Phase 2, respectively.

61. Current scheme annual water diversions for irrigation are about 3,200 MCM (for an irrigated area of 146,000 ha). At final development this will increase to 4,300 MCM to meet an annual irrigation demand of about 5,300 MCM, and 160 MCM for drinking water supplies. It should be noted that the balance between diversions from the Mahaweli Ganga (and associated reservoirs) and demand of 1,200 MCM (5,500 – 4,300 MCM) is to be met from local recharge and storage (within major and minor tanks).

B. WRDIP Project Summary

62. **Table 7** presents a summary of the current system cascade irrigated areas, cropping intensities, duties and water issues (irrigation demand) for the Phase 1 projects (those funded under the WRDIP).

63. The total irrigated area is 32,823 ha of which 12,381 ha is within the command of the proposed UEC in the Systems of IH, I and MH, which have a combined cropping intensity of about 1.37, though it varies significantly between cascade tanks. Annual water issues are of the order of 206 MCM, most of which is generated from local tank recharge as annual diversion form the Mahaweli Scheme are about 60 MCM.

64. The proposed NWPC has an irrigated areas of 11,492 ha and cropping intensity of 1.11. Annual water issues on average are about 155 MCM, again most of which is generated from local recharge, with a minor contribution (about 20 MCM) releases from the Nalanda Reservoir. The MLBC, in System E, with an irrigated area of 7,530 ha has an annual water demand of about 343 MCM, most of which is supplied from the Mahaweli Ganga.

65. The project area also includes D1 Kadulla which is the area (1,420 ha) to be developed downstream of the Moragahakanda Reservoir as compensation for lands inundated by the new reservoir.

66. **Table 8** lists a summary for the WRDIP project areas on completion of the infrastructure works. While the irrigated area remains the same with additional water, the system cropping intensities increase and overall intensity rises to 1.86 from 1.35. The total irrigation demand increases to 892 MCM from 704 MCM.

Table 7: Phase 1 Projects – Existing Status

System	Cascade	Area (ha)	Cropping Intensity Maha	Yala	Annual	Duty (ha/mcm) Maha	Yala	Water Issues (MCM)[22] Maha	Yala	Total
Upper Elahera Canal										
IH	Nuwarawewa	1,052	0.98	0.96	1.94	97	65	11	16	26
	Nachchaduwa	3,335	0.94	0.66	1.60	94	50	33	44	77
	Tis'wa/Basa'ma	520	1.00	0.63	1.63	83	86	6	4	10
I	Manankattiya	607	0.86	0.64	1.50	100	60	5	6	12
	Eruwewa	132	0.70	0.00	0.70	100	60	1	0	1
	Mahakandarawa	2,525	0.41	0.10	0.51	100	60	10	4	15
MH	Huruluwewa	4,210	1.00	0.53	1.53	126	70	33	32	65
	Subtotal	**12,381**	**0.85**	**0.52**	**1.37**			**100**	**106**	**206**
NWP	Stage I	6,505	0.75	0.45	1.20	90	70	54	42	96
	Stage II	4,987	0.80	0.20	1.00	90	70	44	14	59
	Sub Total	**11,492**	**0.77**	**0.34**	**1.11**			**99**	**56**	**155**
E	Minipe LB	7,530	0.98	0.97	1.95	55	35	134	209	343
D1	Kaudulla	1,420	0.00	0.00	0.00					
	Total	**32,823**	**0.82**	**0.54**	**1.35**			**333**	**371**	**704**

Source: PPTA Consultant based on Water Balance Study Report (MCB, 2013)

Table 8: Phase 1 Projects – Developed

System	Cascade	Area (ha)	Cropping Intensity Maha	Yala	Annual	Duty (ha/mcm) Maha	Yala	Water Issues (MCM) Maha	Yala	Total
Upper Elahera Canal										
IH	Nuwarawewa	1,052	1.00	0.96	1.96	105	70	10	14	24
	Nachchaduwa	3,335	1.00	0.80	1.80	100	55	33	49	82
	Tis'wa/Basa'ma	520	1.00	0.80	1.80	85	86	6	5	11
I	Manankattiya	607	1.00	0.80	1.80	100	70	6	7	13
	Eruwewa	132	1.00	0.80	1.80	100	70	1	2	3
	Mahakandarawa	2,525	1.00	0.80	1.80	100	70	25	29	54
MH	Huruluwewa	4,210	1.00	0.80	1.80	126	80	33	42	76
	Subtotal	**12,381**	**1.00**	**0.81**	**1.81**			**116**	**147**	**263**
NWP	Stage I	6,505	1.00	0.80	1.80	100	80	65	65	130
	Stage II	4,987	1.00	0.80	1.80	90	70	55	57	112
	Sub Total	**11,492**	**1.00**	**0.80**	**1.80**			**120**	**122**	**243**
E	Minipe LB	7,530	1.00	1.00	2.00	55	35	137	215	352
D1	Kaudulla	1,420	1.00	1.00	2.00	100	70	14	20	34
	Total	**32,823**	**1.00**	**0.86**	**1.86**			**387**	**505**	**892**

Source: PPTA Consultant based on Water Balance Study Report (MCB, 2013)

[22] In Sri Lanka the term 'Issue' refers to water deliveries

67. The UEC will initially deliver water to the IH, I and MH Systems at the equivalent average annual rate of about 240 MCM (though it is designed to meet the ultimate duty for the NCPCP of 974 MCM as discussed below). Diversion from the Mahaweli Scheme to the NWPC will be from the Nalanda Reservoir to the Wemedilla Reservoir (53 MCM) and from the Dambulu Oya via the Bowettana Reservoir (100 MCM). The MLBC (System E) will initially maintain similar diversion rates at around 350 MCM.

68. The UEC is designed to meet the ultimate duty of the NCPCP, and, therefore, a substantial proportion of the costs are attributable to Phase 2 development (alternatively a substantial proportion of the benefits from the NCPCP are attributable to the conveyance works developed in Phase 1).

69. **Table 9** lists a summary of the areas, cropping intensities and irrigation demand with the addition of the NCPCP (i.e. Phases 1 and 2). In addition to the 47,500 ha under the NCPCP command, there will also be (due to higher water availability) an increase in the irrigated areas in the other UEC serviced systems (I and MH) and the NWPC (due to improved WUE) with an increase in total irrigated area to 86,823 ha. The final (weighted average) final cropping intensity (at full development) is 1.82.

70. With the increase in irrigated area in Phase 2 the irrigation water demand on the UEC supplied systems increases to nearly 1,200 MCM per annum of which 900 MCM will be transferred from the Mahaweli Ganga (it should be noted that the UEC is designed for an average annual duty of 974 MCM of which 70 MCM are assigned for drinking water supplies in the NCPCP) (in addition to 92 MCM within the command of the UEC).

71. Annual irrigation water supply in the NWPC remains at about 250 MCM[23] (but with the addition of 1,000 ha in Yapahuwa due to improved water management), and annual supply marginally declines in the MLBC to 327 MCM (from 352 MCM) of which 318 MCM will be supplied from Mahaweli diversions.

[23] This is anticipated to due to increases in irrigation efficiency and reduction in crop water demand due to changes in cropping patterns (shorter duration paddy, and increased in lower water demand cash crops)

Table 9: Phase 1 Projects – Developed with NCP

System	Cascade	Area (ha)	Cropping Intensity Maha	Yala	Annual	Duty (ha/mcm) Maha	Yala	Water Issues (MCM) Maha	Yala	MCM
Upper Elahera Canal										
IH	Nuwarawewa	1,052	1.00	0.96	1.96	123	73	9	14	22
	Nachchaduwa	3,335	1.00	0.80	1.80	118	57	28	47	75
	Tis'wa/Basa'ma	520	1.00	0.80	1.80	100	89	5	5	10
I	Manankattiya	1,107	1.00	0.80	1.80	117	74	9	12	21
	Eruwewa	132	1.00	0.80	1.80	128	70	1	2	3
	Mahakandarawa	4,025	1.00	0.80	1.80	113	73	36	44	80
MH	Huruluwewa	7,710	1.00	0.80	1.80	150	84	51	73	125
	Subtotal	**17,881**	**1.00**	**0.81**	**1.81**			**140**	**196**	**336**
NCP	Minor Tanks	33,000	1.00	0.80	1.80	119	84	277	314	592
	Major Tanks	14,500	1.00	0.80	1.80	127	84	114	138	252
	NCP Subtotal	**47,500**	**1.00**	**0.80**	**1.80**			**391**	**452**	**844**
	UEC Total	**65,381**	**1.00**	**0.80**	**1.80**			**531**	**649**	**1,180**
NWP	Stage I	6,505	1.00	0.80	1.80	100	80	65	65	130
	Stage II	5,987	1.00	0.80	1.80	100	80	60	60	120
	NWP Subtotal	12,492	**1.00**	**0.80**	**1.80**			125	125	250
E	Minipe LB	7,530	1.00	1.00	2.00	64	36	118	209	327
D1	Kaudulla	1,420	1.00	1.00	2.00	100	70	14	20	34
	Total	**86,823**	**1.00**	**0.82**	**1.82**	**85**	**63**	**774**	**983**	**1,756**

Source: PPTA Consultant based on Water Balance Study Report (MCB, 2013)

72. It should be noted that the total areas in the above tables differ from those for the entire Mahaweli Scheme (Annex 2) as they are confined to those systems directly benefiting from the WRDIP investments. While those systems listed above (IH, I, MH, NWPC, D1 Kadulla) and the future development of the NCPC all directly benefit from increase in water availability.

73. **Conclusions.** The main purpose of this report was to assess the reliability of water availability to meet the WRDIP requirements, and verify that these requirements would not impact on future development within the existing Mahaweli Scheme. As presented in the preceding sections, the planned scheme development, inclusive of the WRDIP, has been comprehensively assessed within the context of the existing scheme and proposed future developments. The outcome of this assessment confirms the reliability of water availability, within acceptable levels of supply reliability to meet the program requirements, and without impacting on other existing water uses and planned water resource development projects and uses within the Mahaweli Scheme.

ANNEX 1

WATER BALANCE MODEL RESULTS

1. The table below lists the relevant (to the WRDIP) results of the water balance model study. It presents the two scenarios for the without and with project cases (A2A and A10A respectively) for the Yala and Maha seasons.

System	Scheme		Yala			Maha			Yala			Maha	
	Model scenario		A2A			A2A			A10A			A10A	
	% exceedance	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%
	no. fail years	8	4	2	8	4	2	8	4	2	8	4	2
A	Allai		0			0			0			0	
B	System B	2	0	0		0			0			0	
C	System C		0			0		1	1	1		0	
D1	Minneriya		0			0			0			0	
D1	Giritale		0			0		1	1	1		0	
D1	Kaudulla	3	2	2	1	0	0		0			0	
D1	Kantale	1	0	0		0			0			0	
E	Minipe LB		0			0			0			0	
G	System G		0			0		1	1	0		0	
H	KalawewaRB	3	3	0		0		6	3	1		0	
H	DambuluOya		0			0			0			0	
H	Kandalama	6	3	1		0		2	2	0		0	
H	KHF		0			0		1	1	0		0	
I	Eruwewa		0			0			0			0	
I	Mahakandarawa	1	1	0		0		2	1	1		0	
I	Manankattiya		0			0			0			0	
IH	Nachchaduwa		0			0			0			0	
IH	Nuwarawewa		0			0			0			0	
IH	Tisawewa		0			0			0			0	
MH	Huruluwewa		0			0		1	1	0		0	
NCP	NCP2(major)								0			0	
NCP	NCP1(minor)							5	3	0	2	2	0
NWP	NWP(minor)							2	2	1	1	1	0
	Kalu Ganga	4	3	2	2	1	0		0			0	

Source: MCB, 2013

Notes:

- % exceedance = threshold of percent of seasons (for the 40 year modeled period); with 5% being 'irrigation failure', 10% being 'significant irrigation failure' and 15% being 'total irrigation failure'.
- No. fail year = the threshold number of years (over the 40 year period) for the above levels of exceedances.
- The number of seasons per system (modelled period) the above exceedance thresholds are exceeded.

ANNEX 2

MAHAWELI SCHEME SUMMARY - CURRENT AND DEVELOPMENT PHASES (2)

1. The tables (3) below present summaries of the areas, cropping intensities and issues for the without project and with project (Stages 1 and 2).

System Areas	CURRENT				
	Area	CI	Duty	Issue	MDP DVN
	ha		ha/MCM	MCM calc	MCM
Phase 1	32,823	1.35	80	679	408
Phase 2	70,576	0.62	86	436	0
Subtotal	**103,399**	**0.85**	**84**	**1,115**	**408**
Balance	129,105	1.88	77	3,364	2,833
Total	**232,504**	**1.42**	**80**	**4,326**	**3,241**

System Areas	PHASE 1				
	Area	CI	Duty	Issue	MDP DVN
	ha		ha/MCM	MCM calc	MCM
Phase 1	32,823	1.86	82	849	641
Phase 2	70,576	0.62	86	435	0
Subtotal	**103,399**	**1.01**	**85**	**1,255**	**641**
Balance	129,105	1.92	78	3,334	2,752
Total	**232,504**	**1.51**	**81**	**4,401**	**3,337**

System Areas	PHASE 2				
	Area	CI	Duty	Issue	MDP DVN
	ha		ha/MCM	MCM calc	MCM
Phase 1	32,823	1.86	85	802	1,345
Phase 2	70,576	1.82	98	1,343	0
Subtotal	**103,399**	**1.83**	**94**	**2,119**	**1,345**
Balance	129,105	1.93	84	3,144	3,002
Total	**232,504**	**1.89**	**89**	**5,064**	**4,294**

Notes:

- The System Areas by phase refers to the total area current and potentially under command of the phase works.
- Phase 1 refers to those systems directly under the command and benefiting from the WRDIP investment program, these include; NWPC, System E (Minipe Left Bank Canal), D1 Kaudulla and those under the command of the UEC canal including MH, IH and I.
- Phase 2 refers to the those systems under the command of the Phase 2 future investment and benefit from the pre-requisite Phase 1 investments, including NCPC (NCP major and NCP minor), System B Maduru Right Bank, D1 Kantale and extensions to the NWP, MH and I Systems.
- The 'Balance' are those system which do not directly benefit from the Phase 1 and 2 investment, that is no significant change in scheme water supply though cropping intensities improve through increased water use efficiency and paddy variety changes and planting dates.

2. The tables below (3) present details of the above by irrigation system.

Mahaweli Scheme Summary – Current

	Basin	CURRENT				
Anicut/OT	**Mahaweli Ganga**	**Area**	**CI**	**Duty**	**Issue**	**MDP DVN**
System	**Cascade**	**ha**		**ha/MCM**	**MCM calc**	**MCM**
Minipe	E	7,530	1.95	44	336	347
	C	22,800	1.88	63	678	1,062
	B-LEFT BANK	18,500	1.78	57	582	
	B-RIGHT BANK	10,000	0.00			
	A	7,050	2.00	50	282	
	Sub Total	**65,880**			**1,878**	**1,409**
Anicut/OT	**Amban Ganga**	**Area**	**CI**	**Duty**	**Issue**	**MDP DVN**
Nalanda	NWP-1	11,492	1.11	90	153	0
	NWP-2	1,000	1.00	90	11	
Bowatenna	H	32,180	1.85	88	678	725
	HFC	2,365	1.92	47	97	
Kaula Ganga	F	3,000	2.00	72	83	
Elahera	M/H-1	4,210	1.53	102	63	61
	M/H-2	3,500	1.00	100	35	
	I/H	4,907	1.68	72	114	
	I-1	3,264	0.70	100	23	
	I-2	2,000	0.70	100	14	
	NCP1(Minor)	33,000	0.70	100	231	
	NCP2(Major)	14,500	1.00	100	145	
EMYE	D1	26,520	1.91	103	492	705
	D1 Kaudulla	1,420	0.00	100	0	
	D1-KANTALE	6,576	0.00	100	0	
	G	6,210	1.85	57	202	
Angamedilla	D2	10,480	1.99	77	271	341
	Sub Total	**166,624**			**2,612**	**1,832**
	DRINKING WATER				**0**	**0**
	TOTAL	**232,504**			**4,490**	**3,241**

Notes:

- Without Project: current scheme areas, ie. for which water is currently supplied from the Mahaweli Basin plus future areas
- With Project Phase 1; the scheme with development of the KMTC and UEC
- With Project Phase 2; the scheme with the development of the NPCPC and Maduru Right Bank Canal
- Anicut/OT; the systems are organised hydraulically upstream to downstream, by Anicut or offtake location
- Area; areas as per the Water Balance Study (Oct 2013)
- CI: annual cropping intensity per annum, as per the Water Balance Study
- Duty; average duty per season (Maha and Yala) expressed as irrigated area per MCM
- Issue; calculated gross irrigation demand (as issued from the tank) as MCM per annum
- MDP DVN; Diversion from the Mahaweli basin, including Amban Ganga as per Water Balance model scenario results and drinking water diversions are inclusive in diversions to transfer canals.

Mahaweli Scheme Summary – Phase 1

	Basin	PHASE I				
Anicut/OT	**Mahaweli Ganga**	**Area**	**CI**	**Duty**	**Issue**	**MDP DVN**
System	**Cascade**	**ha**		**ha/MCM**	**MCM calc**	**MCM**
Minipe	E	7,530	2.00	43	350	349
	C	22,800	2.00	65	702	1,062
	B-LEFT BANK	18,500	1.80	62	537	
	B-RIGHT BANK	10,000	0.00			
	A	7,050	2.00	50	282	
	Sub Total	**65,880**			**1,871**	**1,411**
Anicut/OT	**Amban Ganga**	**Area**	**CI**	**Duty**	**Issue**	**MDP DVN**
Nalanda	NWP-1	11,492	1.80	100	207	56
	NWP-2	1,000	1.00	100	10	
Bowatenna	H	32,180	1.86	88	680	644
	HFC	2,365	1.92	53	86	
Kaula Ganga	F	3,000	2.00	75	80	
Elahera	M/H-1	4,210	1.80	101	75	236
	M/H-2	3,500	1.00	100	35	
	I/H	4,907	1.83	76	118	
	I-1	3,264	1.80	84	70	
	I-2	2,000	0.70	100	14	
	NCP1(Minor)	33,000	0.70	100	231	
	NCP2(Major)	14,500	1.00	100	145	
EMYE	D1	26,520	1.91	103	492	718
	D1 Kaudulla	1,420	2.00	100	28	
	D1-KANTALE	6,576	0.00	100	0	
	G	6,210	2.00	60	207	
Angamedilla	D2	10,480	2.00	78	269	328
	Sub Total	**166,624**			**2,747**	**1,982**
	DRINKING WATER				**92**	
	TOTAL	**232,504**			**4,710**	**3,393**

Notes as above

Mahaweli Scheme Summary – Phase 2

	Basin	PHASE 2				
Anicut/OT	**Mahaweli Ganga**	**Area**	**CI**	**Duty**	**Issue**	**MDP DVN**
System	**Cascade**	**ha**		**ha/MCM**	**MCM calc**	**MCM**
Minipe	E	7,530	2.00	46	327	318
	C	22,800	2.00	66	691	1,239
	B-LEFT BANK	18,500	1.80	66	505	
	B-RIGHT BANK	10,000	1.80	66	273	
	A	7,050	2.00	55	256	
	Sub Total	**65,880**			**2,052**	1,557
Anicut/OT	**Amban Ganga**	**Area**	**CI**	**Duty**	**Issue**	**MDP DVN**
Nalanda	NWP-1	11,492	1.80	99	209	53
	NWP-2	1,000	1.80	99	18	
Bowatenna	H	32,180	1.86	97	617	658
	HFC	2,365	1.92	53	86	
Kaula Ganga	F	3,000	2.00	83	72	
Elahera	M/H-1	4,210	1.80	111	68	974
	M/H-2	3,500	1.80	111	57	
	I/H	4,907	1.83	84	107	
	I-1	3,264	1.80	92	64	
	I-2	2,000	1.80	92	39	
	NCP1(Minor)	33,000	1.80	101	588	
	NCP2(Major)	14,500	1.80	104	251	
EMYE	D1	26,520	2.00	112	474	799
	D1 Kaudulla	1,420	2.00	100	28	
	D1-KANTALE	6,576	2.00	112	117	
	G	6,210	2.00	62	200	
Angamedilla	D2	10,480	2.00	86	244	306
	Sub Total	**166,624**			**3,240**	2,790
	DRINKING WATER SUPPLY				**162**	
	TOTAL	**232,504**			**5,454**	**4,347**

Notes as above

ANNEX 3

WATER BALANCE STUDY OF THE NORTH CENTRAL PROVINCE CANAL PROJECT

Appendix 1

A 1 – Water Balance Study Report

A 2 – Data Analysis of Water Balance Study

A 1 – Water Balance Study Report

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LIST OF ABBREVIATIONS

AIDM	ACRE's Irrigation Demand Model
ARSP	ACRE's Reservoir Simulation Program
ASD	Agrarian Services Department
AYE	Angamedilla Yoda Ela
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CECB	Central Engineering Consultancy Bureau
CI	Cropping Intensity
cumec	cubic meters per second
cu. m/sec	cubic meters per second
DDCs	District Development Councils
EMYE	Elahera - Minneriya - Yoda Ela
FAO	Food & AgriculturalOrganization
FSL	Full Supply Level
GOSL	Government of Sri Lanka
GOJ	Government of Japan
GWH	Gigd Watt Hour
ha	hectare
HCP	Hydrological Crash Program
ID	Irrigation Department
JICA	Japan International Corporation Agency
Km	Kilometers
KRB	Kalawewa Right Bank
LB	Left Bank
m	meters
MASL	Mahaweli Authority of Sri Lanka
MCB	Mahaweli Consultancy Bureau (Pvt) Ltd.
MCM	Million Cubic Meters
MI&WRM	Ministry of Irrigation & Water Resources Management
MKYE	Minneriya - Kantale Yoda Ela
MOL	Minimum Operating Level
MRR	Monthly Review Reports
MRRP	Mahaweli Restructuring & Rehabilitation Project
msl	mean sea level
NCP	North Central Province
NP	Northern Province
NWDZ	North-Western-Dry Zone
NWP	North Western Province
NWS&DB	National Water Supply & Drainage Board
RB	Right Bank
R-K Canal	Randenigala - Kau Ganga Canal
SEDZ	South-East-Dry Zone
SOPs	Seasonal Operation Plans
SSRs	Seasonal Summary Reports
TDS	Trans-Basin Diversion Study
TECs	Technical Evaluation Committees
TOR	Terms of Reference
UEC	Upper Elahera Canal
UNDP	United Nation Development Programme
"With Project"	NCP Canal Project
WMS	Water Management Secretariat

Mahaweli Irrigation System Description

Irrigation System	Irrigation Schemes
C	System C under, Minipe RB Canal
B	Maduru Oya LB, Maduru Oya RB
D1	Minneriya,Giritale, Kaudulla, Kantale
D2	Parakrama Samudraya
G	Elehera
H	Kalawewa, Dambulu Oya, Kandalama
I	Malwathu Oya
I/H	Nachchaduwa, Nuwarawewa,Tisawewa
J	Parangi Aru
K	Kanagarayan Aru
L	Ma Oya
M	Yan Oya
M/H	Huruluwewa
KHFC	Kandalama - Huruluwewa Feeder Canal

1. INTRODUCTION

1.1 Background of the Project

The Mahaweli Authority of Sri Lanka with Ministry of Irrigation and Water Resources Management has carried out a Pre-feasibility study in 2011 to revive NCP Canal Project of Mahaweli Development Program as a solution to scarcity of Irrigation and Drinking water in North Western Province, North Central Province and North Province. At the commencement of the detailed design phase of Moragahakanda and Kalu Ganga projects by two consultancy groups in mid-2012, the NCP consultants have proposed the modifications necessary to the related infrastructures of these two projects based on the results of the Pre-Feasibility Study of 2011. The integration of NCP canal Project with Moragahakanda and Kalu Ganga projects completes the final Stage of Mahaweli Development Program.

The proposed Moragahakanda multipurpose project is by far the most important and integral part of the overall Mahaweli Development Programme. Once constructed, it will regulate and store most of unregulated water in Amban Ganga at present and thereby secure the overall cropping intensity of the existing irrigation systems within and adjacent river basins to above 190% level. Linking the Kalu Ganga reservoir project to Moragahakanda reservoir will raise cropping intensities of Mannakkattiya and Mahakandarawa system also to the same level while securing the domestic and industrial water supply requirements of Matale, Anuradhapura, Polonnaruwa and Trincomalee districts. All the displaced families totalling to about 1,400 under these two projects either will get compensation or new irrigable and homestead area under proposed Kalu Ganga Irrigation system (system F : 3,000 ha) and Kaudulla (system D1 : 1,440 ha). In addition, these two reservoir projects will create a good platform for handling any further diversion plans from Mahaweli Ganga to potential agricultural development areas in the North Central and North-Western Dry Zones/River Basins (NCP and NWP) through regulation and storage.
Therefore the objectives of the present study are to,

i. Assess the water availability at major control points in Mahaweli and Amban Ganga systems and quantify the excess water availability for diversion,

ii. Review and update the water balance study carried out under the prefeasibility level,

iii. Formulate overall agricultural development plan for diverting Mahaweli water for irrigation development in Maduru Oya Right Bank area and existing areas in water scarce Amban Ganga and its adjacent basins, and

iv. Prioritize the irrigation projects and proper implementation plan for the same.

The studies and surveys were carried out mainly to identify the potential demand areas in the North Central Province (NCP) and North Western Province (NWP), the conveyance routes to these areas from Amban Ganga system and main Trans- Basin diversion routes from Mahaweli Ganga to Amban Ganga system together with all the infrastructures connected with the diversion plan. The most appropriate diversion routes identified under prefeasibility level were; Randenigala - Kalu Ganga by gravity and Kalinga Nuwara - Angamedilla - Minneriya - NCP canal by pumps. All adverse effects due to these diversions were well looked in to by maintaining following requirement in the water balance study.

a. High water levels in the major reservoirs in the main Mahaweli and adjacent river systems,

b. Mandatory downstream releases to the main rivers at main diversion points,

c. Maintenance of total hydropower generation in Mahaweli system through introduction of new hydropower development, and

d. Water rights of existing Mahaweli water users through introduction of water allocation policy under both wet and dry hydrologic situations,

Hence, as per the TOR agreed upon by the MCB Consultants and the MASL together with the MI&WRM this study is conducted in formulating an overall development plan to make most efficient use of water resources in the Mahaweli Ganga and its tributaries as well as local inflows to the proposed agricultural development areas.

1.2 Works Performed

In accordance with the scope of work agreed upon between MASL together with MI&WRM and the MCB, during the first four months period of this study Consultants did a water balance study using the updated hydrologic time series by the Water Management Secretariat (WMS) of the MASL. Formulation of an overall agricultural development plan has been prepared, diversion policies and water allocation policies are established and all measures necessary to ensure safe diversion while ensuring the rights of all the beneficiaries of the river system.

As a continuation of work carried out during the prefeasibility of NCP Canal Study a careful consideration has been given to the various comments made by the concerned authorities namely, the MASL, ID, CEA, CEB, NWS&DB, Forest & Wild Life Departments, DDCs, and TECs on the overall development plan, water allocation policies and water availability assessment in the Mahaweli and its tributaries. Therefore all necessary steps were taken in the water balance study presented in this Final Report to include the various opinions made by concerned parties within the limits as given in the TOR.

1.3 Previous Studies

The studies carried out for the Government of Sri Lanka in 1980-84 on Trans-Basin Diversion Study (TDS) by Electrowatt and Zulsguittar, covered the potential irrigable areas in South-East-Dry Zone (SEDZ), North-Western-Dry Zone (NWDZ) and North-Central-River Basin of Sri Lanka. When the possible diversion routes were studied and compared it was concluded that development of about 40,000 ha in SEDZ was given the highest priority, followed by NWP, and then the NCP. The reason for giving lowest priority for the NCRB was due to the high capital costs and high O&M costs involved in pumping.

As a continuation of the above study a second Trans-Basin Diversion Study (TDS) was conducted by the same consultants (Electrowatt and Zulsgittar) together with the staff of the Water Management Secretariat of MASL in 1985/86, mainly to analyze the options for the diversion of water from the Mahaweli Ganga to the Amban Ganga basin to serve the potential irrigable areas in system D1 and the NWDZ. Various options were analyzed using ACREs Reservoir Simulation Program (ARSP) adopting the availability of Kalu Ganga and Moragahakanda reservoirs separately and in combination for different reservoir sizes together with a second Bowatenna tunnel. The results of this study proved it could serve an area of about 14,000 ha to 17,000 ha in system D1 and NWDZ could be served by increasing the Polgolla diversion to 955 MCM and diverting Kalu Ganga water to Elahera through the construction of 250 MCM of capacity reservoir at Hattota Amuna on Kalu Ganga.

The Central Engineering Consultancy Bureau (CECB) has also done a feasibility study in 2003 for MASL, to supply irrigation water to Mee Oya and Deduru Oya basins through a second Bowatenna tunnel to divert 80 to 100 MCM of Mahaweli water to proposed Wemedilla reservoir across Welimitiya Oya.

In 1986, at the request of Government of Sri Lanka (GOSL) the Government of Japan (GOJ) had made arrangements to conduct updating of feasibility report on Moragahakanda Agricultural Development Project which was originally prepared in 1979 (Phase I) and to formulate overall agricultural development plan in the Amban Ganga basin, NCP and NWP as an Extension of the Moragahakanda Agricultural Development Project, Master Plan (Phase II). They have proposed to develop 161,600 ha of land in Kalu Ganga basin (system F), Kala Oya basin (H), Yan Oya basin (System MH, M) and Malwatu Oya (System IH, I) through the construction of Kalu Ganga reservoir, the NCP canal (Kalu Ganga to Huruluwewa, Huruluwewa to Mahakandarawa and Mahakandarawa to proposed Tammennewa reservoir. Out of the many alternative trans-basin diversions plans examined the one recommended consisted of extension of Minipe LB carrying 1,487 MCM annually to Minneriya from where pumping 761 MCM to the NCP canal. This option involved minimum energy consumption in pumping with maximum benefits from agriculture.

2. THE MAHAWELI DEVELOPMENT

2.1 The Water Resource

The rainfall pattern of Sri Lanka are dominated by two monsoons-the South-West monsoon (May to September) and the North-East monsoon (November to February). The strong orographic influence of the central hills together with the associated air movement patterns in two seasons, produce three hydrologic regions or zones, namely Wet Zone, Intermediate Zone and Dry Zone (see **Figure 2.1)**. In the Wet Zone substantial rainfall is experienced during both monsoon periods, and average annual rainfall ranges between 2,000 and 5,000 mm. In the Dry Zone, rainfall occurs during the North-East monsoon period (the 'Maha season'), while the South-East monsoon period (the 'Yala season') is dry; the average annual rainfall in the Dry Zone ranges between 1,000 to 2,000 mm. The **Figure 2.1** also shows typical Wet Zone and Dry Zone rainfall patterns.

The Mahaweli Ganga is the most important river in Sri Lanka from the point of view of irrigation, water supply and hydroelectric energy generation. This river originates from the western portion of the central hills, and hence the upper reaches receive substantial rainfall during both monsoon seasons. The lower portion of the Mahaweli basin, downstream from Kandy, is in the rain shadow of the central hills during the South-West monsoon period (Yala season). The Amban Ganga, a tributary within the Mahaweli Ganga basin, directly feeds irrigation development to the North of the Main River. This river is also important in the context of limited hydroelectric energy generation en-route.

Two other major rivers that rise in central Sri Lanka, namely Kelani and Kalu Ganga are important in the context of hydropower only. The last of major rivers rises from the central hills is the Walawe Ganga, which is also important in the context of both hydropower and irrigation. The Kelani and Kalu Ganga flow to the western direction of the island while the Walawe Ganga flows to the south. The Mahaweli is the only perennial river flowing to the North while some others flow to the south in addition to the above three rivers.

2.2 Mahaweli System

The Mahaweli Ganga Development project consists of several multipurpose projects constructed on the Mahaweli Ganga and Amban Ganga together with irrigation projects served by diversions from the principal rivers. In addition, there are several drinking water supply projects constructed along the rivers to serve the drinking water requirements of surrounding urban areas. Polgolla and Bowatenna projects are two such multipurpose projects came into operation in mid-seventies under Mahaweli Development Programme (MDP). Kotmale, Victoria, Randenigala, and Rantembe are four such multipurpose projects came in to operation in eighties under Accelerated Mahaweli Development Programme (AMDP), and the New Minipe Anicut came in to operation during same period under AMDP with a diversion weir built just downstream of existing old Minipe Anicut to feed new irrigation systems of B and C in addition to the existing system E. The principal features of the Mahaweli system hydropower projects are summarized in **Table 2.1** and system characteristics are summarized in **Figure 2.2.** The latest addition to Mahaweli system is the Upper Kotmale hydropower project of installed capacity of 150 MW. Since this is a run-of-the-river hydropower plant having no impact on existing generation pattern or diversions over rest of the system, this project is not considered under present study.

Figure 2-1: Hydrological Regions of Sri Lanka

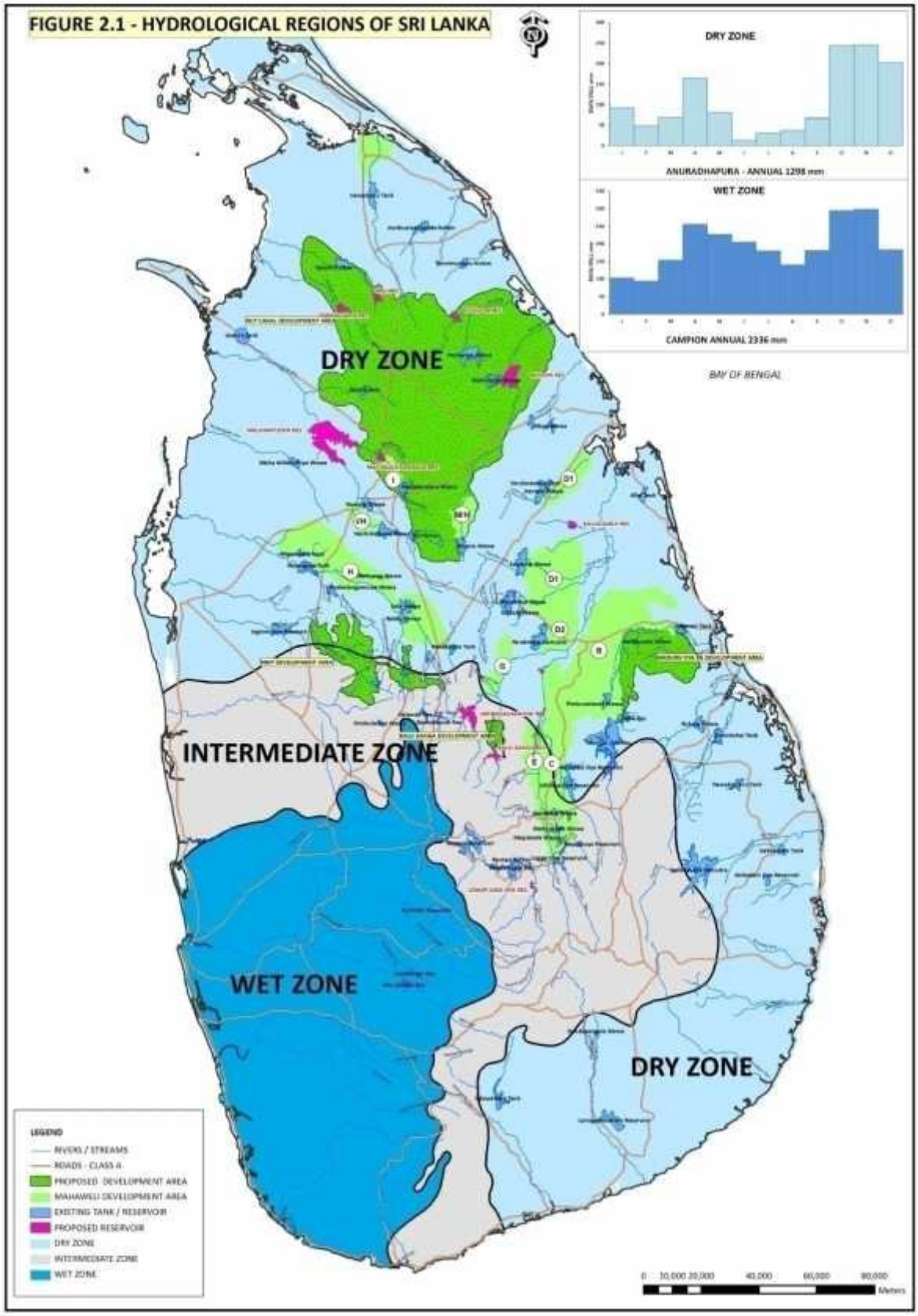


Figure 2-2: Mahaweli System Characteristics

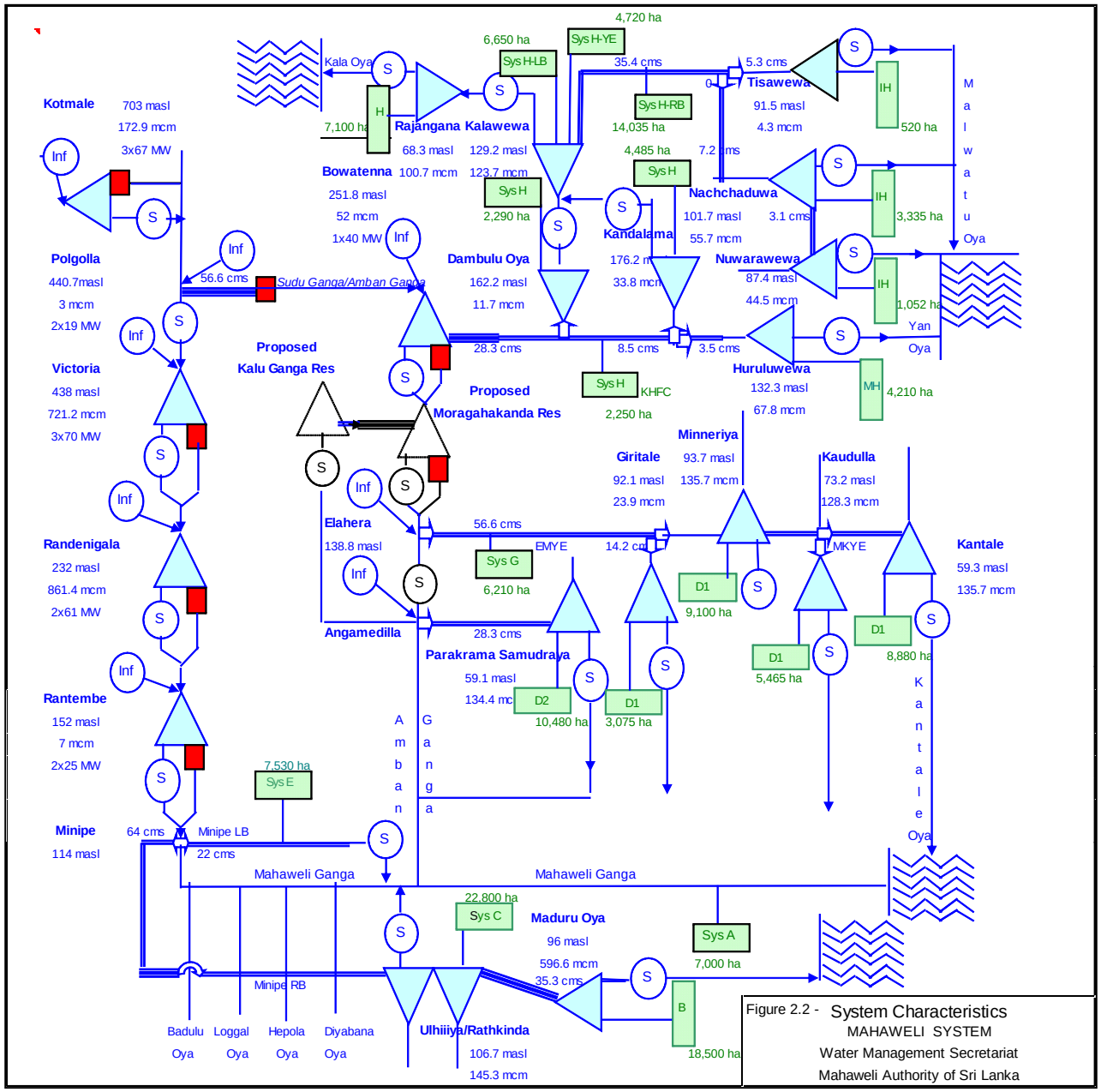


Table 2-1: Principal Features of Mahaweli System

Reservoir	Installed Capacity (MW)	Firm Energy* (GW.h/yr)	Rated Head (m)	Total Storage (MCM)
Kotmale	134	270	201	173
Ukuwela	40	164	78	4
Victoria	210	446	190	721
Randenigala	126	304	78	861
Rantembe	49	174	31.5	7
Bowatenna	40	49	55	52
Total	**599**	**1407**		**1819**

* Based on the results of Mahaweli Water Resources Management Project – 1986
(The install capacity of Kotmale power plant was 2x67 MW according to initial design)

The most important cascade from the view point of hydropower generation is the Victoria - Randenigala - Rantembe in which the generating head is 299.5 m, serving irrigation systems of A, B, C and E. The generating head for partial Amban Ganga route up to Bowatenna is 75 m feeding the irrigation systems of H, IH and MH. The generating head of full Amban Ganga route is 128 m serving irrigation systems of D1, D2 and G. The present diversion policy of 875 MCM annually at Polgolla as recommended by NEDECO consultants in 1978 in their Implementation Strategy for AMDP has been confirmed by ACRE Int. Ltd in their Water Resources Management Project done in 1986. Therefore, increasing the Polgolla diversion not only brings environmental and ecological imbalance in to the system but also not economically viable due to substantial reduction of hydropower generation.

There are number of proposed hydropower projects in the Mahaweli complex. The Victoria expansion project to increase its generation capacity of 3 x 70 MW by another 3 x 70 MW is the most important one from the view point of converting Victoria plant in to a peaking power plant. The other promising project is the raising of Kotmale dam crest from elevation 706.5 m to 735.0 m asl thereby increasing the present energy output of 426 GWh by 20% through existing power plants of 3 x 67 MW. Both these projects were not considered in the present study. In the case of Victoria expansion there is no increase in hydroelectric energy generation. The Kotmale raising has an advantage in increasing the Polgolla diversion above 875 MCM annually for getting more regulated supply of diversion at Polgolla, but not considered in the present study since increased Polgolla diversion has adverse effects on environment downstream of Polgolla especially in connection with high Victoria and high Randenigala option adopted at the implementation Stage of AMDP. In addition, the gain at Kotmale is a loss to the Upper Kotmale generation since the tail water of the latter is the same as present FSL of the former. Therefore, Kotmale expansion is also not considered in this study since, the temporary increase of Polgolla diversion by 400 MCM could be implemented even without Kotmale raising using Moragahakanda as the regulatory reservoir. The Moragolla hydropower project (27 MW) is the next project in the feasibility Stage which is not considered under this study since it is going to be a run-of-the-river hydropower plant having no impact on existing energy generation or diversion patterns on existing system.

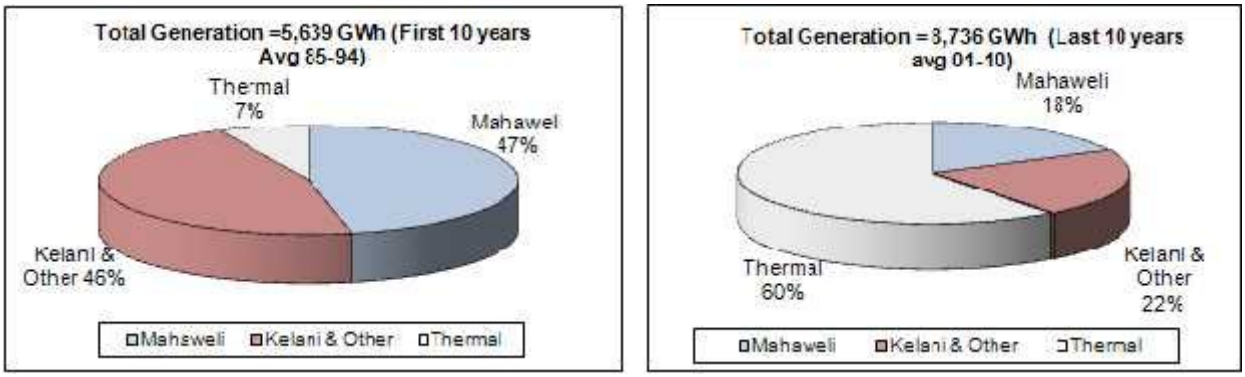
Table 2-2: Existing Hydro Power Plants

Hydro Plant	Installed Capacity			Energy Generation GWh/Year	
	Capacity MW	No. of Units	Total MW	Average Historic	Long Term Expected
Kelani System:					
Canyon	30	2	60	153	178
New Laxapana	50	2	100	520	515
Polpitiya	37.5	2	75	422	466
Wimalasurendra	25	2	50	114	120
Old Laxapana	8.33	3	25	280	293
	12.5	2	25		
Sub Total			**335**	**1,488**	**1,572**
Mahaweli System					
Kotmale	67	3	201	426	502
Ukuwela	19	2	38	166	164
Victoria	70	3	210	684	886
Randenigala	61	2	122	319	494
Rantembe	24.5	2	49	171	246
Bowatenna	40	1	40	57	64
Sub Total			**660**	**1,824**	**2,356**
Walawe System					
Samanalawewa	60	2	**120**	**298**	**421**
Kalu Ganga System					
Kukule	35	2	**70**	**327**	**317**
Small Hydro					
Inginiyagala	2.475	2	5	33	#N/A
	3.15	2	6		
Udawalawe	2	3	6	5	15
Nilambe	1.6	2	3	9	#N/A
Sub Total			**20**	**48**	**60**
Total			**1,205**	**3,985**	**4,726**

Note : Historic averages are computed for the period 2006 - 2010

The other hydropower generating systems are Kehelgamu - Maskeli Oya system in Kelani Ganga basin (335 MW), Kukule in Kalu Ganga basin (70 MW) and Samanalawewa in Walawe basin (120 MW). For summary of existing hydropower plants, their generation and basic parameters see **Table 2.2**. Unlike in past hydropower contribution as a percentage has dropped tremendously in meeting the National Energy Demand at present. In the early Stage of AMDP (first 10 years) the Mahaweli system occupied 47% of total generation (3,187 GWh), while last ten years contribution was only 18% of total generation (8,736 GWh). The giant combined-cycle and coal power plants supply majority of total energy and power demand today. This comparison of 10 year total energy generation in 1985-94 period and 2001-10 periods are shown in **Figure 2.3**

Figure 2-3: Comparison of Total Energy Generation Durations 1985 - 94 and 2001 - 10



According to CEB's "National Energy Policy" (2008) document the "Energy Policy Elements" are given as, providing electricity for lowest possible fee, ensuring energy security, consideration of system security and environmental impacts etc., it is very clear that they would prefer to use cheapest hydropower for peaking purposes and coal power plant as base load plants. This is the best option available for the next 2 or three decades. In this connection this study will give topmost priority in meeting this target. The proposed modifications to the Minipe weir for CEB to run even Rantembe as a peaking plant is a step taken in this regards.

2.3 Mahaweli Irrigation Systems

The Mahaweli Water Resources System supplies water to number of irrigation areas in the Dry Zone of Sri Lanka. The locations of most of these irrigation areas and diversion locations are shown in **Figure 2.1** and alphabetical letters designate these irrigation systems. The principal features of existing Irrigation systems of A, B, C, D1, D2, E, G, H, IH and MH are shown in **Table 2.3** and system characteristics are shown schematically in **Figure 2.2**.

There is new irrigation developments proposed under Kalu Ganga and Moragahakanda Projects, namely systems F and extension of Left Bank branch channel of Kaudulla scheme in system D1, and existing areas under Mahakandarawa, Eruwewa and Mannakkattiya in system I. These areas are shown in **Figure 2.1**. The potential irrigation areas considered under this project are Maduru Oya RB in system B, Kantale sugar cane area in system D1, existing irrigation cascade systems under NCP and NWP. The study area is briefly described in the following section.

Table 2-3: Principal Features of Irrigation Area

Irrigation System	River Basin	Principal Reservoir	Active Storage (MCM)	Net Irrigated Area (ha)
System A	Mahaweli			7,050
System B	Maduru Oya	Maduru Oya	478	18,500
System C	Mahaweli	Ulhitiya Oya	98	22,800
System D1	Amban Ganga	Minneriya	136	9,100
		Giritale	23	3,075
		Kaudulla	114	5,465
		Kantale	133	8,880
Subtotal System D1			*406*	*26,520*
System D2	Amban Ganga	Parakrama Samudra	116	10,480
System E	Mahaweli Ganga			7,530
System G	Amban Ganga			6,210
System H, IH, MH	Amban Ganga	Dambulu Oya (H)	9	2,290
		Kandalama (H)	32	4,485
		Huruluwewa (MH)	65	4,210
		Kandalama-Huruluwewa Canal Scheme(H)		2,250
		Kalawewa (H)	123	25,405
		Nachchaduwa (IH)	56	3,335
		Nuwarawewa (IH)	45	1,052
		Tisawewa (IH)	3.3	520
		Rajangana (H)	94	7,100
Subtotal System H			*427*	*50,647*
Total			*1,525*	*149,737*

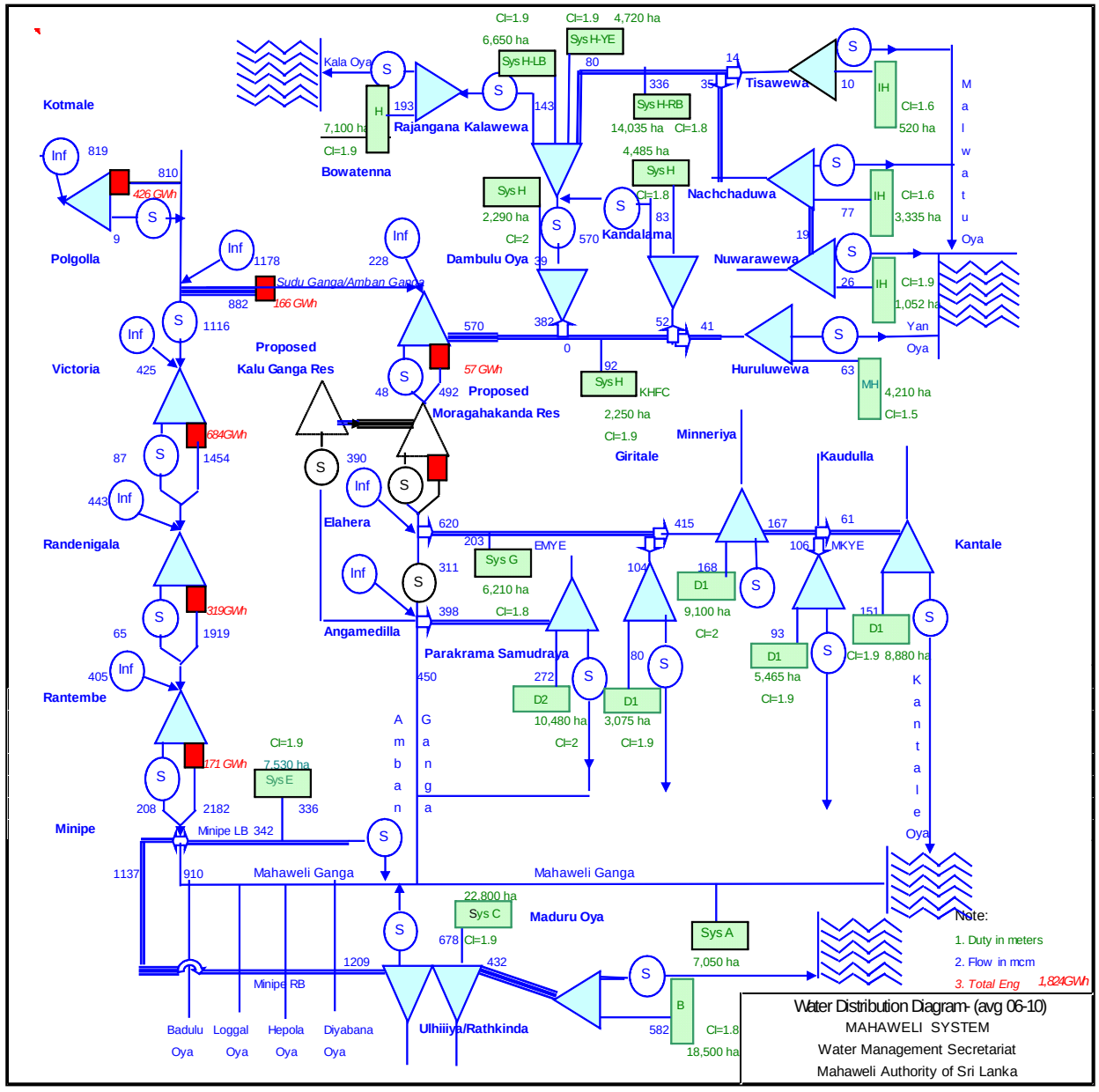
Source: WMS data

2.3.1 Existing Irrigation Systems and Potential Areas

The existing Mahaweli Water Resources system and its performance with respect to diversions, power flows, spill flows, energy generations, and extents cultivated, sluice issues and cropping intensities of individual schemes during last five year period is shown schematically in **Figure 2.4**. The unutilized average annual flow at Elahera and Minipe are 311 MCM and 910 MCM respectively as per last 5 - year average annual figures. It is also estimated that about 600 - 700 MCM would have been spilling during the same time at Angamedilla. The proposed Moragahakanda reservoir intends capturing 80-85% of the former while the Kalu Ganga reservoir will capture about 200 mcm of spillage at Angamedilla. The intention of proposed Randenigala - Kalu Ganga Transfer Canal Project is to divert part of this spill at Minipe after allocating for the committed diversions from Mahaweli to Maduru Oya RB at Minipe and to Kirindi Oya at Upper Uma Oya (about 150 MCM annually).

The **Table 2.4** gives the system wise water usage, extents cultivated and the cropping intensities. The overall average annual water usage of Amban Ganga system is 84 ha/MCM while that of main Mahaweli is 56 ha/MCM. Therefore the performance of Amban Ganga system is commendable. If not for the poor

Figure 2-4: Water Distribution Diagram (Avg 2006-2010)



hydrologic situation prevailed in the upper reach of Mahaweli River in last Yala 2009 the irrigation systems in main Mahaweli were doing double cropping during the recent past.

Table 2-4: Existing Irrigation Systems (5-Year Period 2005/06 to 2010/11)

Mahaweli System	Irrigable Area (ha)	Average Annual Water Issue (MCM)	Average Annual Water Duty (ha/MCM)	Cropping Intensity
Amban Ganga System				
H	32,180	681	88	1.85
I/H	4,907	113	72	1.67
M/H	4,210	63	102	1.53
D1	26,520	493	103	1.91
D2	10,480	272	77	1.99
G	6,210	203	57	1.85
HFC	2,250	92	47	1.92
Sub Total	86,757	1,918	84	1.86
Mahaweli Ganga System				
E	7,530	336	44	1.95
C	22,800	678	63	1.88
B	18,500	582	57	1.78
A**	7,050	285	50	2.00
Sub Total	55,880	1,881	56	1.87
** - assumed values			Source: WMS,ID	

i. System E

The Minipe LB canal having a total length of over 74 km gets irrigation water for 7,530 ha of irrigation area mainly from Mahaweli River with some augmentation from Hasalaka Oya and Heen Ganga at present. The annual average diversion to scheme at Minipe is around 330 MCM. There are number of constraints for the smooth operation of this scheme such as the limited regulatory capacity of Minipe pool, the location of LB sluice sill is being 0.7 m higher than that of the RB sill, flow availability for diversion is limited to 20 hrs due to generation limitation at Rantembe from 1200 mid night to 0400 hr daily. Also, during the rainy season all the streams entering in to this single banking canal bring heavy loads of silts and during dry season growing of water weeds resulting reduced carrying capacity are the other main operational problems associated with the canal.

The Ceylon Electricity Board (CEB) prefers to use hydropower generation in Mahaweli system especially for peaking purposes with the availability of more coal power stations in the future. In addition the proposed Upper Uma Oya diversion to Kirindi Oya and proposed Randenigala Diversion to Kalu Ganga as per this project also limits flow availability at Minipe by about 700 MCM annually. Therefore, this project proposes operating Rantambe one power plant for a reduced number of hours and peaking with both machines for maximum of 4 Hrs daily to release equivalent volume instead of operating one machine for 16 hrs and both machines for 4 hr peaking daily as practiced today. This project proposes to raise Minipe Anicut by 4 m to regulate and store power flows during 4-hour

peaking period with both machines at Rantambe are in operation, in order to release a continuous flow to LB, RB by minimizing the downstream release. In addition, the proposed Hasalaka Oya and Heen Ganga reservoirs will also augment this canal to avoid any irrigation deficiency especially during the Yala cultivation season. About 10 km stretch of Stage IV of LB will be lined to avoid reduced water flow due to weed growth. In addition, the existing structures and the entire canal will be rehabilitated to achieve better regulation and distribution of water "With Project".

ii. System C

System C comprises of about 22,800 ha of farmland, irrigated from the water diverted through the 31 km long Minipe RB trans-basin canal via Ulhitiya - Rathkinda reservoir complex and three main canals. The RB trans-basin canal which is a concrete lined canal of discharge capacity 64 cumec crosses Loggal Oya, Hepolo Oya and Diyabana Oya as level crossings and Badulu Oya through an aqueduct. In the simulation study it is assumed that these streams do not contribute to Minipe RB Canal but join the Mahaweli River to satisfy the environmental flows down stream of Minipe Anicut.

There are irrigation water issues from Minipe RB to three ancient irrigation schemes, namely Sorabora, Mapakada and Diyabana on its way to Ulhitiya. At present, due to excess water availability in Mahaweli system water usage has been high in system C. Nevertheless, on comparison water usage in system C is much better than the Minipe LB scheme. This is mainly due to lack of a regulatory reservoir in system E compare to 145 MCM regulatory capacity at Ulhitiya / Rathkinda reservoirs in system C. For key parameters and their locations refer **Figure 2.2**. It is proposed to improve water-use efficiency of this system from 63 ha/MCM at present to 66 ha/MCM through formulation of a project based on the experience gained from the MRRP.

iii. System B

Maduru Oya reservoir originally built to accommodate 775 MCM at a Full Supply Level of 98 m asl is now being operating at 96 m asl with a partly built spillway wall at storage capacity of 597 MCM. The catchment inflow of about 300 MCM is augmented from Mahaweli water diverted at Minipe through RB trans-basin canal via Ulhitiya - Rathkinda reservoirs and finally through the Maduru Oya link tunnel of discharge capacity 35 cu. m/sec. Due to the excessive water availability the CI has been always 200% with an improving water use efficiency of 48 ha/MCM in year 2000 to 57 ha/MCM in 2010 (5 year-moving average). This is somewhat better performance compared to system E for the same period but much lower than that of system C. For details of water use efficiencies of systems E, C and B see **Figure 2.6.** The 2,100 ha of cultivated extent in 1985 has increased to 16,780 ha in 2008 and suddenly to 18,500 ha in 2010 with the mass exodus of migrants from war threatened areas in the North after the disturbances.

According to the original proposal, an area of 14,000 ha has to be developed under the RB canal of Maduru Oya reservoir with the settlement of some 18,200 families. Nevertheless, only the NDK dam and the first stretch of the RB main canal (6.5 km) had been constructed in 1984. This water balance study considers the development of system B, RB area as a potential irrigable area to be fed from diversion at Minipe. After allowing for the already declared forest reserves of Nelugala and Baron's Cap areas the irrigable area has reduced to 10,000 ha as per today. Nevertheless, the Maduru Oya Spillway has to be constructed to its original level to store about 50 MCM of spill water during the rainy period and additional diversion of about 210 MCM from Ulhitiya/Rathkinda during the Maha season. At present the inflows to NDK reservoir is released for cultivation of Vakaneri scheme during

the Yala season. But once RB extent is become fully operational the drainage water from both LB and RB will be sufficient for augmenting this scheme.

The average annual diversion of about 430 MCM is more than sufficient to irrigate its previous extent of 16,780 ha of land lying on LB side of the Maduru Oya as at 2008. Now that the above extent on LB has increased to 18,500 ha and with new developments of 10,000 ha proposed under Maduru Oya RB, the diversion to Maduru Oya has to be increased by at least 360 MCM per annum to achieve 180% cropping intensity at present efficiency of water usage. Therefore, it is proposed to improve water-use efficiency of this system from 57 ha/MCM at present to 62 ha/MCM in Maduru Oya LB and to 60 ha/MCM on average in entire system through formulation of a water management improvement project based on the experience gained from the MRRP. Further improvement to the water use efficiency will result raising overall CI in system B to even 200%.

iv. System A

Allai scheme is formed by the retention of flow in Mavil Aru and Verugal river – both branches of Mahaweli Ganga, by means of the Mavil Aru Anicut, Verugal Aru Anicut and the flood bund at Verugal. Since the flow in Mahaweli is perennial, the small detention is more than sufficient with continuous overflow at this location for Allai Scheme. Nevertheless, there were few occasions in which augmentation from extra releases from Minipe was required during the recent past, i.e. towards the end of Yala season. In addition to the water requirement of this irrigation scheme there is also a proposed abstraction of Mahaweli water for domestic and industrial water supply close to Manampitiya Bridge. Therefore a sufficient release of water from Minipe has to be allowed in order to maintain river flow below Kalinga Nuwara, which is the lowest diversion location proposed under this study.

v. System H, IH and MH

The irrigable areas under Kandalama, Dambulu Oya, Kalawewa and Rajangana reservoirs in Kala Oya basin are coming under System H, while those of Nachchaduwa, Nuwarawewa and Tissawewa are coming under System IH. The supplies to the latter are through the Branch channel 2 and 5 of Kalawewa RB channel. The irrigable area of Huruluwewa, which receives Mahaweli Water through Kandalama - Huruluwewa Feeder Canal (KHFC), is called System MH. The System IH and MH are named after System H since they are fed from supply route to System H. These two systems were originally planned to fed from the NCP canal but merged with system H due to its delay in implementation. Though all three systems are suffering from water deficiency during Yala season, the systems IH and MH are the worst affected as indicated in Table 2.4 due to their location far away from the source of water and lengthy feeder channels are running through many other irrigation systems operated by different organizations with large scale of illicit tapping.

Diversion to Nachchaduwa feeder canal from Kalawewa RB (KRB) is getting least priority during KRB land preparation periods and during June - July periods in which highest water demand occurs. This feeder canal issues water to Thuruwila and Rathmalwetiya, Wettikulama and Siyambalagaswewa from three separate outlets and runs through three reservoirs / irrigation systems, namely Mawathawewa, Kelegama and Karuwalagaswewa reservoirs in the first reach and another three in the second reach namely, Halmillakulama, Puliyankulama and Ulukeththewa. The extent cultivated under Nachchaduwa feeder canal scheme is around 1,000 ha. Previously the Agrarian Services Department (ASD) operated these minor irrigation works, but later ID has taken over the operations. The KHFC feeds Kandalama scheme and Feeder Canal Scheme operated by the MASL and runs through Pahala-

Thalkote, Hiriwaduna and Habarana reservoirs / irrigation systems operated by the Agrarian Services Department on its way to Huruluwewa. Under this study it is proposed to give irrigation water directly to Nachchaduwa and Huruluwewa from Upper Elahera Canal and to raise their CI to 180%.

There is a vast improvement to the water-use efficiency of System H compared to its counterparts IH and MH according to **Figure 2.6**. Nevertheless, System MH maintains very high water-use efficiency on average. This situation will be improved "with-project" once IH and MH will be fed from an alternate route originating from the proposed Upper Elahera Canal (UEC) via Mannakkattiya and Eruwewa. As a result both these two systems could be fed either of these two routes depending on the excess water availability at point of diversion.

vi. System D1, D2 and G

The irrigation systems fed from ancient Elahera Anicut are named as System G and D1 in the Mahaweli Development Program (MDP) while the area fed from ancient Angamedilla Anicut is called system D2. The purpose of 33 km long Elahera - Minneriya Yoda Ela (EMYE) is to divert flow in the Amban Ganga for direct irrigation development in system G while augmenting supply to Giritale and Minneriya reservoirs. The Minneriya - Kantale Yoda Ela (MKYE) of length 32 km is the main supply channel to both Kadulla and Kantale with the augmentation from Gal Oya and Kuda Oya. Due to the large conveyance capacities of the EMYE (56 cumec) and MKYE (28 cumec) and large in-system storage of Giritale, Minneriya, Kaudulla and Kantale, reservoirs (425 MCM), this system enjoys much higher CI of 191%, at highest water-use efficiency of 103 ha/MCM.

The Parakrama Samudra scheme gets diverted water through Angamedilla Yoda Ela (AYE) of discharge capacity 28 cu. m/sec and 6 km long. The fresh water of Kalu Ganga which joins Amban Ganga upstream of Angamedilla is the main source of supply to this channel. The CI is almost 200% but water-use efficiency is being at a low 77 ha/MCM as per 2010 data. See **Table 2.4** and **Figure 2.6** for comparison.

Under Moragahakanda project it is proposed to raise the CI of all the irrigation systems in Amban Ganga to 200%. The water availability for systems G and D1 will be assured through Moragahakanda project while PSS will get an additional assurance through Kalu Ganga project.

The water for sugarcane cultivation had been issued from the Kantale reservoir until mid-eighties but with the privatization of sugar factory followed by the breach of this reservoir in 1986, the sugar cultivation had been neglected mainly due to poor management and lack of water. This study has identified providing water to sugarcane as high priority and proposes to reallocate water to revive abandoned sugarcane cultivation area under the Kantale reservoir.

With respect to water allocation under any crisis situation, this study will ensure highest priority to the existing irrigation systems in Amban Ganga (D1, D2 and G) over that of irrigation systems in adjoining river basins (H, IH and MH).

vii. North Central Province

According to the UNDP/FAO study done in 1968, Implementation Strategy Study done by NEDECO in 1977 and Trans-Basin Diversion Study (TDS) done by Electrowatt in 1981 & 1984 the potential net irrigable area available under systems I, M, J, K, L for development is estimated to be 150,000 ha. It is the intension of this study to estimate optimal cultivable area depending on the availability of water

locally and safe withdrawal from the available water from the main system without deprive of the water rights of current water users, including the environmental needs. As proposed in the Prefeasibility Study this study will examine the possibility of allocating irrigation water to 33,000 ha of existing irrigable land under minor tank system and 20,000 ha of land under major tank system with raising of the present CI up to 180% and the development of a suitable Stage wise implementation strategy for the same.

The existing areas under minor tank systems are located above the proposed large scale irrigation systems to be developed under original Master Plan and below the NCP Canal. It is assumed in this simulation study that the upper reservoirs in the cascade system retain 50% of storage before releasing to the downstream reservoir. A suitable outlet works have to be provided for this purpose. In addition to this a suitable water management plan has to be proposed for the smooth operation of these small tank cascade systems. The main advantages of selecting the augmentation of cascades of minor irrigation systems instead of major schemes are automatic recharging of medium to major reservoir schemes in the bottom of the river basins, enrichment of flora and fauna, wild life, forest, the villages and small townships in the periphery with fresh water.

viii. North Western Province

At present, Wemedilla reservoir constructed on Welamitiya Oya regulates and stores local inflows as well as the diversions from Nalanda and provides irrigation water to extents under Wemidilla amounting to 729 ha and that of Dewahuwa scheme 1,215 ha. The average CI of these two systems is almost 200%. Nevertheless, the existing irrigation areas of Mee Oya and Deduru Oya basins are suffering from shortage of irrigation water especially during Yala season. Therefore, diversion of Mahaweli water to NWP has become a very important issue and this diversion project is considered as of high priority, under this study due to the prevailing social and political considerations.

This study has identified that rehabilitation of Nalanda Reservoir will help to divert maximum possible to NWP after meeting the irrigation requirements of Wemedilla and Dewahuwa schemes. With the construction of Moragahakanda and Kalu Ganga reservoirs together with Upper Elahera canal the diversion to Huruluwewa and Nachchaduwa will commence from UEC and the diversion through Bowatenna tunnel will be relaxed. Then only it becomes possible to divert about 100 MCM from Lenadora tunnel outlet to NWP area. There are 13,500 ha of existing irrigable land in the NWP including the existing land under Wemedilla and Dewahuwa.

The water balance study carried out during the Prefeasibility study of the NCP canal study ensured water for 7,500 ha of existing land for 180% CI under Mee Oya and Hakwatuna Oya basins with regulation of 100 MCM of water from Bowatenna and locally available water through the existing reservoir system. The consideration of Nalanada reservoir as a main source of water in addition to the Bowatenna diversion is the major change in the present study.

Figure 2-5: Five Year Moving Average Duties of System E, C and B

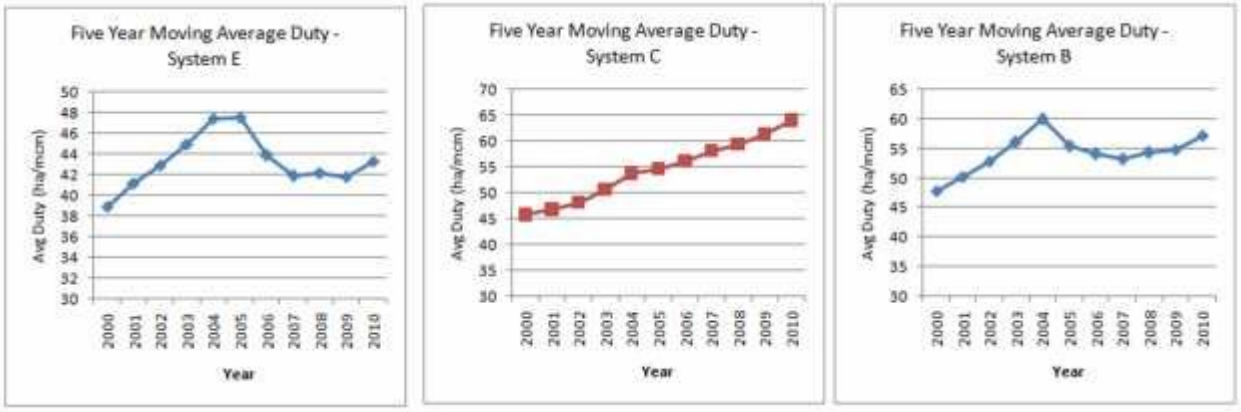


Figure 2-6: Five Year Moving Average Duties of System H, MH and IH

Figure 2-7: Five Year Moving Average Duties of System G, D1 and D2

3. WATER AVAILABILITY ASSESSMENT

3.1 Natural River Flows

This section of water availability assessment for the Extension of Moragahakanda Multipurpose Development Project describes the work that has been carried out to establish a reliable set of data base to model different project scenarios and to establish the corresponding water balances.

The NEDECO consultants had prepared a hydrological data base for the Mahaweli and Amban Ganga systems in 1979 on a daily basis under Hydrological Crash Program at each of gauging stations on Mahaweli River. Later they have extended this database to proposed major structures under Mahaweli Master Plan to derive an Implementation Strategy for Accelerated Mahaweli Development Program using relevant catchment area factors and areal rainfall factors. In 1986, under Mahaweli Water Resources Management Project, the ACREs International Limited has recompiled the weekly flow data into monthly time series for the period of 1949 to 1981 and subsequently up to 1984. This data base had been used in various studies by different consultant in connection with water resources development studies in the Mahaweli and adjoining river basins, namely; Trans-basin diversion option for Polgolla by Electrowatt and Salzgittar in 1986, The Study on Extension of Moragahakanda Extension Project by JICA in 1989, Feasibility Study on Kalu Ganga Reservoir and Agricultural Extension Project by Central Engineering Consultancy Bureau (CECB) , in March 1992, Feasibility Study of Moragahakanda Development Project by Lahmeyer et. al in August 2001 and September 2002 and Feasibility Study on Kalu Ganga Development Project by Lahmeyer et. al in July 2004. This data base is regularly used by the Water Management Secretariat (WMS) of the Mahaweli Authority of Sri Lanka (MASL), in the preparation of six monthly Seasonal Operation Plans (SOPs), Monthly Review Reports (MRR) and Seasonal Summary reports (SSRs) in connection with operational planning of Mahaweli, Kelani, Kalu, Walawe, Amban Ganga, Kala Oya, Malwatu Oya, Yan Oya, Kantale Oya and Maduru Oya river basins.

With the extinction of river gauging stations on Mahaweli system due to inundation after the construction of reservoirs under Accelerated Mahaweli Development Program the measurements of river flow has been restricted to measurements done at these control structures such as power flows, diversions, downstream release and spillway releases etc.,. A separate water-use database has been established since 1984 and the updating of the hydrological data base was carried out by the Water Management Secretariat using the rainfall-runoff regression analysis. The water-use database consisted of daily operation records of individual stations while hydrological database consists of naturalized inflow series at these stations if such structures are not in existence.

The methodology adopted in computing irrigation tank inflows is same as that adopted in generating the inflow series for the period 1949 – 1981 by ACRES. The regression coefficients derived for the irrigation tank catchment areas have been used in deriving the inflow time series for irrigation tanks. See **Table 3.1** for average monthly inflow series at control points.

Table 3-1: Natural Inflow Series at Main Control Points (1971-2010)

CONTROL POINT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
KOTMALE	43.2	24.0	23.0	38.7	55.6	100.5	115.3	106.1	98.3	111.4	94.2	69.3	879.6
POLGOLLA	36.3	21.8	23.9	49.7	90.6	127.7	121.1	101.8	99.5	130.6	130.9	80.1	1013.8
VICTORIA	65.7	27.5	25.5	28.9	48.1	40.1	40.8	49.0	33.0	63.9	94.4	90.2	607.0
RANDENIGALA	42.5	77.6	98.2	90.6	37.8	20.3	20.1	23.7	12.3	15.4	18.9	19.0	476.2
RANTEMBE	80.7	56.4	38.6	58.7	52.9	30.1	32.3	22.5	24.6	50.4	76.4	83.1	606.7
MANAMPITIYA	382.7	179.7	133.1	91.4	86.5	42.2	47.6	48.4	63.5	118.3	165.0	304.3	1662.7
BOWATENNA	58.2	36.5	28.4	29.2	22.7	14.7	13.6	12.8	13.4	27.1	55.6	77.1	389.2
ELAHERA	71.4	34.0	25.2	19.8	14.5	9.3	9.5	9.2	9.9	18.0	44.4	80.2	345.2
ANGAMEDILLA	159.0	81.9	67.8	47.8	14.3	10.9	11.8	8.2	11.4	17.6	67.7	157.5	656.0

source: WMS/MASL

3.2 Meteorological Data

Rainfall time series consists of monthly data from 1949 up to 2010 with the update done by the WMS from 1984 to 2010 at every two year interval. In the case of evaporation from the reservoirs a set of long-term, average monthly evaporation data of nearby meteorological stations have been used.

In establishing the rainfall reference base, the WMS has used historic monthly rainfall data from 147 representative rainfall stations of respective river basins. In fill-in and extending the rainfall reference base, they have used an adapted version of the HEC-4 multi-site multiple-regression model originating from US Army Corps of Engineers. In deriving the areal rainfall series, Theissen Polygon method has been used. This methodology has been adopted in the Hydrological Crash Program (HCP) by NEDECO in 1979 and Electricity Master Plan Study by Lahmeyer in 1987 too.

3.3 Reservoir Inflow Series

In the planning and design of Mahaweli multipurpose water resources system, simulation studies were carried out using various computer models to simulate the system performance with new projects. These models require monthly flow data at the control points in the macro system and irrigation subsystems as well. The natural river flow time series for new control points were derived through applying corresponding catchment area factors and weighted average rainfall ratios on natural river flow time series measured at gauging stations available at that time. Even the operational planning and regulation of this system has been carried out using the same computer models and extended data bases since then. Nevertheless, it has been found that, these natural time series differ by significant margin when compared with the inflow time series derived through water balance studies for some control points. These findings are surfaced with the accumulation of measured daily operation data (water-use database) at control points and real time operations under low flow situations. Hence, the effects of new water retaining structures and the man made operations on river flows have to be simulated in computing the reservoir inflow series in future simulation studies.

Construction of a series of new control structures along a river divides a river course in to number of river reaches. Then the computed natural river flow (inflow) series for newly established control points derived through application of catchment area factors and weighted average rainfall ratios to the measured flow data series at gauging stations are mathematically correct. Nevertheless, actual

flow availability at new control point may vary from the computed series depending on the changes done to the upstream reach via construction of large reservoir, diversion of water away from its natural path, manmade releases etc The changes to time of concentration, subsurface and deep percolation flow component, change of flow pattern from continuous flow to 4 to 6 hours of releases like in peaking operations, tank losses due to static head of water in the reservoir etc, in a reach may collectively or individually contributes to change in the flow availability. The downstream leak of Samanalawewa dam is proportional to the head of water in the reservoir and hence to minimize the water loss and as a safety measure it is operated few meters below the FSL. Therefore, it is advisable to adopt suitable inflow proration factors to the naturalized flow series to simulate actual flow series after giving due consideration to all the above factors.

Table 3-2: Inflow Proration Factors

Inflow Series		***Factor***
Inflow Series	***Station Name***	2010
Q01	Kotmale	1.01
Q02	Polgolla	1.22
Q03	Victoria	0.79
Q04	Randenigala	1
Q05	Rantembe	0.51*
Q06	Manampitiya	1
Q07	Bowatenna	0.60**
Q08	Elahera	1
Q09	Angamedilla	0.8
Q15	Kala/Damb/Kand	2.5
Q16	Giritale	1
Q17	Minneriya	1
Q18	Kaudulla (Alut & Gal)	1
Q19	Kantale	1
Q20	Parakrama Samudra	1
Q21	Maduru Oya	1
Q22	Ulhitiya/Rathkinda	1
Q23	System E	1
Q24	Kandalama	1.5
Q25	Kalawewa	3
Q26	Huruluwewa	1
Q27	Nachchaduwa	1
Q28	Nuwarawewa	1

Note : Proration factors were modified at Rantembe

* by adding the savings to Bathmedilla with proposed Thalpitigala reservoir and, at Bowatenna

** After seperating out Nalanda

Q05	Rantembe	0.664
Q07	Bowatenna	0.920

The WMS has been using inflow proration factors at control points to derive the local inflow time series at these points in their planning processes in order to reach at more realistic flow patterns. The computed inflow series at control points have been compared with historic inflow series derived through water balance study for the period 1984 to 2010. The inflow proration factors shown in **Table 3.2** derived through the above analysis were applied to develop the modified inflow series given in **Table 3.3.**

The Rantembe and Bowatenna are two such locations in the Mahaweli system where the measured inflow time series so derived through water balance study differ by significant amount that of computed inflow series.

Table 3-3: Modified Inflow Series at Main Control Points (1971-2010)

CONTROL POINT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
KOTMALE	111.4	94.1	68.5	43.6	24.3	23.3	39.1	56.2	101.5	116.5	107.2	99.3	884.9
POLGOLLA	159.6	159.1	98.1	44.3	26.5	29.1	60.7	110.5	155.8	147.7	124.2	121.4	1237.0
VICTORIA	51.2	74.1	72.0	51.9	21.7	20.1	22.9	38.0	31.7	32.3	38.7	26.1	480.6
RANDENIGALA	40.0	77.4	96.2	87.4	33.7	19.8	18.4	24.4	12.0	15.2	19.1	19.1	462.8
UPPER UMA OYA	15.7	23.7	25.4	25.0	17.5	12.0	18.2	16.4	9.3	10.0	7.0	7.6	187.8
LOWER OMA OYA	14.2	21.4	23.0	22.6	15.8	10.8	16.4	14.8	8.4	9.1	6.3	6.9	169.6
RANTEMBE	4.0	6.1	6.6	6.5	4.5	3.1	4.7	4.2	2.4	2.6	1.8	2.0	48.5
HASALAKA	3.6	15.8	24.1	13.9	5.6	3.9	5.3	2.3	0.3	0.3	0.3	0.7	76.1
HEEN GANGA	4.3	19.3	29.4	17.0	6.9	4.8	6.5	2.9	0.4	0.4	0.3	0.9	93.0
KALINGA NUWARA	23.6	33.0	61.1	76.5	35.9	26.6	18.3	17.3	8.4	9.5	9.7	12.7	332.8
MANAMPITIYA	94.5	131.8	244.6	306.2	143.8	106.5	73.2	69.2	33.8	38.1	38.8	50.8	1331.0
NALANDA	6.7	12.4	15.4	17.7	5.0	4.3	4.7	3.2	2.9	2.1	1.7	2.9	78.9
BOWATENNA	18.7	38.7	56.7	37.2	29.0	22.1	22.6	18.0	10.9	10.6	10.2	9.7	284.4
MORAGAHAKANDA	18.0	43.2	79.9	71.5	34.0	25.2	19.8	14.5	9.3	9.5	9.2	9.9	343.8
PALLEGAMA	5.5	20.6	49.4	49.3	25.4	21.0	14.8	4.4	3.4	3.7	2.5	3.5	203.5
HATTOTA AMUNA	1.6	6.0	14.3	14.3	7.4	6.1	4.3	1.3	1.0	1.1	0.7	1.0	59.1
ANGAMEDILLA	7.1	26.6	63.7	63.6	32.7	27.1	19.1	5.7	4.4	4.7	3.3	4.6	262.6
NCP RES2 (MAJOR)	26.8	58.3	49.4	19.0	10.2	9.9	31.0	9.1	0.6	0.9	1.0	2.9	219.1
NCP1 (MINOR)	26.1	56.8	48.1	18.5	10.0	9.6	30.2	8.8	0.5	0.9	1.0	2.9	213.5
NWP (MINOR)	10.6	23.1	19.6	7.5	4.1	3.9	12.3	3.6	0.2	0.4	0.4	1.2	86.8

source: WMS/MASL

i. Rantembe Inflow

The upper catchment area of Uma Oya basin consists of a network of minor and medium scale irrigation schemes and tea estates while the lower catchment area consists of jungles, scrub jungle, and grassland. The Mahatotilla Oya, Kuda Oya, Ambewela Oya, Dalgolla Oya and Hal Oya in the upper catchment are the main tributaries of Uma Oya. There are number of medium scale irrigation schemes namely Uma Ela, Mahatotilla, Maha Eliya and Hangiliella schemes are operating in the upper catchment area consuming about 50 MCM of water annually. The proposed Dyraaba and Puhulpola reservoirs to be constructed in Uma Oya will divert about 150 MCM annually to Kirindi Oya also located in the upper catchment. The Bathmedilla scheme in the adjoining Badulu Oya basin is also fed from a canal leading from the right bank above proposed Lower Uma Oya reservoir. This canal has a capacity of 2.3 cubic meters per second and diverting about 50 MCM annually from Uma Oya which is a lost to the system. With proposed Thalpitigala reservoir above Lower Uma Oya it is expected to supply a regulated supply of irrigation water to this system which is estimated to be

22 MCM annually. Therefore, the computed flow series is multiplied by a inflow proration factor of 0.664 to get a reasonably accurate flow series at Rantembe with the savings due to Bathmedilla added to the flow series. The average incremental natural flow at Rantembe is 606.7 MCM annually for the period 1971-2010 become 406 MCM.

The high gradient of the river course above Rantembe becomes almost zero after Minipe weir with the river course changes from storage zone to deposition zone after Minipe. The name Mahiyangana also implies vast extent of flat land. The flow of Mahaweli Ganga in this reach consists of two components namely, sub surface and surface water flow. It could be assumed that part of inflow to Rantembe is lost as subsurface flow from the tank bed itself. This loss is proportional to the inflow but may be varying with respect to the head of water in the reservoir.

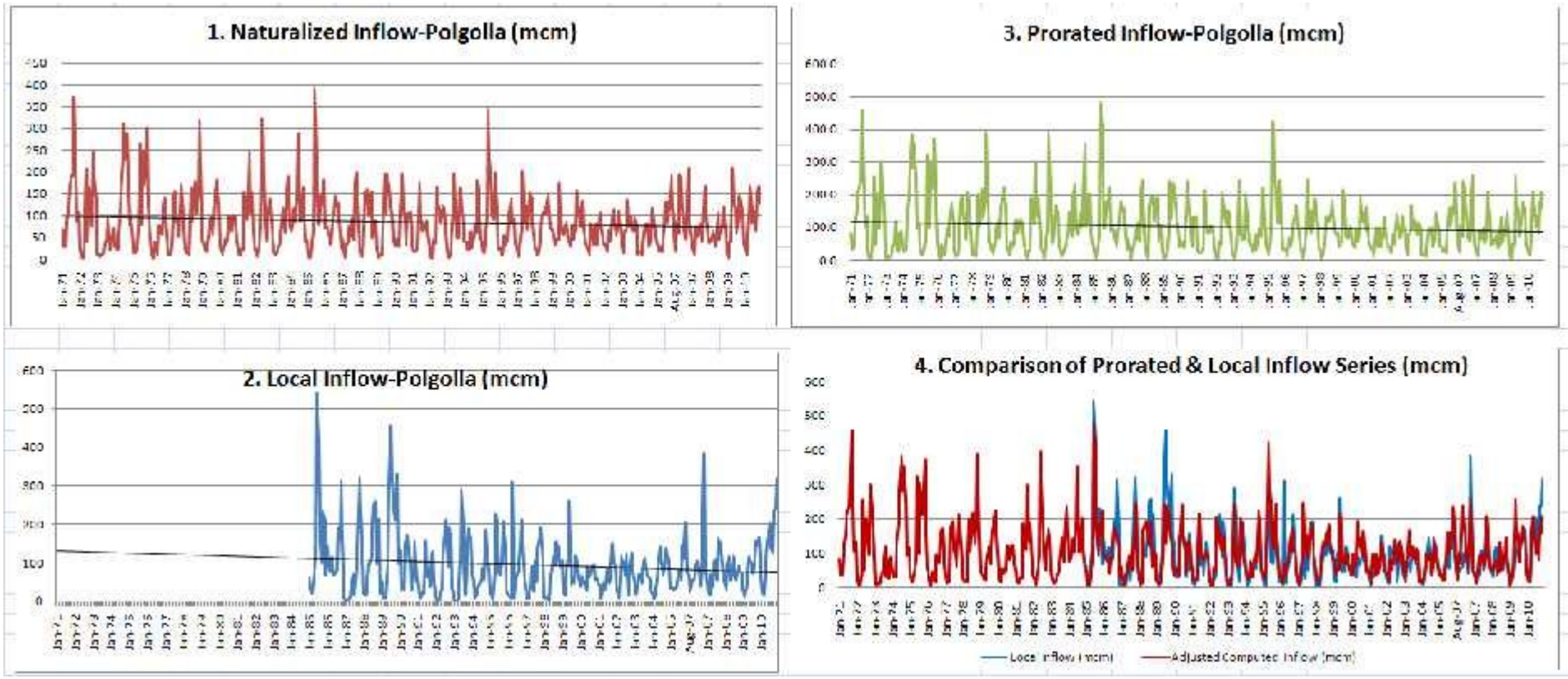
ii. Bowatenna Inflow

Under this project it is proposed to divert maximum possible Nalanda inflow and 100 mcm from Bowatenna irrigation tunnel to NWP area. Nalanda diversion will continue to supply water to existing Wemedilla and Dewahuwa schemes while the balance will augment Hakwatuna Oya scheme in Deduru Oya basin and irrigation systems in Upper Mee Oya basin. In the present study the Bowatenna inflow series is subdivided in to two. This is done based on catchment area factors and areal rainfall factors. The computed inflow series so derived for Bowatenna is compared with the inflow series derived through water balance study. Then the application of a inflow Proration factor of 0.9 to the computed series gave local inflow at Bowatenna as 284 MCM per annum on average (1971-2010) which is compatible with the inflow series derived through water balance study.

iii. Polgolla Inflow

As described above, the construction of large reservoirs, diversion of water away from its natural path, manmade releases to the downstream according to the needs of the water users etc., will make a definite impact on water availability at downstream control point. Therefore, the naturalized flow series derived at various points in an undisturbed river system has to be modified to reproduce flow availability at various control points in a disturbed system. In order to explain the methodology adopted the application of inflow proration to Polgolla naturalized inflow series is presented in **Figure 3-2**. The series 1 consisted of the measured flow at Peradeniya gauging station extended to Polgolla until 1984 and since then it is extended up to 2010 using rainfall and runoff regression analysis. It has a declining trend from 100 mcm in 1971 to 75 mcm in 2010 on average. The series 2 is the inflow series derived through back routing for the disturbed system. This series too has a trend of 110mcm in 1984 and 80 mcm in 2010. Proration factor derived for series 1 and 2 is 1.22. After the application of this factor to series 1, the third series was derived. The resulting series 3 also has a declining trend of 110 mcm in 1971 and 90 mcm in 2010. The comparison of series 2 and 3 is shown in 4. Except for some high flows in late eighties during rest of the period both series matches each other.

Figure 3-1: Proration of Polgolla Inflow Series



3.4 Irrigation Water Requirements

Monthly irrigation water demands for existing, committed and potential irrigation systems were computed for the period 1949 – 2010 using ACRE's Irrigation Demand Model (AIDM) for three different time-frames as described below. The method of computation of the irrigation demands are based on computation of water requirements for land preparation and different Stages of crop developments for half-month time steps depending on the type of crop, crop factors, soil type, land preparation requirements, percolation and field application efficiency etc,.. Monthly effective rainfall for paddy and upland crops are computed separately and subtracted from the crop water requirements to get farm water requirement. After dividing it by the canal, efficiency irrigation water issues at sluice level are computed. The overall efficiency of computed sluice issue is adjusted until computed duty of water and existing duty of water are equal. The water requirements computed for existing situation is Case A.

Case A : (2012- 2017) – Irrigation demand series have been computed for all existing irrigation systems under the Mahaweli project . Last 5 year averages of paddy and OFC extents and cropping patterns have been used in the computations. The computed water duties are compared with last 5-year of recorded water duties and assumed canal efficiencies are modified where ever necessary to arrive at reasonably good estimation of present water usage. These studies formed the basis for calculation of a set of "Present case" or "Case A" irrigation water requirements at key supply points. Nevertheless, the exact cropping patterns like to be practiced in the future cannot be forecasted or cannot be imposed. Therefore, it is reasonable to assume that, it should be an extension of what is being practiced today. As such, it is reasonable to assume a hypothetical cropping pattern, which will give rise to saving of water in Stages. Therefore it is assumed that, the current practice of the farmers is to cultivate long-term variety of paddy in 1/3 of extent, and Medium-term variety in 2/3 of extent in Maha season and medium-term variety in 2/3 of the extent and short-term variety in 1/3 of the extent in Yala season in existing systems of NWP and NCP.

Case B : (2018 -2022) – The water-use efficiency of irrigated agriculture can be improved through many methods. Considerable potential exists for achieving even 10% increase in the water-use efficiency through increase of reliability of water supply which will result in increasing the CI. In this case, it is assumed that with both Moragahakanda and Kalu Ganga reservoirs are in operation, there is adequate and reliable supply of water in the system and hence, the overall system performance will be improved. The advancement of the starting dates of the cultivation season will also become possible there by reducing the overall water usage with increased effective rainfall with catching up of inter-monsoon rains.

Case C : (2023 – 2027 & 2028 - 32) - In computing the demand series for this case the same cropping pattern as given in the case B has been adopted with the exception of using more medium-term (2/3) to less short-term (1/3) varieties of paddy in Maha season and less medium (1/3) to more short term varieties (2/3) of paddy during Yala season. The canal efficiencies adopted remain the same in both cases.

The details of CI and water duties for Yala and Maha seasons for all the above cases are given in **Table 3.4.** Also, refer **Table 3.5** for details of cropping patterns adopted for a sample irrigation area with starting dates, Canal efficiencies for Maha and Yala seasons separately.

Table 3-4: Improvements to Water Duties and Cropping Extents 'With Project"

			without Moragahakanda (last 5 years avg - Year 2010)				With Moragahakanda/Kalu Ganga Reservoirs (Year 2017)					With NCP Reservoirs (Year 2017)					With NCP Reservoirs (Year 2023					With NCP Reservoirs (Year 2028				
System	Scheme	Extent (ha	Cropping Intencities		Duty of Water (ha/m		Extent (ha	Cropping Intencities		Duty of Water (ha/m		Extent (ha	Cropping Intencities		Duty of Water (ha/m		Extent (ha	Cropping Intencities		Duty of Water (ha/m		Extent (ha	Cropping Intencities		Duty of Water (ha/m	
	last 10 year avg		Maha	Yala	Maha	Yala	Available	Maha	Yala	Maha	Yala	Available	Maha	Yala	Maha	Yala	Available	Maha	Yala	Maha	Yala	Available	Maha	Yala	Maha	Yala
IH	Nuwarawewa	1,052	0.98	0.96	97	65	1,052	1.00	0.96	105	70	1,052	1.00	0.96	105	70	1,052	1.00	0.96	123	73	1,052	1.00	0.96	123	73
	Nachchaduwa	3,335	0.94	0.66	94	50	3,335	1.00	0.80	100	55	3,335	1.00	0.80	100	55	3,335	1.00	0.80	118	57	3,335	1.00	0.80	118	57
	Tis'wa/Basa'ma	520	1.00	0.63	83	86	520	1.00	0.80	85	86	520	1.00	0.80	85	86	520	1.00	0.80	100	89	520	1.00	0.80	100	89
	Sub Total	4,907	0.95	0.72	93	56	4,907	1.00	0.83	99	60	4,907	1.00	0.83	99	60	4,907	1.00	0.83	117	63	4,907	1.00	0.83	117	63
I	Manankattiya	607	0.86	0.64	100	60	607	1.00	0.80	100	70	1,107	1.00	0.80	100	70	1,107	1.00	0.80	117	74	1,107	1.00	0.80	117	74
	Eruwewa	132	0.70	0.00	100	60	132	1.00	0.80	100	70	132	1.00	0.80	100	70	132	1.00	0.80	128	70	132	1.00	0.80	128	70
	Mahakandarawa	2,525	0.41	0.10	100	60	2,525	1.00	0.80	100	70	4,025	1.00	0.80	100	70	4,025	1.00	0.80	113	73	4,025	1.00	0.80	113	73
	Sub Total	3,264	0.51	0.20	100	60	3,264	1.00	0.80	100	70	5,264	1.00	0.80	100	70	5,264	1.00	0.80	114	73	5,264	1.00	0.80	114	73
MH	Huruluwewa	4,210	1.00	0.53	126	70	4,210	1.00	0.80	126	80	7,710	1.00	0.80	126	80	7,710	1.00	0.80	150	84	7,710	1.00	0.80	150	84
H	KHF Canal	2,250	1.00	0.92	58	39	2,365	1.00	0.92	65	45	2,365	1.00	0.92	65	45	2,365	1.00	0.92	63	46	2,365	1.00	0.92	63	46
	Kalawewa LB	6,650	0.99	0.88	94	81	6,650	1.00	0.88	95	85	6,650	1.00	0.88	95	85	6,650	1.00	0.88	111	88	6,650	1.00	0.88	111	88
	YE	4,720	0.99	0.88	111	88	4,720	1.00	0.88	111	88	4,720	1.00	0.88	111	88	4,720	1.00	0.88	131	92	4,720	1.00	0.88	131	92
	RB	14,035	0.99	0.85	78	76	14,035	1.00	0.85	80	80	14,035	1.00	0.85	80	80	14,035	1.00	0.85	94	82	14,035	1.00	0.85	94	82
	Dambulu Oya	2,290	0.99	0.97	117	91	2,290	1.00	0.97	117	91	2,290	1.00	0.97	117	91	2,290	1.00	0.97	139	94	2,290	1.00	0.97	139	94
	Kandalama	4,485	0.99	0.81	111	85	4,485	1.00	0.81	111	90	4,485	1.00	0.81	111	90	4,485	1.00	0.81	131	93	4,485	1.00	0.81	131	93
	Sub Total	32,180	0.99	0.86	91	81	32,180	1.00	0.86	92	84	32,180	1.00	0.86	92	84	32,180	1.00	0.86	109	87	32,180	1.00	0.86	109	87
D1	Kantale	8,880	0.94	0.93	130	94	8,880	1.00	1.00	135	95	13,980	1.00	1.00	135	86	13,980	1.00	1.00	155	86	15,436	1.00	1.00	155	86
	Kaudulla	5,465	1.00	0.88	152	85	6,885	1.00	1.00	152	85	6,885	1.00	1.00	152	85	6,885	1.00	1.00	180	89	6,885	1.00	1.00	180	89
	Minneriya	9,099	1.00	0.98	128	91	9,099	1.00	1.00	130	95	9,099	1.00	1.00	130	95	9,100	1.00	1.00	154	99	9,100	1.00	1.00	154	99
	Giritale	3,076	1.00	0.92	94	60	3,076	1.00	1.00	100	65	3,076	1.00	1.00	100	65	3,076	1.00	1.00	118	68	3,076	1.00	1.00	118	68
	Sub Total	26,520	0.98	0.94	127	86	27,940	1.00	1.00	132	88	33,040	1.00	1.00	132	85	33,041	1.00	1.00	155	88	34,497	1.00	1.00	155	88
G	Elahera	6,210	1.00	0.91	64	50	6,210	1.00	1.00	65	55	6,210	1.00	1.00	65	55	6,210	1.00	1.00	76	52	6,210	1.00	1.00	76	52
KGB	Kalu Ganga						3,000	1.00	1.00	100	60	3,000	1.00	1.00	100	60	3,000	1.00	1.00	121	63	3,000	1.00	1.00	121	63
D2	PSS	10,480	1.00	1.00	90	67	10,480	1.00	1.00	90	70	10,480	1.00	1.00	90	70	10,480	1.00	1.00	104	73	10,480	1.00	1.00	104	73
A	System A	7,050	1.00	1.00	50	50	7,050	1.00	1.00	50	50	7,050	1.00	1.00	50	50	7,050	1.00	1.00	59	52	7,050	1.00	1.00	59	52
B	Maduru Oya	18,500	0.93	0.85	72	46	18,500	1.00	0.80	75	50	18,500	1.00	0.80	75	50	18,500	1.00	0.80	89	53	18,500	1.00	0.80	89	53
	RB											10,000	1.00	0.80	70	45	10,000	1.00	0.80	82	47	10,000	1.00	0.80	82	47
C	Ulhitiya	22,800	1.00	0.88	80	51	22,800	1.00	1.00	80	55	22,800	1.00	1.00	80	55	22,800	1.00	1.00	93	51	22,800	1.00	1.00	93	51
E	Minipe LB	7,530	0.98	0.97	55	35	7,530	1.00	1.00	55	35	7,530	1.00	1.00	55	35	7,530	1.00	1.00	64	36	7,530	1.00	1.00	64	36
NCP	Minor Tanks											5,000	1.00	0.80	100	80	25,000	1.00	0.80	119	84	33,000	1.00	0.80	119	84
	Major Tanks																4,500	1.00	0.80	127	84	14,500	1.00	0.80	127	84
												5,000	1.00	0.80	100	80	29,500	1.00	0.80	120	84	47,500	1.00	0.80	121	84
NWP	Minor Tanks											9,000	1.00	0.80	100	80	9,000	1.00	0.80	118	84	11,000	1.00	0.80	117	84
	Grand Total	145,901	0.97	0.87	80	57	150,436	1.00	0.92	85	63	185,036	1.00	0.91	87	64	212,993	1.00	0.90	101	64	230,993	1.00	0.89	105	68

Table 3-5: Cropping Pattern for Sample Area (ha)

Item	CASE A	CASE B	CASE C
	MAHA	MAHA	MAHA
Total Area	3,000	3,000	3,000
Paddy 135 days	1,000	1,000	
Paddy 105 days	2,000	2,000	2,000
Paddy 90 days			1,000
Sub total	3,000	3,000	3,000
	YALA	YALA	YALA
Paddy 135 days			
Paddy 105 days	1,600	1,600	800
Paddy 90 days	800	800	1,600
Sub total	2,400	2,400	2,400
Canal eff - Maha	0.55	0.60	0.60
Canal eff - Yala	0.65	0.75	0.75
Starting Date -M	Nov-01	Oct-15	Oct-15
Starting Date -Y	May-15	1-May	1-May

In the preparation of Seasonal Operating Plans for both Maha and Yala seasons, the WMS uses a Reliability Criterion in assessing the irrigation deficits of individual irrigation systems in the simulated system performance. This is in the case of Medium-term planning. Nevertheless, in the present study too the same Reliability Criterion has been used even though it is for long-term planning. This way the ability of the Mahaweli system to provide irrigation water, with acceptable reliability to the irrigation systems under the Mahaweli Project has been guaranteed. The acceptable reliability criterion that was adopted made use of a three-level definition of irrigation water supply shortage.

An ***'Irrigation failure'*** was assumed to have occurred in a given simulated year if the sum of the Yala season deficits in an irrigation system, as a whole, exceeded 5% of the total Yala demand. In an operating situation, such a shortage would probably be accommodated by 'tightening up' on water deliveries, while no significant agricultural losses.

A ***'significant irrigation failure'*** was assumed to have occurred in a given simulated year if the sum of the Yala season deficits in an irrigation system, as a whole, exceeded 10% of the total Yala demand. In an operating situation, such a shortage would probably result in agricultural losses, either planned (Yala crop cut-backs) or unplanned.

A ***'total irrigation failure'*** was assumed to have occurred in a given simulated year if the sum of the Yala season deficits in an irrigation system, as a whole, exceeded 20% of the total Yala demand. In an operating situation, such a shortage would probably result in total agricultural losses, either planned (Yala crop cut-backs) or unplanned.

The criterion of '**acceptable' reliability** was then defined as incorporating frequency of occurrence of such failures to be;
Less than 20% in the case of ***'irrigation failure'***, and
Less than 10% in the case of ***'significant failure'***, and
Less than 5% in the case of ***'total failure'***.

With this definition of acceptable reliability, the system simulation model has been used to determine the irrigation area, which could be supported in each irrigation system, given the constraints imposed by water availability. This is the same criterion adopted by the WMS in their planning processes.

3.5 Proposed Irrigation Development

3.5.1 With Moragahakanda and Kalu Ganga

With the construction of proposed Moragahakanda and Kalu Ganga reservoirs of storage capacities 570 MCM and 265 MCM respectively, the water availability in Amban Ganga will be improved through regulation and storage of most of unutilized water in the system. These two-reservoir projects will ensure double cropping for the Amban Ganga system while the CI in adjoining river basins (Kala Oya, Malwatu Oya and Yan Oya) will be improved up to 180%. Nevertheless, the irrigation systems having reached more than 180% CI at present will continue to enjoy that benefit without any change (eg. System H, KHFC & Nuwarawewa). As the reliability of water supply improves, it is expected that water-use efficiency of the Amban Ganga system will also improve and achieve an overall CI of 1.93 for reduced water issue while maintaining of Polgolla diversion at 875 MCM. See **Table 3.6** for details. The proposed system expansion will include development of new land under Kalu Ganga LB and RB (System F), Kadulla (extension of LB Branch channel) and augmentation of existing irrigation areas under Eruwewa, Mannakkattiya, Mahakandarawa and providing water supply requirements of Matale, Anuradhapura, Polonnaruwa and Trincomalee districts and this could be highlighted as the direct benefits of these two reservoir projects.

3.5.2 NCP and NWP

The main target area of Randenigala - Kalu Ganga Diversion Project is NCP and NWP. It is expected to raise the prevailing CIs of these areas from present range of 90 - 110% to 180% "with Project" under average hydrological situation through augmentation from Mahaweli water. In addition, the irrigation water to Kantale sugarcane and drinking water requirements of NCP are also planned "with Project". The diversion of excess water from Mahaweli system should be done according to the Randenigala diversion policy, which is discussed in latter part of the report. Sufficient water should be allocated for committed projects like Upper Uma Oya diversion to Kirindi Oya basin, Maduru Oya RB development area and water needs of existing water users including the environmental consideration in main and tributaries under varied hydrologic conditions. It is proposed that the implementation of NCP Canal Project will be done in three stages in three time-frames.

Under **Moragahakanda and Kalu Ganga projects** the total irrigation water requirements in Amban Ganga system is estimated at 2,110 MCM as per **Table 3.6**. This is an increase of around 200 MCM in comparison to the existing situation as per **Table 2.4**. The main advantage of these two projects is that Amban Ganga system will get guaranteed quantity of water to maintain its CI at 200%. Similarly, after fulfilling the requirements of Amban Ganga irrigation systems the adjoining river

basins will get sufficient water to maintain their CIs around 180% in all the existing and potential Irrigation systems under average hydrologic situation.

Table 3-6: Average Water Issues to the Irrigation Systems under Moragahakanda and Kalu Ganga Projects (5-Year Period 2018 to 2022)

Mahaweli System	Irrigable Area (ha)	Average Annual Water Issue (MCM)	Average Annual Water Duty (ha/MCM)	Cropping Intensity
Amban Ganga System				
H	32,180	677	88	1.86
I/H	4,907	118	76	1.83
M/H	4,210	75	101	1.80
D1	27,940	529	106	2.00
D2	10,480	268	78	2.00
G	6,210	209	60	2.00
HFC	2,365	85	53	1.92
I	3,264	70	84	1.80
F	3,000	80	75	2.00
NWP				
NCP1(minor)				
NCP2(Major)				
Total	94,556	2,110	86	1.93
Mahaweli Ganga System				
E	7,530	351	43	2.00
C	22,800	700	65	2.00
B	18,500	540	62	1.80
A	7,050	285	50	2.00
Sub Total	55,880	1,875	58	1.93

Stage I (2018-2022)

With the implementation of Moragahakanda and Kalu Ganga projects in 2018, it is expected that following projects are completed.

i. The implementation of Kalu Ganga link tunnel/canal and Upper Elehera Canal (UEC) up to Huruluwewa bifurcation is completed.

ii. The diversion of Mahaweli Water to Mannankattiya, Eruwewa and Mahakandarawa in system I, new irrigation area in Kaudulla and Kalu Ganga LB, RB areas for displaced persons is completed.

iii. The new diversion route to Huruluwewa, Nachchaduwa/Nuwarawewa via UEC is in progress.

The implementation of **Stage I** of NCP Canal project also coincides with the implementation of Moragahakanda and Kalu Ganga projects. Refer the difference in sluice issue in **Table 3.6 & 3.7.** The implementation of Kalu Ganga, Moragahakanda projects together with the Kalu Ganga link tunnel and Upper Elahera canal enable diversion of Mahaweli water to proposed irrigation systems under the NCP Canal project. The proposed projects to be implemented under stage I of NCP Canal are as follows;

I. Maduru Oya RB will also be developed as an independent project by making use of increased diversion through Minipe RB and optimizing the use of local inflow through raising of its spillway crest level by 2 m up to 98 m asl as per the original design of Maduru Oya project.

II. It is also assumed that the Upper Uma Oya project has been completed and diversion of 150MCM to Kirindi Oya is in progress.

III. It is also proposed to increase Polgolla diversion as a temporary measure to increase irrigation and power benefits under NCP Canal project.

IV. To commence diversion of Heen Ganga power releases to Kalu Ganga through the construction of the final stretch of Randenigala Kalu Ganga canal/tunnel to supplement the irrigation needs of target areas under NCP Canal Project.

V. Further, the proposed Lower Uma Oya hydropower project under NCP project is also completed and its power flows are released to Randenigala to minimize the energy loss in Mahaweli cascade due to increased Polgolla diversion.

VI. Raising of Minipe anicut by 4 m to facilitate to regulate and release four hours of power releases from Rantembe power plant during the night peaking.

VII. Facilitate provision of irrigation water to 3,500 ha of existing irrigation systems under Yan Oya anicut scheme.

VIII. Facilitate provision of irrigation water to existing irrigation area of 500 ha under Eruwewa and 1,500 ha under Mahagalkadawala reservoir scheme downstream of Mahakandarawa.

IX. Facilitate the provision of irrigation water to 5,120 ha of sugarcane area under Kantale using the existing infrastructures.

X. The construction of first 30 km of the NCP canal, which is the extension of UEC will also be ready at this stage to divert Mahaweli water to additional 5,000 ha of minor irrigation systems on either side of this canal.

XI. Bowatenna diversion to NWP will also commence during this period to provide irrigation water to 9,000ha of existing land.

XII. The 33% water supply demand will be met under NCP Canal Project.

There is an additional water usage of about 500 MCM available through locally and through increased Polgolla diversion and Heen Ganga diversion. Refer **Table 3.7**.

Table 3-7: Average Water Issues to the Irrigation Systems Stage I - (5 - Year Period 2018 to 2022)

Mahaweli System	Irrigable Area (ha)	Average Annual Water Issue (MCM)	Average Annual Water Duty (ha/MCM)	Cropping Intensity
Amban Ganga System				
H	32,180	677	88	1.86
I/H	4,907	118	76	1.83
M/H	7,710	138	101	1.80
D1	33,060	635	104	2.00
D2	10,480	268	78	2.00
G	6,210	209	60	2.00
HFC	2,365	85	53	1.92
I	5,264	113	84	1.80
F	3,000	80	75	2.00
NWP	9,000	181	90	1.80
NCP1(Minor) NCP2(Major)	5,000	100	90	1.80
Total	119,176	2,603	87	1.91
Mahaweli Ganga System				
E	7,530	351	43	2.00
C	22,800	700	65	2.00
B	28,500	862	60	1.80
A	7,050	285	50	2.00
Sub Total	65,880	2,197	57	1.91

Stage II (2023-2027)

The irrigation sluice issues for **case C** water requirements will be applied to both **Stage II and III** of this study. The largest savings on water-use is expected at **Stage II** through growing short duration paddy with the water use efficiency used in **case B**. In **Stage II** of this project, the following projects will be implemented.

I. It is proposed to construct Hasalaka and Heen Ganga stretch of the Randenigala Kalu Ganga Trans-basin Canal (RKTC) to divert Hasalaka power flows to Kalu Ganga

II. Pumping of excess water available at Angamedilla during Maha season to Minneriya will be commissioned.

III. The NCP Canal will be extended for further 30 km up to Kahatagasdigiliya in this Stage to cultivate additional extent of 20,000 ha under minor tank systems and 4,500 ha under major tank system in NCP

IV. The water supply demand will be met up to 66% during this stage.

The total water requirements in Amban Ganga system has increased from 2,603 to 2,785 MCM annually. Although, the total additional water requirement needed at this stage is more than 425 MCM and about 240 MCM is obtained through the change in cropping pattern from case B to case C.

Table 3-8: Proposed Water Issues to the Irrigation Systems Stage II - (5-Year Period 2023 to 2027)

Mahaweli System	Irrigable Area (ha)	Average Annual Water Issue (MCM)	Average Annual Water Duty (ha/MCM)	Cropping Intensity
Amban Ganga System				
H	32,180	616	97	1.86
I/H	4,907	107	84	1.83
M/H	7,710	125	111	1.80
D1	33,060	585	113	2.00
D2	10,480	244	86	2.00
G	6,210	200	62	2.00
HFC	2,365	85	53	1.92
I	5,264	104	92	1.80
F	3,000	72	83	2.00
NWP	9,000	122	133	1.80
NCP1(minor)	25,000	447	101	1.80
NCP2(Major)	4,500	78	104	1.80
Total	143,676	2,785	98	1.89
Mahaweli Ganga System				
E	7,530	325	46	2.00
C	22,800	692	66	2.00
B	28,500	781	66	1.80
A	7,050	255	55	2.00
Sub Total	65,880	2,052	61	1.91

Stage III (2023-2028)

The following projects will be completed at the beginning of Stage III of this project.

I. The first stretch of the diversion route from Randenigala to Hasalaka will be completed

II. The diversion of water from Randenigala to Kalu Ganga will commence

III. The Polgolla diversion will be reduced up to 875 MCM level.

IV. It is also expected to pump excess water at Kalinga Nuwara in Mahaweli Ganga to Angamedilla in Amban Ganga during the Yala season. Since, the quality of Kalinga Nuwara water is found as of high standard the second stage pumping from Angamedilla to Minneriya will commence. Nevertheless, least cost operation incurs when pumped water from Kalinga Nuwara to Angamedilla is used in PSS itself in Stage III.

V. The final stretch of NCP canal when extended for further 30 km up to Chenmadu Kulam will provide water for additional 8,000 under minor tanks system in NCP and another 10,000 ha under Iranamadu Tank.

VI. Additional irrigation water will be diverted to increase sugarcane area in Kantale up to 6,576 ha for year round cultivation

NWP to cultivate up to 11,000 ha with a CI of 180%.

Water requirements in Amban Ganga system has increased by 425 MCM according to **Table 3.8 – 9** and part of this demand is obtained locally while the balance through the RKTC diversion and Kaliga Nuwara pumping.

Table 3-9: Proposed Water Issues to the Irrigation Systems Stage III - (5-Year Period 2028 to 2032)

Mahaweli System	Irrigable Area	Average Annual Water Issue (MCM)	Average Annual Water Duty (ha/MCM)	Cropping Intensity
H	32,180	616	97	1.86
I/H	4,907	107	84	1.83
M/H	7,710	125	111	1.80
D1	34,516	616	112	2.00
D2	10,480	244	86	2.00
G	6,210	200	62	2.00
HFC	2,365	85	53	1.92
I	5,264	104	92	1.80
F	3,000	72	83	2.00
NWP	11,000	200	99	1.80
NCP1(minor)	33,000	590	101	1.80
NCP2(Major)	14,500	251	104	1.80
Total	165,132	3,210	97	1.88
Mahaweli Ganga System				
E	7,530	325	46	2.00
C	22,800	692	66	2.00
B	28,500	781	66	1.80
A	7,050	255	55	2.00
Sub Total	65,880	2,052	61	1.91

3.5.3 Hydropower Requirements

In this study Mahaweli system is analyzed in isolation from rest of the hydropower generating system to find out the effects of NCP canal on existing Mahaweli system. In addition, it is expected to estimate the safe volume for diversion at Randenigala with due consideration to minimize loss of hydropower generation in Mahaweli system.

The National Energy Demand forecasts are available in Table 3.2 – Base Load Forecast (2007) from 2008 to 2027 in the Long Term Generation Expansion Plan, 2009 - 2022 of the CEB. Except for the time periods 2014 - 17, 2018 – 22 and 2023 - 27 demand forecast for 2028 - 32 is not available in this table. According to the above Table national demand forecast for the Year 2027 is 47,236 GWh. At 8.13% average growth rate demand for 2032 will be 69,824. However, the present energy generation in Mahaweli system is only 1,874 GWh on average for last 5 year period, which is only 2.7% of total demand by 2032. Hence, an energy demand of double this amount will be a reasonable demand to work with in this study in consideration to the probable maximum energy generation during the wet spells and since Mahaweli system is simulated in isolation from the main

system. Therefore, the assumed energy demand is only a 6% of the year 2032 national energy demand as given in **Table 3.10**.

Table 3-10: Hydropower Demand for Mahaweli System (GWh)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Hydropower	353	336	352	357	330	370	330	349	343	355	355	347	4177

In future, the hydropower stations in the Mahaweli systems can operate over a wide range of patterns, from base loading when water is plentiful or diversion for irrigation purposes is at its peak, to peaking when water is scarce or downstream irrigation demand is low.

3.5.4 Potable and Industrial Water Demand

The monthly water supply demands of Matale, Anuradhapura, Polonnaruwa and Trincomalee as computed by Lahmeyer Consultants in their feasibility reports of Moragahakanda and Kalu Ganga are given in **Table 3.11** for the time-frames of 2012-17, 2018-22 and 2023-28. These three demand series has been applied in Stage I, II and III of the simulation study to the appropriate nodes in the Mahaweli system.

Table 3-11: Seasonal Potable and Industrial Water Demand under Moragahakanda- Kalu Ganga Projects (Unit: m3/s)

District	Station	2012/2017				2018			
		Oct-Mar	Apr-Sep	Avg.	Total (MCM)	Oct-Mar	Apr-Sep	Avg.	Total (MCM)
Matale	Sudu Ganga	0.137	0.187	0.162	5.1	0.157	0.214	0.186	5.9
	Dambulu Oya	0.049	0.067	0.058	1.8	0.113	0.154	0.134	4.2
Anuradhapura	Nuwarawewa/Tisawewa/Thuruwila	0.278	0.380	0.329	10.4	0.289	0.396	0.342	10.8
Polonnaruwa	Kaudulla/Minneriya	-	-	-	0.0	0.043	0.059	0.051	1.6
	Parakrama Samudra	0.060	0.083	0.071	2.3	0.062	0.084	0.073	2.3
Trincomalee	Kantale	0.245	0.334	0.290	9.1	0.245	0.334	0.290	9.1
	Mahaweli Ganga	0.000	0.000	0.000	0.0	0.136	0.186	0.161	5.1
Total		0.769	1.050	0.910	28.7	1.044	1.427	1.236	39.0
District	**Station**	**2023**				**2028**			
		Oct-Mar	**Apr-Sep**	**Avg.**	**Total (MCM)**	**Oct-Mar**	**Apr-Sep**	**Avg.**	**Total (MCM)**
Matale	Sudu Ganga	0.209	0.286	0.247	7.8	0.279	0.381	0.330	10.4
	Dambulu Oya	0.251	0.343	0.297	9.4	0.557	0.762	0.660	20.8
Anuradhapura	Nuwarawewa/Tisawewa/Thuruwila	0.322	0.439	0.381	12.0	0.402	0.549	0.476	15.0
Polonnaruwa	Kaudulla/Minneriya	0.095	0.130	0.113	3.6	0.212	0.289	0.251	7.9
	Parakrama Samudra	0.082	0.113	0.098	3.1	0.110	0.150	0.130	4.1
Trincomalee	Kantale	0.245	0.334	0.290	9.1	0.245	0.334	0.290	9.1
	Mahaweli Ganga	0.302	0.413	0.358	11.3	0.672	0.918	0.795	25.1
Total		1.506	2.058	1.782	56.2	2.476	3.384	2.930	92.4

Source : National Water Supply and Drainage Board (NWSDB)

Table 3-12: Monthly Potable and Industrial Water Demand "With Project"

Oct.	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total/Avg
5	5	5	5	6	6	7	7	7	7	5	5	**70 mcm**
1.867	2.48	2.24	2.701	2.614	2.701	2.614	1.867	1.929	1.867	1.929	1.867	**2.22 cms**

The monthly water supply demands of NCP computed according to the National Water Supply Drainage Board's forecasts are given in **Table 3.12** for Year 2030. Therefore, its distribution for 2018-22 and 2023-27 periods are assumed as 66% and 100% respectively. The demand forecasts for the townships of NCP and NP as given by the NWS&DB's letter No. ADGM/NC/78 dated 21-06-2011 addressed to the Secretary Ministry of Irrigation and Water Resources Management is given in **Table 3.13** below. The NWS&DB will implement proposed water supply schemes in the NCP and NP with the implementation of this project.

With the latest developments, NWS&DB now plans to abstract drinking water requirements of Rambewa and Medawachchiya from Mahakandarawa Reservoir and Padaviya, Kebithigollewaand Horowpatana PS from Wahalkada reservoir, while a project to provide drinking water to Vavunia is underway through new reservoir (Per Aru) exclusively for drinking water problem.

Table 3-13 : Drinking and Industrial Water Supply Demand of the NCP as NWSDB's letter No. ADGM/NC/78 dated 21-06-2011 addressed to the Secretary Ministry of Irrigation and Water Resources Management

No.	Divisional Secretaries Divisions	Drinking Water Requirement (MCM/ Year)	No. of Beneficiaries
A	**North Central Province**		
1	Rambewa & Mihintale	3.6	
2	Kahatagasdigiliya & Ratmalgahawewa	3.6	
3	Medawach chiya	4.5	
4	Horowpatana	3.3	**300,000**
5	Kebithigollewa	2	
6	Galenbidunu Wewa	4.6	
7 .	Future Expansion	12	
	Sub Total for NCP	*33.6*	
B	**North Province**		
1	Vavuniya	5.47	30,000
2	PulliyanKulama	1.46	8,000
3	ManKulam	1.82	10,000
4	Omanthai	1.82	10,000
5	Future Expansion	5.83	
	Sub Total For NP	*16.4*	58,000
	Total for NCP & NP	**50**	**358,000**
	Additional for NP	**20**	
	Grand Total for NCP&NP	**70**	

3.5.5 River Maintenance Flow

All water users along a river course should have easy access to their day-to-day requirements in the river as the need arises. The excessive consumptive use or pollution of water by any water user will affect the requirements of a downstream user in both quantity and quality. Therefore, any diversion or extraction of water away from the river should guarantee the requirements of the downstream users unaffected. In this regards the river maintenance flow is the minimum discharge required to maintain sufficient depth of water, flow velocity, water quality, aquatic ecosystem and scenery, requirements of all the livestock in and around the river, sea water extrusion, prevention of estuary clogging, ground water table and riparian rights of people, etc.

The defining of river maintenance flow will limit excessive withdrawal from a river. Therefore, river maintenance flow at strategic locations should be based on realistic assessment of minimum flow requirements from the natural flow series. The **Table 3.14** shows maintenance flows allowed at strategic locations in this project. Therefore, river maintenance flow selected should be the highest value of minimum monthly flow or 10% of minimum monthly average flow of the time series adopted for that location. Nevertheless, the recommended flows are large enough to maintain sufficient depth across the river section for the present water users to continue to enjoy the right for access to the river water flow even in the future "With Project".

Table 3-14: River Maintenance Flows Allowed at Strategic Locations in cumec

Location	River	10% of minimum monthly average	Month of occurance	Minimum monthly value	Month and Year of occurance	Allowable minimum environmental flow
Polgolla	Mahaweli	0.90	February	0.75	Mar-72	4.25
Lower Uma Oya	Uma Oya	0.16	August	0.92	Mar-88	1.00
Kalinga Nuwara	Mahaweli	0.32	June	0.22	Jul-90	4.25
Hasalaka*	Hasalaka Oya	0.01	August	0	Feb,Jun-Sep	0.50
Heen Ganga**	Heen Ganga	0.01	August	0	June, Aug	0.10

** 2.4 and 0.4 cumec to be released to Minipe LB during month of June and July respectively each year from Heen Ganga Reservoir for irrigation requirements and 0.1 cumec during balance period

* 0.5 cumec should be released as environmental and irrigation requirements from Hasalaka reservoir

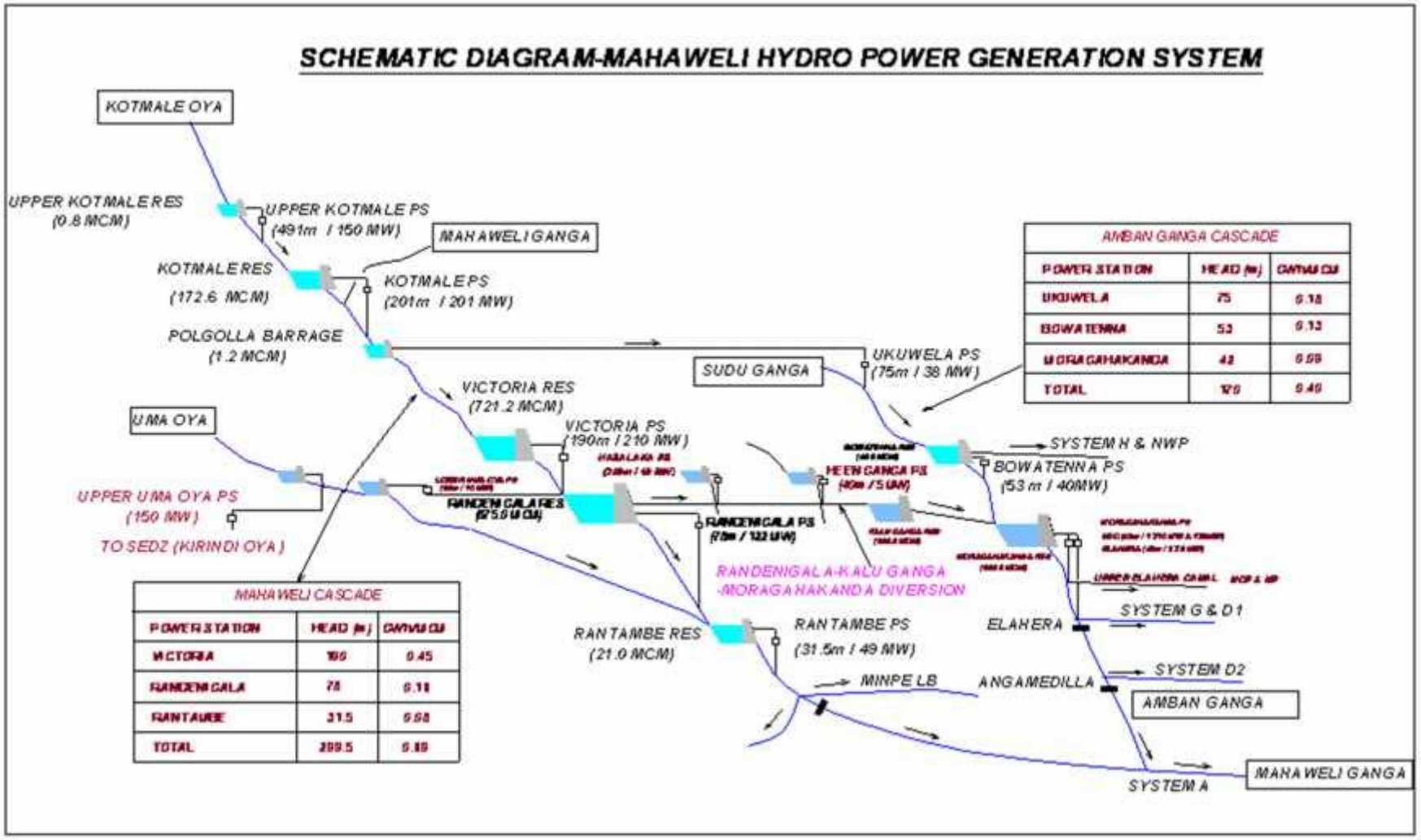
3.5.6 Multipurpose Water Use

A multipurpose reservoir system like Mahaweli cannot be operated to maximize the energy benefits without affecting the water availability for irrigation purposes. Similarly, meeting irrigation demand as the first priority can affect the energy benefits realized from the power stations. If more Mahaweli water is diverted from Polgolla for irrigation development in Amban Ganga system there will be an adverse effect on power production due to the head loss (129.5 m) compared to that of diversion from Randenigala (67.5 m). Any diversion below Rantembe involves no loss of energy generation but involves high cost of pumping in more difficult terrains having many concerns on environmental, social, wild life and forests etc. The **Figure 3.1** clearly shows the two cascades and the generating heads involved.

The interactions of irrigation and power demands have been closely examined and an ideal location for the diversion of Mahaweli to Amban Ganga has been identified as Randenigala after careful consideration of various alternative paths studied in the prefeasibility study.

In developing the operating rule curves for multipurpose reservoirs "With project", careful consideration was given for maintaining overall energy generation of the system unaffected while maximizing the energy generation at individual stations. A rule curve for a multipurpose reservoir define a level above which power demand can be satisfied without restrictions, and below which irrigation demands would dictate release volumes. When the Mahaweli component of the National energy demand is applied on the system the individual hydropower station would generate energy depending on the prevailing water level of the reservoir and downstream demand.

Figure 3-2: Schematic Diagram – Mahaweli Hydropower Generation System



4. WATER BALANCE STUDY

The major uses of Mahaweli Water Resources are for hydroelectric power generation and for irrigated agriculture. At present, the Polgolla diversion to Amban Ganga is limited to 875 MCM on average and this is only a 41% of the total flow available at Polgolla. This arrangement had been acceptable to each sector and served the purposes of both parties. Nevertheless, conflicts may arise in case of any proposal to divert further quantity of Mahaweli Ganga flows away from the path of maximum generating head to serve the irrigation needs in the Amban Ganga basin as explained in section 3.5.6. Less significant conflicts can also arise over the timing of reservoir releases either for power or irrigation purposes. Therefore, the selection of correct location and correct volume of diversion is of paramount important to avoid any conflicts in loss of energy or generating head and this factor had been carefully studied and selected in the present study. Allowing sufficient quantities of river flows at strategic locations as river maintenance flow in consideration of environmental and drinking water needs of in-stream water users is an another positive step taken in this study in the same direction.

4.1 System Characteristics

The Mahaweli system characteristics of the reservoirs , hydropower plants, conveyance canals and tunnels as used by the WMS, MASL, Irrigation Department (ID) and Ceylon Electricity Board (CEB) in short-term, long-term operational planning and daily operation activities etc., are summarized in **Figure 2.2.** All the basic items in this system are represented by a set of nodes with and without storages connected with channels having flow limits, as shown in **Figure 4.1**.

In order to minimize the complexity of the Mahaweli water resources system reservoirs of storage capacity more than 5 MCM are included in the network. Nevertheless, the large numbers of minor and major reservoirs available in potential irrigable areas are represented by a combined reservoir equal to the total storage of all the reservoirs in the system. The inflow channel to the combine reservoir represents total of all the inflow to individual reservoirs. The active storage zone of a reservoir is divided in to 7 zones and 6 zones below Rule Curve is divided into equal volumes having increasing penalties assigned to each of the storage zones. Each storage zone has a purpose in storing and releasing water according to system water demand such as flood control, flow conservation and augmentation. As such, there is a penalty for every withdrawal of unit volume with respect to the zone it occupies. A similar set of reservoirs can have one set of zonal penalties but can be differed by a value assigned to a reservoir based on their priority for withdrawal or storing within the set. The upper zone is for storing floods and hence, rule curves derived should keep low before the rainy season starts to store maximum amount of floods as possible and keep high as possible at the end of the rainy season. Nevertheless, the end of the month position of reservoir levels (Rule Curve) are positioned at correct levels over the year in order to minimize the spillage, to maximize the hydropower generation and to minimize the irrigation deficits by trial and error method.

4.2 Simulation Period and the Time Step

The WMS of MASL, as an organization responsible for overall operational planning and regulation of Mahaweli system has been using a simulation period of 30 years in their simulation studies. Their studies are for the simulation of 6 months period of Yala (Dry) or Maha (Wet) season. However in order to accommodate more critical wet and dry spells occurred in the past, a simulation period of 40 years has been used in this study. This covers the most critical dry period in the seventies and

wettest period in the latter part of 2000. A simulation has been carried out for the last 20 year period too for comparison purposes.

The time step adopted in this study was one month, which is the accepted standard in this type of feasibility studies for long term planning.

Table 4-1: Water Balance Study (Simulation Results)

Features	Station\Run No \STAGE	Actual (2006-2010)	A1A W/O MORA	A2A Stage 1 WI MORA	A3A Stage 1	A4A Stage 1	A5A Stage I	A6A Stage II	A7A Stage III	A8A Stage III	A9A Stage III	A10A Stage III	A11A Stage III (1991-2010)	A14A Stage III refined new hydro
	Time frame			2018-22	2018-22	2018-22	2018-22	2023-27	2028-32	2028-32	2028-32	2028-32	2028-32	2028-32
Proposed Irrigation Developments														
NCP	Under minor tanks						5,000 180%	25,000 180%	25,000 ha 180%	33,000 ha 180%	33,000 ha 180%	33,000 ha 180%	33,000 ha 180%	33,000 ha 180%
	under major tanks					5,500 ha 180%	5,500 180%	10,000 180%	10,000 ha 180%	20,000 ha 180%	20,000 ha 180%	20,000 ha 180%	20,000 ha 180%	20,000 ha 180%
	Kantale (sugarcane)					5,120 ha 200%	5,120 200%	5,120 200%	5,120 ha 200%	6,576 ha 200%	6,576 ha 200%	6,576 ha 200%	6,576 ha 200%	6,576 ha 200%
NWP	Under minor tanks				9,000 ha 180%	9,000 ha 180%	9,000 180%	9,000 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%
Maduru Oya RB					10,000 ha	10,000 ha	10,000 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%
Proposed WS Demand (overall)							33%	66%	100%	100%	100%	100%	100%	100%
Target Diversions (mcm)														
	Polgolla	875	875	875	875+100	875+300	875+300	875+375	875	875	875	875	875	875
	Randenigala								600	200+400	200+400	200+400	200+400	200+400
	Heen/Hasalaka Res						100	150	150	150	150	150	150	150
	Angamedilla-Minneriya							54	75		75			75
	Kalinga Nuwara+Angamedilla									225		225	225	225
	Kalinga Nuwara-UEC										150			
New Features added														
	Cropping Pattern	Type I	Type I	Type II	Type II	Type II	Type II	Type II	Type II	Type II	Type III	Type III	Type III	Type III
	Moragaha+Kalu Res			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Upper Elahera canal			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Lower Uma Oya Res					yes	yes	yes	yes	yes	yes	yes	yes	yes
	Randenigala Diver								yes	yes	yes	yes	yes	yes
	Heen Ganga Res						yes	yes	yes	yes	yes	yes	yes	yes
	Hasalaka Oya Res							yes	yes	yes	yes	yes	yes	yes
	div UEC to MH+IH			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	div UEC to I			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
SIMULATION RESULTS														
Diversion	**Polgolla**	882	941	849	934	1185	1207	1244	871	853	854	868	808	873
	Nalanda (Wemedilla)		0	0	56	56	56	55	54	54	54	53	50	52
	to Bowatenna		0	74	18	18	17	19	20	20	20	21	27	27
(mcm)	**Bowatenna**	570	725	603	644	637	626	586	643	642	636	658	653	658
	KH Canal	196	211	143	141	142	141	136	136	136	136	135	132	134
	NWP	0	0	0	68	67	67	53	94	95	95	99	99	99
	Dambulu Oya	382	514	460	435	428	418	397	413	411	405	425	422	425
	Nachchaduwa	35	96	13	11	8	9	12	10	10	9	15	18	16
	Tisawewa	14	16	16	16	16	16	15	15	15	15	15	15	15
	Upper Elahera Canal	0	0	234	236	348	488	725	778	987	844	974	961	972
	NCP	0	0	0	0	0	144	414	452	647	661	640	632	639
	Mannan/Hurulu	0	0	222	225	331	322	277	289	294	301	287	281	287
	Huruluwewa	41	61	82	82	144	143	126	128	128	130	128	126	128
	Mannakattiya	0	0	141	143	186	179	151	161	166	171	159	155	159
	Mahakandara	0	0	42	41	72	70	62	64	64	65	64	63	64
	Nachchaduwa	0	0	103	105	109	103	87	103	99	103	93	91	93
	EMYE	620	705	715	718	851	840	746	765	598	756	617	606	616
	Minneriya	415	377	390	393	515	507	432	448	284	429	300	295	300
	Kaudulla	0	103	103	121	121	118	113	119	116	113	119	114	119
	Kantale	0	126	133	119	238	232	234	240	253	246	278	268	277
	Giritale	104	79	76	76	75	75	68	69	79	79	81	80	81
	Angamedilla	398	341	328	328	331	330	309	311	331	347	306	303	306
	Randenigala-Heen	0	0	0	0	0	0	0	590	544	551	555	534	557
	Heen-Kalu Ganga	0	0	0	0	0	71	136	686	646	654	659	645	651
	Kalu Ganga-Moraga	0	0	91	90	90	167	241	779	768	775	771	756	763
	Minipe LB	342	347	349	349	349	328	320	318	318	318	318	311	311
	Minpe RB	1137	1062	1107	1351	1325	1324	1251	1226	1228	1227	1239	1204	1239
	Maduru Oya	432	455	464	726	713	712	639	623	628	627	632	616	632
	Kalinga to UEC/MIN										166 UEC	182 Min	174 Min	182
	Kalinga Nuwara-Anga	0	0	0	0	0	0	0	0	241				
	Angamedilla-Minneriya	0	0	0	0	0	0	58	54	230	74	61	51	61
Mahaweli	**Div to Amban Ganga**	882	941	849	934	1185	1278	1380	1557	1739	1674	1709	1626	1706
SPILL FLOWS	Polgolla	1116	1174	1266	1181	931	908	872	1244	1263	1261	1247	1085	1243
(mcm)	Minipe	910	1039	933	606	391	391	430	253	307	300	280	169	279
	Elahera	311	201	57	41	54	36	40	70	11	12	10	4	10
	Angamedilla		479	194	177	198	177	135	177	120	33	84	89	83
	Kalinga Nuwara		2503	2416	2089	1873	1873	1906	1729	1541	1608	1643	1453	
Power Flows	Kotmale	810	856	846	847	856	856	854	859	856	858	858	785	858
(mcm)	Victoria	1454	1502	1592	1514	1304	1282	1234	1645	1634	1638	1630	1509	1624
	Randenigala	1919	1941	2016	2124	1919	1898	1841	1658	1722	1718	1694	1590	1689
	Rantembe	2182	2304	2253	2174	1972	1951	1900	1733	1773	1769	1766	1668	1761
	Polgolla	882	941	849	934	1185	1207	1244	871	853	854	868	808	873
	Bowatenna	492	533	562	550	809	843	919	487	469	476	469	437	474
	Moragahakanda			789	776	1100	1160	1292	1562	1547	1559	1542	1538	1541
	Lower Uma Oya				181	188	188	181	170	193	193	183	196	183
	Upper Uma Oya			152	152	151	151	151	151	151	150	146	152	146
	Heen Ganga						75	82	75	78	78	79	83	88
	Hasalaka							62	56	58	59	59	61	63
Energy	Kotmale	426	451	448	447	443	443	439	447	444	444	445	408	445
(GWh)	Victoria	684	723	758	714	579	569	558	690	701	698	696	643	694
	Randenigala	319	388	403	422	366	362	356	303	321	319	309	290	308
	Rantembe	171	188	184	177	152	151	150	125	132	131	131	125	130
	Polgolla	166	172	156	171	216	220	226	159	156	157	159	149	160
	Bowatenna	57	69	73	71	105	109	119	63	61	62	61	57	62
	Moragahakanda	0	0	59	56	82	85	98	133	111	112	107	107	107
	Lower Uma Oya	0	0	0	24	25	25	25	21	25	25	26	27	25
	Heen Ganga						4	5	6	6	6	6	7	7
	Hasalaka							35	33	34	34	35	36	31
	Total (Project)	1823	1992	2081	2083	1969	1968	2010	1981	1990	1987	1975	1849	1970
	Upper Uma Oya	0	0	294	294	293	293	294	293	293	292	284	297	284
Moragaha-	Power Flow	0	0	789	776	1100	1160	1292	1562	1547	1559	1542	1538	1541
Kanda	Spill Flow	0	91	13	8	12	9	10	13	9	10	8	4	7
(mcm)	Bottom outlet	0	814	203	211	140	196	210	38	41	43	51	30	50
Water Supply	under Moragaha/Kalu	0	92	39	39	39	39	56	92	92	92	92	92	92
(mcm)	Under NCP Project	0	45	45	45	45	45	45	70	70	70	70	70	70

4.3 Method of Analysis

4.3.1 ACRE's Reservoir Simulation Program (ARSP) and Irrigation Demand Model (AIDM)

A complete water balance study has been carried out using ARSP computer model, which is a general multipurpose and multi-reservoir computer model which has been developed by the ACRE's International Ltd, Canada. A major advantage of this model is its flexibility in allowing the user to make structural and operating policy changes by modifying the input data rather than by changing the computer program itself. The main features of the Mahaweli water resources management system is represented in the model with nodes and links. The nodes and link representation of Mahaweli system is shown in **Figure 4.1.** Out-of-Kilter algorithm, which will decides least cost paths to send water to the demand point from the source of water will govern the distribution of water in the system.

ACRE's Irrigation Demand Model (AIDM) computes sets of irrigation demand time series for all the committed irrigation systems in all the river basins receiving Mahaweli water. These time series are going to be an input to the ARSP.

4.4 Results of Water Balance Simulation and Water – Use Plan

A series of simulation runs have been carried out for all three Stages of developments (Stage I, II and III) and making use of all three cases (A, B and C) of water usages. The results of the simulation runs are summarised in **Table 4.1**, and illustrated in **Figure 4.2 - 6.** The results of the simulations are described below.

4.4.1 Water Balance Simulation under Present Condition (Existing System: Case A- Run No. A1A) (Polgolla Diversion: 875 MCM)

The water balance simulation was carried out for the existing system which includes the irrigation areas under MDP and AMDP using the AIDM and ARSP computer Models.

For the correct estimation of water requirements for the future developments the present conditions of water balance in the Mahaweli Ganga system is an essential component. The available water resources for future development plan, the future water-use efficiencies of irrigation systems and possible reservoir operation rule curves can be established with this knowledge base.

Simulation run A1A predicts the system performance if the present configuration of Mahaweli system was in existence for last 40 years with present day irrigation water requirements, drinking water supply requirement and hydropower generation are imposed on this system as demands and simulated for 40 years using rainfall series over the irrigation systems and inflows time series at control points. There is no actual data series available to compare with the simulated results, but the system performance of the present system (base-case) is very much useful to compare with "With Project" scenarios. See **Table 4.1** for details. The last five years' average system performance (2006-2010) is also given in the Table to visualize the existing system performance for the present system configuration.

Figure 4-1: Representation of Mahaweli System in Nodes and Channels

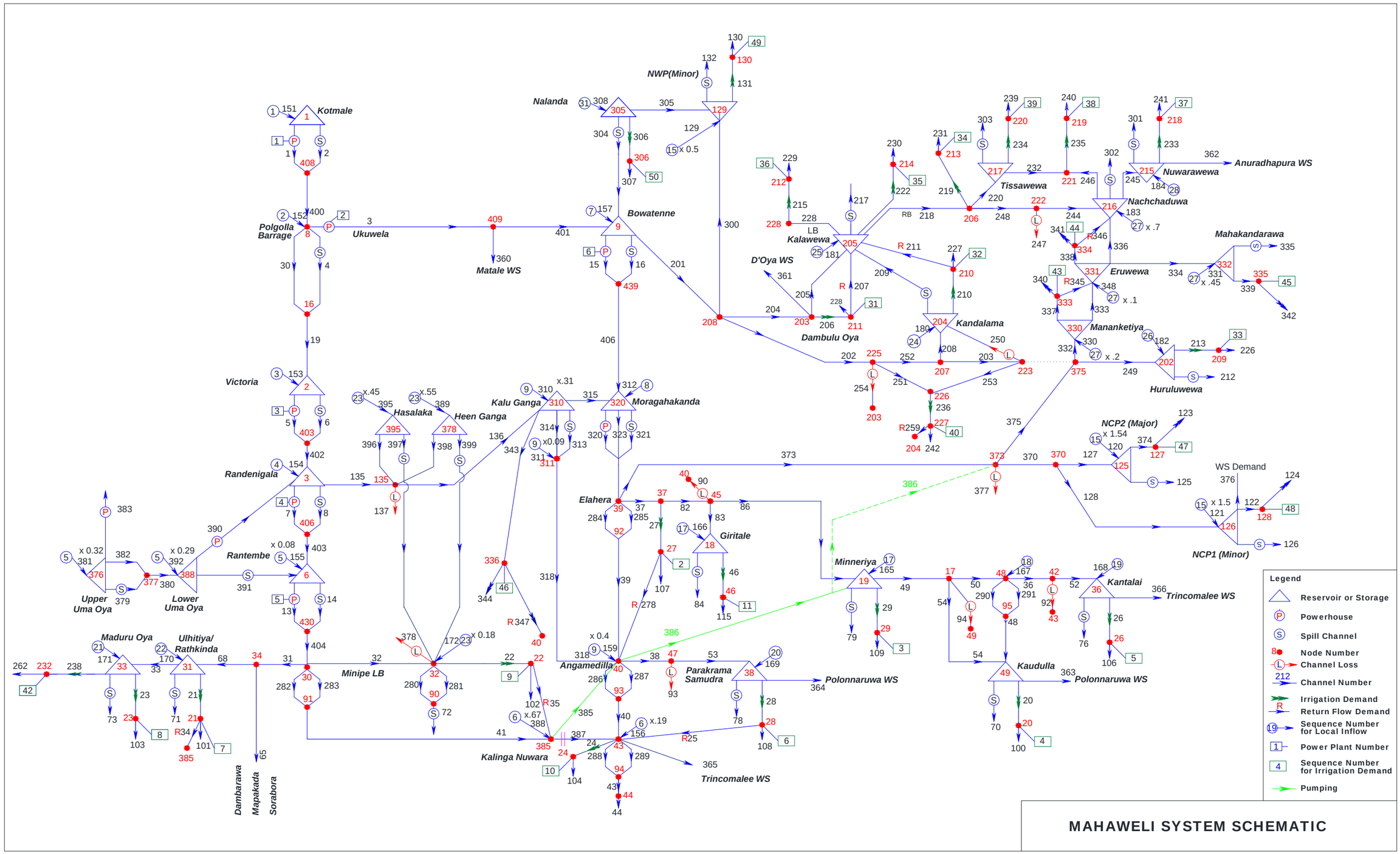


Figure 4-2: Water Distribution Diagram for time frame 2018-22 stage I

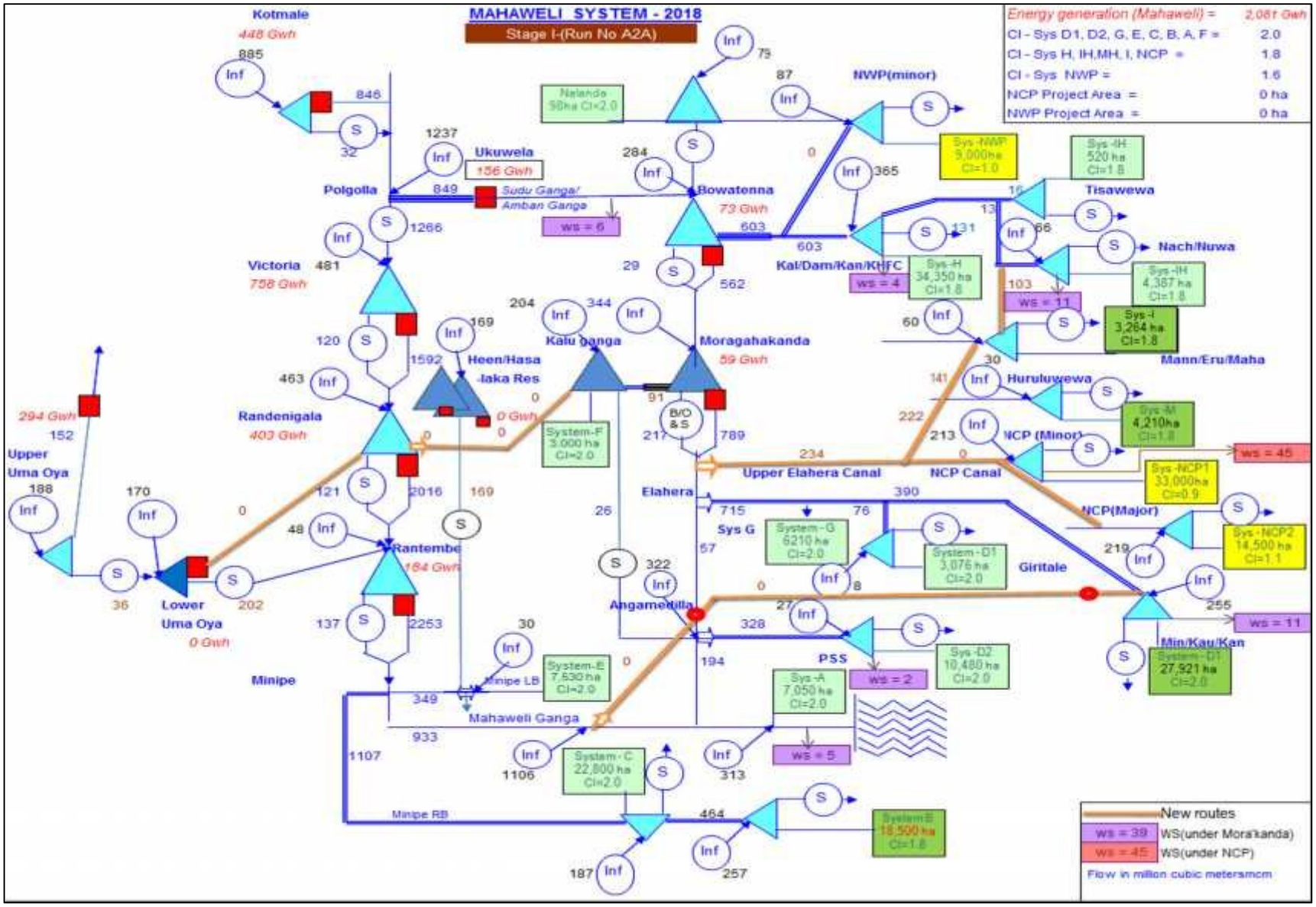


Figure 4-3: Water Distribution Diagram for time frame 2023-27 stage II

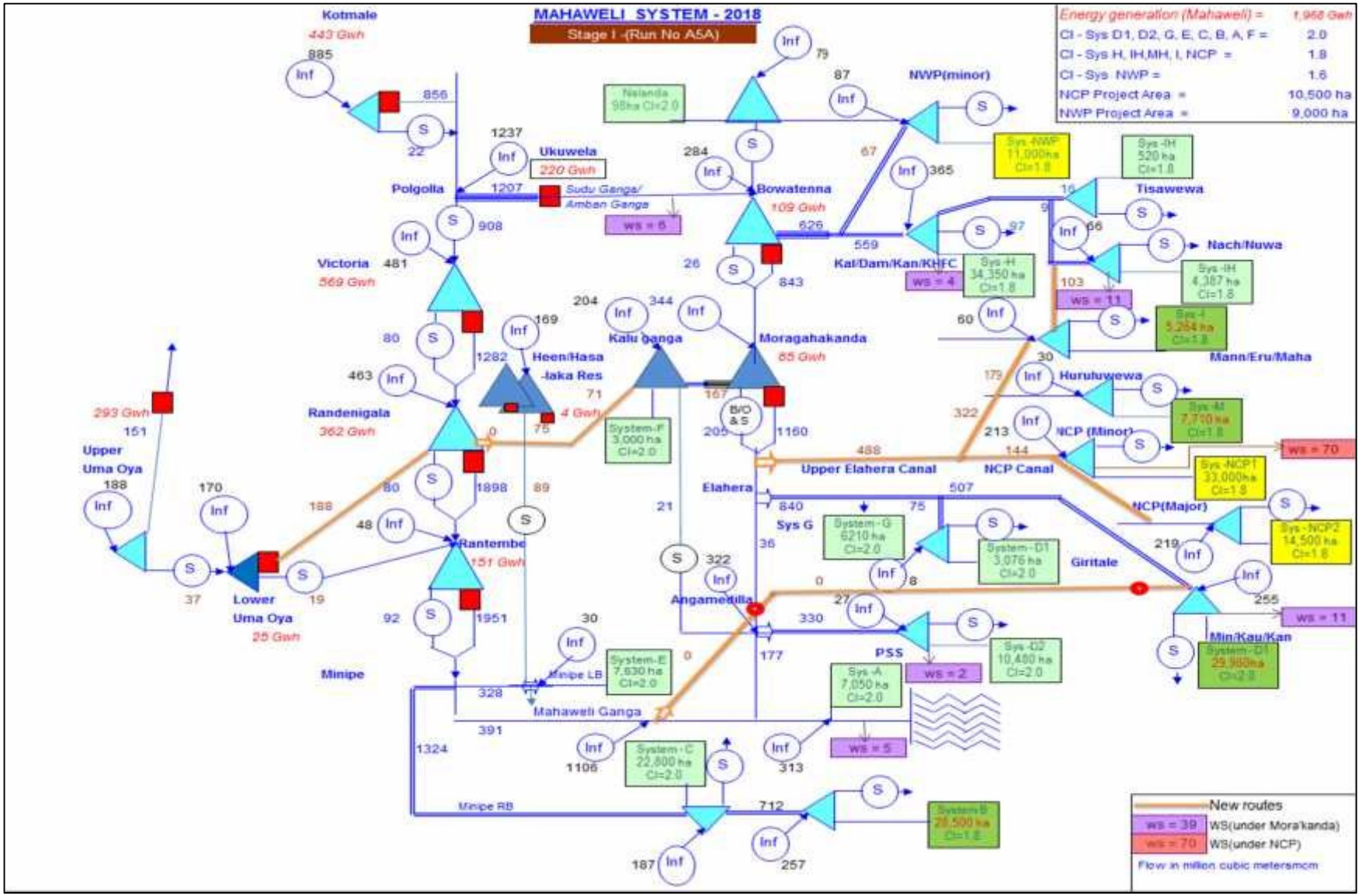


Figure 4-4: Water Distribution Diagram for time frame 2028-32 stage III

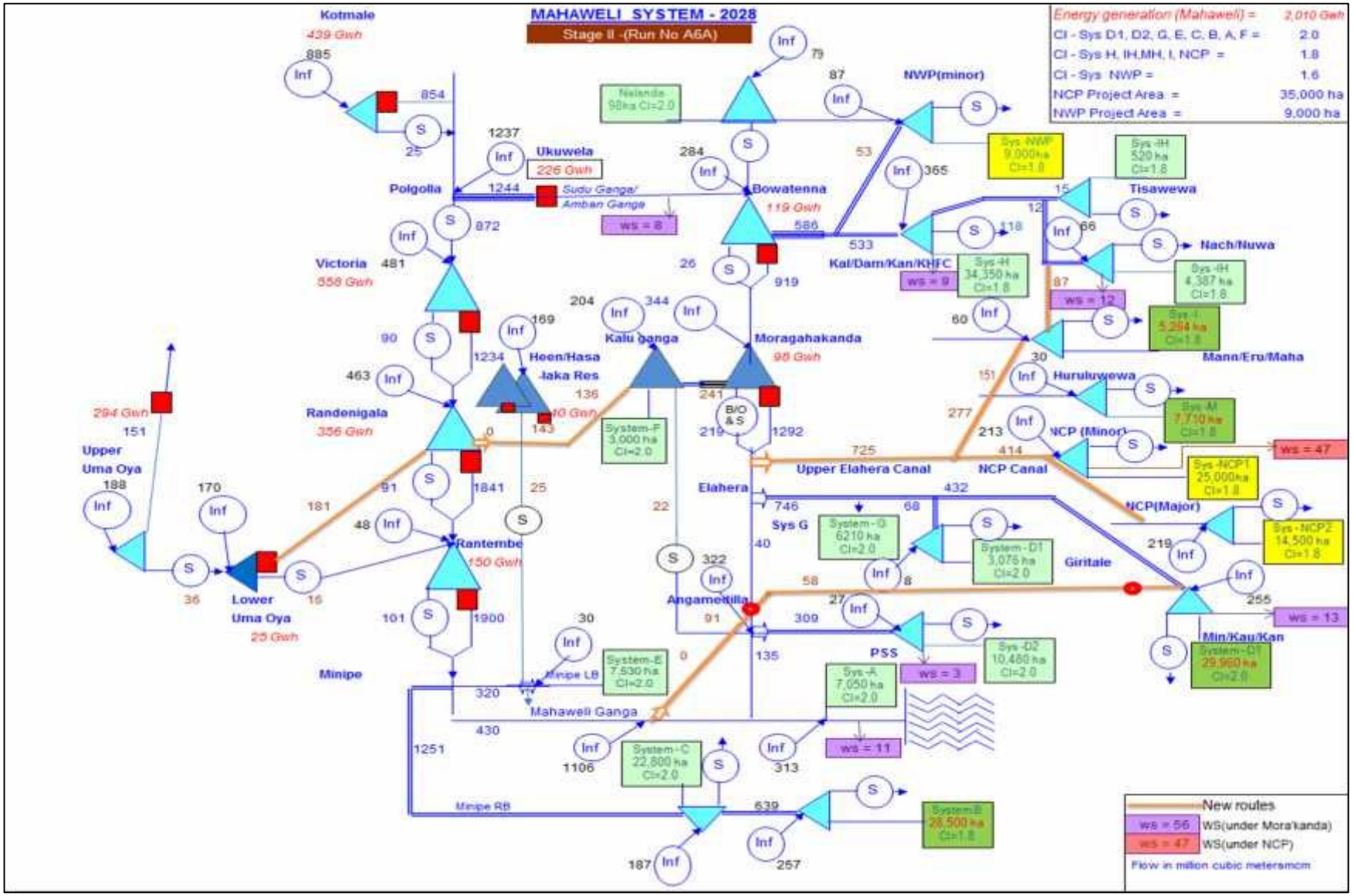


Figure 4-5: Water Distribution Diagram for time frame 2028-32 stage III (simulation period 1991-2010)

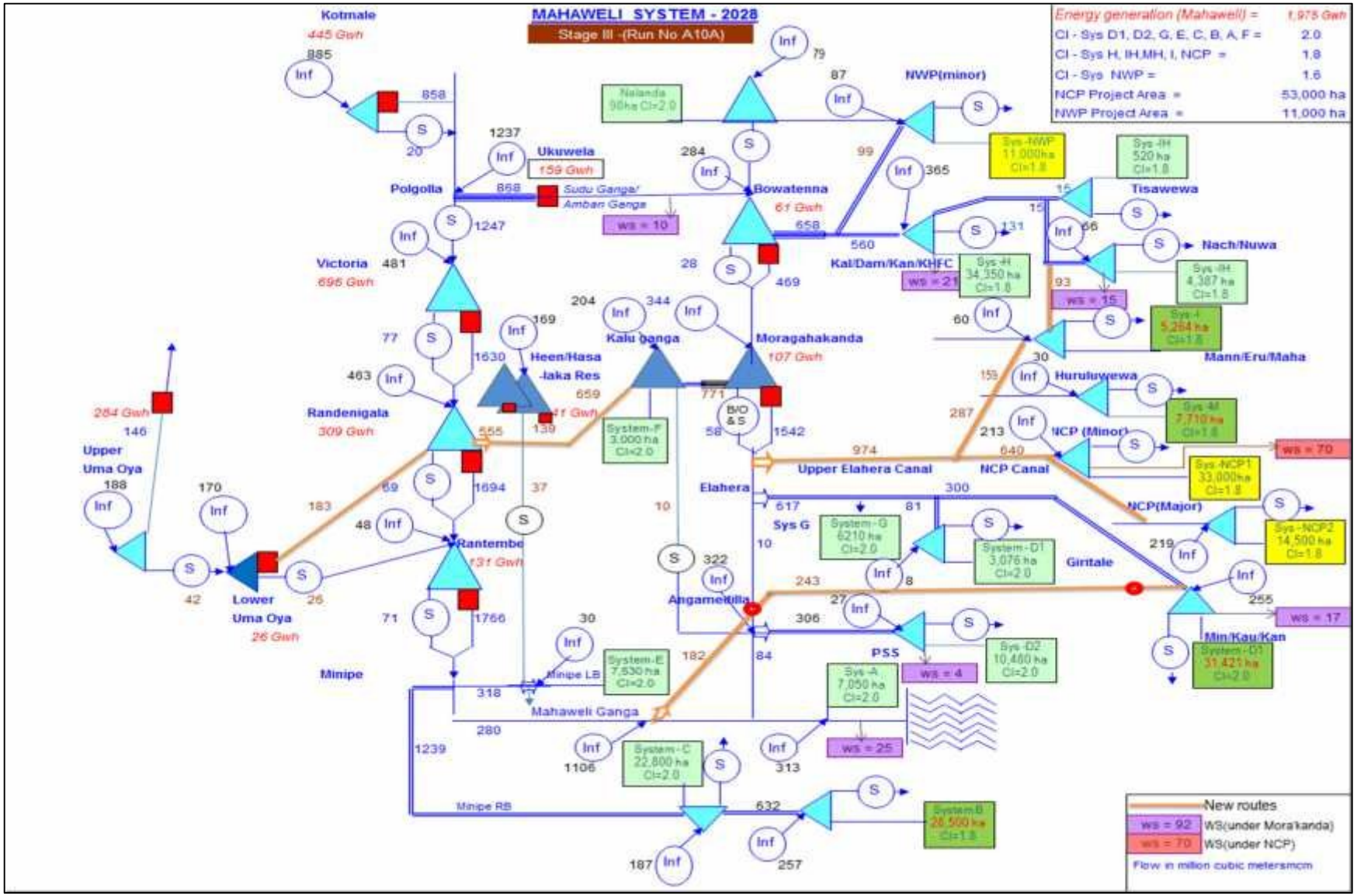


Figure 4-6: Water Distribution Diagram for time frame 2028-32 stage III (simulation period 1991-2010)

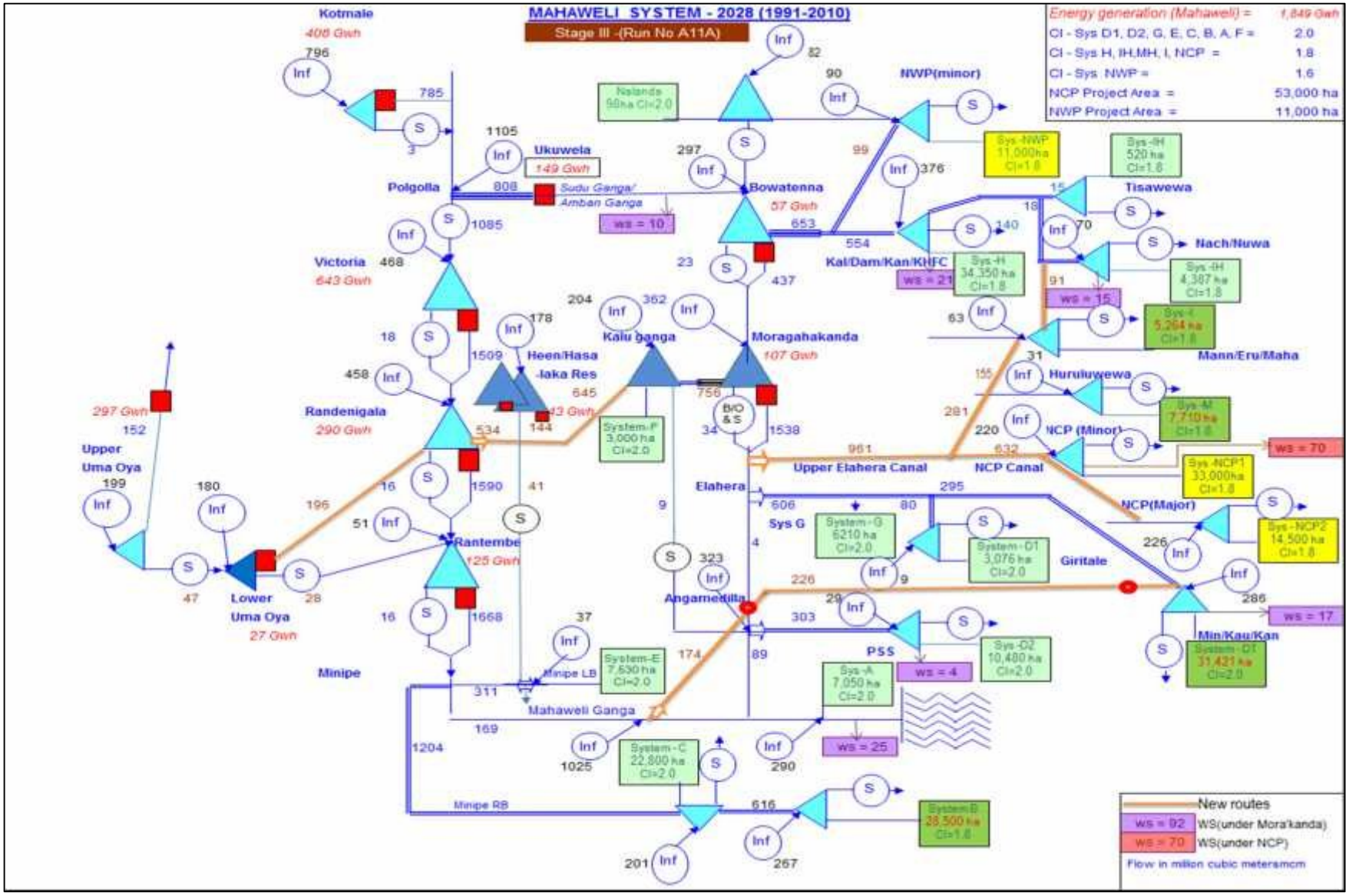


Table 4-2: Average Monthly Spillages at Diversion Anicuts- without Kalu/Mora (A1A)

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Angamedilla	1	36	155	155	50	39	43	0	0	0	0	0	479
Minipe	112	200	235	157	30	37	76	31	46	39	31	45	1039
Kalinga Nuwara	190	338	486	461	190	138	137	117	127	123	109	87	2503

The water availability at target diversion points are given in **Table 4.2** as per simulation run No A1A. The total spillage at Minipe is 1,039 MCM and about 2,503 MCM at proposed diversion site at Kalinga Nuwara downstream of Minipe anicut on main Mahaweli Ganga and about 479 MCM at Angamedilla on Amban Ganga. The monthly distribution of these spillages is shown in **Table 4.2** which are going unutilized at present. After allowing for the river maintenance flow, such surplus water could be utilized for irrigation purposes. According to **Table 4.2** this surplus water is available mainly during Maha season.

The proposed Moragahakanda and Kalu Ganga projects will reduce spillage at Angamedilla anicut and hence residual spillage after this project will give a better picture of the water availability in the system. Hydropower plants are generating energy even during the Maha season either to minimize the spillages in reservoirs or to maintain the required peak power and firm energy requirements in the system. Nevertheless, irrigation requirement during this period is low. Therefore, once the proposed Moragahakanda and Kalu Ganga reservoirs come in to operation, together with Minneriya, Kaudulla and Kantale system should be utilized in full capacity for storing water during Maha season in 'With Project" situation. Even Victoria and Randenigala should be utilized for this purpose in making the Mahaweli water resource system a fully utilized multipurpose reservoir system. Maintenance of high reservoir levels in the main Mahaweli will increase the total energy generation too.

Therefore, in order to utilize surplus water in the Maha season Mahaweli Hydropower reservoirs could be utilized for storage purposes and generate only the irrigation requirements. The proposed modifications to the Minipe anicult and diversion of lower Uma Oya water to Randenigala will enable generating even Rantembe hydropower station as a peaking plant under "With Project" situation in this Stage.

4.4.2 Water Availability after Kalu Ganga and Moragahakanda (Case B/Stage I - Run No. A2A)

The Moragahakanda and Kalu Ganga Projects together with Kalu Ganga link tunnel and Upper Elahera canal will make available a much needed storage and a new conveyance route with separate outlets for each irrigation system for diversion of Mahaweli water. The main benefit of this system configuration will give 200% CI to systems D1, D2, F and G while systems H, KHFC, IH, MH and I will get minimum of 180% CI if their present CI is below 180% or continue to enjoy present CI if it is more than 180%. The systems IH and MH will get direct issues from the UEC. In this Stage it is assumed that Upper Uma Oya diversion is implemented. The water availability at important diversion points after Moragahakanda and Kalu Ganga is given in **Table 4.3.**

Table 4-3: Average Monthly Spillages at Diversion Anicuts with Kalu/Mora (A2A)

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Angamedilla	0	2	50	68	26	31	16	0	0	0	0	0	194
Minipe	91	161	221	142	39	79	59	21	21	27	25	46	933
Kalinga Nuwara	183	317	475	449	193	168	130	116	98	111	83	93	2416

After allocating Mahaweli water to the committed area as described above the balance water available at Angamedilla has been reduced to 194 MCM. The Polgolla diversion is also reduced to 850 MCM annually. About 265 MCM of unutilized water within Amban Ganga system is used in the system together with savings from change of cropping pattern from case A to B. Still there is enough water at Angamedilla for diversion during Maha season.

According to **Table 4.3** the water availability at Minipe downstream and at Kalinga Nuwara has also gone down by 250 MCM. This is after allocating 150 MCM to Upper Uma Oya diversion to Kirindi Oya and firming up of CI in system E and C to 200% and System B to 180%. The water availability after Minipe and at Kalinga Nuwara is high enough to divert about 700 MCM annually to Amban Ganaga. Yet, sufficient water should be allocated for Maduru Oya RB development at Minipe and river maintenance flow at Kalinga Nuwara.

4.4.3 NWP & NCP (Stage I, Case B – Run Nos. A3A - A5A)

After considering the availability of Kalu Ganga and Moragahakanda projects and the amount of spillage at Polgolla, it will be beneficial if some immediate agricultural benefits can be realised with NCP project without disturbing the much needed energy generation in the Mahaweli system. Therefore, it is proposed to maximize the Polgolla diversion as a temporary measure and to derive immediate agricultural benefits “With Project” while maintaining the energy generation in the Mahaweli system over and above present generation.

The proposed Lower Uma Oya diversion project aimed at achieving increased energy generation and increasing the water availability at Randenigala is expected to come into operation with the completion of Kalu Ganga - Moragahakanda Complex. With the inclusion of this reservoir in the system any increase in Polgolla diversion is not going to affect the overall energy generation in the Mahaweli system since the power plants at Ukuwela, Bowatenna and Moragahakanda starts generating more. The raising of Minipe anicut by 4 m would enable the operation of Rantembe as a peaking plant.

The diversion to committed irrigation extent of 10,000 ha under Maduru Oya R/B is allocated by increasing the diversion to Maduru Oya link tunnel by 200 - 250 MCM in these simulation runs. At this Stage the spillway of the Maduru Oya reservoir should be raised up to its designed level of 98 m asl from 96 m asl.

In this Stage it is also assumed that Nalanda rehabilitation work has been completed and it is fully operational. Simulation Run (A3A) carried out to find out the maximum extent that could be cultivated under NWP has shown that 9,000 ha could be cultivated with a diversion of 68 MCM from Bowatenna tunnel outlet with increased Polgolla diversion of 934 MCM annually. The diversion to NWP has become possible with the rerouting the diversion to Nachchaduwa and Huruluwewa from the UEC.

From simulation Runs A4A to A5A the extents cultivable under minor and major tank systems are increased to 5,000 ha and 5,500 ha respectively and 5,120 ha of sugarcane cultivation under Kantale has been taken in to consideration with the raising of Polgolla diversion to 1,207 MCM annually. Allocation for domestic and industrial water requirements under Moragahakanda and Kalu Ganga is 50% while that for "With Project" is 66%. The augmentation of Amban Ganga with the implementation of Heen Ganga and connecting tunnel to Kalu Ganga was also included in this Stage with transfer of 80 MCM annually.

According to **Table 4.4** there is excess water available at Angamedilla during Maha season. This is the balance water available after diverting the irrigation and water supply requirements, which could be utilized for increasing the cultivable extents under NCP (**Table 4.4**).

Table 4-4: Average Monthly Spillages at Diversion Anicuts in Stage I (A5A)

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Angamedilla	0	2	40	65	24	30	15	0	0	0	0	0	177
Minipe	21	51	102	73	18	25	25	10	10	15	12	27	391
Kalinga Nuwara	113	207	356	380	172	114	96	104	87	99	71	73	1873

4.4.4 Maximizing Polgolla Diversion - Stage II (Case C – Run No. A6A)

As indicated in **Table 4.4** part of the excess water available at Angamedilla is utilized to augment Minneriya through pumping in this Stage. This will enable reduced diversion to EMYE enabling increased diversion to UEC. The other source of water utilized in this Stage is Hasalaka Oya power releases via Kalu Ganga. It is also expected that entire irrigation systems under Mahaweli to save water through better water management or by adopting improved cropping patterns and contribute towards diverting more to the NCP. The adoption of Case C Water demands in this Stage has resulted in increasing the water availability and increased diversion to UEC. The water availability at Minipe has also increased. See **Table 4.4 and 4.5.**

Increasing the area cultivable under minor tank systems in the NCP up to 25,000 ha and that under major tank system, (including Pavatkulam reservoir system) up to 10,000 ha has been possible with the increase of water availability in Amban Ganga as discussed above. About 66% of domestic and industrial water usage has also been allocated "With Project" and under Kalu Ganga and Moragahakanda Projects.

Table 4-5: Average Monthly Spillages at Diversion Anicuts in Stage II (A6A)

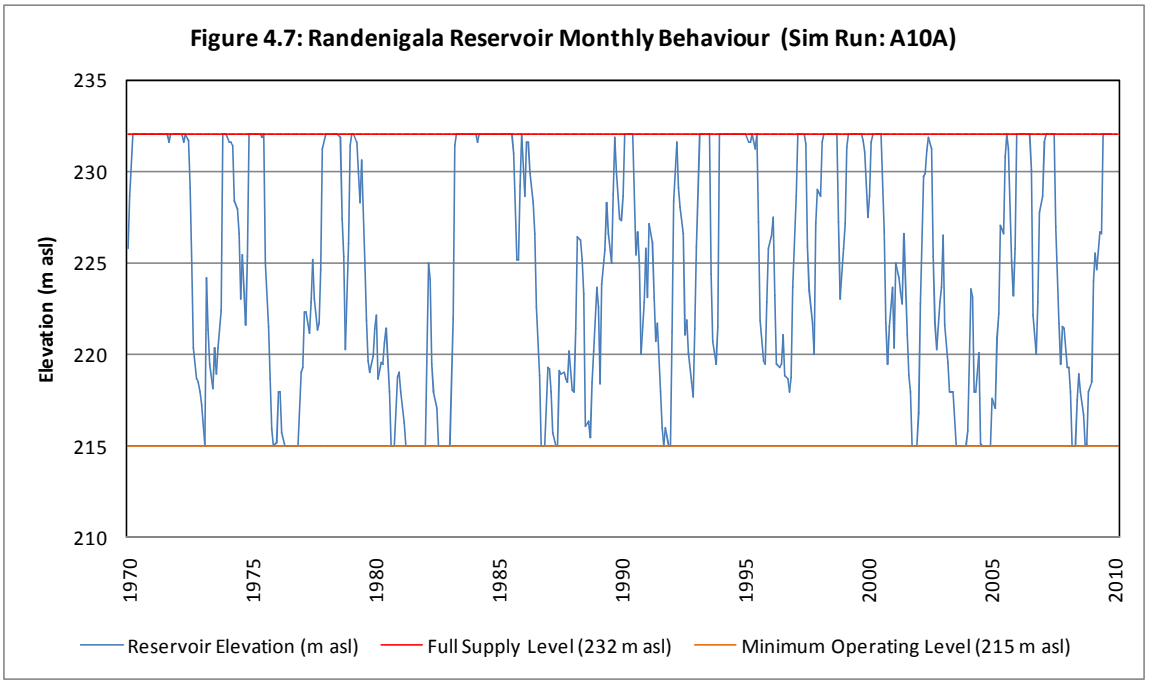
Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Angamedilla	0	0	36	45	22	21	11	0	0	0	0	0	135
Minipe	26	49	96	73	36	41	29	10	12	15	13	30	430
Kalinga Nuwara	118	205	350	380	169	129	101	110	99	106	67	74	1906

4.4.5 Polgolla Diversion 875 MCM – Stage III (Run Nos A7A – A10A)

In this Stage, the Polgolla diversion is reduced to 875 MCM with the commencement of diversion from Randenigala reservoir to Kalu Ganga reservoir. Victoria and Randenigala will be the main storage reservoirs for entire Mahaweli system now. At this Stage as the power releases from Hasalaka and Heen Ganga to Randenigala - Kau Ganga canal (R-K) increases, flow from Randenigala

will be decreased. The Randenigala Minimum Operating Level (MOL) for R-K Canal will be 215 m asl under average hydrologic situations. Nevertheless, it could be lowered to supply downstream irrigation requirements under dry hydrologic situation if necessity arises. The simulation results show that it has never gone down below 215 m asl during 40 year simulation period. See **Figure 4.7.**

Figure 4-7: Randenigala Reservoir Behaviour at Average Year (Sim Run: A10A)



With Randenigala diversion of 590 MCM annually and Hasalaka and Heen Ganga contribution of 75 and 56 MCM respectively the extent cultivable under NWP will be increased up to 11,000 ha with 180% CI in this Stage. The Nalanda diversion to NWP is 54 MCM while The Bowatena diversion is rising to 95 MCM. The water supply and industrial demand is also raised to 100% under both projects (refer Run No. A7A for details).

The last trans-basin diversion proposed is the Pumping option to transfer Mahaweli river flow at Kalinga Nuwara to Minneriya via Angamedilla. The total pumped volume of 240 MCM will cater for the final target area in NCP of 33,000 ha under minor tank system and 20,000 ha under major tank system. In addition the diversion to Kantale reservoir from Minneriya will make entire extent of sugarcane (6,576 MCM) could be provided with Mahaweli water (Sim Run No. A8A).

The last option of pumping Kalinga Nuwara excess water is going to create following adverse environmental effects:

- The movement of sand towards Manampitiya will be cut-off if a low head weir is constructed across Mahaweli Ganga at Kalinga Nuwara. As such, sand miners will move towards this point, which is declared as a wetland forest area with a high concentration of elephants.
- The division of the National Park due to the diversion channel running across the park will make the division of living habitat.
- The people of Polonnaruwa protest on using Kalinga Nuwara water in their irrigation system as an alternative to Amban Ganga water which they enjoy at the moment.

As a solution to the above issues this study has identified a natural pond and a suitable elevated location (a hillock) for a ground storage tank on the left bank at the project site for the pumping of Mahaweli water at Kalinga Nuwara. It is planned to pump water to this elevated storage tank and allow to flow under gravity up to Angamedilla along a set of buried pipeline laid across the National Park. The flood plain from Mahiyangana (downstream Minipe) to Manampitiya will be allowed to recharge during the rainy season (December – April) and pumping around 61 MCM to Minneriya will be mainly from Angamedilla with some occasional pumping of 23 MCM from Kalinga Nuwara on average. During the Dry season (May – November) an amount of 159 MCM is to be pumped at the rate of 10 cumec up to Angamedilla and from there pumping will be done to a proposed elevated tank and allowed to flow under gravity along a set of buried pipeline upstream of Minneriya Tank.

In the new arrangement there is no weir across the river but there will be a side spillway to collect water in the enlarged water body on left bank of the proposed weir site which will allow for the free movement of sand downstream without any interruption. RunNo. A10A gives the details of this simulation Run. The main disadvantage is the high operation and maintenance cost involved in pumping 108 m of head along a path of 42 km. In addition, it is unfair to divert Kalinga Nuwara water to UEC if the reason for the diversion is the bad quality.

It is observed that major part of Mahaweli water at Kalinga Nuwara comes through the regolith aquifer consisting of natural sand filters. Therefore, it is recommended to pump Kalinga Nuwara water to Angamedilla and from there to Minneriya with the assurance from the University field staff of its high quality standard at Kalinga Nuwara. See Appendix for Laboratory report on water quality test by the University field staff. After allowing sufficient spill water at Minipe (280 MCM annually) and river maintenance flow beyond Kalinga Nuwara (1,643 MCM) diversion from Kalinga Nuwara to Angamedilla and from there to Minneriya is recommended for implementation as it is the most economical and the most feasible one (See **Table 4.1** as per SR A10A).

4.4.6 Reservoir Rule Curves and Reservoir Behaviours (Sim Run No. A10A)

The long-term average storage of Victoria had been 54% level and Randenigala at 69% level during last 25 years (See **Table 4.6**). This study identifies that maintaining these two reservoirs above these storage levels is an essential requirement to maintain the eco-system in Victoria - Rantembe cascade without further deteriorating it in the future with planned diversion from Randenigala reservoir. Fixing Randenigala MOL at 215 m asl (above 58%) and allowing Victoria water levels to vary between MOL and FSL, it is possible to achieve better performance than actual situation in "With Project" situation. The adopted Rule Curves and the simulated average reservoir behaviours are given in **Table 4.6.** Applied rule curves for Victoria and Randenigala allows them to fill up during October to December with reduced Randenigala diversion. Nevertheless, Hasalaka, Heen Ganga and Kalu Ganga provide their excess water to meet the diversion requirements. After January, diversion from Randenigala increases until July, drawing from Victoria and Randenigala. Moragahakanda start drawing down after April. Hence, the behaviour of the reservoir levels over the simulation period for the three reservoirs is 54% for Victoria, 82% for Randenigala, 63% for Moragahakanda and 35% for Kalu Ganga. High storage level in Randenigala will definitely maintain water table high in the Mahaweli river basin. The reservoir behaviour of Main system and diversion along Randenigala to Upper Elahera Canal via, Kalu Ganga and Moragahakanda are also shown graphically in **Figure 4.8**. Applied rule curves for Victoria and Randenigala allows them to fill up during October to December.

Table 4-6: Rule Curves and End of the Month Reservoir Storages (MCM)-(SR_A10A)

Reserv	VICTORIA			RANDENIGALA			MORAGAHAKANDA		KALU GANGA	
Month	RC	Sim	actual	RC	Sim	actual	RC	Sim	RC	Sim
OCT	432	342	439	716	689	538	262	211	207	191
NOV	557	395	504	777	703	601	387	323	182	176
DEC	681	450	528	837	748	664	511	463	157	190
JAN	635	447	490	837	759	723	511	493	157	194
FEB	606	427	438	802	742	672	511	493	176	191
MAR	577	418	340	768	742	660	511	496	195	200
APR	547	435	292	733	747	663	449	493	213	215
MAY	518	398	266	699	709	616	387	392	232	215
JUN	501	369	308	664	679	543	325	312	232	210
JUL	484	328	336	630	650	484	262	246	232	202
AUG	466	317	332	595	637	468	200	191	232	203
SEP	449	317	357	656	661	510	138	155	232	207
% vol	75%	54%	54%	84%	82%	69%	66%	63%	36%	35%

4.4.7 River Maintenance Flow

The ancient irrigation diversion schemes like Minipe LB on main Mahaweli, EMYE and Angamedilla Yoda Ela on Amban Ganga can now be considered as part of natural river system due to their prolong existence. In the dry seasons, the entire river flow has been diverted, but other side streams joining after the diversion point together with drainage flows of upstream irrigation systems contributed towards maintaining the required river flows downstream. This way the ecosystems along the rivers were maintained and operating under regime conditions. There had been no any adverse effects to the river morphology, the downstream requirements of water users and any kind of environmental degradation. Therefore, in this study the diversion locations were selected after the conservation and storage zones of this water resource system to make this project a more sustainable and environmental friendly one.

Nevertheless, the diversion schemes came into operation under MDP, such as Polgolla and Bowatenna diversion had led to adverse environmental effects on main Mahaweli, but beneficial river basins like Amban Ganga and Kala Oya became more environmental friendly. Therefore, fixing of Polgolla diversion to long-term average of 875 MCM in the AMDP, which is 41% of the total river flow at Polgolla was a move in right direction. This diversion volume was considered to bring optimum economic benefits from hydropower generation and irrigated agriculture as well. The new diversions introduced at Minipe, Bowatenna and Elahera under AMDP had been following some diversion pattern to date and the river system had come to a different regime condition as per today. The new diversions volumes proposed at these diversion locations are safe in relations to river maintenance flow downstream. The estimation of river maintenance flow is based on the methodology established in section 3.5.5. The results are summarised in **Table 4.6.** The river maintenance flows for Polgolla, Lower Uma Oya and Kalinga Nuwara were included in simulation run of A10A.

Table 4-7: Proposed River Diversions and River Maintenance Flow

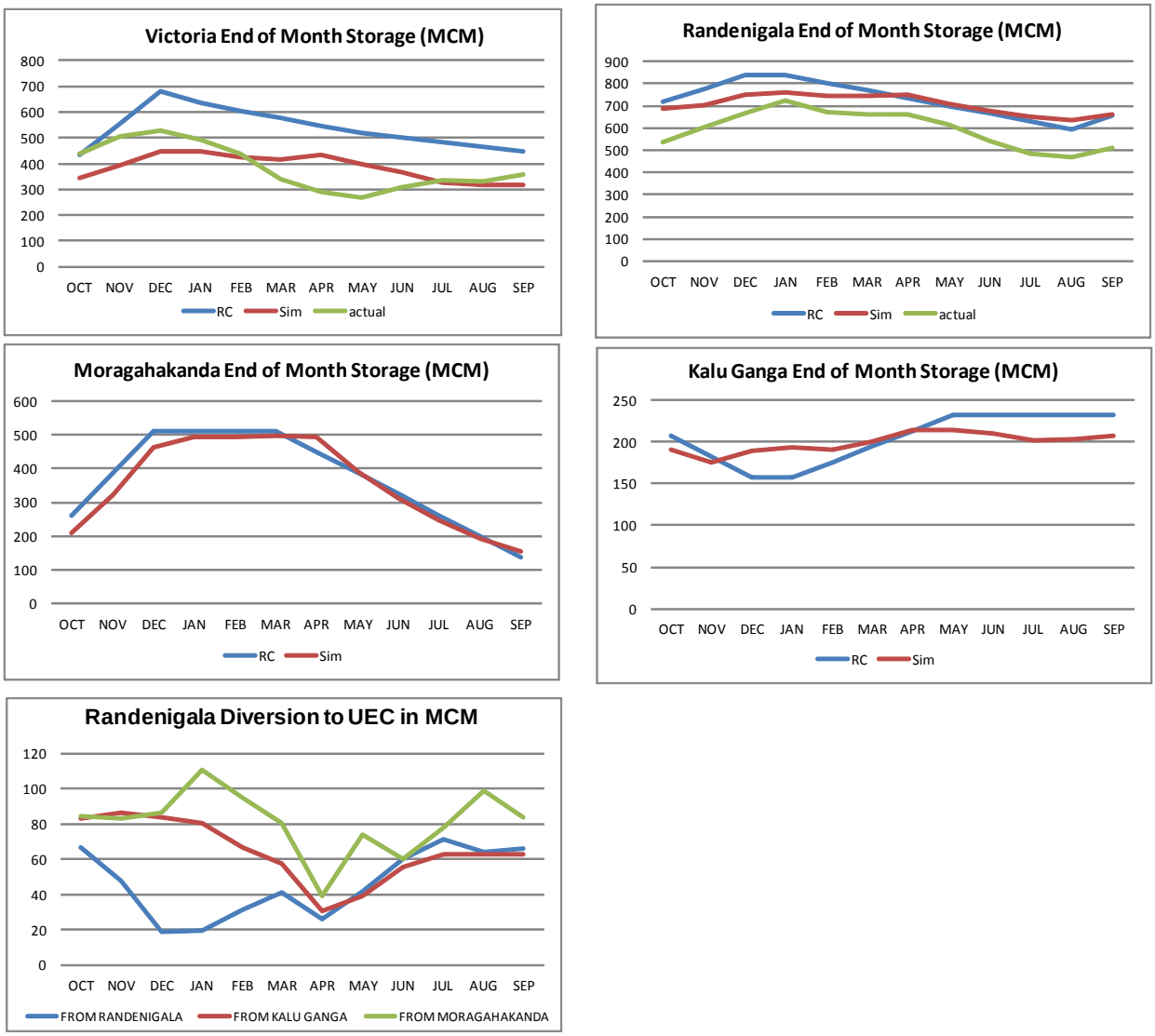
Control Point	Diversion (MCM)	% of Diversion	Maintenance Flow (MCM)	Minimum Mainten -ance Flow (m3/s)
Polgolla	868	41%	1247	4.25
Upper Uma Oya	146	78%	42	1.00
Lower Uma Oya	183	87%	26	0.75
Kalinga Nuwara	182	10%	1643	4.25
Hasalaka	79	83%	16	0.5
Heen Ganga	59	83%	12	0
Randenigala	555	24%	1763	6.71

Minimum river maintenance flow (MRMF) is given in the last column as read out from the results output of the simulation run A10A. The ARSP converts naturalized flow series in to river flow series using Pro-rata factors. This factor absorbs all abstractions in the river reaches for irrigation, water supply and industries etc. as such minimum maintenance flow excludes all such releases. The MRMF for Hasalaka will be 1 cumec during day time only to provide the requirements of Ratna Ella Falls and Ratna Ela scheme.

At Heen Ganga, there is an existing anicut diversion scheme to augment the stage IV of Minipe LB at present. After the proposed rehabilitation programme for Minipe LB, the diversion at Minipe anicut will be sufficient to meet irrigation demand of entire scheme. Nevertheless, the water balance study has shown deficits of 2.4 cumec in June and 0.4 cumec in July in the MInipe LB canal. Even though, these figures are less than 5% of total demand of Minipe LB requirement, if this deficit is concentrated towards the last reach of LB canal (stage IV) it will be a significant amount. Therefore, if such a situation arises this requirement has to be released from the bottom outlet of Heen Ganga reservoir. It is also revealed from field recognisance survey that Heen Ganga anicut diversion canal is being tapped and cultivating some?? ha of land. Sufficient quantity of water has to be released from Heen Ganga to augment the irrigation supplies of these schemes too.

Randenigala - Kalu Ganga canal which is running side by side with Heen Ganga Dam will receive Heen Ganga power flows at the foot of Heen Ganga Dam. The releases to Minipe LB will be 2.4 and 0.4 cumec during June and July respectively from the Randenigala - Kalu Ganga canal as per the simulation run A10A of the water balance study.

Figure 4-8: Main System Reservoir Behaviour and Diversion Along Proposed Randenigala to Upper Elahera Canal (Average 1971-2010/SR A10A)



4.4.8 Randenigala Diversion Policy

The simulation study results reveal that long-term average diversion at Randenigala is 555 MCM highest diversion is 826 MCM (1988/89) and lowest is 289 MCM (1982/83). The lowest diversion is a result of low water availability in main Mahaweli reservoirs during which time Moragahakanda was also operating at low levels. During the highest diversion time only Victoria was drawn down but the others Mahaweli reservoirs were above average. In operational planning Stage of this project the recommended long-term average diversion policy at Randenigala will be **550 MCM** in addition to the existing Polgolla diversion of **875 MCM** on average.

4.4.9 Proposed Priority Order for Diversions

In the operational planning Stage of this project after allowing for River Maintenance Flow, diversion of water for Irrigation systems within and among adjacent basins under average conditions should be carried out according to a priority order. The recommended priority order for diversion can be

summarized as given in **Table 4.8**. Under average conditions, CI of 200% should be maintained in Mahaweli, Amban and Kalu Ganga river basins. CI of 180% should be maintained in the adjacent river basins. The recommended priority order of diverting Mahaweli water to the users in the same river basin will be priority 1 for ancient irrigation systems and priority 2 for late additions under MDP or AMDP. The diversions to adjacent river basins after fulfilling the in-basin requirements will assign priority 3 for existing and priority 4 for new irrigation systems.

In the ARSP model, allocation of water to demand points are based on penalties assigned to the channels and storage zones etc along that path. Therefore, in the model penalties were assigned to the irrigation systems and supply channels in allocating water for irrigation systems to reflect the following priority order as given in **Table 4.8.** At the same time, provision of drinking water is given highest priority over irrigation.

Table 4-8: Priority Order for Diversion

River Basin	Location	Irrig System	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4
Mahaweli Ganga	in-basin	Sys E,A	M1			
		Sys C		M2		
	adjoining	Sys B			M3	
Amban Ganga	in-basin	Sys D1,D2,G	A1		M3	
	adjoining	Sys H,IH,MH		A2	M3	
		Sys I			A3	M4
		NCP			A3	M4
		NWP			A3	M4
Kalu	in-basin	Sys F	K1			
	adjoining	Sys D2	K1			
		Sys I		K2		
NOTE : 1	M - Mahaweli		A - Amban Ganga		K - Kalu Ganga	
2	Under Avg hydrologic conditions - Mahaweli,Amban & Kalu CI = 200%					
				Adjoining Basin		CI = 180%

4.4.10 Proposed Priority Order for Diversion under Dry Hydrologic Situation

Should the prevailing hydrologic conditions goes below average in the operational planning Stage of this project the rationing of water issues has to be applied to the irrigation systems within and outside the main river basins. For example if M1 is assigned CI of 180% M2, M3 and M4 will be assigned 160%, 140% and 120% respectively. In order to maintain the peaking capabilities of the power stations, rationing Rule Curves have to be developed to limit the withdrawals, primarily during Yala season. Then water for irrigation becomes secondary benefit after firm power generation. The water for drinking and river maintenance will be included in these power releases. This is a detailed assignment to be done in the operational Stage with the consultation of water users, operating agencies and administrative institutions etc. This simulation has to be carried out for extremely dry hydrologic scenarios on short-term planning mode combining all hydropower generating water resources systems together.

4.4.11 Mahaweli Energy Generation "With Project"

One of the important observations of these Simulation Runs is the loss of energy "With Project". The magnitude of the energy loss is only 17 GWh (A10A) when compared with the present configuration (A1A). The various developments proposed in Stage I to stage III when represented by simulation runs A2A through A10A. Mahaweli system energy generation rises by 89 GWh with the implementation of Moragahakanda, Kalu Ganga, Projects, when compared with after Moragahakanda and Kalu Ganga (A2A), this loss is as high as 106 GWh. The NCP canal project, which is a left over project of AMDP after the construction of most economic attractive projects, should be considered as an extension of Moragahakanda Project, because without Moragahakanda as a regulatory reservoir no diversion is possible from Mahaweli Ganga to NCP area. Hence, loss of Mahaweli Energy generation "With Project" can be considered as only 17 GWh annually. See **Table 4.9**. This is insignificant when compared to the economic returns from agriculture in the NCP. Since this is a project to be built immediately to build-up the social and economic development in NCP area in particular, and the country as a whole, no financial terms should apply to the economic viability of this project.

Table 4-9: Hydropower Generation "With Project"

	HYDROPOWER STATION	W/O M&K	STAGE I		STAGE II	STAGE III		
		A1A	A2A	A5A	A6A	A8A	A10A	min. power flow
ENERGY (GWh)/ MIN PFLW (cumec)	Kotmale	451	448	443	439	444	445	10
	Victoria	723	758	569	558	701	696	20
	Randenigala	388	403	362	356	321	309	
	Rantembe	188	184	151	150	132	131	10-15
	Polgolla	172	156	220	226	156	159	5
	Bowatenna	69	73	109	119	61	61	5
	Moragahakanda		59	85	98	111	107	
	Lower Uma Oya			25	25	25	26	
	Heen Ganaga			4	5	6	6	
	Hasalaka				35	34	35	
	Total (Project)	1992	2081	1968	2010	1990	1975	

In the final simulation run of A10A a minimum draft power of 75 MW continuous is applied while its upper limit which is a variable over different months of the year is 477 MW continuous or 4,177 GWh annually according to the **Table 3.9**. According to the results of the simulation run minimum draft power of 75 MW is violated only once and the upper level is reached only twice. The resulting lowest annual energy generation of 1,470 GWh has occurred in 1982/83 and the highest of 3,213 GWh has occurred in 1970/71. See the integrated power system energy generation table in **Annex 1A** for details. The energy generation is allowed unlimited only when water level of the hydropower reservoir is above the rule curve level (or within flood control zone) and limited to irrigation requirements when the water level is below the rule curve.

Minimum power flows introduced in this study for main hydropower stations are given in the last column of **Table 4.9** for completeness but this should be computed after considering entire hydropower stations (proposed/ongoing) within and outside Mahaweli. The main parameters of "With Project" new hydropower stations are given in **Table 4.10**. A separate simulation run has been carried out accommodating recent developments subsequent to the field surveys. Therefore,

for details of hydropower generations at proposed hydropower stations **r**efer simulation results of Run No. A14A in **Table 4.1.**

Table 4-10: Principal Features of Hydropower Projects "With Project"

Reservoir	Installed Capacity (MW)	Average Energy (GW.h/yr)	Design Head (m)	Design Discharge (cumec)	Total Storage (MCM)
Lower Uma Oya	10.5	25.5	68	28	58
Hasalaka	28	31.4	237	14	7
Heen Ganga	5.5	6.6	40	16	65
Moragahakanda	25	107	36	70	570
Total	69	170.5			

Table 4-11: Check of Irrigation Reliability - A10A & A11A

			Yala			Maha					Yala			Maha		
Allowable No. of Failures			**8**	**4**	**2**	**8**	**4**	**2**			**4**	**2**	**1**	**4**	**2**	**1**
Scheme	**Yala Issue**	**Maha Issue**	**A10A**			**A10A**			**Yala Issue**	**Maha Issue**	**A11A**			**A11A**		
			5%	**10%**	**20%**	**5%**	**10%**	**20%**			**5%**	**10%**	**20%**	**5%**	**10%**	**20%**
KalawewaRB	257	245	6	3	1		0		259	235	3	1	0		0	
KalawewaLB																
KalawewaYE																
DambuluOya	24	17		0			0		24	16		0			0	
Kandalama	39	34	2	2	0		0		40	33		0			0	
Huruluwewa	74	51	1	1	0		0		74	50		0			0	
Nachchaduwa	47	28		0			0		47	27		0			0	
Nuwarawewa	14	9		0			0		14	8		0			0	
Tisawewa	5	5		0			0		5	5		0			0	
Allai	136	119		0			0		138	116		0			0	
System B	451	329		0			0		450	317		0			0	
System B - RB																
System C	448	244	1	1	1		0		448	236		0			0	
Minneriya	92	59		0			0		93	57		0			0	
Giritale	45	26	1	1	1		0		46	25		0			0	
Kaudulla	78	38		0			0		78	37		0			0	
Kantale	179	99		0			0		180	94		0			0	
PSS	143	100	2	1	0	2	0	0	145	97		0		1	0	0
Minipe LB	207	117		0			0		206	115		0			0	
System G	118	82	1	1	0		0		119	78		0			0	
KHF	47	38	1	1	0		0		47	35		0			0	
Manankattiya	12	9.4		0			0		12	9.1		0			0	
Eruwewa	2	1.0		0			0		2	1.0		0			0	
Mahakandarawa	44	35.7	2	1	1		0		44	34.6	1	0	0		0	
Kalu Ganga	47	24.7		0			0		47	24.3		0			0	
NCP2(major)	137	114		0			0		138	110		0			0	
NCP1(minor)	312	277	5	3	0	2	2	0	315	269	1	1	0		0	
NWP(minor)	105	95	2	2	1	1	1	0	106	90		0			0	

4.4.12 Reliability of Irrigation Water Issues

In all the simulation runs carried out the Reliability of Irrigation Water Supply has been checked as per the Failure criteria given in section 3.5 and the result for the final runs of A10A and A11A are given in **Table 4.11** as follows. The A10A refers to the simulation period of 1971-2010 and A11A refers to that of 1991- 2010. In the last 20 year period the number of failures is less than that of last 40 year period. This implies that the first 20 year period is having more dry spells than last 20 years.

4.4.13 Design Parameters of the Conveyance

The summary of conveyance capacities of canals as used in this study is given in **Table 4.12**. Nevertheless, in the design of conveyance canals these values may be increased by 15% to cater for the monthly variations and in the case of inlet or outlet structures these values may be increased by 30% to cater for the future expansions. The designer may even increase the line free board of the conveyance canals to carry 150% of canal capacity under overload conditions since the maximum demand is occurring in the dry months of the year.

Table 4-12 : Design Parameters of the Conveyance System

Name of Channel	Capacity (cumec)
Randenigala - Heenganga	30
Heenganaga - Kaluganga	30
Kaluganga - Moragahakanda	35
Upper Elahera	42
Huruluwewa	15
Manankattiya	10
Mahakanadarawa	4
NCP	35
NWP	10
Angamedilla to Minneriya	20
Kaliganuwara to Angamedilla	15

4.5 Recommended Project Formulation

As per the recommended project, representative simulation run for the Project Formulation is A10A. Agricultural development of 53,000 ha of existing land under NCP, 11,000 ha of existing land under NWP, 6,576 ha of abandoned sugarcane area under Kantale reservoir and development of 10,000 ha of new land under Maduru Oya RB and providing 70 MCM of drinking water for NCP area is recommended as a result of Water Balance Simulation of A10A. In order to facilitate above requirements there are number of infrastructures to be built namely, Lower Uma Oya Hydropower Project, Raising of Minipe Anicut, Randenigala - Kalu Ganga Diversion Canal, Hasalaka Oya Hydropower Project with in-basin irrigation development, Heen Ganga Hydropower Development Project, Angamedilla Pump Station and its Diversion Channel and Kalinga Nuwara pump station and its diversion channel to Angamedilla and booster pumping stations en-route if necessary.

Table 4-13: Summary of Project Packages

Stage No.	Package No.	Name of Development	Projects / Systems or Schemes
Stage I	P1	Link Tunnel/UEC	Kalu Ganga link tunnel, UEC up to Mahakandarawa
	P2	Lower Uma Oya Hydro	Dam, Diversion Tunnel, Power House
	P3	Raising Minipe Anicut	New Anicut, Rehabilitation of LB canal
	P4	Nalanda Reservoir	strengthening of dam structure
	P5	9,000 ha in NWP	diversion canal and reservoirs
	P6	10,500 ha in NCP	NCP canal up to Kahatagasdigiliya (30 km)
	P7	5,120 ha in Kantale	Rehabilitation of sugarcane area
	P8	10,000 ha in System B	raise spill (2m), main, branch, d canal & d/s development
	P9	Heen Ganga Hydro	Dam, PH & 10 km transfer canal
Stage II	P1	Hasalaka Oya Hydro	Dam, Diversion Tunnel, PH & 13 km transfer canal
	P2	Angamedilla pumping	pumping(20 m) from Ang'dilla to Minneriya (15 km)
	P3	24,500 ha in NCP	NCP canal up to Kebithigollewa (30 km)
Stage III	P1	Randenigala Canal	link tunnel Randenigala - Hasalaka 14.6 km
	P2	Kalinga Nuwara pump	Pumping (40m) from Kalinga Nuwara to Minneriya (30 km)
	P3	18,000 ha in NCP	NCP canal up to Chenmedikulam (30 km)
	P4	2,000 ha NWP	canal network
	P4	1,456 ha Kantale	improvements to canal network

A 2 – Data Analysis of Water Balance Study

APPENDIX 5

CLIMATE RISK AND VULNERABILITY ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 5

CLIMATE RISK AND VULNERABILITY ASSESSMENT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
CC	–	Climate Change
CP	–	Concept Paper
DOI	–	Department of Irrigation
EIA	–	Environment impact assessment
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MAP	–	Mean Annual Precipitation
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MRB	–	Mahaweli River Basin
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
NCPCP	–	North Central Province Canal Program
NWPC	–	North Western Province Canal
PDA	–	project design advance
PMDC	–	program management and design consultant
PPTA	–	project preparatory technical assistance
SIWRM	–	strengthening integrated water resources management
SLPI	–	Sri Lanka Prosperity Index
UEC	–	Upper Elahera Canal

WEIGHTS AND MEASURES

ACE	–	annual per capita endowment
ha	–	Ha
km	–	Kilometer
MCM	–	million cubic meters
mm	–	Millimeter
m^3	–	cubic meter
MW	–	Megawatt

CONTENTS

I. OVERVIEW

A. Introduction

1. **Agriculture and natural resources** is key sector in Sri Lanka contributing to improving household food and financial security, as 80% of the population are rural and of which 70% are dependent on the sector for their livelihood. The sector as a whole accounts for more than 10% of GDP, 30% of employment and 25% of export revenue. However, the contribution to GDP has declined in recent years, and productivity needs to increase to keep pace with rising demand for domestic consumption and to achieve national goals of food self-sufficiency and poverty reduction.

2. The sector is a major contributor to national food security, particularly attainment of self-sufficiency in rice and other staple crops. More than 80% of rice production nationally is from the 750,000 ha (1.8 million acres) of irrigated lands. Paddy production is highly dependent on seasonal rainfall and irrigation water sources, traditionally from tanks (local storage reservoirs) and in recent times transfer from large dams in the Mahaweli River Basin.

3. The climate is tropical with two monsoon periods; Southwest Monsoon (SWM) (May to September) (referred to as the *Yala* season) and Northeast Monsoon (NEM) (December to February) (or *Maha* season).[1] The rainfall pattern and distribution is a function of both the monsoons and topographic relief, with highland in the southwest. As a result the country is divided into two principal and relative agro-climatic zones; a wet zone of the south west covering about 30% of the land area, and a dry zone of the north and east.

4. The majority (70%) of the irrigated lands are located within the dry zone, within which water availability is a major constraint during the Yala season and as a result cropping intensities are generally restricted to 100 to 130%. Whereas within the wet zone they are generally 150 to 180%, due to higher water availability.

5. Historically water availability, for both irrigation and drinking water supply, was improved through construction of tanks for intra and inter seasonal use, of which there are estimated to be nearly 30,000 nationally. In the past 50 years the government has been proactive in the development of large scale water resources projects to improve water supply and use for both consumptive use and hydropower generation. Under the Mahaweli Development Program (MDP), started in the 1960s, water is being harvested within the water 'rich' Mahaweli Ganga (largest river basin) for use within and transfer to dry zone areas, principally to the north but also to the south.

6. The current project is the penultimate stage in the MDP, as part of the North Central Province Canal Project (NCPCP), with the extension of water transfers to the north and northwest, both regions severely limited by water availability and areas recovering, physically and socio-economically from the recent conflicts.

[1] There are also two inter-monsoonal periods; inter-monsoonal I (IM1) March to April, and inter-monsoonal II (IM2) October to November.

B. North Central Province Canal Project

7. As mentioned above, the WRDIP fits within the overall NCPCP, and as it will be the first part to be implemented it is referred to as Phase 1 of the NCPCP in this report. The NCPCP as a whole when complete will transfer approximately 1,100 MCM per annum of water from the Mahaweli River Basin to irrigation systems in the northern provinces.[2] Approximately 1,040 MCM of this will be supplied to 84,000 ha of irrigation systems, and 160 MCM to community water supplies. The key elements of the NCPCP, include those listed below under the WRDIP (ie, Phase 1), plus construction of the Lower Uma Oya Dam to increase storage volume and hydropower production, Randenigala-Kalu Ganga canal for water transfer to the Kalu Gala reservoir (and thence further north), North Central Province Canal for transfer from the Upper Elahera Canal to cascade tank systems, and Kalinga Nuwara pump station to lift water from the lower Mahaweli River to the Elahera-Minneriya – Yoda Ela (EMYE) systems. These additional works will form the next part of the NCPCP's development (Phase 2).

8. The WRDIP includes:

(i) Infrastructure works for water transfers and storage (as listed **Table 1** and shown in **Figure 1**) including:

- Kalu Ganga – Moragahakanda Transfer Canal (KMTC); principally an approximately 10 km canal (mostly tunnel) for the transfer of water from the Kalu Ganga Reservoir to the Moragahakanda Reservoir to supply the UEC.
- Upper Elahera Canal (UEC); a canal (approximately 65.5 km) (of which about half is in tunnels) for transfer from the Moragahakanda Reservoir to the northern provinces.
- North Western Province Canal (NWPC); a combination of new canals (96 km) and reservoirs (2) to supply existing cascade systems in the NWP.
- Minipe Left Bank Canal (MLBC); the heightening of the Minipe Anicut (diversion weir) and modernization of the main canal to limit water losses (for transfer to the northern provinces) and improve system efficiencies.

(ii) Studies to improving water sector management including;

- Improving System Use Efficiencies and Water Productivity (ISEWP); the purpose of the study is to identify ways and means of improving cascade water system efficiencies, which are currently very low. The potential benefits may include adaptation to anticipated climate change impacts, such as increased water demand and/or reduced water availability.
- Strengthening Integrated Water Resources Management (SIWRM); the study will help the government further develop IWRM, including development of intra-basin management and trans-basin management plan(s).

[2] These northern provinces are the North Central, North Western and Northern.

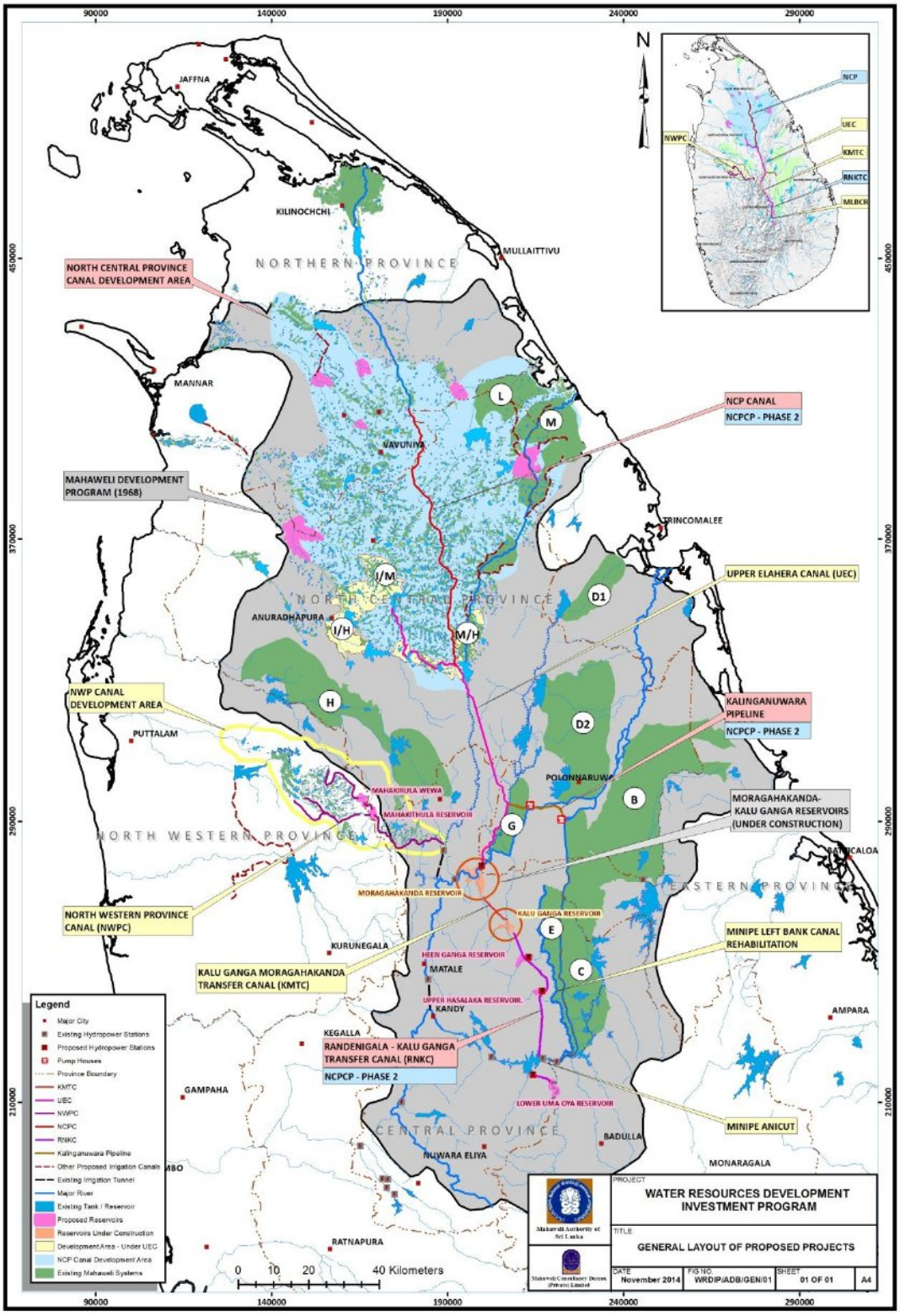
Table 1: Summary of Project Components

Project	Area (ha)	Canal (km)	Annual Volume (MCM)
KMTC	-	9	100
			(770)
UEC	12,381	70	300
	(53,000)[3]		(970)
NWPC	11,492	80	130
MLBC	7,530	76	318
Total	**31,403**	**235**	**430[4]**
	(84,403)		**(1,100)**

KMTC = Kaluganga – Moragahakanda Transfer Canal, MCM = million cubic meters,
Source: PPTA Consultant

[3] () areas and volumes for Stage 2
[4] Volume transferred as part of NCP development (UEC and NWPC)

Figure 1: Project Base Map



Source: MCB, 2014

II. CLIMATE RISK SCREENING

9. The project climate risk screening includes the preparation of a screening report based on the project (ADB, 2014) and AWARE risk assessment for the program and projects. The screening report is presented in **Annex 1** and the AWARE assessment in **Annex 2**.

10. The screening report identified the climate changes under the A2 scenario[5] for the Mahaweli Basin as a rise of 1.8°C in average annual mean temperature, and an increase of 4.2% (85 mm) in annual precipitation, but with a higher increase in the lower catchment (>4%) and a lower increase in the upper catchment (<4%). It also identified seasonal differences in precipitation with a decrease of 3.8% in the December to April period (corresponding to the NEM (Maha season)) and 11% increase for the May to November period (corresponding to the SWM (Yala season)).

11. The climate sensitive components are identified as: (i) changes in hydrology of the Mahaweli River Basin due to a decline in annual runoff resultant reduction in water availability; and (ii) a reduction in reservoir capacity due to siltation as a result of increase SWM precipitation exacerbating soil/bank erosion in the upper catchment and loss of reservoir storage capacity.

12. However, there appears to be some inconsistencies between the climate change predictions and climate sensitive components, namely predicted increase in annual precipitation and projected decline in annual runoff, and the prediction of higher siltation though the increase in precipitation is likely to be relative small.

13. Natural hazard risks and rates include (i) landslides – medium risk due to high precipitation in the upper catchment, (ii) flooding – medium/high due to more intensive precipitation, and (iii) drought – medium/high due to higher temperatures and more variable precipitation. The overall hazard risk is rated in the screening report (Annex 1) as medium[6].

14. The screening report concludes with the statement that "*rainfall variability is identified as the most important contributing factor to increased climate risk in the Mahaweli Basin. And as such water availability is very likely to be affected by climate change if the current trend continues*". And goes on to say "*the project team is advised to factor in the impact of climate change on future scenarios of water availability and its seasonal variability during project design (e.g. reservoir capacities) as well as implementation (e.g. water allocation). The risks of natural hazards (landslides and flooding) may also need to be taken into account during project design*".

15. Additional risk analysis was also prepared by ADB using the AWARE project assessment (**Annex 2**). The AWARE assessment evaluates risks within sixteen individual topic categories and provides an overview final project risk. The individual risks are presented on a radar chart within

[5] The A2 "*storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines*". IPCC Special Report, Emissions Scenarios, 2000.

[6] Rating as per the ADB WRDIP 'Climate Change Screening Report', 2014 (as presented in Annex 1).

three color bands; green band (inner circle) suggests a lower level of risk in relation to a risk topic, red band (outer band) suggests a higher level of risk and orange band (middle band).

16. **Table 2** presents a summary of the risk topic for the overall program (WRDIP) as a whole as well as the individual projects; UEC (inclusive of the KTMC), NWPC and MLBC. The project and sub-projects are all rated as high risk and therefore warrant further assessment of potential impacts.

Table 2: Summary Risk Assessment

Risk Topic	WRDIP	UEC	NWP	MLBC
A) Temperature increase	High	Medium		
B) Wild fire	Low			
C) Permafrost				
D) Sea ice				
E) Precipitation increase				
F) Flood				
G) Snow loading				
H) Landslide				
I) Precipitation decrease				
J) Water availability				
K) Wind speed increase				
L) Onshore Category 1 storms				
M) Offshore Category 1 storms				
N) Wind speed decrease				
O) Sea level rise				
P) Solar radiation change				

Source: PPTA Consultant adapted from AWARE analysis

17. The key risk topics include temperature increase rated high, precipitation increase, precipitation decrease, water availability, wind speed increase and onshore category 1 storms. The most relevant to the specific project activities and infrastructure include:

- **Temperature increase**; higher temperatures and heatwaves may increase crop water demand (due to higher evapotranspiration) and reduce crop productivity (due to temperature sensitivity).
- **Increased SWM precipitation** may lead to increased runoff and therefore erosion and siltation of water courses, reservoirs, and flooding and landslide events
- **Decreased NEM precipitation** may result in higher soil moisture deficits, and therefore increase irrigation demand and reduce crop yields.
- **Water availability** at local project command area level and for transfer from the Mahaweli River Basin is directly linked to the changes in precipitation above.
- **Wind speed increase:** high peak speeds may be associated with more extreme weather events particularly onshore storms.
- **Extreme events:** due to more frequent and intensified rainfall events.

III. ASSESSING ADAPTATION NEEDS AND OPTIONS

18. The adaptation measures appropriate to the project are derived in a three step process namely: impact, vulnerability and adaptation analysis.

19. Impact assessments are typically "top-down", drawing from largely global and regional climate change models to predict future climate changes at the local level. The vulnerability assessment also takes into consideration observed current vulnerability and climate patterns, or a "bottom-up" assessment, for example trends based on information collected by meteorological stations and experienced by local communities. Both of these carry with them a certain amount of uncertainty but together provide the best available knowledge, which can provide insights into decision making for adaptation.

20. Based on the above, an assessment of the various adaptation options (ideally including those already in practice) is made from expert opinion and stakeholder consultations. This is carried out on both engineering and non-engineering solutions, such as improved irrigation efficiency and water resource management, respectively. The options are then weighed against each other through a cost-benefit/cost-effectiveness analysis to help identify the most effective adaptation measures.

21. Consideration of the likelihood of climate change impacts based on current conditions and future trends are used to assess the most appropriate design and adaptation options. These priority adaptations will be implemented through the program and monitored through identified indicators. Given the uncertainties in predicting climate change, options which provide other co-benefits are likely to be lower risk. For this PPTA, this latter step is presented in principal only and will be further developed during program implementation.

A. Impact Assessment

1. Recent Climate Trends

22. While there are a number of climate change parameters, the principal ones directly relevant to the project for the assessment of risk and adaptation measures are changes in temperature and rainfall.

23. The analysis of temperature records over a 100-year period shows an increase in air temperature in all meteorological stations from 1961 to 1990 (Fernando and Chandrapala, 1992). The rate of increase over this period is in the order 0.016ºC per annum or the equivalent of 1.6ºC per 100 years.

24. Rainfall in Sri Lanka is characterized by high annual variability with alternate dry and wet periods observed from 1880 until about 1970 and a significant reduction thereafter (MIWRM, 2010).[7] Over the period 1931 to 1990 the average annual rainfall is reported to have decreased

[7] Sri Lanka Water Development Report: 2010.

from 2,005 mm to 1,861 mm, a decline of 7% (Jayatilake et al, 2005).[8] The decrease differed between seasons, with the highest decline in the March to April inter-monsoonal period. Also it was noted that intensities have strengthened and return period of extreme events appear to have become shorter.

25. Rainfall trends over the past 40 to 60 years for locations within the Mahaweli River Basin and project areas appear to agree with the decreasing trend. **Table 3** presents a summary rainfall trends for five locations: two within the upper basin 'wet' zone (Kotmale and Pologolla) and three in the 'dry zone' (Anuradhapura, Polonaruwa and Iranamadu). Annual rainfall within the upper basin over the past 60 years (1949-2010) has declined by 15 to 20% and in the lower basin by 7 to 8%. The rate of decline is generally greater for the SWM in both the upper and lower basins, at around 20%. While the decline for the NEM is about 6%. **Annex 3** presents the plots of annual rainfall for the five stations.

Table 3: Rainfall Trends between 1949-1959 and 2000-2010

		Annual		Maha (NEM)*		Yala (SWM)	
Location	**Zone**	**MAP mm**	**%change**	**MAP mm**	**%change**	**MAP mm**	**%change**
Kotmale	Wet	2,548	-20%	998	-12%	1,550	-25%
Pologolla	Wet	3,009	-15%	1,162	-8%	1,848	-20%
Anuradhapura	Dry	1,298	-7%	903	-1%	394	-19%
Polonnaruwa	Dry	1,656	-8%	1,284	-7%	372	-10%
Iranamadu	Dry	1,656	-4%	1,017	1%	264	-24%

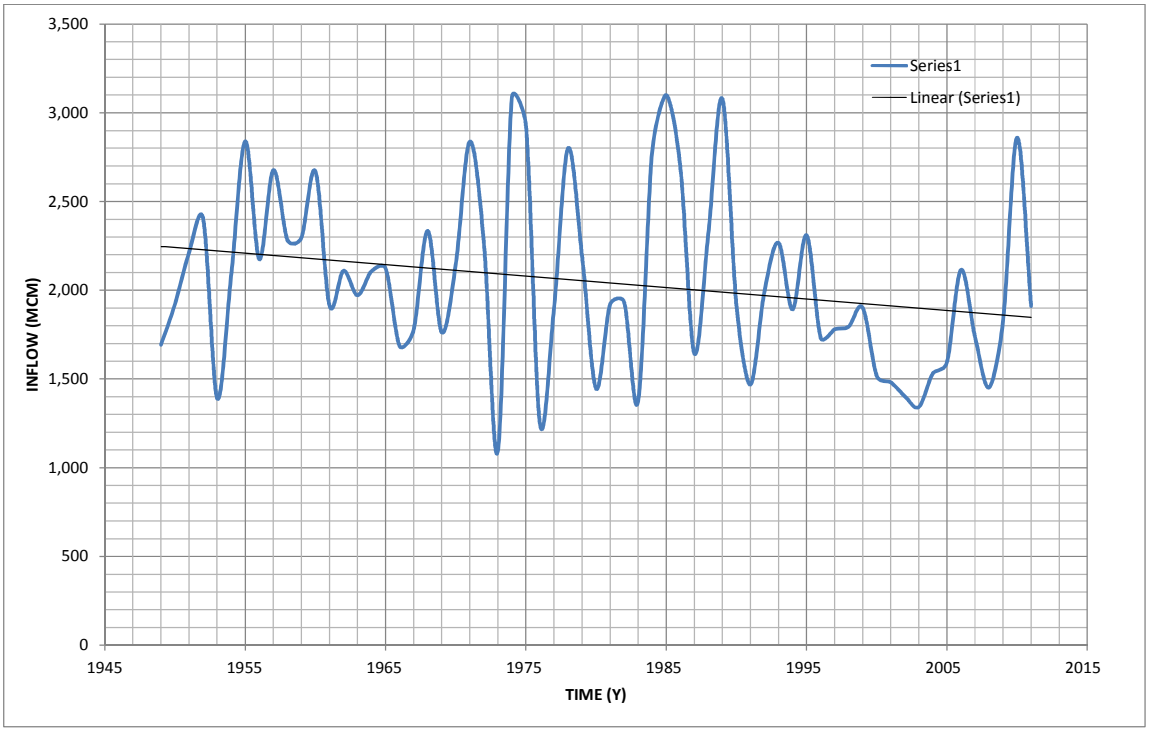
MAP = Mean Annual Precipitation

* For the purpose of the analysis NEM is the period from October to March, and SWM April to September. Source: MASL rainfall records

26. The trend in rainfall is also reflected in the flow records for the Mahaweli River. A comparison on mean annual flow at Pologolla in the upper catchment shows that between the 1940s and 2000s annual average flow declined by about 20% (from 2,300 to 1,900 MCM).

[8] Jayatillake, H.M., Chandrapala, L, Basnayake, B.R.S.B, Dharmaratne, G.H.P, (2005). Water Resources and Climate Change. *Proceedings of the Workshop on Sri Lanka National Water Development Report*, World Water Assessment Programme, Paris.

Figure 2: Pologolla Inflows



Source: MCB – Water Balance Study

2. Climate Predictions

27. Climate change predictions vary between sources, models and emission scenarios.

28. Based on the HadCM3 circulation model and emission scenarios A2 and B2[9], De Silva (2013)[10] predicts[11] an increase in SWM rainfall between 38% (A2) and 16% (B2) and a decrease in NEM rainfall between 34% (A2) and 26% (B2) by the 2050s and temperature increases of 1.5 to 2ºC, and maximum potential soil moisture deficit increase by 11% (A2) and 4% (B2). And goes on to recommend that adaptations focus on storage of excess run-off during the SWM for dry months and diversion if possible to the dry zone.

29. Muthuwaththa et al (2013)[12] predicts (also based on HadCM3 model) an increase in mean annual precipitation (MAP) from 2,094 mm (from the baseline 1970-2000) to 2,249 mm by

[9] The B2 "*storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the A1 and B1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels*". IPCC Special Report, Emissions Scenarios, 2000.

[10] De Silva, C.S. 2013. Impact of Climate Change on Water Resources and Agriculture in Sri Lanka. *Climate Change Impacts and Adaptations for Food and Environmental Security, Proceedings of the International Conference Colombo,* Sri Lanka, 30-31st July 2013.

[11] Baseline of 1961 - 1990

[12] Muthuwaththa, L.P. and Liyanage, P.K.N.C. Impact of Rainfall Change on the Agro-Ecological Regions of Sri Lanka. *Climate Change Impacts and Adaptations for Food and Environmental Security*. *Proceedings of the International Conference,* Colombo, Sri Lanka, 30-31st July 2013.

2050 (7% increase). The impact on agro-ecological zones is a contraction of the dry zone area by 8% and increase in the intermediate zone by 22%, and with the extent of the wet zone unchanged.

30. In a 2010 IWMI publication[13] mean temperature is predicted to increase by 0.9 to 4ºC (over the 1961-1990 baseline) by the year 2100, as a result Maha season irrigation water requirements for paddy could increase by 13 to 23% by 2050.

31. All models predict an increase in mean annual temperature, with the A2 and B2 generally being within the range of 1.2 to 4ºC. However, rainfall projections are highly variable and contradictory, but with the majority predicting a higher MAP. Those predicting higher MAP envisage an increase in SWM rainfall, and decrease in NEM rainfall. De Silva (2006) predicts MAP increase by 14% for A2 and 5% for B2 (baseline 1961-1990); a NEM rainfall decrease by 34 to 26% (for A2 and B2 respectively), and increase of SWM rainfall by 38% to 16% (for A2 and B2 respectively). The projections also infer an increase in the variability and intensity of rainfall events.

32. In the Second National Communication on Climate Change[14] the MOE reports a trend (1961-2000) of increasing temperature of up to 0.46ºC per decade (per station) and rainfall decline in all stations of 1.5 to 19 mm per year. And a projected temperature rise to 2100 of 2ºC (best estimate), consistent with IPCC values for South Asia. While rainfall changes are more complex and seasonally dependent, with an increase in MAP of between 400 mm (A2 scenario) to 133 mm, of which most is in the SWM. However, there are also predictions of a decrease in MAP of 166 mm. **Table 4** lists the estimated range of change in SWM rainfall by 2100 for three emission scenarios and three climate change models.

Table 4: SWM Rainfall Changes (2100)

	Changes in SWM Rainfall to 2100 (mm)			
Scenario	**HadCM3**	**CSIRO**	**CGCM**	**Mean***
A1FI	0 to 476	2 to 157	-190 to 6	-94 to 213
A2	0 to 403	2 to 133	-161 to 5	-180 to 80
B1	0 to 215	1 to 71	-86 to 3	-43 to 96

* Mean is the average of the minimum and maximum values for the three models.
Source: MOE, 2011 (Second National Communication on Climate Change)

33. The current trends and model predictions for temperature indicate that it is most likely to increase over the project lifetime, to 2050 and beyond. As outlined above, the best estimate is an increase of up to 2ºC by 2100. As discussed below the project implications are likely to be an increase in irrigation water demand and potential adverse impact on crop productivity.

34. The situation regarding precipitation patterns is somewhat contradictory, with current trends indicating a general decline in rainfall over the past 60 or more years, and climate change models giving mixed predictions of both higher and lower future rainfall. Though there appears to be consistency that in terms of seasonal change, with SWM precipitation increasing

[13] IWMI. 2010. *Impacts of Climate Change on Water Resources and Agriculture in Sri Lanka: A Review and Preliminary Vulnerability Mapping*. Report No. 135. International Water Management Institute, Colombo.
[14] MOE. 2011. *Sri Lanka's Second National Communication on Climate Change*. Ministry of Environment, Colombo.

and a decline NWM precipitation. Changes in precipitation would have a number of impacts on the project, lower rainfall would reduce water availability, both at field level (reduce effective rainfall) and basin level i.e. transfer from the Mahaweli, and higher rainfall would increase water availability and reduce irrigation demand, and therefore could be an opportunity for increased productivity (increase irrigated areas and higher cropping intensity). Changes in rainfall intensity may also have implications for system design, on duties of canals, cross drainage structures and reservoirs capacities.

B. Vulnerability Assessment

35. The goal of a vulnerability assessment is to identify current and future vulnerabilities and understand the key determinants of this assessed vulnerability.[15] '*Vulnerability refers to the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change.'*

36. The impact assessment shows the principal climate change effects likely to directly impact on the project are air temperature which impacts on water demand and agricultural productivity, and those related to precipitation; annual and seasonal changes and frequency and intensity of events, which determine water availability and hazard risks (droughts, flooding, landslides and siltation).

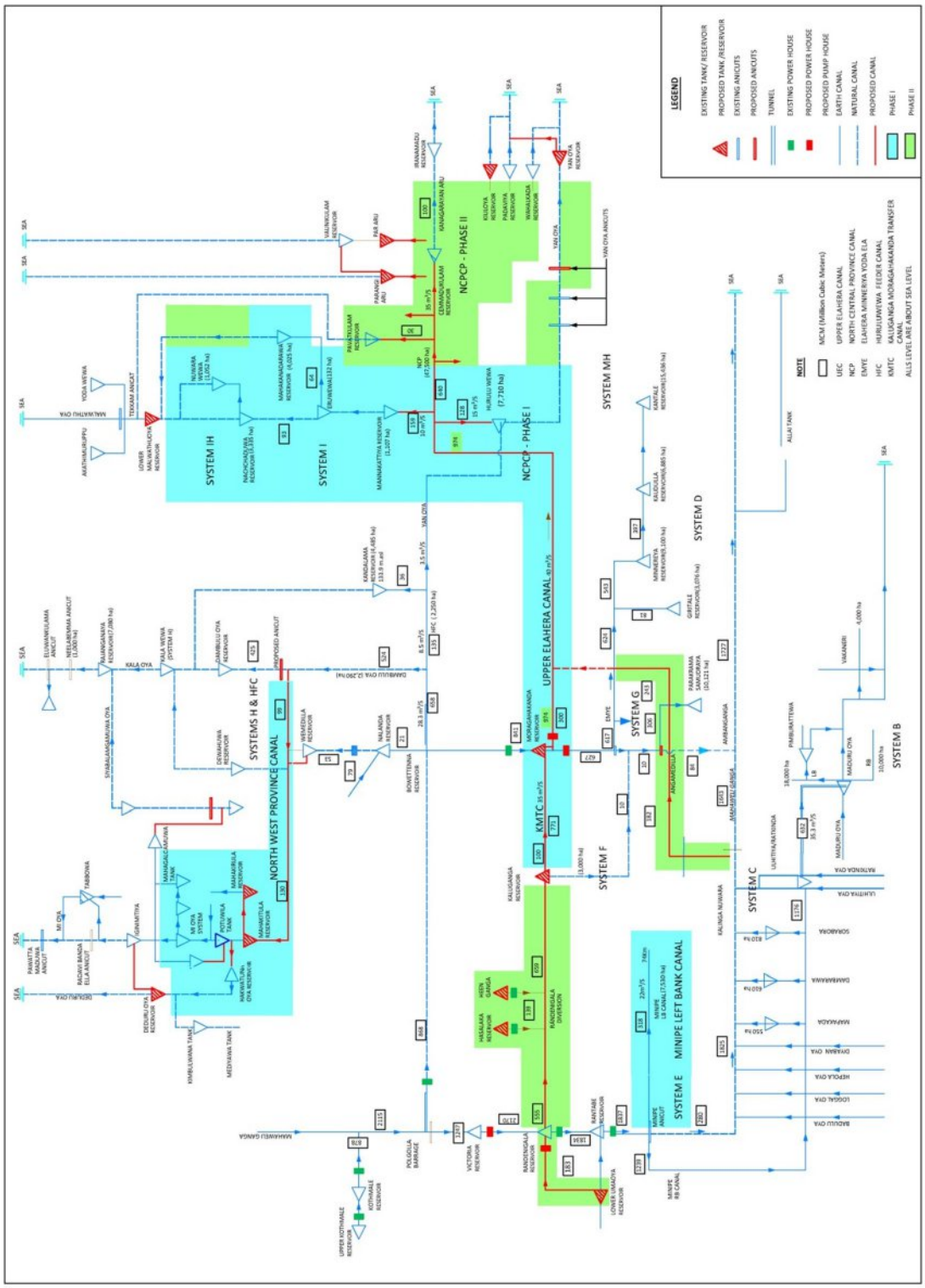
37. Reference to long-term studies done by IRRI's shows that rice yields dropped by 10% for each 1ºC increase in growing season minimum temperature in the dry season.[16] Thus, productivity would have to improve just to maintain the status quo; the design of the investment program provides support to the irrigation sector and to improve productivity and system efficiencies.

38. The approach to assessing vulnerability is to determine the sensitivity of the project to likely climate change driven changes in water demand and availability. Sensitivity was tested for the scenarios of **increased water demand** (Scenario 1) and **decreased water availability** (Scenario 2) at three levels (5%, 10% and 15%), which are likely to exceed likely change levels.

39. The scenarios were applied to the Mahaweli Water Balance model[17] over a 40-year time series, to determine the impact on scheme water balances, water availability and hydropower generation to Mahaweli Scheme at full development[18]. **Figure 3** shows the scheme schematic layout to aid the following description.

[15] ADB. 2012. *Guidelines for Climate Proofing Investment in Agriculture, Rural Development and Food Security*. Manila.
[16] Peng, S., et al. 2004. "*Rice yields decline with higher night temperature from global warming*." Proc. Nat. Academy of Sci., Vol. 101(27)9971-9975.
[17] The Mahaweli Water Balance Model is a mathematical computer used for the planning and management of the Mahaweli Scheme. The model integrates scheme inputs, functions and outputs, including inflows, reservoir storage, hydropower generation and water issues (allocations) for irrigation and domestic drinking water supplies. It was developed in the 1980s by the Canadian consulting firm, ACRES, as a purpose-built package for MASL. It is used for preparation of seasonal operational plans (Maha and Yala) and system management. The model was used in preparation of the Water Balance Study Report (MCB, 2013) for assessment of development options for the NCPCP.
[18] This is as planned under the NCPCP.

Figure 3: Mahaweli Scheme Schematic



Source: MCB updated from Water Balance Study Report

40. The key points to note include:

- The supply side of the system is the Mahaweli Basin, [19] with an average annual flow volume of 5,474 MCM, and associated storage dams (Kotmale, Victoria, Randenigala and Rantambe (and Upper Uma Oya and Lower Oma Oya) cascade on the Mahaweli, and Nalanda, Bowatenne and Moragahakanda and Kalu Ganga[20] on the Amban Ganga, as well as the Hasalaka Oya and Heen Ganga on tributaries of the lower Mahaweli) with a combined storage volume of more than 2,700 MCM.
- The points for water transfer from the Mahaweli to the northern areas include; Pologolla to the Bowatenne reservoir thence on to the Dambulu (including supply to the NWPC), Moragahakanda for transfer to the UEC, Randgenigala for transfer to the Kalu Ganga and onto the Moragahakanda, (and thence onto the UEC) and Kalinga Nuwara and Angamedilla for pumping to the EMYE, a diversion canal from Amban Ganga at downstream of Moragahakanda to feed Minneriya and Giritale Reservoirs and command area from the Mahaweli Ganga and Amban Ganga respectively (in lieu for water transfer upstream from the Amban Ganga to the UEC).
- On the demand side the command areas in the WRDIP include the project areas (NWP and NCP), which are located in river basins to the north. The exception being the Minipe system on the Mahaweli left bank below the dam cascade.

41. The Mahaweli scheme is characterized by the high storage volume (more 50% of the mean annual volume) and the multiple transfer points, from the Pologolla in the upper catchment, Randenigala below the main dam cascade and (planned) pumping from the lower catchment at Kalinga Nuwara. The multiple storage dams and multiple transfer points offer a number of options for system operation to optimize water transfer and hydropower generation. There are well established operating rules for both, and which vary according to reservoir levels (rule curves) and levels of irrigation and hydropower demand. Under normal operating conditions the first criteria is to maintain hydropower production, and secondly to optimize water deliveries for irrigation according to priority rules, riparian and development order.

42. The scheme design and operation include water allocations for irrigation based on not exceeding three progressive levels of service reliability,[21] these are:

- *Irrigation failure* (occurs when the supply deficit exceeds 5% of Yala seasonal demand[22]) should not exceed 20%
- *Significant failure* (occurs when the supply deficit exceeds 10% of Yala seasonal demand) should not exceed 10%
- *Total failure* (occurs when the supply deficit exceeds 20% of Yala seasonal demand) should not exceed 5%

[19] The Mahaweli basin includes the Mahaweli Aru and Amban Ganga (major tributary of the Mahaweli Aru).
[20] The Moragahakanda Reservoir is currently under construction. Kalu Ganga Reservoir scheduled for construction and the Lower Uma Oya, Hasalaka and Heen Ganga planned for as part of the NCPCP.
[21] Over the forty year modelled period 1971 - 2010
[22] The Yala season is the critical period for water demand within the command areas.

43. The scheme and operation enables a number of options to meet water demand, both for irrigation and hydropower under a range of water supply situations. In essence the scheme under normal hydrological conditions has more than enough water to meet demands with average annual volume of 5,500 MCM compared annual demand of 3,700 MCM. However, one constraint is to maintain hydropower generation and water availability during prolonged droughts.

44. The potential impacts of climate change were tested under two scenarios at three levels as listed below. The approach was to look at a range of possible impacts so to provide an indication of the scale of impacts as the basis for determining the scale of necessary adaption measures, if any. However, it is stressed that this is only indicative of the potential impacts only.

45. The scenarios and levels assessed are:

- Scenario 1: Increase in water demand; irrigation demand is a function of the crop water demand and effective precipitation. Crop water demand was determined based on estimated crop evapotranspiration (calculated using the reference evapotranspiration (ETo) and crop coefficient (Kc) approach). A rise in air temperature will lead to an increase in crop evapotranspiration. Effective rainfall is dependent not only the total quantity but also on the frequency and intensity of rainfall events. The prediction of lower NEM precipitation and greater variability of precipitation mean that effective rainfall is likely to decline within the project command areas (dry zone) and therefore increase irrigation demand. The magnitude of the demand increase is likely to be of the order of 5 to 15%, therefore to establish a likely range of impacts three levels of increase were assessed; +5%, +10% and +15%.
- Scenario 2: Decrease in water supply from the Mahaweli Scheme. While the general consensus is that annual water demand will increase, though with a seasonal shift, the current trend is of decreasing rainfall and inflows, and there are predictions of decreased supplies. A decline in rainfall, and consequently run-off, could have a significant impact on the water supply for the WRDIP and the scheme as a whole. Therefore, to test the potential vulnerability a decrease in inflows was assessed at three levels; -5%, -10% and -15%.

46. A third potential scenario is for increased water supply from the Mahaweli due to the predicted increase in annual precipitation, and specifically in SWM precipitation. This is likely to increase benefits for the project through additional water resources for consumptive use, irrigation and drinking water and hydropower generation, and could be further investigated during project implementation. However, the present assessment conducted during the PPTA is based on scenarios 1 and 2 above, as these are most likely to require adaptation measures.

47. The increase in irrigation demand was applied as a percentage increase in reference evapotranspiration (for the six main climate stations), and thus carried through into irrigation water demand and combined system demand.

48. The decrease in water availability was applied to inflow values at the key flow nodes including Kotmale, Pologolla, Victoria, Randenigala, Lower Uma Oya, Rantambe and Kalinga Nuwara.

49. The model output includes: (i) the number of years for the three reliability criteria over the modelled period (40 years) that were not met; (ii) the volume of water pumped at Kalinga Nuwara to compensate for upstream diversions (at Pollonuwara and Randenigala) to the NWPC and UEC; and (iii) the scheme's annual energy production. **Annex 4** presents the scenario output tables.

50. A summary of the assessment of increased irrigation demand (Scenario 1) for the sub-projects, with the NCP divided between major and minor systems is shown in **Table 5**. The highlighted cells (yellow) occur when the irrigation reliability criteria have been exceeded in 8, 4 and 2 years (out of 40 years) for 5%, 10% and 20% of Yala season respectively. It shows full reliability at 5% ETo increase for all sub-projects, and full reliability for both the NCP major systems and MLBC at the higher demand levels. However, partial failure for the NCP minor and NWP systems occurs at a 10% ETo increase, and full failure at a 15% ETo increase. As discussed in the next section, there are a number of adaptation options that can be adopted to reduce demand and increase supply reliability.

51. A point to note with the simulation is that impacts on reliability between the sub-projects and other systems with the Mahaweli Scheme point to the fact that allocation rules vary between systems, with those with prior riparian rights ranked higher (such as MLBC) and more recent additions to the scheme ranked lower.

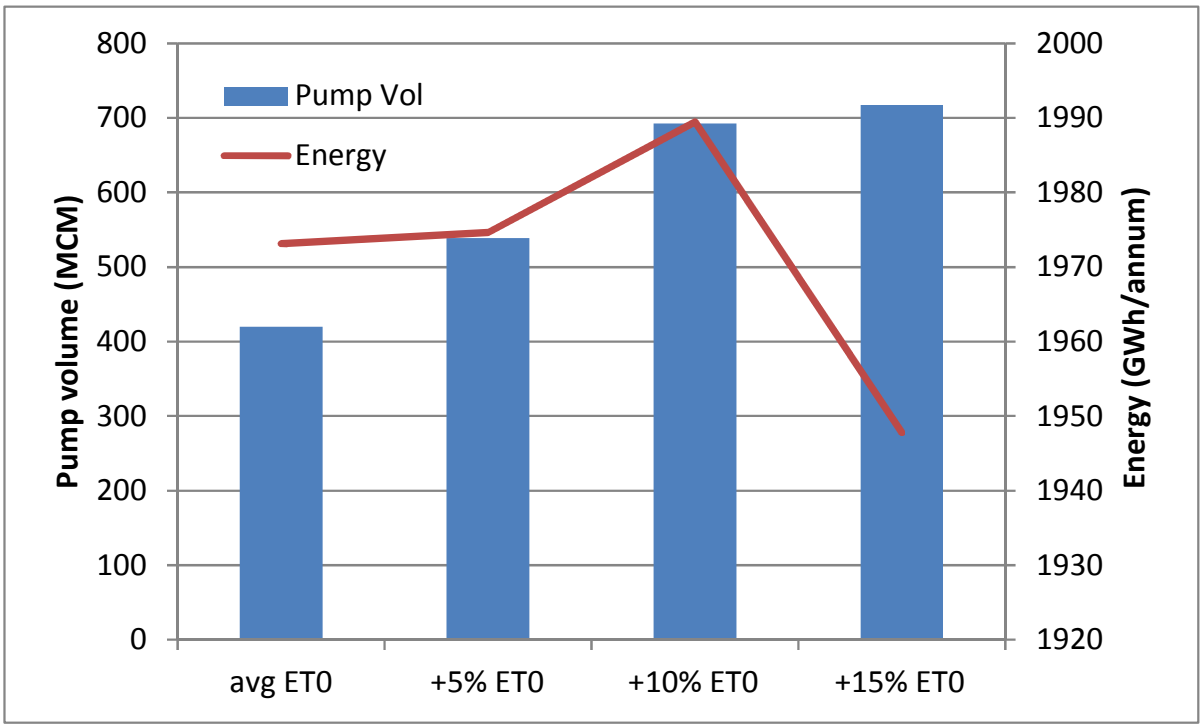
52. **Figure 4** shows the increase in pumping from the Lower Mahaweli at Kalinga Nuwara needed to compensate for addition diversion of water to meet the increase in irrigation demand within the scheme as a whole. The base case annual volume of 400 MCM would have to increase to about 700 MCM with an increase of in crop water demand of 15%, which would create an additional scheme cost. There is little impact on the hydropower generation, with a decline by only 1% due to the additional water diverted upstream at Pologolla to meet increased demand.

Table 5: Scenario 1 – Increased Irrigation Demand (Number of Failure Events)

Scheme	Eto Increase	+15% ETO						+10% ETO						+5% ETO						avg ETO					
	Season	Yala			Maha			Yala			Maha			Yala			Maha			Yala			Maha		
	Failure criteria	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2
	Yala Issue	A43A			A43A			A42A			A42A			A41A			A41A			A40A			A40A		
	Maha Issue	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%
NCP (major)	123		0			0			0			0		4	2	2	2	2	1	3	2	1	2	1	1
NCP (minor)	301	20	10	6	6	4	2	10	7	2	4	4	0	2	2	0	1	0	0	2	1	0		0	
NWP	102	36	27	8	2	2	1	12	3	1	3	3	1	3	2	2	1	1	0	3	3	1	1	1	0
MLBC	223	3	1	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0

Source: MCB – Water Balance model simulation

Figure 4: Scenario 1 - Pumped Volume and Power Production



Source: MCB – Water Balance model simulation

53. The results of the assessment for a decrease in inflow for water transfers (Scenario 2) is shown in **Table 6** with the highlighted cell (yellow) showing when reliability criteria have been exceeded. It shows a similar result to the increase scenario of increased irrigation demand, with no failures for the 5% decline in inflows, but with failure at the 10% and 15% for NCP minor cascades and NWP. The NCP major cascades and MLBC remain reliable at the 10% and 15% levels.

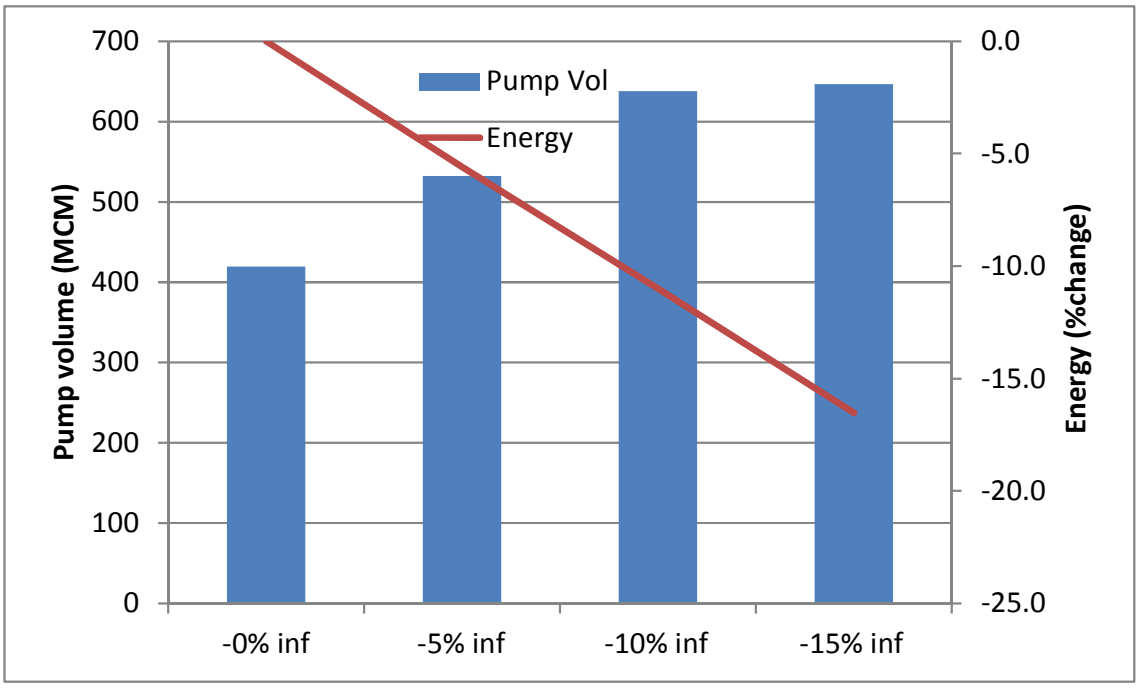
54. A similar trend to Scenario 1 is shown in **Figure 5** for Scenario 2 which indicates that increased volumes of water have to pumped at Kalinga Nuwara to compensate for increased diversion upstream at Pologolla and Randenigala. Energy production progressively declines due to the lower volumes of water with the system, by 16% of annum generation with a 15% reduction in inflows.

Table 6: Scenario 2 – Decreased Water Availability (Number of Failure Events)

Scheme	Info	-15% inf						-10% inf						-5% inf						-0% inf					
	Season	Yala			Maha			Yala			Maha			Yala			Maha			Yala			Maha		
	Failure criteria	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2
	Yala	A53A			A53A			A52A			A52A			A51A			A51A			A50A			A50A		
	Issue	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%
NCP (major)	137	5	2	0	1	1	0	3	2	0	1	1	0	2	2	2	1	1	1	3	2	1	2	1	0
NCP (minor)	323	15	11	6	4	4	2	4	4	2	2	1	0	1	1	1		0		2	1	0		0	0
NWP	109	15	13	5	2	1	0	11	8	4	1	1	0	4	4	2	1	1	0	3	3	1	1	1	0
MLBC	213	1	1	0	0	0	0	1	0	0	0	0	0		0		0	0	0	1	0	0	0	0	0

Source: MCB – Water Balance Model

Figure 5: Scenario 2 - Pumped Volume and Power Production



Source: MCB – Water Balance model simulation

55. In addition to increased water demands for irrigation, temperature rise may also adversely impact on rice production. Rice is highly sensitive to temperature during the reproductive stage, with significant increases in grain sterility occurring when temperatures reach above 34ºC.[23] This is more likely to occur during the Yala season, when temperatures can exceed this threshold. Given that rice is the principal crop within the project areas (and in Sri Lanka) any decline in productivity could adversely impact on project area's financial and economic performance, as well as household food security and income. However, what is not clear from the current literature is the likely level of yield impact with varying estimates. In some cases it is speculated that the effect of temperature rise will be partially offset by plant response to higher CO_2 levels. Therefore, while there is potential for a decline in rice productivity it is not possible with a reasonable degree of certainty to assess the probability or scale of such an impact (spatially). However, as outlined in the next section there are potential adaptation measures that could be implemented should this potential become a reality.

56. Changes in precipitation with higher intensity storm events may result in higher run-off and flood events. A potential project impact could be higher flood flows than those applied in irrigation and dam designs, particularly for the design of spillways and cross drainage structures. Typically, these structures are designed for an event magnitude (based on real and/or calculated data) and return period (1 in 100 years for cross drainage up to 1 in 10,000 years for major dam spillways).

[23] Horie T., J.T. Baker, H. Nakagawa, T. Matsui. and H.Y. Kim. (2000). Crop Ecosystem Responses to Climatic Change: Rice. In: *Climate Change and Global Crop Productivity*. (Editors K.R. Reddy and H.F. Hodges). CAB International, Wallingford, UK. pp. 81-106.

C. Adaptation Assessment

57. ADB (2012)[24] states that "*the purpose of adaptation assessment is to identify and prioritize the most appropriate adaptation measures to incorporate into the project. This includes the identification of strategies to minimize damages caused by the changing climate and to take advantage of the opportunities that a changing climate may present".*

58. Potential climate adaptation options in the agriculture sector can be classified into four groups (ADB, 2012): (i) engineering options (structural; specifications, design standards, irrigation etc.); (ii) non-engineering (management, operation, maintenance, capacity building etc.); (iii) biophysical (plant breeding); and (iv) maintaining the status quo (ie, 'do nothing'). The following paragraphs outline a number of adaptions options for the potential project climate change vulnerabilities.

59. Options for adapting to an <u>increase in water demand</u> include:

- Improve irrigation efficiencies[25] to reduce overall irrigation demand. The current system efficiencies are low due in part to significant conveyance losses (estimated to be of the order of 30-40% some project areas), and there is considerable room for improvement through investments in canal and water control infrastructure (at cascade tank and farm levels).
- Reduce cropping intensities.[26] A reduction in cropping intensity would reduce overall irrigation demand, and however, while relatively low cost to administer this would reduce project and farm benefits.
- Improve cascade system water management. There is potential for improvement of the scheduling of irrigation diversions to reduce losses to percolation and drainage, thus improve system conveyance efficiency.
- Improve farm irrigation management; current application efficiencies are reportedly low and there is potential to improve on-farm irrigation scheduling. Introduce low water demanding farming techniques such as alternative wetting and drying for paddy.
- Change cropping regimes; the promotion of lower water demand and higher value cropped (vegetables) is part of the ongoing development planning, which should reduce water demand.

60. Options for adapting to a <u>decrease in water availability</u> include:

- Reduce irrigation demand using the above options.
- Increase water storage capacity. There is some potential to increase storage capacity within the project command areas through construction of new reservoirs and heightening of existing tanks.

[24] ADB. 2012. *Guidelines for Climate Proofing Investment in Agriculture, Rural Development and Food* Security. Manila
[25] Engineering option
[26] Non-engineering option

61. Options for adapting to a decrease in rice productivity include:

- Improve farming practices; changes to on-farm practices such adjustments to planting dates to avoid flowering during high temperature periods, and selection of more heat tolerant varieties
- Improved plant breeding; the development of heat tolerant varieties less sensitive to peak temperatures.
- Crop diversification; as mentioned above there is potential for diversification to other more profitable crops with lower water demand as is planned under the Stage III of the NCPCP.

62. Options for adapting to an increase in flood risks include

- Design standards; review current design standards for water infrastructure (dams, cross drainage and protection) to verify compliance with potential increase in flood event magnitudes and return periods and if necessary (during project implementation) modify detailed design.
- Water resources management; improve catchment and river basin management to better capacity, planning and monitoring to reduce flood risk.

D. Implementation

63. During project implementation the above options will be further developed within the WRDIP components to support improved water resources and irrigation planning and management, within the project areas and more generally within the Mahaweli Basin. These components consist of two major consultancy packages:

(i) Improving System Water Use Efficiencies and Water Productivity (ISEWP). The primary purpose of the component is the formulation of a strategy for the improvement of water use efficiency and productivity of the cascade tank irrigation systems. This will be achieved through a comprehensive assessment of case example systems (within the NWPC, NCPCP and MLBCR project areas) to identify current constraints, physical and non-physical, towards improving irrigation water use and farm productivity and the development of a program for irrigation system and on-farm improvements. This will be achieved through system and field assessments and in consultation with key stakeholders. The range of improvements is anticipated to be physical improvements to system and on-farm irrigation infrastructure and non-physical irrigation and farm management. The component will integrate climate adaptation options into the assessment of improvement options and analysis of cost and benefits of improvements.

(ii) Strengthening of Integrated Water Resources Management (SIWRM). The objective of this component is to support the improvement of capacity for integrated water resources management at basin, trans-basin and national levels, with a specific focus on the Mahaweli Basin and the greater Mahaweli scheme (including the NCPCP and NWPC). It is envisaged this will include the updating of

the current scheme simulation modeling and management and operation plans, to refine and improve current planning procedures and operational rules. This process will also include the assessment of and planning for prospective climate change conditions and options are presented above.

64. Both of the above components shall take into account anticipated climate change issues including quantification of impacts and benefits, cost benefit analysis of options and formulation of suitable implementation programs.

IV. REFERENCES

Costa, W.A.J.M. 2011. Adaptation of Agricultural Crop Production to Climate Change: A Policy Framework for Sri Lanka. *Journal of Natural Science Foundation,* Sri Lanka, 2010 38 (2).

Herath, S. *Adapting to Climate Change: Developing Local Capacity*.

ADB. 2009. *Building Climate Change Resilience in the Agricultural Sector of Asian and the Pacific*. Manila.

ADB. 2013. *Building Resilience to Climate Change: Adaptation of Technical Resources*. Manila.

CSDS-IACC. 2012. *Comparative Studies on Development Strategies Considering Impacts of Adapting to Climate Change*. Tokyo.

ADB. 2012. *Guidelines for Climate Proofing Investment in Agriculture, Rural Development and Food Security*. Manila.

ADB. 2011. *Scoping Mission and Preliminary Assessment on Climate Change Adaptation in Sri Lanka*. Manila.

MOE. 2011. *Sri Lanka's Second National Communication on Climate Change*. Colombo.

De Silva, C.S. 2013. Impact of Climate Change on Water Resources and Agriculture in Sri Lanka*. Climate Change Impacts and Adaptations for Food and Environmental Security*. *Proceedings of the International Conference Colombo*, Sri Lanka, 30-31st July 2013.

IWMI. *Impacts of Climate Change on Water Resources and Agriculture in Sri Lanka: A Review and Preliminary Vulnerability Mapping*. Report No. 135. International Water Management Institute, Colombo.

MOE. 2011. *Sri Lanka's Second National Communication on Climate Change. Ministry of Environment*. Colombo.

Muthuwaththa, L.P. and Liyanage, P.K.N.C. Impact of Rainfall Change on the Agro-Ecological Regions of Sri Lanka. *Climate Change Impacts and Adaptations for Food and Environmental Security. Proceedings of the International Conference Colombo*, Sri Lanka, 30-31st July 2013.

Premalal, K.H.M.S. and Punyawardena, B.V.R. Occurrence of Extreme Climatic Events in Sri Lanka. *Climate Change Impacts and Adaptations for Food and Environmental Security, Proceedings of the International Conference, Colombo*, Sri Lanka, 30-31st July 2013.

Weerakoon, W.M.W. Impact of Climate Change on Food Security in Sri Lanka. *Climate Change Impacts and Adaptations for Food and Environmental Security, Proceedings of the International Conference,* Colombo, Sri Lanka, 30-31st July 2013.

ANNEX 1: CLIMATE CHANGE SCREENING

Water Resources Development Investment Program – **Sri Lanka**

Climate Change

Under the A2 scenario, average annual mean temperature within the Mahaweli Basin is projected to rise 1.8^0C by 2050s. Annual precipitation is projected to increase 85mm (4.2%). Precipitation in the December-April period (largely corresponds to the Northeast Monsoon) is projected to decrease by 3.8% while an increase of 11% is proejcted for the May-November period which corresponds to the Southwest Monsoon.

Climate-Sensitive Components

1). Changes in Hydrology of the River Basin and Reduced Water Availability.
A significant amount of rainfall in the upper catchment of Mahaweli Basin has been observed to have declined by 39.12% during the past century consequently the stream flow in the Mahaweli Basin is declining. Under the A2 scenario, total annual runoff within the upper catchment is projected to decrease by 2050s and the reduction is much greater during the Northeast Monsoon. Water availability is very likely to be affected by climate change if the current trend continues.

2). Reduction in Reservoir Capacity due to Siltation
The projected increase in Southwest Monsoon precipitation is likely to cause exacerbated soil/bank erosion within the upper catchment resulting in reduced water storage capacity.

Draft Report

C Y Ji
February 17, 2014

Date: 2014-02-11

Project Information				
Project Title/Number	**Country/Province**	**Sector/Type/Sections**	**Modality**	**Stage**
Water Resources Development Investment Program /47381	Sri Lanka/	Agriculture/water Resources Management	MFF	Concept Paper
Project Components	**1**). Construction of Kaluganga - Moragahakanda Transfer Canal with capacity of 771M m^3/yr to downstream irrigation and water supply schemes; **2**). Construction of Upper Elahera Canal which will annually convey up to 974M m^3 northwards from Moragahakanda Reservoir along a 70km canal to the existing Huruluwewa and Mannakattiya reservoirs which feed existing irrigation and water supply schemes; **3**). Construction of North Western Province Canal and associated infrastructure to withdraw 130M m^3 from Dambulu Oya River and the existing Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located throughout North Western Province via 80km of new and upgraded canals; **4**). Minipe Anicut heightened, and Left Bank Canal and associated infrastructure rehabilitated (located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River). The project will add upstream storage by heightening the headwork's weir by 4 meters to regulate generation inflows, and rehabilitate the 76km left bank canal to improve conveyance and reliability of service to existing farmers.			
	Climate Projection – 2050s/A2/Multi-Model Ensemble Mean			**Maps**
Temperature	The baseline (1960-1990) average annual mean temperature within the Mahaweli River Basin is about 24.55^{0}C. Seasonal variation is weak, the highest occurs in May (~26^{0}C) and lowest in January (22.7^{0}C). Temperature varies strongly with elevation and is substantially lower within the upper catchment (~18^{0}C). Average annual mean temperature in 2050s is projected to rise by 1.8^{0}C under the A2 scenario. Temperature rise is projected to be lower during August-January period (<1.8^{0}C) and higher during the rest of the year. The highest temperature rise is projected for the month of April (>2^{0}C). No marked spatial variation in temperature rise is projected.			Map 1
Precipitation	Annual total precipitation within the Mahaweli River Basin is about 2054mm (baseline, 1960-1990, WorldClim). The upper catchment is endoewed with much high precipitation (>2,400mm). Annual precipitation is projected to increase by 85mm (or 4.2%) under the A2 scenario by 2050s. The increase is proejted to be higher within the lower catchment (>4%) and lower in the upper catchment (<4%). Precipitation in the December-April period (corresponds to the Northeast Monsoon is projected to decrease by 3.8% while an increase of 11% is proejcted for the May-November period which corresponds to the Southwest Monsoon. A study[1] using Statistical Downscaling Model (SDSM 4.2) for a neighboring basin (Kelani) arrived at similar results.			Map 2
Natural Hazards				
Type	**Risk/Score**	**Evaluation**	**CC Implications**	**Maps**
Landslide Triggered by Precipitation[2]	Medium	Annual precipitation within the upper catchment area is high	Increased intensity of storms during the monsoon season has been observed during	Map 3

[1] Silva, S. B. Weerakoon, Srikantha Herath, Analysis of future rainfall trebds in the Kelani River Basin under the impact of climate change. Water Board of Sri Lanka.

[2] Slow moving slides have significant economic consequences for constructions and infrastructure, but rarely cause fatalities.

		(>2400mm). The Left Bank Canal downstream from the Mahaweli Hydropower Complex appears to be prone to landslides due to excessive rainfall and steep slopes of the central hills.	the past decades. Under the A2 scenario, precipitation during the Southwest Monsoon in 2050s is projected to increase by about 11%. When the HadCM3 model is used alone, annual runoff in the wet zone is expected to increase by 40 to 100% and the risks of landslide and flooding are expected to be much exacerbated[3].	
Flood	Medium/High	All project sites are prone to flash floods[4]. There is high risk for the Left Bank Canal downstream from Mahaweli Hydropower Complex. Other project sites appear to be under moderate risk.	Under the conditions of rising temperature, precipitation is more likely to arrive in the form of heavy rains accompanied by an increase in flood risk[5,6,7,8,9]. Flood risks are very likely to aggravate in the future.	Map 4
Drought	Medium/High	A large part of the island is drought prone from February to April and, if the subsidiary rainy season from May to June is deficient, drought may continue into September. North-Central and Northwestern provinces are prone to high risk of drought. Droughts occur in the south-eastern, north-central and north-western areas of Sri Lanka mainly due to low rainfall during monsoons. Droughts of a serious nature occur every	Sri Lanka has recently been experiencing prolonged and frequent dry spells or drought periods as a result of increased variability of seasonal rainfall coupled with increased temperatures[11]. Increased frequency of dry periods and droughts are expected[12]. Increased precipitation intensity and variability are projected to increase the risk of both flooding and drought in any area[13].	Map 5

[3] De Silva C. S., 2009. Impact of climate change predictions on food production in Sri Lanka and possible adaptation measures. Abstract of the National Symposium on promoting knowledge transfer to strengthen disaster risk reduction and climate change adaptation, BMICH, Colombo, p7.

[4] Our experiences strongly suggest that the actual flood hazard is much underestimated and underrepresented by the global flood hazard dataset at local scales. This is largely due to the relatively coarse spatial resolution at which the dataset was compiled.

[5] Allen, M. R., and W. J. Ingram, 2002. Constraints on the future changes in climate and the hydrological cycle, Nature, 419, 224–232, doi:10.1038/nature01092.

[6] Goswami, B. N., V. Venugopal, D. Sengupta, M. S. Madhusoodanan, and Prince K. Xavier, 2006. Increasing trend of extreme rain events over India in a warming environment, Science, 314, 1442–1445, doi:10.1126/science.1132027.

[7] Min, S. H., X. Zhang, F. W. Zwiers, and G. C. Hegerl, 2011. Human contribution to more-intense precipitation extremes, Nature, doi:10.1038/nature09763.

[8] Trenberth, K. E., 1998. Atmospheric moisture residence times and cycling: Implications for rainfall rates and climate change, Clim. Change, 39: 667–694. doi:10.1023/A:1005319109110.

[9] Trenberth, K. E., A. Dai, R. M. Rasmussen, and D. B. Parsons, 2003. The changing character of precipitation, Bull. Amer. Meteor. Soc., 84, 1205–1217, doi:10.1175/BAMS-84-9-1205.

		3-4 years and severe droughts of national significance occur every 10 years or so. In 2004, the north-western, north-central and south-eastern provinces experienced severe drought. It also affected hydropower generation[10].		
Overall Scoring	**Multi-Hazard Index**	Standard Deviation	Category	
	Medium		**B/C**	
Sector-Specific Climate Risks				
Sensitive Components	**Climate Variable**	**Climate Change Analysis**		
Capacity of Reservoirs	Changes in the amount and intensity of precipitation; Flooding; Increased soil erosion	Climate change may impose a negative impact on reservoir capacity due to projected increase in both the amount and intensity of Southwest Monsoon. Large-scale deforestation occurred in the Upper Mahaweli Catchment (UMC) during the last 2 centuries for plantation agriculture and the watershed is exposed to severe soil erosion and landslides. The rate of soil loss on hill slopes and sediment yields in the streams of the UMC indicates that the anthropogenic activities have increased rates of ongoing erosion by more than 100 times over the rate of natural erosion. Mahaweli River and its tributaries carry enormous amounts of sediments during the rainy seasons, both as bed and suspension loads downstream and a large amount is deposited in the reservoirs leading to a reduction of their storage capacities[14]. Climate change-related weather aberrations (e.g. high precipitation events and longer dry periods) also aggravates land erosion in the upper and mid catchments causing sedimentation of reservoirs leading to reduced storage capacity[15]. The Multi-Model Ensemble projects an increase of 11% in Southwest Monsoon precipitation. Increased intensity of precipitation will exacerbate soil erosion particularly from rain-fed cultivation lands (tea, rubber, coffee, cocoa, vegetables, etc.) in the UMC leading to more sedimentation load. Erosion of river banks is also likely to be worsening due to projected increase in river flow during intensive rainfall events. The reservoirs within the upstream areas (Minipe Anicut, Kalu Ganga Dam, Nalanda Reservoir, and Moragahakanda Reservoir) are likely to be affected the	

[11] UNDP, 2007. Managing risks of a changing climate to support development. Report of the Asia Regional Workshop 23-26 April 2007, Kathmandu, Nepal.
[12] Department of Meteorology/ Adapted from the National Adaptation Strategy 2011-2016.
[13] IPCC, 2007. Executive Summary.
[10] Government of Sri Lanka, 2005. Towards a Safer Sri Lanka - A Road Map for Disaster Risk Management.
[14] Tilak Hewawasam, Effect of land use in the upper Mahaweli catchment area on erosion, landslides and siltation in hydropower reservoirs of Sri Lanka. J. Natn. Sci. Foundation, Sri Lanka, 2010, 38 (1):3-14.
[15] World Food Programme. Addressing Climate Change Impacts on Marginalized Agricultural Communities Living in the Mahaweli River Basin of Sri Lanka.

		most.	
Water Resources		Mahaweli is the longest river in Sri Lanka and serves as a principal source of water for irrigation in the dry zone. A significant amount of rainfall in the upper catchment of Mahaweli Basin has been observed to have declined by 39.12% during the past 100 years[16]. A 16.6% reduction is estimated for the next 21-year period which is expected to severely affect power generation, agriculture and domestic use[17]. While there are large year-to-year fluctuations, the stream flow within the basin has been observed to be declining. The existing reservoirs constructed on the basis of historical stream flow have only filled up three times in two decades[18]. Over the last 50 years, the stream flow into Victoria Reservoir has declined by 40%, and rainfall declined by 30%. Much of Victoria's capacity cannot be used as was the case[19]. In the tropical humid regions, runoff regimes are very much influenced by the timing and duration of the rainy season or seasons. Climate change therefore may affect river flows not only through a change in the magnitude of rainfall but also through possible changes in the onset or duration of rainy seasons (such as those caused by monsoon) (IPCC, 2007). For mid-latitudes and some subtropical regions, the general increase in evaporation means that some areas that see an increase in precipitation will experience a reduction in river runoff (IPCC, 2007). The results from the monthly water balance model simulation indicate a decrease (>5%) in total annual runoff within the upper catchment by 2050s under the A2 scenario, and 14% reduction within the middle and lower catchment area. Reduction in runoff is projected to be much greater during the Northeast Monsoon. Additionally, the river flow within Mahaweli Basin is strongly influenced by ENSO[20].	
Summary of Screening Results			
Natural Hazard	Climate change in the Mahaweli Basin is manifested in increased natural disasters such as landslides, drought, and floods, increased land degradation in the upper and mid elevations which are attributable to both temperature increase and rainfall variability[21]. 1). Landslides: The risks of landslide appear to be higher within the Left Bank Canal project area. 2). Flooding: Projected increase in Southwest Monsoon precipitation and increase in the intensity of extreme weather events are likely to aggravate the risks of flooding.		
Project Components	1). Siltation of reservoirs due to flooding and soil/bank erosion.		

[16] Shantha, W.W.A., and Jayasundara J.M.S.B. Study on Changes of Rainfall in the Mahaweli Upper Watershed in Sri Lanka, Due to Climatic Changes and Develop a Correction Model for Global Warming. http://stabilisation.metoffice.com/posters/Shantha_WWA.pdf.
[17] Shantha, W.W.A., and Jayasundara J.M.S.B. Study on Changes of Rainfall in the Mahaweli Upper Watershed in Sri Lanka, Due to Climatic Changes and Develop a Correction Model for Global Warming. http://stabilisation.metoffice.com/posters/Shantha_WWA.pdf.
[18] https://www.jamstec.go.jp/frcgc/jp/publications/news/no19/eng/topic3.html.
[19] https://www.jamstec.go.jp/frcgc/jp/publications/news/no19/eng/topic3.html.
[20] IRI (International Research Institute for Climate Prediction), Climate Risk Management in the Mahaweli River Basin, Sri Lanka. http://iri.columbia.edu/~lareef/reports/MahaweliRiverBasin/CRMinMahaweliRBrev2.pdf.
[21] World Food Programme. Addressing Climate Change Impacts on Marginalized Agricultural Communities Living in the Mahaweli River Basin of Sri Lanka.

	2). Water availability is likely to be affected by the changing precipitation pattern.	
Project's Relevance to Climate Change		
	Irrigation agriculture is the mainstay of Sri Lanka's rural economy. The need for water for irrigation and domestic use is particularly acute in the downstream of Mahaweli River. Due to projected increase in temperature, dry-zone boundary being pushed outward, bringing more land under lower rainfall regime. The combined effect of higher temperatures and less rain is projected to lead to a greater than 11% loss in revenue from paddy by 2050[22]. It has been reported that if the current rate of irrigation water use continues in the future several districts with major irrigated rice areas will have severe water scarcities according to IWMI criteria by the year 2025. Some districts will be in serious water scarce conditions so that the available water resources may not be adequate to meet their projected demand[23]. Water predictions for Sri Lanka indicate that water scarcity will increase[24]. The projected precipitation change in Sri Lanka for 2080 indicates that the entire dry and intermediate zones, which represent 75% of the island, are projected to become drought prone with 30% less rainfall in worst hit areas if the prevailing climate change trends continue[25]. Sustenance of systems, particularly in the Mahaweli River Basin of Sri Lanka that contributes towards the majority of food production in the country are identified as critical areas of focus to ensure long-term food security in the country[26]. Diverting and transferring water from the central hills region to major irrigation schemes within the dry zone through the construction of reservoirs and canal networks is indispensable to sustain rice production (especially during the Yala season as precipitation at the beginning of the season – April is projected to decrease) and provide adequate drinking water supply. Rehabilitation of dams and river banks would minimize wastage through leakage, avoid water related disasters, and ensure water security. The proposed project is therefore classified as an adaptation project.	
	Recommendations	
	Rainfall variability is by far the most important contributing factor to increased climate risk in the Mahaweli Basin[27]. As such, water availability is very likely to be affected by climate change if the current trend continues. Understanding climate and environment at sufficiently small scales is necessary to understand hydrological variability and change. The project team is advised to factor in the impact of climate change on future scenarios of water availability and its seasonal variability during project design (e.g. reservoir capacities) as well as implementation (e.g. water allocation). The risks of natural hazards (landslides and flooding) may also need to be taken into account during project design.	

[22] Munasinghe Institute for Development, Sri Lanka. Agriculture and Climate Change 2010.
[23] Senanayake Nanda & M.T.M.D.R. Perera, Global climate change: Effect on agriculture food sector in Sri Lanka in the year 2025.
http://sci.martinkoechy.de/Climate_Change_and_the_Middle_East_2006_Proceedings/05_land_use_systems.pdf
[24] UNDP, 2007. Managing risks of a changing climate to support development. Report of the Asia Regional Workshop 23-26 April 2007, Kathmandu, Nepal.
[25] World Food Programme. Addressing Climate Change Impacts on Marginalized Agricultural Communities Living in the Mahaweli River Basin of Sri Lanka.
[26] UNDP, 2007. Managing risks of a changing climate to support development. Report of the Asia Regional Workshop 23-26 April 2007, Kathmandu, Nepal.
[27] Expert views presented at the Project Design Workshop, hosted by Ministry of Environment, Kandy, September 31 to October 1, 2011.

ANNEX 2: AWARE RISK ASSESSMENT

01

Introduction

This report summarises results from a climate risk screening exercise. The project information and location(s) are detailed in Section 02 of this report.

The screening is based on the Aware™ geographic data set, compiled from the latest scientific information on current climate and related hazards together with projected changes for the future where available. These data are combined with the project's sensitivities to climate variables, returning information on the current and potential future risks that could influence its design and planning.

Project Information

PROJECT NAME: SRI: Water Resources Development Investment Program

SUB PROJECT: WRDIP

REFERENCE: Concept Paper

SECTOR: Agriculture

SUB SECTOR: Irrigation (surface & groundwater) and drainage

DESCRIPTION:

02

Chosen Locations

1) Sri Lanka
2) Sri Lanka
3) Sri Lanka
4) Sri Lanka

03

Project Risk Ratings

Below you will find the overall risk level for the project together with a radar chart presenting the level of risk associated with each individual risk topic analysed in Aware™. Projects with a final “High risk” rating are always recommended for further more detailed climate risk analyses.

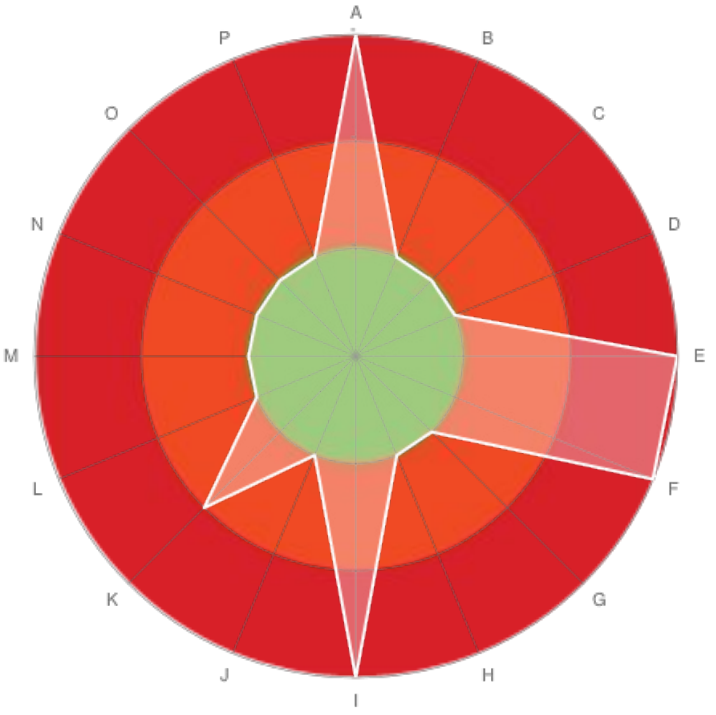
The radar chart provides an overview of which individual risks are most significant. This should be used in conjunction with the final rating to determine whether the project as a whole, or its individual components, should be assessed in further detail. The red band (outer circle) suggests a higher level of risk in relation to a risk topic. The green band (inner circle) suggests a lower level of risk in relation to a risk topic.

In the remaining sections of this report more detailed commentary is provided. Information is given on existing and possible future climate conditions and associated hazards. A number of questions are provided to help stimulate a conversation with project designers in order to determine how they would manage current and future climate change risks at the design stage. Links are provided to recent case studies, relevant data portals and other technical resources for further research.

Final project risk ratings

High Risk

Breakdown of risk topic ratings



A) Temperature increase
B) Wild fire
C) Permafrost
D) Sea ice
E) Precipitation increase
F) Flood
G) Snow loading
H) Landslide
I) Precipitation decrease
J) Water availability
K) Wind speed increase
L) Onshore Category 1 storms
M) Offshore Category 1 storms
N) Wind speed decrease
O) Sea level rise
P) Solar radiation change

04

HIGH RISK

TEMPERATURE INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

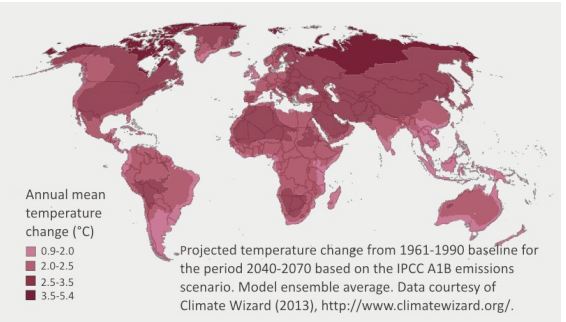
• The project is considered to have high sensitivity to increased temperature and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of high temperatures as well as potential future changes.

2. How could current high temperatures affect the project even without future climate change?

• Heatwaves put stress on buildings and other infrastructure, including roads and other transport links. In cities, the 'urban heat island' can increase the risk of heat related deaths.
• Warm weather can raise surface water temperatures of reservoirs used for industrial cooling. In addition, this could impact local eco-systems, improving the growing conditions for algae and potentially harmful micro-organisms in water courses.
• Heatwaves can have an impact on agricultural productivity and growing seasons.
• High temperatures can have implications for energy security. Peak energy demand due to demand for cooling can exceed incremental increases on base load in addition to the risk of line outages and blackouts.
• Human health can be affected by warmer periods. For example, urban air quality and disease transmission (e.g. malaria and dengue fever) can be impacted by higher air temperatures.
• Wildfire risk is elevated during prolonged warm periods that dry fuels, promoting easier ignition and faster spread.
• Permafrost and glacial melt regimes as impacted by warm periods.
• If our data suggests that there are existing hazards associated with high temperatures in the region, they will be highlighted elsewhere in the report. This may include existing wildfire risks as well as areas potentially impacted by permafrost and glacial melt.

3. What does the science say could happen by the 2050s?



Projected temperature change from 1961-1990 baseline for the period 2040-2070 based on the IPCC A1B emissions scenario. Model ensemble average. Data courtesy of Climate Wizard (2013), http://www.climatewizard.org/.

• Climate model projections do not agree that seasonal temperature will increase beyond 2 ˚C in the project location.
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to temperature and climate change.

I have acknowledged the risks highlighted in this section.

05
HIGH RISK

PRECIPITATION INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have high sensitivity to increased precipitation and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of heavy precipitation events as well as potential future changes.

2. How could current heavy precipitation affect the project even without future climate change?

• Seasonal runoff may lead to erosion and siltation of water courses, lakes and reservoirs.
• Flooding and precipitation induced landslide events.
• In colder regions, seasonal snow falls could lead to overloading structures and avalanche risk.
• If our data suggests that there are existing hazards associated with heavy precipitation in the region, they will be highlighted elsewhere in the report. This may include existing flood and landslide risks.

3. What does the science say could happen by the 2050s?

• Climate model projections agree that seasonal precipitation will increase in the project location. This indicates a relatively low degree of uncertainty that precipitation will increase in the region.
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to water and climate change.

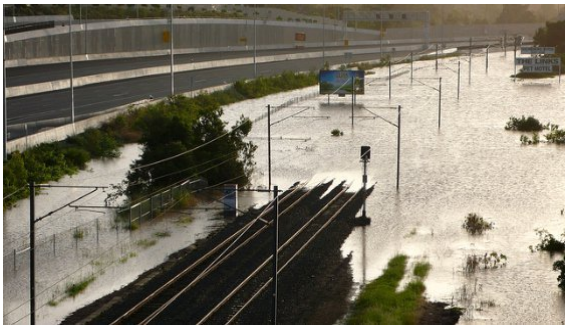
I have acknowledged the risks highlighted in this section.

06

HIGH RISK

FLOOD

ACCLIMATISE COMMENTARY



Our data suggest that the project is located in a region which has experienced recurring major flood events in the recent past. A high exposure in Aware means that between 1985 and 2010 there have been more than one significant, large-scale flood event in the region. This is based on post-processed data from the Dartmouth Flood Observatory at the University of Colorado. The risk and type of flooding is dependent on local geographical factors including:

• Proximity to the coast and inland water courses
• Local topography
• Urban drainage infrastructure
• Up to date information on flood risk worldwide is available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of flood events.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from flooding. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If flooding is identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by flooding?
Q2 Is there a plan to integrate climate change into a flood risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of floods?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to floods and climate change.

I have acknowledged the risks highlighted in this section.

07
HIGH RISK

PRECIPITATION DECREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have high sensitivity to decreased precipitation and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of decreased precipitation events as well as potential future changes.

2. How could reduced precipitation affect the project even without future climate change?

• Decreased seasonal runoff may exacerbate pressures on water availability, accessibility and quality.
• Variability of river runoff may be affected such that extremely low runoff events (i.e. drought) may occur much more frequently.
• Pollutants from industry that would be adequately diluted could now could become more concentrated.
• Increased risk of drought conditions could lead to accelerated land degradation, expanding desertification and more dust storms.
• If our data suggests that there are existing hazards associated with decreased precipitation in the region, they will be highlighted elsewhere in the report. This may include water availability and wildfire.

3. What does the science say could happen by the 2050s?

• Climate model projections do not agree that seasonal precipitation will decrease in the project location which could indicate a relatively high degree of uncertainty (see the section "Model agreement and uncertainty" in "Help and glossary" at the end of this report). On the other hand, this could also mean precipitation patterns are not expected to change or may even increase (see elsewhere in the report for more details of projections related to precipitation increase).
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to water and climate change.

I have acknowledged the risks highlighted in this section.

08

MEDIUM RISK

WIND SPEED INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have medium sensitivity to wind and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of increasing wind speed as well as potential future changes.

2. How could stronger winds affect the project even without future climate change?

• The design and operation of certain infrastructure (e.g. wind turbines) is determined by the prevailing climatic wind conditions.
• Given the energy in the wind is the cube of wind speed, a small change in the wind climate can have substantial consequences for the wind energy available.
• Similarly, small changes could have dramatic consequences for wind related hazards e.g. wind storm damage.
• If our data suggests that there is an existing risk of tropical storms in the region, it will be highlighted elsewhere in the report.

3. What does the science say could happen in the future?

• Climate change could alter the geographic distribution and/or the seasonal variability of wind resource.
• Climate model projections remain uncertain and it appears unlikely that mean wind speeds will change by more than the current inter-annual variability.
• Changes in extreme wind speeds associated with extra-tropical and tropical storm are similarly uncertain. However, there have been studies that suggest fewer but more intense events. Stronger storms bring with them an increases risk of coastal storm surge, coastal erosion, wind damage and flooding.
• Given future uncertainty it is advisable to carefully assess past wind speed in the region, bearing in mind that it could change in the future. The UNEP Solar and Wind Energy Resource Assessment SWERA provides a useful global overview of wind information.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to wind and climate change.

I have acknowledged the risks highlighted in this section.

09

The sections above detail all High and Medium risks from Aware™. Selected Low risks are also detailed. Local conditions, however, can be highly variable, so if you have any concerns related to risks not detailed in this report, it is recommended that you investigate these further using more site-specific information or through discussions with the project designers.

HELP AND GLOSSARY:

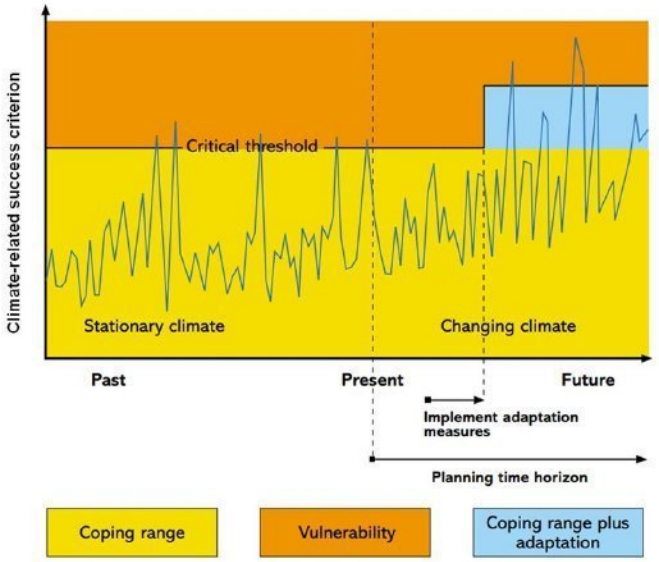
Model agreement and uncertainty:

Although climate models are constantly being improved, they are not good enough to predict future climate conditions with a degree of confidence which would allow precise adaptation decisions to be made. Outputs from different climate models often differ, presenting a range of possible climate futures to consider, and ultimately a wide range of possible actions to take. In Aware, climate projections are described as having potentially higher degree of uncertainty when less than 14 out of 16 GCMs agree on the direction and / or a pre-defined magnitude of change.

Even with improvements in climate modelling, uncertainties will remain. It is likely that not all the climate statistics of relevance to the design, planning and operations of a project's assets and infrastructure will be available from climate model outputs. The outputs are typically provided as long-term averages, e.g. changes in average monthly mean temperature or precipitation. However, decisions on asset integrity and safety may be based on short-term statistics or extreme values, such as the maximum expected 10 minute wind speed, or the 1-in-10 year rainfall event. In such cases, project designers or engineers should be working to identify climate-related thresholds for the project (see "Critical thresholds" section below) and evaluate whether existing climate trends are threatening to exceed them on an unacceptably frequent basis. Climate models can then be used to make sensible assumptions on potential changes to climate variables of relevance to the project or to obtain estimates of upper and lower bounds for the future which can be used to test the robustness of adaptation options.

The key objective in the face of uncertainty is therefore to define and implement design changes (adaptation options) which both provide a benefit in the current climate as well as resilience to the range of potential changes in future climate.

Critical thresholds:



The relationship between a critical threshold and a climate change related success criterion for a project. [Source: Willows, R.I. and Connell, R.K. (Eds.) (2003). *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report, UKCIP, Oxford].

A key issue to consider when assessing and prioritising climate change risks is the critical thresholds or sensitivities for the operational, environmental and social performance of a project. Critical thresholds are the boundaries between 'tolerable' and 'intolerable' levels of risk. In the diagram above, it can be seen how acceptable breaches in a critical threshold in today's climate may become more frequent and unacceptable in a future climate.

Climate change scenarios can be used to see if these thresholds are more likely to be exceeded in the future. The simplest example is the height of a flood defence. When water heights are above this threshold, the site will flood. The flood defence height is the horizontal line labelled 'critical threshold'. Looking at the climate trend (in this case it would be sea level or the height of a river) – shown by the blue jagged line – it can be seen that the blue line has a gradual upward trend because of climate change. This means that the critical threshold is crossed more often in the future – because sea levels are rising and winter river flows may be getting larger. So, to cope with this change, adaptation is needed – in this case, one adaptation measure is to increase the height

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Further reading:

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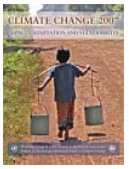	IPCC report on impacts, adaptation and vulnerability: Working Group II Report "Impacts, Adaptation and Vulnerability"
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[Meehl, G. A., C. Covey, T. Delworth, M. Latif, B. McAvaney, J. F. B. Mitchell, R. J. Stouffer, and K. E. Taylor: The WCRP CMIP3 multi-model dataset: A new era in climate change research, Bulletin of the American Meteorological Society, 88, 1383-1394, 2007]

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In some instances Risk Topic ratings are only based on Aware data, including:
• Flood
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"Climate model projections agree": defined as more than 14 out of 16 GCMs agreeing on the magnitude (e.g. temperature warming of 2 °C) and / or direction of change (e.g. seasonal precipitation).
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"Significant proportion": defined as at least 25% of locations when multiple locations are selected.
"Large proportion": defined as at least 75% of locations when multiple locations are selected.

The above thresholds are used as a means of providing a project-wide risk score where a project may be spread across multiple locations. This requires more than one individual location to be at risk to begin signifying whether there is a risk at the overall project level. However, it is always recommended that individual locations are analysed separately for more accurate, site-specific risk screening. The overall risk score for the project (high, medium or low) is based on a count of high risk topic scores. A project scores overall high risk if greater than or equal to 3 individual risk topics score high. A project scores overall medium risk if between 1 and 2 individual risk topics score high. A project scores overall low risk if none of the individual risk topics score high.

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The Content does not provide any form of advice (investment, tax, legal) amounting to investment advice, or make any recommendations regarding particular financial instruments, investments or products. Acclimatise will not be liable for any loss or damage caused by a reader's reliance on information obtained in our Content. Users are solely responsible for their own investment decisions. Acclimatise’s opinions and analyses are based on sources believed to be reliable and are written in good faith, but no representation or warranty, expressed or implied, is made as to their accuracy or completeness. Acclimatise is not authorised for the conduct of investment business (as defined in the UK's Financial Services and Markets Act 2000) and the Content provided in our services and products are not intended as, and shall not constitute, investment advice.

01

Introduction

This report summarises results from a climate risk screening exercise. The project information and location(s) are detailed in Section 02 of this report.

The screening is based on the Aware™ geographic data set, compiled from the latest scientific information on current climate and related hazards together with projected changes for the future where available. These data are combined with the project's sensitivities to climate variables, returning information on the current and potential future risks that could influence its design and planning.

Project Information

PROJECT NAME:	Sri Water resources Development Project
SUB PROJECT:	Upper Elehera Canal
REFERENCE:	Concept paper
SECTOR:	Agriculture
SUB SECTOR:	Irrigation (surface & groundwater) and drainage
DESCRIPTION:	Irrigation

02

Chosen Locations

1) Sri Lanka

03

Project Risk Ratings

Below you will find the overall risk level for the project together with a radar chart presenting the level of risk associated with each individual risk topic analysed in Aware^{TM}. Projects with a final “High risk” rating are always recommended for further more detailed climate risk analyses.

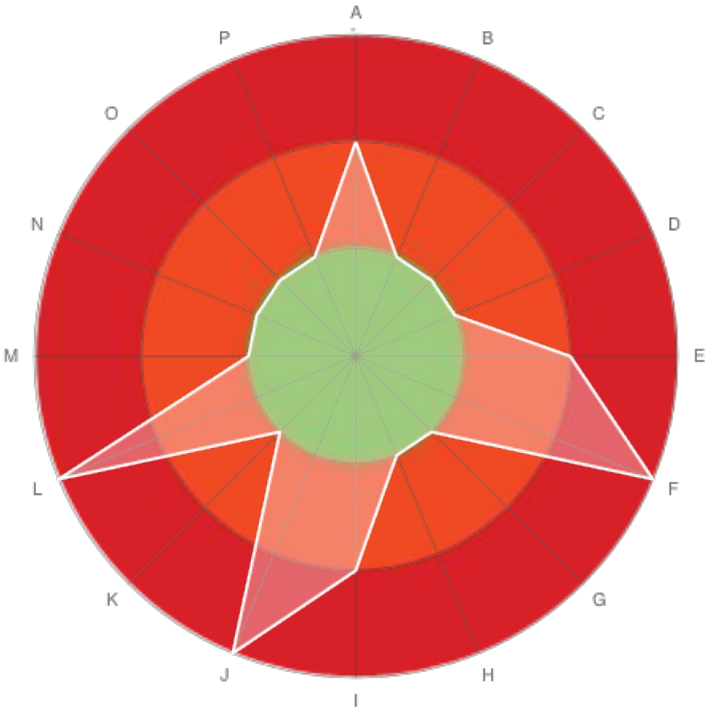
The radar chart provides an overview of which individual risks are most significant. This should be used in conjunction with the final rating to determine whether the project as a whole, or its individual components, should be assessed in further detail. The red band (outer circle) suggests a higher level of risk in relation to a risk topic. The green band (inner circle) suggests a lower level of risk in relation to a risk topic.

In the remaining sections of this report more detailed commentary is provided. Information is given on existing and possible future climate conditions and associated hazards. A number of questions are provided to help stimulate a conversation with project designers in order to determine how they would manage current and future climate change risks at the design stage. Links are provided to recent case studies, relevant data portals and other technical resources for further research.

Final project risk ratings

High Risk

Breakdown of risk topic ratings



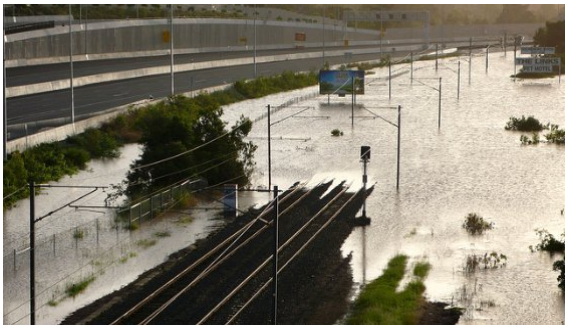
A) Temperature increase
B) Wild fire
C) Permafrost
D) Sea ice
E) Precipitation increase
F) Flood
G) Snow loading
H) Landslide
I) Precipitation decrease
J) Water availability
K) Wind speed increase
L) Onshore Category 1 storms
M) Offshore Category 1 storms
N) Wind speed decrease
O) Sea level rise
P) Solar radiation change

04

HIGH RISK

FLOOD

ACCLIMATISE COMMENTARY



Our data suggest that the project is located in a region which has experienced recurring major flood events in the recent past. A high exposure in Aware means that between 1985 and 2010 there have been more than one significant, large-scale flood event in the region. This is based on post-processed data from the Dartmouth Flood Observatory at the University of Colorado. The risk and type of flooding is dependent on local geographical factors including:

• Proximity to the coast and inland water courses
• Local topography
• Urban drainage infrastructure
• Up to date information on flood risk worldwide is available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of flood events.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from flooding. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If flooding is identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by flooding?
Q2 Is there a plan to integrate climate change into a flood risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of floods?

3. What next?

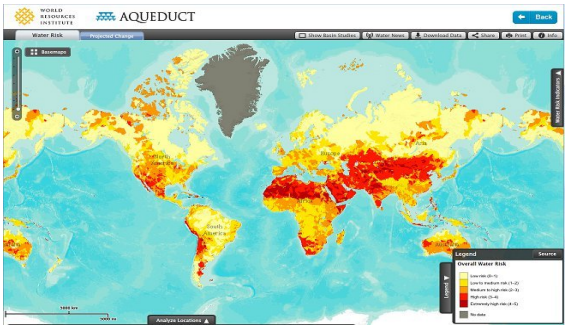
• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to floods and climate change.

I have acknowledged the risks highlighted in this section.

05
HIGH RISK

WATER AVAILABILITY

ACCLIMATISE COMMENTARY



• Our data suggest that the project is located in a region where there may be future water stress (2020s - 2050s). A high exposure in Aware means that either water stress is 'extreme' or high seasonal temperatures coincide with relatively low rainfall. Extreme water stress is defined as 'less than 0.5 million litres available per person per year' based on climate information as well as the effects of income, electricity production, water-use efficiency and other driving forces. This is post-processed data from Alcamo et al., 2007. Away from populated regions, high exposure also occurs where high seasonal temperatures (above 28 degrees Celsius average over 6 months) coincide with low rainfall (less than 100 mm per month average over 6 months). This is based on post-processed data from the Global Precipitation Climatology Centre (GPCC), Climatic Research Unit (CRU) and a range of GCM projections.
• The situation may be exacerbated if there is increased competition for water with other users in the area and changes in local demographics.
• An associated reduction in water quality could also have a negative impact on the project.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence water availability. Regions that are already dry may suffer further if future precipitation is projected to decrease. Increased evaporation due to rising temperature will further impact on water availability. Seasonal availability of water may also change whereby there may be a shift in the timing of its availability.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from water availability and design standards may not be met. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If water availability is identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.
• If you want to know more about projected changes in water availability in the project location, please refer to: the World Resources Institute's Aqueduct.

2. As a starting point you may wish to consider the following questions:

Q1 How would a lack of water impact the expected performance of the project?
Q2 Would a reduction in water supply have consequences for the expected maintenance of the project?
Q3 Will there be a water shortage continuity strategy in place for the project?
Q4 Will it be necessary to carry out water availability risk assessments in any of the project locations? If so, these assessments should take into account climate change?
Q5 Will there be an investment in water efficient technology or practices to help minimise the quantities of water required for its operational processes?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to water and climate change.

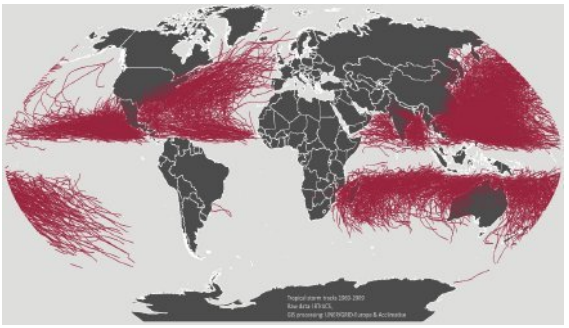
I have acknowledged the risks highlighted in this section.

06

HIGH RISK

ONSHORE CATEGORY 1 STORMS

ACCLIMATISE COMMENTARY



• Our data suggest that the project is located in a region which has experienced Category 1 storms in the recent past. A high exposure in Aware means that between 1968 and 2009 there have been at least one Category 1 storm in the region. This is based on post-processed data from UNEP/ GRID-Europe.
• On the Saffir-Simpson Hurricane Scale a category 1 storm is characterised by sustained winds in excess of 119 km/hr (33 m/s).
• Even this least intense storm can still produce plenty of damage and be life threatening.
• These regions may also susceptible to lower intensity but more frequent tropical storms as well as less frequent higher-intensity storms.
• Up to date information on storm risk worldwide is widely available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of tropical storms.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from tropical or extra tropical storms. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If coastal surges and high winds are identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by hazards associated with tropical storms e.g. storm surges and strong winds?
Q2 Are there any plans to integrate climate change factors into a storm risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of storm damage?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to storms and climate change.

I have acknowledged the risks highlighted in this section.

07
MEDIUM RISK

TEMPERATURE INCREASE

Would an increase in temperature require modifications to the design of the project in order to successfully provide the expected services over its lifetime?

Chosen Answer

Cannot answer.

Not enough information is known about the sensitivity of the project design to increases in temperature.

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

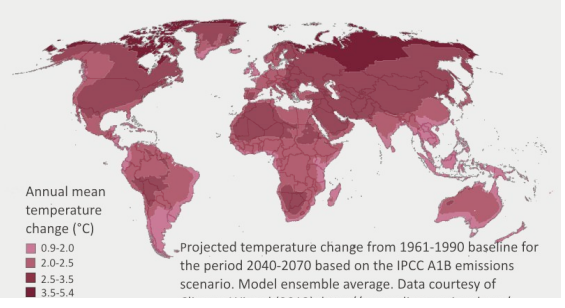
• Although you have stated that you could not answer whether the project is sensitive to increases in temperature it is recommended that you consider that an increase in mean seasonal and annual temperature could have implications for a number of hazards.
• There is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of high temperatures as well as potential future changes.

2. How could current high temperatures affect the project even without future climate change?

• Heatwaves put stress on buildings and other infrastructure, including roads and other transport links. In cities, the 'urban heat island' can increase the risk of heat related deaths.
• Warm weather can raise surface water temperatures of reservoirs used for industrial cooling. In addition, this could impact local eco-systems, improving the growing conditions for algae and potentially harmful micro-organisms in water courses.
• Heatwaves can have an impact on agricultural productivity and growing seasons.
• High temperatures can have implications for energy security. Peak energy demand due to demand for cooling can exceed incremental increases on base load in addition to the risk of line outages and blackouts.
• Human health can be affected by warmer periods. For example, urban air quality and disease transmission (e.g. malaria and dengue fever) can be impacted by higher air temperatures.
• Wildfire risk is elevated during prolonged warm periods that dry fuels, promoting easier ignition and faster spread.
• Permafrost and glacial melt regimes as impacted by warm periods.
• If our data suggests that there are existing hazards associated with high temperatures in the region, they will be highlighted elsewhere in the report. This may include existing wildfire risks as well as areas potentially impacted by permafrost and glacial melt.

3. What does the science say could happen by the 2050s?



• Climate model projections do not agree that seasonal temperature will increase beyond 2 ˚C in the project location.
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

Climate Wizard (2013), http://www.climatewizard.org/.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to temperature and climate change.

I have acknowledged the risks highlighted in this section.

08
MEDIUM RISK

PRECIPITATION INCREASE

Would an increase in precipitation require modifications to the design of the project in order to successfully provide the expected services over its lifetime?

Chosen Answer

Cannot answer.

Not enough information is known about the sensitivity of the project design to increases in precipitation.

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• There is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of heavy precipitation events as well as potential future changes.

2. How could current heavy precipitation affect the project even without future climate change?

• Seasonal runoff may lead to erosion and siltation of water courses, lakes and reservoirs.
• Flooding and precipitation induced landslide events.
• In colder regions, seasonal snow falls could lead to overloading structures and avalanche risk.
• If our data suggests that there are existing hazards associated with heavy precipitation in the region, they will be highlighted elsewhere in the report. This may include existing flood and landslide risks.

3. What does the science say could happen by the 2050s?

• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

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2. Click here or here for the latest news and information relating to water and climate change.

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09
MEDIUM RISK

PRECIPITATION DECREASE

Would a decrease in precipitation require modifications to the design of the project in order to successfully provide the expected services over its lifetime?

Chosen Answer

Cannot answer.

Not enough information is known about the sensitivity of the project design to decreases in precipitation.

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• There is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of decreased precipitation events as well as potential future changes.

2. How could reduced precipitation affect the project even without future climate change?

• Decreased seasonal runoff may exacerbate pressures on water availability, accessibility and quality.
• Variability of river runoff may be affected such that extremely low runoff events (i.e. drought) may occur much more frequently.
• Pollutants from industry that would be adequately diluted could now could become more concentrated.
• Increased risk of drought conditions could lead to accelerated land degradation, expanding desertification and more dust storms.
• If our data suggests that there are existing hazards associated with decreased precipitation in the region, they will be highlighted elsewhere in the report. This may include water availability and wildfire.

3. What does the science say could happen by the 2050s?

• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

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10

The sections above detail all High and Medium risks from Aware™. Selected Low risks are also detailed. Local conditions, however, can be highly variable, so if you have any concerns related to risks not detailed in this report, it is recommended that you investigate these further using more site-specific information or through discussions with the project designers.

HELP AND GLOSSARY:

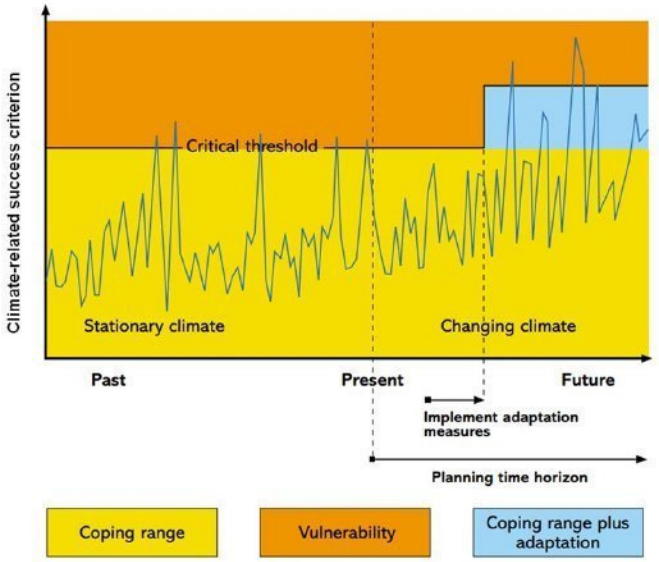
Model agreement and uncertainty:

Although climate models are constantly being improved, they are not good enough to predict future climate conditions with a degree of confidence which would allow precise adaptation decisions to be made. Outputs from different climate models often differ, presenting a range of possible climate futures to consider, and ultimately a wide range of possible actions to take. In Aware, climate projections are described as having potentially higher degree of uncertainty when less than 14 out of 16 GCMs agree on the direction and / or a pre-defined magnitude of change.

Even with improvements in climate modelling, uncertainties will remain. It is likely that not all the climate statistics of relevance to the design, planning and operations of a project's assets and infrastructure will be available from climate model outputs. The outputs are typically provided as long-term averages, e.g. changes in average monthly mean temperature or precipitation. However, decisions on asset integrity and safety may be based on short-term statistics or extreme values, such as the maximum expected 10 minute wind speed, or the 1-in-10 year rainfall event. In such cases, project designers or engineers should be working to identify climate-related thresholds for the project (see "Critical thresholds" section below) and evaluate whether existing climate trends are threatening to exceed them on an unacceptably frequent basis. Climate models can then be used to make sensible assumptions on potential changes to climate variables of relevance to the project or to obtain estimates of upper and lower bounds for the future which can be used to test the robustness of adaptation options.

The key objective in the face of uncertainty is therefore to define and implement design changes (adaptation options) which both provide a benefit in the current climate as well as resilience to the range of potential changes in future climate.

Critical thresholds:



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Climate change scenarios can be used to see if these thresholds are more likely to be exceeded in the future. The simplest example is the height of a flood defence. When water heights are above this threshold, the site will flood. The flood defence height is the horizontal line labelled 'critical threshold'. Looking at the climate trend (in this case it would be sea level or the height of a river) – shown by the blue jagged line – it can be seen that the blue line has a gradual upward trend because of climate change. This means that the critical threshold is crossed more often in the future – because sea levels are rising and winter river flows may be getting larger. So, to cope with this change, adaptation is needed – in this case, one adaptation measure is to increase the height

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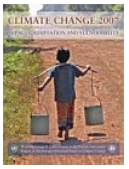	IPCC report on impacts, adaptation and vulnerability: Working Group II Report "Impacts, Adaptation and Vulnerability"
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"Significant proportion": defined as at least 25% of locations when multiple locations are selected.
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The above thresholds are used as a means of providing a project-wide risk score where a project may be spread across multiple locations. This requires more than one individual location to be at risk to begin signifying whether there is a risk at the overall project level. However, it is always recommended that individual locations are analysed separately for more accurate, site-specific risk screening. The overall risk score for the project (high, medium or low) is based on a count of high risk topic scores. A project scores overall high risk if greater than or equal to 3 individual risk topics score high. A project scores overall medium risk if between 1 and 2 individual risk topics score high. A project scores overall low risk if none of the individual risk topics score high.

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01

Introduction

This report summarises results from a climate risk screening exercise. The project information and location(s) are detailed in Section 02 of this report.

The screening is based on the Aware™ geographic data set, compiled from the latest scientific information on current climate and related hazards together with projected changes for the future where available. These data are combined with the project's sensitivities to climate variables, returning information on the current and potential future risks that could influence its design and planning.

Project Information

PROJECT NAME:	SRI Water Resources Development Investment Program
SUB PROJECT:	North Western Province
REFERENCE:	Concept Paper
SECTOR:	Agriculture
SUB SECTOR:	Irrigation (surface & groundwater) and drainage
DESCRIPTION:	Irrigation

02

Chosen Locations

1) Sri Lanka

03

Project Risk Ratings

Below you will find the overall risk level for the project together with a radar chart presenting the level of risk associated with each individual risk topic analysed in Aware^{TM}. Projects with a final “High risk” rating are always recommended for further more detailed climate risk analyses.

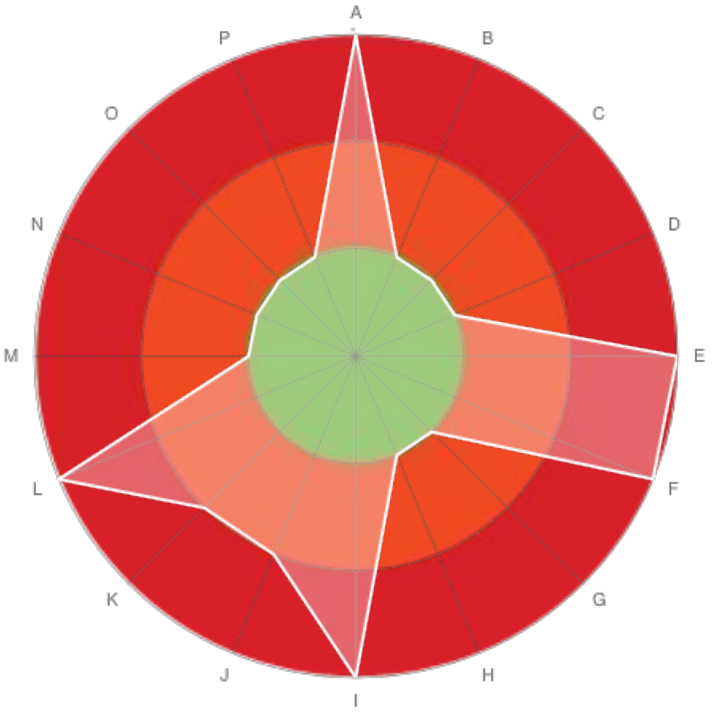
The radar chart provides an overview of which individual risks are most significant. This should be used in conjunction with the final rating to determine whether the project as a whole, or its individual components, should be assessed in further detail. The red band (outer circle) suggests a higher level of risk in relation to a risk topic. The green band (inner circle) suggests a lower level of risk in relation to a risk topic.

In the remaining sections of this report more detailed commentary is provided. Information is given on existing and possible future climate conditions and associated hazards. A number of questions are provided to help stimulate a conversation with project designers in order to determine how they would manage current and future climate change risks at the design stage. Links are provided to recent case studies, relevant data portals and other technical resources for further research.

Final project risk ratings

High Risk

Breakdown of risk topic ratings



A) Temperature increase
B) Wild fire
C) Permafrost
D) Sea ice
E) Precipitation increase
F) Flood
G) Snow loading
H) Landslide
I) Precipitation decrease
J) Water availability
K) Wind speed increase
L) Onshore Category 1 storms
M) Offshore Category 1 storms
N) Wind speed decrease
O) Sea level rise
P) Solar radiation change

04

HIGH RISK

TEMPERATURE INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

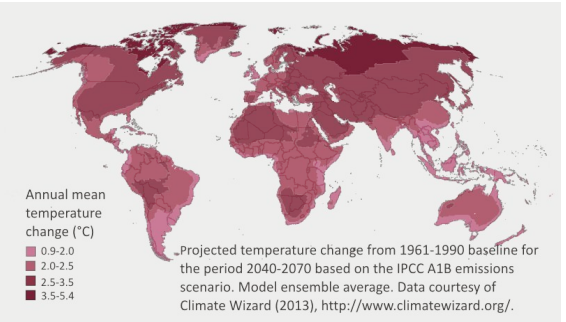
• The project is considered to have high sensitivity to increased temperature and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of high temperatures as well as potential future changes.

2. How could current high temperatures affect the project even without future climate change?

• Heatwaves put stress on buildings and other infrastructure, including roads and other transport links. In cities, the 'urban heat island' can increase the risk of heat related deaths.
• Warm weather can raise surface water temperatures of reservoirs used for industrial cooling. In addition, this could impact local eco-systems, improving the growing conditions for algae and potentially harmful micro-organisms in water courses.
• Heatwaves can have an impact on agricultural productivity and growing seasons.
• High temperatures can have implications for energy security. Peak energy demand due to demand for cooling can exceed incremental increases on base load in addition to the risk of line outages and blackouts.
• Human health can be affected by warmer periods. For example, urban air quality and disease transmission (e.g. malaria and dengue fever) can be impacted by higher air temperatures.
• Wildfire risk is elevated during prolonged warm periods that dry fuels, promoting easier ignition and faster spread.
• Permafrost and glacial melt regimes as impacted by warm periods.
• If our data suggests that there are existing hazards associated with high temperatures in the region, they will be highlighted elsewhere in the report. This may include existing wildfire risks as well as areas potentially impacted by permafrost and glacial melt.

3. What does the science say could happen by the 2050s?



Projected temperature change from 1961-1990 baseline for the period 2040-2070 based on the IPCC A1B emissions scenario. Model ensemble average. Data courtesy of Climate Wizard (2013), http://www.climatewizard.org/.

• Climate model projections do not agree that seasonal temperature will increase beyond 2 ˚C in the project location.
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to temperature and climate change.

I have acknowledged the risks highlighted in this section.

05
HIGH RISK

PRECIPITATION INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have high sensitivity to increased precipitation and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of heavy precipitation events as well as potential future changes.

2. How could current heavy precipitation affect the project even without future climate change?

• Seasonal runoff may lead to erosion and siltation of water courses, lakes and reservoirs.
• Flooding and precipitation induced landslide events.
• In colder regions, seasonal snow falls could lead to overloading structures and avalanche risk.
• If our data suggests that there are existing hazards associated with heavy precipitation in the region, they will be highlighted elsewhere in the report. This may include existing flood and landslide risks.

3. What does the science say could happen by the 2050s?

• Climate model projections do not agree that seasonal precipitation will increase in the project location which could indicate a relatively high degree of uncertainty (see the section "Model agreement and uncertainty" in "Help and glossary" at the end of this report). On the other hand, this could also mean precipitation patterns are not expected to change or may even decrease (see elsewhere in the report for more details of projections related to precipitation decrease).
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to water and climate change.

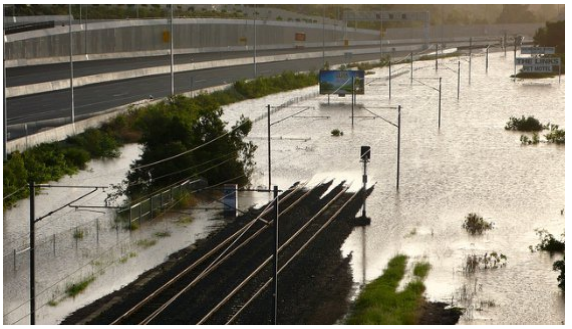
I have acknowledged the risks highlighted in this section.

06

HIGH RISK

FLOOD

ACCLIMATISE COMMENTARY



Our data suggest that the project is located in a region which has experienced recurring major flood events in the recent past. A high exposure in Aware means that between 1985 and 2010 there have been more than one significant, large-scale flood event in the region. This is based on post-processed data from the Dartmouth Flood Observatory at the University of Colorado. The risk and type of flooding is dependent on local geographical factors including:

• Proximity to the coast and inland water courses
• Local topography
• Urban drainage infrastructure
• Up to date information on flood risk worldwide is available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of flood events.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from flooding. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If flooding is identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by flooding?
Q2 Is there a plan to integrate climate change into a flood risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of floods?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to floods and climate change.

I have acknowledged the risks highlighted in this section.

07
HIGH RISK

PRECIPITATION DECREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have high sensitivity to decreased precipitation and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of decreased precipitation events as well as potential future changes.

2. How could reduced precipitation affect the project even without future climate change?

• Decreased seasonal runoff may exacerbate pressures on water availability, accessibility and quality.
• Variability of river runoff may be affected such that extremely low runoff events (i.e. drought) may occur much more frequently.
• Pollutants from industry that would be adequately diluted could now could become more concentrated.
• Increased risk of drought conditions could lead to accelerated land degradation, expanding desertification and more dust storms.
• If our data suggests that there are existing hazards associated with decreased precipitation in the region, they will be highlighted elsewhere in the report. This may include water availability and wildfire.

3. What does the science say could happen by the 2050s?

• Climate model projections do not agree that seasonal precipitation will decrease in the project location which could indicate a relatively high degree of uncertainty (see the section "Model agreement and uncertainty" in "Help and glossary" at the end of this report). On the other hand, this could also mean precipitation patterns are not expected to change or may even increase (see elsewhere in the report for more details of projections related to precipitation increase).
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to water and climate change.

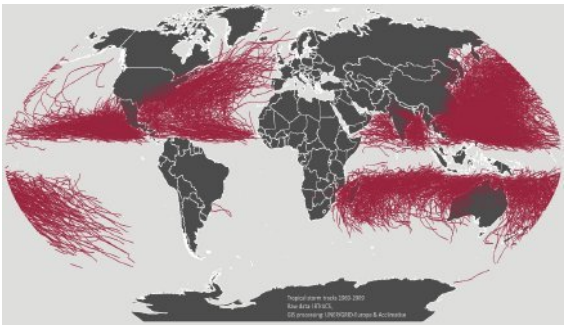
I have acknowledged the risks highlighted in this section.

08

HIGH RISK

ONSHORE CATEGORY 1 STORMS

ACCLIMATISE COMMENTARY



• Our data suggest that the project is located in a region which has experienced Category 1 storms in the recent past. A high exposure in Aware means that between 1968 and 2009 there have been at least one Category 1 storm in the region. This is based on post-processed data from UNEP/ GRID-Europe.
• On the Saffir-Simpson Hurricane Scale a category 1 storm is characterised by sustained winds in excess of 119 km/hr (33 m/s).
• Even this least intense storm can still produce plenty of damage and be life threatening.
• These regions may also susceptible to lower intensity but more frequent tropical storms as well as less frequent higher-intensity storms.
• Up to date information on storm risk worldwide is widely available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of tropical storms.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from tropical or extra tropical storms. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If coastal surges and high winds are identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by hazards associated with tropical storms e.g. storm surges and strong winds?
Q2 Are there any plans to integrate climate change factors into a storm risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of storm damage?

3. What next?

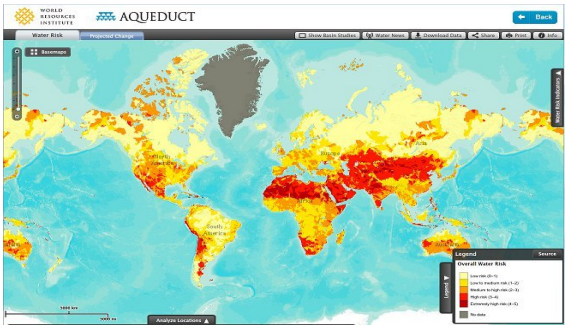
• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to storms and climate change.

I have acknowledged the risks highlighted in this section.

09
MEDIUM RISK

WATER AVAILABILITY

ACCLIMATISE COMMENTARY



• Our data suggest that the project is located in a region where there may be future water stress (2020s - 2050s). A high exposure in Aware means that either water stress is 'extreme' or high seasonal temperatures coincide with relatively low rainfall. Extreme water stress is defined as 'less than 0.5 million litres available per person per year' based on climate information as well as the effects of income, electricity production, water-use efficiency and other driving forces. This is post-processed data from Alcamo et al., 2007. Away from populated regions, high exposure also occurs where high seasonal temperatures (above 28 degrees Celsius average over 6 months) coincide with low rainfall (less than 100mm per month average over 6 months). This is based on post-processed data from the Global Precipitation Climatology Centre (GPCC), Climatic Research Unit (CRU) and a range of GCM projections.
• The situation may be exacerbated if there is increased competition for water with other users in the area and changes in local demographics.
• An associated reduction in water quality could also have a negative impact on the project.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence water availability. Regions that are already dry may suffer further if future precipitation is projected to decrease. Increased evaporation due to rising temperature will further impact on water availability. Seasonal availability of water may also change whereby there may be a shift in the timing of its availability.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from water availability and design standards may not be met. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If water availability is identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.
• If you want to know more about projected changes in water availability in the project location, please refer to: the World Resources Institute's Aqueduct.

2. As a starting point you may wish to consider the following questions:

Q1 How would a lack of water impact the expected performance of the project?
Q2 Would a reduction in water supply have consequences for the expected maintenance of the project?
Q3 Will there be a water shortage continuity strategy in place for the project?
Q4 Will it be necessary to carry out water availability risk assessments in any of the project locations? If so, these assessments should take into account climate change?
Q5 Will there be an investment in water efficient technology or practices to help minimise the quantities of water required for its operational processes?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to water and climate change.

I have acknowledged the risks highlighted in this section.

10
MEDIUM RISK

WIND SPEED INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have medium sensitivity to wind and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of increasing wind speed as well as potential future changes.

2. How could stronger winds affect the project even without future climate change?

• The design and operation of certain infrastructure (e.g. wind turbines) is determined by the prevailing climatic wind conditions.
• Given the energy in the wind is the cube of wind speed, a small change in the wind climate can have substantial consequences for the wind energy available.
• Similarly, small changes could have dramatic consequences for wind related hazards e.g. wind storm damage.
• If our data suggests that there is an existing risk of tropical storms in the region, it will be highlighted elsewhere in the report.

3. What does the science say could happen in the future?

• Climate change could alter the geographic distribution and/or the seasonal variability of wind resource.
• Climate model projections remain uncertain and it appears unlikely that mean wind speeds will change by more than the current inter-annual variability.
• Changes in extreme wind speeds associated with extra-tropical and tropical storm are similarly uncertain. However, there have been studies that suggest fewer but more intense events. Stronger storms bring with them an increases risk of coastal storm surge, coastal erosion, wind damage and flooding.
• Given future uncertainty it is advisable to carefully assess past wind speed in the region, bearing in mind that it could change in the future. The UNEP Solar and Wind Energy Resource Assessment SWERA provides a useful global overview of wind information.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to wind and climate change.

I have acknowledged the risks highlighted in this section.

11

The sections above detail all High and Medium risks from Aware™. Selected Low risks are also detailed. Local conditions, however, can be highly variable, so if you have any concerns related to risks not detailed in this report, it is recommended that you investigate these further using more site-specific information or through discussions with the project designers.

HELP AND GLOSSARY:

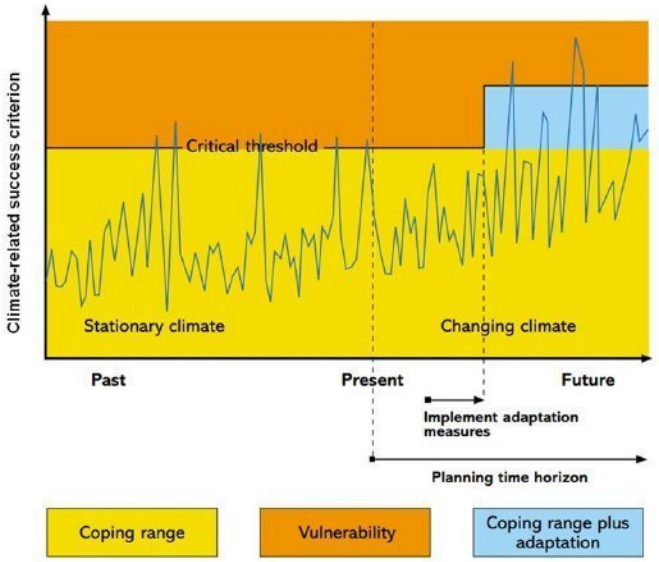
Model agreement and uncertainty:

Although climate models are constantly being improved, they are not good enough to predict future climate conditions with a degree of confidence which would allow precise adaptation decisions to be made. Outputs from different climate models often differ, presenting a range of possible climate futures to consider, and ultimately a wide range of possible actions to take. In Aware, climate projections are described as having potentially higher degree of uncertainty when less than 14 out of 16 GCMs agree on the direction and / or a pre-defined magnitude of change.

Even with improvements in climate modelling, uncertainties will remain. It is likely that not all the climate statistics of relevance to the design, planning and operations of a project's assets and infrastructure will be available from climate model outputs. The outputs are typically provided as long-term averages, e.g. changes in average monthly mean temperature or precipitation. However, decisions on asset integrity and safety may be based on short-term statistics or extreme values, such as the maximum expected 10 minute wind speed, or the 1-in-10 year rainfall event. In such cases, project designers or engineers should be working to identify climate-related thresholds for the project (see "Critical thresholds" section below) and evaluate whether existing climate trends are threatening to exceed them on an unacceptably frequent basis. Climate models can then be used to make sensible assumptions on potential changes to climate variables of relevance to the project or to obtain estimates of upper and lower bounds for the future which can be used to test the robustness of adaptation options.

The key objective in the face of uncertainty is therefore to define and implement design changes (adaptation options) which both provide a benefit in the current climate as well as resilience to the range of potential changes in future climate.

Critical thresholds:



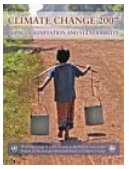
The relationship between a critical threshold and a climate change related success criterion for a project. [Source: Willows, R.I. and Connell, R.K. (Eds.) (2003). *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report, UKCIP, Oxford].

A key issue to consider when assessing and prioritising climate change risks is the critical thresholds or sensitivities for the operational, environmental and social performance of a project. Critical thresholds are the boundaries between 'tolerable' and 'intolerable' levels of risk. In the diagram above, it can be seen how acceptable breaches in a critical threshold in today's climate may become more frequent and unacceptable in a future climate.

Climate change scenarios can be used to see if these thresholds are more likely to be exceeded in the future. The simplest example is the height of a flood defence. When water heights are above this threshold, the site will flood. The flood defence height is the horizontal line labelled 'critical threshold'. Looking at the climate trend (in this case it would be sea level or the height of a river) – shown by the blue jagged line – it can be seen that the blue line has a gradual upward trend because of climate change. This means that the critical threshold is crossed more often in the future – because sea levels are rising and winter river flows may be getting larger. So, to cope with this change, adaptation is needed – in this case, one adaptation measure is to increase the height

of the flood defence.

Further reading:

	Report detailing changes in global climate: The Global Climate 2001 - 2010 (PDF)
	IPCC report on climate-related disasters and opportunities for managing risks: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)
	IPCC report on impacts, adaptation and vulnerability: Working Group II Report "Impacts, Adaptation and Vulnerability"
	IFC report on climate-related risks material to financial institutions: Climate Risk and Financial Institutions. Challenges and Opportunities.

Aware data resolution:

The proprietary Aware data set operates at a resolution of 0.5 x 0.5 decimal degrees (approximately 50 km x 50 km at the equator). These proprietary data represent millions of global data points, compiled from environmental data and the latest scientific information on current climate / weather related hazards together with potential changes in the future. Future risk outcomes are based on projections data from the near- to mid-term time horizons (2020s or 2050s, depending on the hazard and its data availability).

Global climate model output, from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset (Meehl et al., 2007), were downscaled to a 0.5 degree grid.

[Meehl, G. A., C. Covey, T. Delworth, M. Latif, B. McAvaney, J. F. B. Mitchell, R. J. Stouffer, and K. E. Taylor: The WCRP CMIP3 multi-model dataset: A new era in climate change research, Bulletin of the American Meteorological Society, 88, 1383-1394, 2007]

Aware data application:

In some instances Risk Topic ratings are only based on Aware data, including:
• Flood
• Permafrost
• Landslides

Country level risk ratings:

These are generated from the data points within a country's borders. For single locations, site-specific data are used, and for multiple locations or countries, composite data across the portfolio of locations are used.

Glossary of terms used in report

"Climate model projections agree": defined as more than 14 out of 16 GCMs agreeing on the magnitude (e.g. temperature warming of 2 °C) and / or direction of change (e.g. seasonal precipitation).
"Climate model projections do not agree": defined as 14 or fewer out of 16 GCMs agreeing on the magnitude (e.g. temperature warming of 2 °C) and / or direction of change (e.g. seasonal precipitation).
"Significant proportion": defined as at least 25% of locations when multiple locations are selected.
"Large proportion": defined as at least 75% of locations when multiple locations are selected.

The above thresholds are used as a means of providing a project-wide risk score where a project may be spread across multiple locations. This requires more than one individual location to be at risk to begin signifying whether there is a risk at the overall project level. However, it is always recommended that individual locations are analysed separately for more accurate, site-specific risk screening. The overall risk score for the project (high, medium or low) is based on a count of high risk topic scores. A project scores overall high risk if greater than or equal to 3 individual risk topics score high. A project scores overall medium risk if between 1 and 2 individual risk topics score high. A project scores overall low risk if none of the individual risk topics score high.

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01

Introduction

This report summarises results from a climate risk screening exercise. The project information and location(s) are detailed in Section 02 of this report.

The screening is based on the Aware™ geographic data set, compiled from the latest scientific information on current climate and related hazards together with projected changes for the future where available. These data are combined with the project's sensitivities to climate variables, returning information on the current and potential future risks that could influence its design and planning.

Project Information

PROJECT NAME: SRI: Water Resources Development Investment Program

SUB PROJECT: Minipe Anicut and left bank canal

REFERENCE: Concept paper

SECTOR: Agriculture

SUB SECTOR: Irrigation (surface & groundwater) and drainage

DESCRIPTION:

02

Chosen Locations

1) Sri Lanka

03

Project Risk Ratings

Below you will find the overall risk level for the project together with a radar chart presenting the level of risk associated with each individual risk topic analysed in Aware™. Projects with a final “High risk” rating are always recommended for further more detailed climate risk analyses.

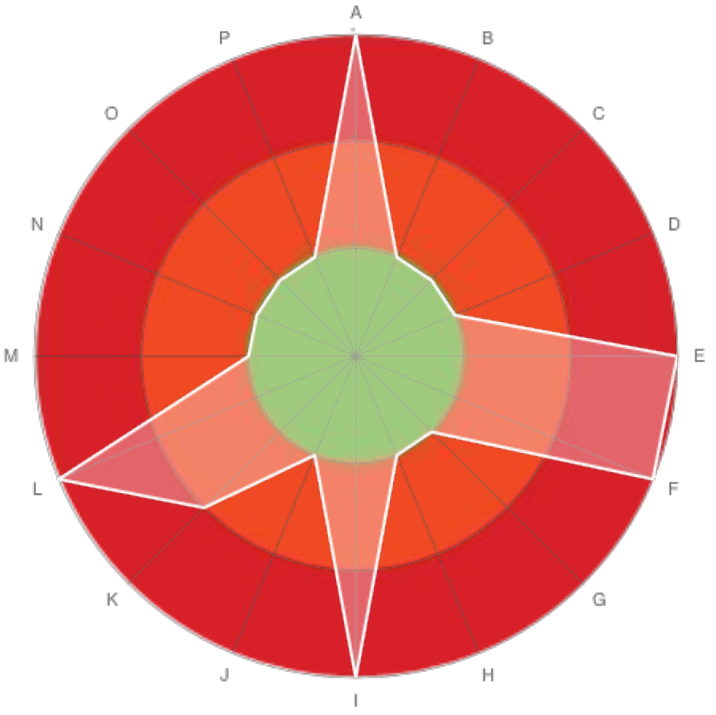
The radar chart provides an overview of which individual risks are most significant. This should be used in conjunction with the final rating to determine whether the project as a whole, or its individual components, should be assessed in further detail. The red band (outer circle) suggests a higher level of risk in relation to a risk topic. The green band (inner circle) suggests a lower level of risk in relation to a risk topic.

In the remaining sections of this report more detailed commentary is provided. Information is given on existing and possible future climate conditions and associated hazards. A number of questions are provided to help stimulate a conversation with project designers in order to determine how they would manage current and future climate change risks at the design stage. Links are provided to recent case studies, relevant data portals and other technical resources for further research.

Final project risk ratings

High Risk

Breakdown of risk topic ratings



A) Temperature increase
B) Wild fire
C) Permafrost
D) Sea ice
E) Precipitation increase
F) Flood
G) Snow loading
H) Landslide
I) Precipitation decrease
J) Water availability
K) Wind speed increase
L) Onshore Category 1 storms
M) Offshore Category 1 storms
N) Wind speed decrease
O) Sea level rise
P) Solar radiation change

04

HIGH RISK

TEMPERATURE INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

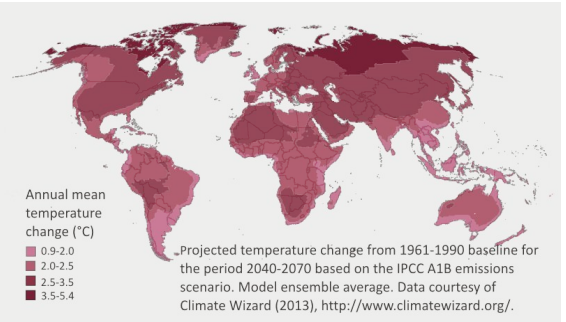
• The project is considered to have high sensitivity to increased temperature and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of high temperatures as well as potential future changes.

2. How could current high temperatures affect the project even without future climate change?

• Heatwaves put stress on buildings and other infrastructure, including roads and other transport links. In cities, the 'urban heat island' can increase the risk of heat related deaths.
• Warm weather can raise surface water temperatures of reservoirs used for industrial cooling. In addition, this could impact local eco-systems, improving the growing conditions for algae and potentially harmful micro-organisms in water courses.
• Heatwaves can have an impact on agricultural productivity and growing seasons.
• High temperatures can have implications for energy security. Peak energy demand due to demand for cooling can exceed incremental increases on base load in addition to the risk of line outages and blackouts.
• Human health can be affected by warmer periods. For example, urban air quality and disease transmission (e.g. malaria and dengue fever) can be impacted by higher air temperatures.
• Wildfire risk is elevated during prolonged warm periods that dry fuels, promoting easier ignition and faster spread.
• Permafrost and glacial melt regimes as impacted by warm periods.
• If our data suggests that there are existing hazards associated with high temperatures in the region, they will be highlighted elsewhere in the report. This may include existing wildfire risks as well as areas potentially impacted by permafrost and glacial melt.

3. What does the science say could happen by the 2050s?



Projected temperature change from 1961-1990 baseline for the period 2040-2070 based on the IPCC A1B emissions scenario. Model ensemble average. Data courtesy of Climate Wizard (2013), http://www.climatewizard.org/.

• Climate model projections do not agree that seasonal temperature will increase beyond 2 ˚C in the project location.
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to temperature and climate change.

I have acknowledged the risks highlighted in this section.

05
HIGH RISK

PRECIPITATION INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have high sensitivity to increased precipitation and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of heavy precipitation events as well as potential future changes.

2. How could current heavy precipitation affect the project even without future climate change?

• Seasonal runoff may lead to erosion and siltation of water courses, lakes and reservoirs.
• Flooding and precipitation induced landslide events.
• In colder regions, seasonal snow falls could lead to overloading structures and avalanche risk.
• If our data suggests that there are existing hazards associated with heavy precipitation in the region, they will be highlighted elsewhere in the report. This may include existing flood and landslide risks.

3. What does the science say could happen by the 2050s?

• Climate model projections agree that seasonal precipitation will increase in the project location. This indicates a relatively low degree of uncertainty that precipitation will increase in the region.
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to water and climate change.

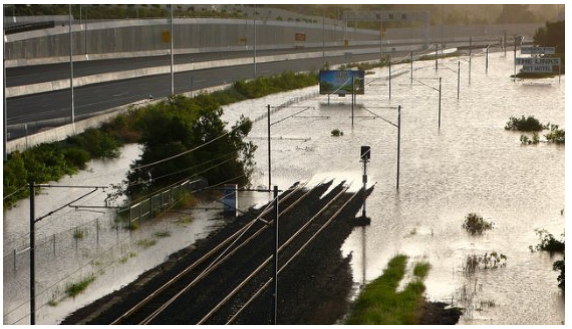
I have acknowledged the risks highlighted in this section.

06

HIGH RISK

FLOOD

ACCLIMATISE COMMENTARY



Our data suggest that the project is located in a region which has experienced recurring major flood events in the recent past. A high exposure in Aware means that between 1985 and 2010 there have been more than one significant, large-scale flood event in the region. This is based on post-processed data from the Dartmouth Flood Observatory at the University of Colorado. The risk and type of flooding is dependent on local geographical factors including:

• Proximity to the coast and inland water courses
• Local topography
• Urban drainage infrastructure
• Up to date information on flood risk worldwide is available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of flood events.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from flooding. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If flooding is identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by flooding?
Q2 Is there a plan to integrate climate change into a flood risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of floods?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to floods and climate change.

I have acknowledged the risks highlighted in this section.

07
HIGH RISK

PRECIPITATION DECREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have high sensitivity to decreased precipitation and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of decreased precipitation events as well as potential future changes.

2. How could reduced precipitation affect the project even without future climate change?

• Decreased seasonal runoff may exacerbate pressures on water availability, accessibility and quality.
• Variability of river runoff may be affected such that extremely low runoff events (i.e. drought) may occur much more frequently.
• Pollutants from industry that would be adequately diluted could now could become more concentrated.
• Increased risk of drought conditions could lead to accelerated land degradation, expanding desertification and more dust storms.
• If our data suggests that there are existing hazards associated with decreased precipitation in the region, they will be highlighted elsewhere in the report. This may include water availability and wildfire.

3. What does the science say could happen by the 2050s?

• Climate model projections do not agree that seasonal precipitation will decrease in the project location which could indicate a relatively high degree of uncertainty (see the section "Model agreement and uncertainty" in "Help and glossary" at the end of this report). On the other hand, this could also mean precipitation patterns are not expected to change or may even increase (see elsewhere in the report for more details of projections related to precipitation increase).
• If you want to know more about projected changes in the project location across a range of GCMs and emissions scenarios please refer to The Nature Conservancy's Climate Wizard for detailed maps and Environment Canada's Canadian Climate Change Scenarios Network for scatter plots of expected changes.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to water and climate change.

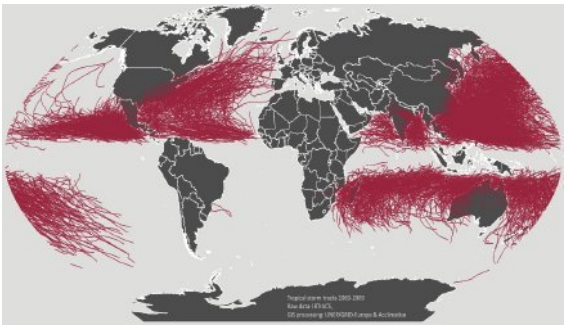
I have acknowledged the risks highlighted in this section.

08

HIGH RISK

ONSHORE CATEGORY 1 STORMS

ACCLIMATISE COMMENTARY



• Our data suggest that the project is located in a region which has experienced Category 1 storms in the recent past. A high exposure in Aware means that between 1968 and 2009 there have been at least one Category 1 storm in the region. This is based on post-processed data from UNEP/ GRID-Europe.
• On the Saffir-Simpson Hurricane Scale a category 1 storm is characterised by sustained winds in excess of 119 km/hr (33 m/s).
• Even this least intense storm can still produce plenty of damage and be life threatening.
• These regions may also susceptible to lower intensity but more frequent tropical storms as well as less frequent higher-intensity storms.
• Up to date information on storm risk worldwide is widely available online, for example UNEP / UNISDR's Global Risk Data Platform.

1. What the science says could happen in the future and what does this mean for the design of my project?

• Climate change is projected to influence the frequency and intensity of tropical storms.
• Existing engineering designs may not take into consideration the impact of climate change on the risks from tropical or extra tropical storms. See "Critical thresholds" in the "Help & glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.
• If coastal surges and high winds are identified as a potential problem for the project, it is recommended that a more localised and in-depth assessment is carried out. This information can then be used to inform the project design process if necessary.

2. As a starting point you may wish to consider the following questions:

Q1 Would the expected performance and maintenance of the project be impaired by hazards associated with tropical storms e.g. storm surges and strong winds?
Q2 Are there any plans to integrate climate change factors into a storm risk assessment for the project?
Q3 Will the project include continuity plans which make provision for continued successful operation in the event of storm damage?

3. What next?

• See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
• Click here or here for the latest news and information relating to storms and climate change.

I have acknowledged the risks highlighted in this section.

09
MEDIUM RISK

WIND SPEED INCREASE

ACCLIMATISE COMMENTARY

1. What does this mean for the design of my project?

• The project is considered to have medium sensitivity to wind and there is a potential for an increase in incidences where current design standards will not be sufficient. See "Critical thresholds" in the "Help and glossary" section for further details on how a changing climate can impact on critical thresholds and design standards.

• The design, operational and maintenance standards should be reviewed - take into consideration current impacts of increasing wind speed as well as potential future changes.

2. How could stronger winds affect the project even without future climate change?

• The design and operation of certain infrastructure (e.g. wind turbines) is determined by the prevailing climatic wind conditions.
• Given the energy in the wind is the cube of wind speed, a small change in the wind climate can have substantial consequences for the wind energy available.
• Similarly, small changes could have dramatic consequences for wind related hazards e.g. wind storm damage.
• If our data suggests that there is an existing risk of tropical storms in the region, it will be highlighted elsewhere in the report.

3. What does the science say could happen in the future?

• Climate change could alter the geographic distribution and/or the seasonal variability of wind resource.
• Climate model projections remain uncertain and it appears unlikely that mean wind speeds will change by more than the current inter-annual variability.
• Changes in extreme wind speeds associated with extra-tropical and tropical storm are similarly uncertain. However, there have been studies that suggest fewer but more intense events. Stronger storms bring with them an increases risk of coastal storm surge, coastal erosion, wind damage and flooding.
• Given future uncertainty it is advisable to carefully assess past wind speed in the region, bearing in mind that it could change in the future. The UNEP Solar and Wind Energy Resource Assessment SWERA provides a useful global overview of wind information.

4. What next?

1. See the section "Further reading" in "Help and glossary" at the end of this report which lists a selection of resources that provide further information on a changing climate.
2. Click here or here for the latest news and information relating to wind and climate change.

I have acknowledged the risks highlighted in this section.

10

The sections above detail all High and Medium risks from Aware™. Selected Low risks are also detailed. Local conditions, however, can be highly variable, so if you have any concerns related to risks not detailed in this report, it is recommended that you investigate these further using more site-specific information or through discussions with the project designers.

HELP AND GLOSSARY:

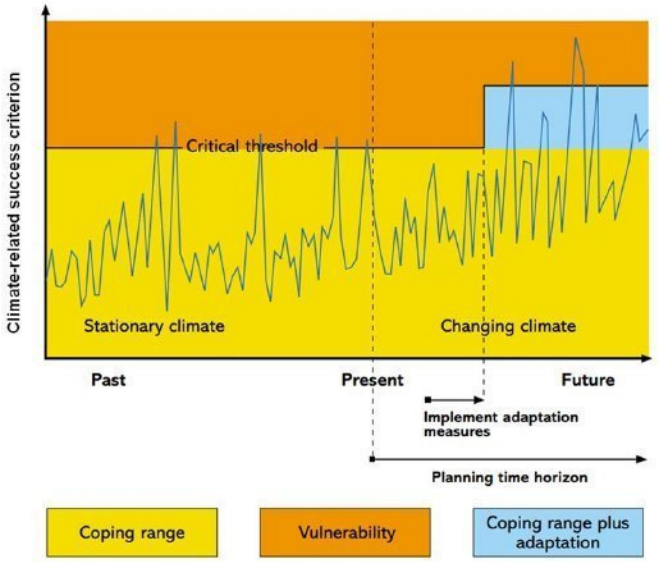
Model agreement and uncertainty:

Although climate models are constantly being improved, they are not good enough to predict future climate conditions with a degree of confidence which would allow precise adaptation decisions to be made. Outputs from different climate models often differ, presenting a range of possible climate futures to consider, and ultimately a wide range of possible actions to take. In Aware, climate projections are described as having potentially higher degree of uncertainty when less than 14 out of 16 GCMs agree on the direction and / or a pre-defined magnitude of change.

Even with improvements in climate modelling, uncertainties will remain. It is likely that not all the climate statistics of relevance to the design, planning and operations of a project's assets and infrastructure will be available from climate model outputs. The outputs are typically provided as long-term averages, e.g. changes in average monthly mean temperature or precipitation. However, decisions on asset integrity and safety may be based on short-term statistics or extreme values, such as the maximum expected 10 minute wind speed, or the 1-in-10 year rainfall event. In such cases, project designers or engineers should be working to identify climate-related thresholds for the project (see "Critical thresholds" section below) and evaluate whether existing climate trends are threatening to exceed them on an unacceptably frequent basis. Climate models can then be used to make sensible assumptions on potential changes to climate variables of relevance to the project or to obtain estimates of upper and lower bounds for the future which can be used to test the robustness of adaptation options.

The key objective in the face of uncertainty is therefore to define and implement design changes (adaptation options) which both provide a benefit in the current climate as well as resilience to the range of potential changes in future climate.

Critical thresholds:



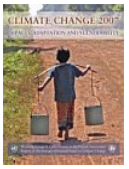
The relationship between a critical threshold and a climate change related success criterion for a project. [Source: Willows, R.I. and Connell, R.K. (Eds.) (2003). *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report, UKCIP, Oxford].

A key issue to consider when assessing and prioritising climate change risks is the critical thresholds or sensitivities for the operational, environmental and social performance of a project. Critical thresholds are the boundaries between 'tolerable' and 'intolerable' levels of risk. In the diagram above, it can be seen how acceptable breaches in a critical threshold in today's climate may become more frequent and unacceptable in a future climate.

Climate change scenarios can be used to see if these thresholds are more likely to be exceeded in the future. The simplest example is the height of a flood defence. When water heights are above this threshold, the site will flood. The flood defence height is the horizontal line labelled 'critical threshold'. Looking at the climate trend (in this case it would be sea level or the height of a river) – shown by the blue jagged line – it can be seen that the blue line has a gradual upward trend because of climate change. This means that the critical threshold is crossed more often in the future – because sea levels are rising and winter river flows may be getting larger. So, to cope with this change, adaptation is needed – in this case, one adaptation measure is to increase the height

of the flood defence.

Further reading:

	Report detailing changes in global climate: The Global Climate 2001 - 2010 (PDF)
	IPCC report on climate-related disasters and opportunities for managing risks: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)
	IPCC report on impacts, adaptation and vulnerability: Working Group II Report "Impacts, Adaptation and Vulnerability"
	IFC report on climate-related risks material to financial institutions: Climate Risk and Financial Institutions. Challenges and Opportunities.

Aware data resolution:

The proprietary Aware data set operates at a resolution of 0.5 x 0.5 decimal degrees (approximately 50 km x 50 km at the equator). These proprietary data represent millions of global data points, compiled from environmental data and the latest scientific information on current climate / weather related hazards together with potential changes in the future. Future risk outcomes are based on projections data from the near- to mid-term time horizons (2020s or 2050s, depending on the hazard and its data availability).

Global climate model output, from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset (Meehl et al., 2007), were downscaled to a 0.5 degree grid.

[Meehl, G. A., C. Covey, T. Delworth, M. Latif, B. McAvaney, J. F. B. Mitchell, R. J. Stouffer, and K. E. Taylor: The WCRP CMIP3 multi-model dataset: A new era in climate change research, Bulletin of the American Meteorological Society, 88, 1383-1394, 2007]

Aware data application:

In some instances Risk Topic ratings are only based on Aware data, including:
• Flood
• Permafrost
• Landslides

Country level risk ratings:

These are generated from the data points within a country's borders. For single locations, site-specific data are used, and for multiple locations or countries, composite data across the portfolio of locations are used.

Glossary of terms used in report

"Climate model projections agree": defined as more than 14 out of 16 GCMs agreeing on the magnitude (e.g. temperature warming of 2 °C) and / or direction of change (e.g. seasonal precipitation).
"Climate model projections do not agree": defined as 14 or fewer out of 16 GCMs agreeing on the magnitude (e.g. temperature warming of 2 °C) and / or direction of change (e.g. seasonal precipitation).
"Significant proportion": defined as at least 25% of locations when multiple locations are selected.
"Large proportion": defined as at least 75% of locations when multiple locations are selected.

The above thresholds are used as a means of providing a project-wide risk score where a project may be spread across multiple locations. This requires more than one individual location to be at risk to begin signifying whether there is a risk at the overall project level. However, it is always recommended that individual locations are analysed separately for more accurate, site-specific risk screening. The overall risk score for the project (high, medium or low) is based on a count of high risk topic scores. A project scores overall high risk if greater than or equal to 3 individual risk topics score high. A project scores overall medium risk if between 1 and 2 individual risk topics score high. A project scores overall low risk if none of the individual risk topics score high.

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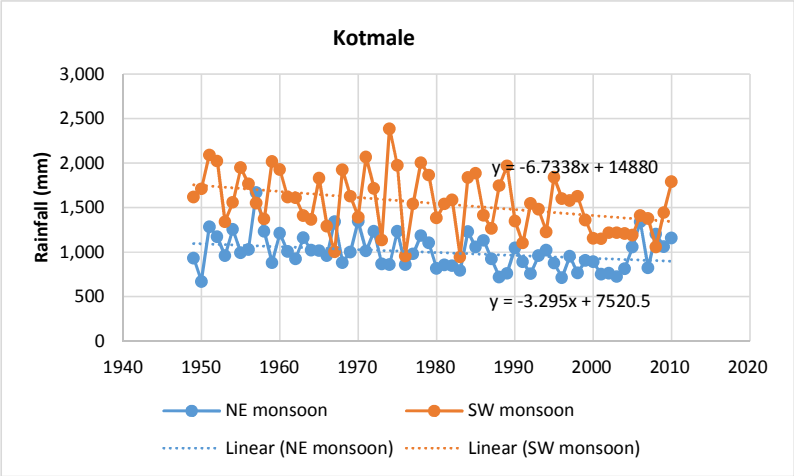
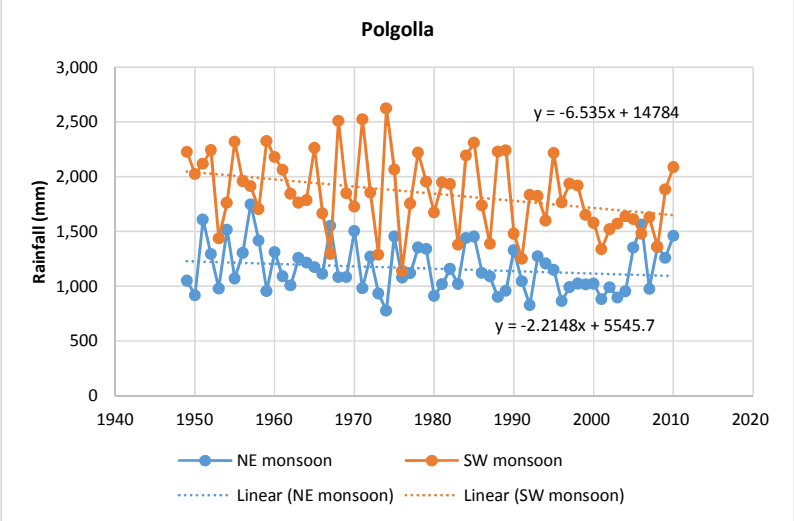
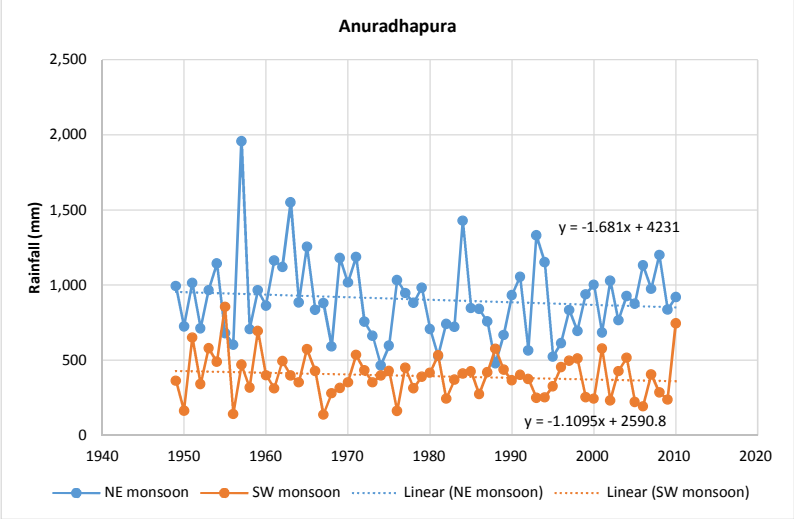
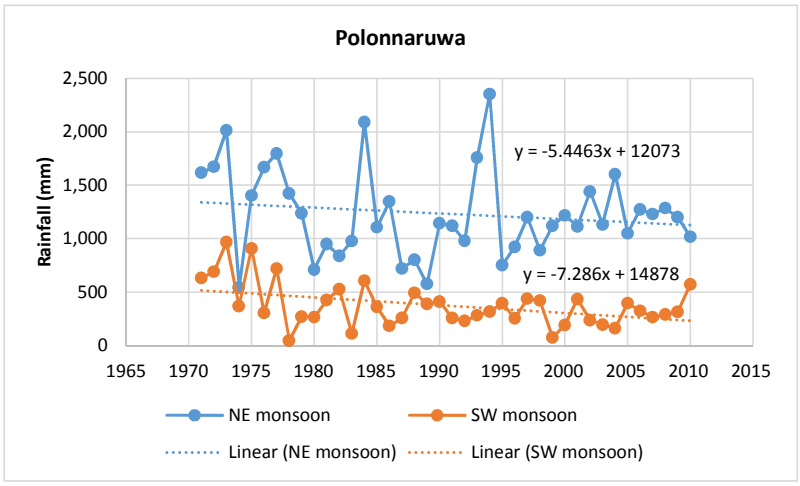
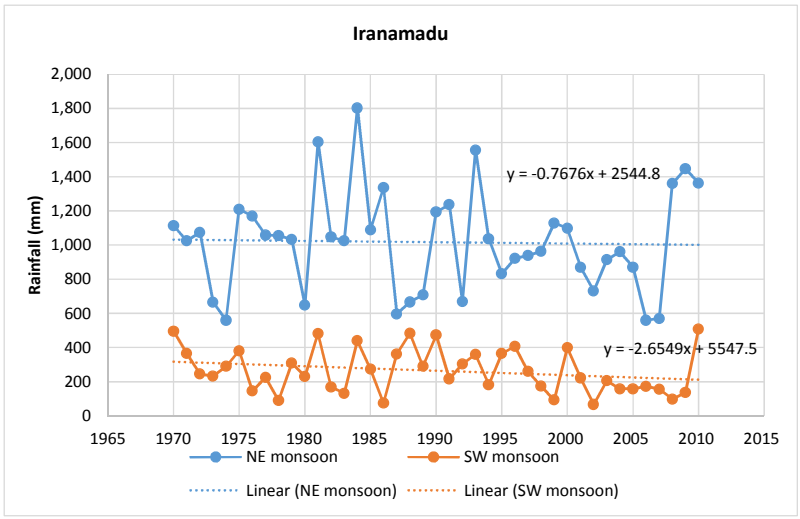
ANNEX 3: RAINFALL TRENDS








Polonnaruwa
Rainfall (mm)
2,500
2,000
1,500
1,000
500
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
y = -5.4463x + 12073
y = -7.286x + 14878
NE monsoon
SW monsoon
Linear (NE monsoon)
Linear (SW monsoon)


Iranamadu
Rainfall (mm)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
y = -0.7676x + 2544.8
y = -2.6549x + 5547.5
NE monsoon
SW monsoon
Linear (NE monsoon)
Linear (SW monsoon)

ANNEX 4: VULNERABILITY ASSESSMENT

Scenario 1 – Increase in Irrigation Demand

Scheme	Eto Increase		+15% ETO						+10% ETO						+5% ETO						avg ETO					
	Season		Yala			Maha			Yala			Maha			Yala			Maha			Yala			Maha		
	Failure criteria		8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2
	Yala	Maha	A43A			A43A			A42A			A42A			A41A			A41A			A40A			A40A		
	Issue	Issue	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%
KalawewaRB	284	266	9	4	2	2	1	0	8	4	2	1	0	0	8	4	1	1	0	0	4	3	1		0	
KalawewaLB																										
KalawewaYE																										
DambuluOya	26	18	1	1	1		0			0			0		2	2	2		0		1	1	1		0	
Kandalama	43	37	1	1	1		0			0			0		5	3	2	1	0	0	3	3	0		0	
Huruluwewa	81	56	1	1	1		0		1	1	1		0		2	2	1		0		2	1	1		0	
Nachchaduwa	51	31	1	1	1		0		1	1	1		0		1	1	1		0			0			0	
Nuwarawewa	15	9		0			0			0			0			0			0			0			0	
Tisawewa	5	6		0			0		1	1	1		0			0			0			0			0	
Allai	149	130	1	0	0		0			0			0			0			0			0			0	
System B	489	352	1	1	0		0			0			0		1	0	0		0			0			0	
SYSTEM B-RB				0			0			0			0			0			0			0			0	
System C	489	262	4	3	2		0		3	2	1		0		4	2	1		0		1	1	1		0	
Minneriya	102	64		0			0			0			0			0			0			0			0	
Giritale	50	29		0			0			0			0			0			0			0			0	
Kaudulla	86	42		0			0			0			0		4	3	1		0		1	1	0		0	
Kantale	205	115	4	3	2	1	1	0	2	2	0	1	0	0	5	3	1	1	1	1	4	3	1	1	1	0
PSS	158	109	3	2	0	2	1	0	1	0	0	1	0	0		0		1	0	0		0			0	
Minipe LB	223	124	3	1	0		0		3	0	0		0		1	0	0		0		1	0	0		0	
System G	128	87	1	1	1		0		1	1	1		0		2	2	2		0		2	1	1		0	
KHF	53	41	8	4	1	1	0	0	10	2	1		0		2	2	2		0		2	2	2		0	
Manankattiya	13	10.3		0			0			0			0			0			0			0			0	
Eruwewa	2	1.1		0			0			0			0			0			0			0			0	
Mahakandarawa	48	38.9	2	2	1	1	0	0	2	1	0		0		4	4	1		0		3	3	2		0	
Kalu Ganga	51	26.5		0			0			0			0			0			0			0			0	
NCP2(major)	151	123		0			0			0			0		4	2	2	2	1		3	2	1	2	1	1
NCP1(minor)	343	301	20	10	6	6	4	2	10	7	2	4	4	0	2	2	0	1	0	0	2	1	0		0	
NWP(minor)	115	102	36	27	8	2	2	1	12	3	1	3	3	1	3	2	2	1	1	0	3	3	1	1	1	0

Source: MCB – Water Balance model simulation

Scenario 2 – Decrease in Water Availability

Scheme	Info		-15% inf						-10% inf						-5% inf						-0% inf					
	Season		Yala			Maha			Yala			Maha			Yala			Maha			Yala			Maha		
	Failure criteria		8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2	8	4	2
	Yala	Maha	A53A			A53A			A52A			A52A			A51A			A51A			A50A			A50A		
	Issue	Issue	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%	5%	10%	20%
KalawewaRB	266	252	6	4	1		0		5	3	1		0		7	3	1		0		4	3	1		0	
KalawewaLB																										
KalawewaYE																										
DambuluOya	25	17	1	1	1		0		1	1	0		0		2	2	2		0		1	1	1		0	
Kandalama	41	35	4	3	1		0		2	2	2		0		3	3	2		0		3	3	0		0	
Huruluwewa	76	53	1	1	1		0		1	1	1		0		2	2	2		0		2	1	1		0	
Nachchaduwa	48	29	1	1	1		0		1	1	1		0		2	1	1		0			0			0	
Nuwarawewa	14	9		0			0			0			0			0			0			0			0	
Tisawewa	5	5		0			0			0			0			0			0			0			0	
Allai	140	122		0			0			0			0			0			0			0			0	
System B	464	337	1	1	1		0		1	0	0		0			0			0			0			0	
SYSTEM B-RB				0			0			0			0			0			0			0			0	
System C	462	250	5	4	3		0		3	3	2		0		3	2	1		0		1	1	1		0	
Minneriya	95	61		0			0			0			0			0			0			0			0	
Giritale	47	27		0			0			0			0			0			0			0			0	
Kaudulla	80	39	3	2	1		0		1	0	0		0		1	1	0		0		1	1	0		0	
Kantale	188	104	6	4	2	1	0	0	4	3	2		0		4	2	1	1	0	0	4	3	1	1	1	
PSS	148	103		0		1	0	0		0			0			0			0			0			0	
Minipe LB	213	120	1	1	0		0		1	0	0		0			0			0		1	0	0		0	
System G	122	84	2	2	1		0		2	2	0		0		4	3	2		0		2	1	1		0	
KHF	49	39	2	2	2		0		1	1	1		0		2	2	2		0		2	2	2		0	
Manankattiya	12	9.7		0			0			0			0			0			0			0			0	
Eruwewa	2	1.1		0			0			0			0			0			0			0			0	
Mahakandarawa	45	36.7	2	2	1		0		2	1	0		0		4	3	2		0		3	3	2		0	
Kalu Ganga	49	25.3		0			0			0			0			0			0			0			0	
NCP2(major)	137	114	5	2	0	1	1	0	3	2	0	1	1	0	2	2	2	1	1	1	3	2	1	2	1	
NCP1(minor)	323	285	15	11	6	4	4	2	4	4	2	2	1	0	1	1	1		0		2	1	0		0	
NWP(minor)	109	96	15	13	5	2	1	0	11	8	4	1	1	0	4	4	2	1	1	0	3	3	1	1	1	

Source: MCB – Water Balance model simulation

APPENDIX 6

TECHNICAL DESIGN REVIEW AND ASSESSMENT

TECHNICAL DESIGN REVIEW AND ASSESSMENT
UPPER ELAHERA CANAL
KALU GANGA – MORAGAHAKANDA TRANSFER CANAL

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 6

TECHNICAL SUMMARY

KALU GANGA – MORAGAHAKANDA TRANSFER CANAL
UPPER ELAHERA CANAL

NOVEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
AIDM	–	Acres Irrigation Demand Model
ARSP	–	Acres Reservoir Simulation Program
BTL	–	Bund Top Level
BW	–	Bed Width
CEB	–	Ceylon Electricity Board
CECB	–	Ceylon Engineering Consultancy Bureau
CI	–	Cropping Intensity
CSS	–	Cross Sections
DAD	–	Department of Agrarian Development
DDF	–	Depth Duration Frequency
DSWRPP	–	Dam Safety and Water Resources Planning Project
FOS	–	Factor of Safety
fb	–	free board
fsl	–	full supply level
GDP	–	Gross Domestic Product
GOSL	–	Government of Sri Lanka
HFL	–	High Flood Level
HEC	–	Human Elephant Conflict
HFC	–	Huruluwewa Feeder Canal
ID	–	Irrigation Department
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
LB	–	Left Bank
LBMC	–	Left Bank Main Canal
LSS	–	Longitudinal Sections
MASL	–	Mahaweli Authority of Sri Lanka
masl	–	meters above sea level
MCB	–	Mahaweli Consultancy Bureau
MDP	–	Mahaweli Development Project
MLBC	–	Minipe Left Bank Canal
MIWRM	–	Ministry of Irrigation and Water Resources Management
PMF	–	Peak Maximum Flood
RB	–	Right Bank
RDA	–	Rural Development Authority
RKTC	–	Randenigala Kalu Ganga Transfer Canal
SOP	–	Seasonal Operational Plan
UEC	–	Upper Elahera Canal
WMS	–	Water Management Secretariat

WEIGHTS AND MEASURES

ha	–	hectares
GW	–	gigawatt
km	–	kilometre
km^2	–	square kilometer
km^3	–	cubic kilometer
MCM	–	million cubic meters
mm	–	millimeter
m^3	–	cubic meter
m^3/s	–	cubic meter per second
MW	–	megawatt

CONTENTS

I. INTRODUCTION

A. Technical Summary

1. The purpose of this appendix[1] is to present a summary of the key technical elements of the Kalu Ganga Moragahakanda Transfer Canal – Upper Elahera Canal Project (KMTC-UECP. The project forms part of the planned North Central Province Canal Project (NCPCP) and expansion of the Mahaweli Development Project (MDP).

2. The following sections present an outline of the rationale for the project, the main works components and the criteria adopted for engineering design. This information is drawn from the project feasibility study and from more recent and on-going work on detailed design and costing.

B. Background

1. Mahaweli Development Program

3. The Mahaweli Development Program (MDP) was conceived in the mid-1960s as a multi-purpose agriculture development project for (i) augmenting water starved dry zones in the northern and eastern parts of central, and north central and northern provinces; (ii) enhancing hydro power generation; and (iii) improving other infrastructure facilities in project area. The project implementation was envisaged to span a period of 30 years and increase the irrigable area from 110,283 to 363,847 ha. The benefit areas include 110,283 ha of existing irrigated land and 253,564 ha of new land totaling to 363,847 ha of land.

4. The Government of Sri Lanka (GOSL) commenced the project implementation in 1970 with Polgolla Diversion encompassing the barrage, tunnel, Ukuwela Powerhouse. This followed with the Bowatenna regulation reservoir across Amban Ganga including a powerhouse and Lenadora tunnel to divert water to Kala Oya, part of the Malwatu Oya, Yan Oya and Amban Ganga Basins namely Systems H, IH, MH, G and D covering a total benefit area of 118,300 ha.

5. In order to cater for the increasing water demands for the agriculture and power and realize benefits in a shorter period 6 years, the GOSL decided in 1977 to accelerate the project implementation and set the targets for achieving; (a) self-sufficiency in rice by mid 1980s, (b) meet the energy requirements for mid 1990s, by hydropower in Mahaweli cascade, and (c) employment generation to reduce poverty. The Accelerated Mahaweli Development Program (AMDP) gave priority for; (a) construction of Mahaweli regulatory reservoirs, Kotmale, Victoria, Randenigala and Rantambe, (b) completion of Systems H, IH and MH including construction of Dambulu Oya Reservoir and improving Kala Wewa Reservoir, (c) improving irrigation infrastructure in Systems D and G, and (d) completion of irrigation infrastructure in Systems B, C, and E including construction of the new reservoirs Ulhitiya, Ratkinda, and Maduru Oya. The direct benefits included establishing 665 MW of

[1] This appendix was prepared by the Mahaweli Consultancy Bureau (MCB) from information from past feasibility studies and current and on-going tender design work, and reviewed and edited by the PPTA consultants.

hydropower generation capacity and 363,847 ha of irrigated land contributing to the national gross domestic product (GDP).

6. The accelerated plan to complete the MDP in 6 years achieved completion of Mahaweli regulation reservoirs and irrigation systems in Systems B-LB, C, D, E, G, H, IH and MH. However the work in the balance of the systems could not commence due to civil disturbances in the country, especially the Northern and Eastern Provinces from 1983 to 2009. The total benefits realized from the agriculture sector are therefore about 41% of the originally envisaged under MDP.

2. NCP Canal and Past Studies

7. In the post conflict era, after 2009, the government again gave high priority for the socio-economic development of dry zone rural sector and resolving long awaited provision for domestic and industrial water demands in Jaffna peninsula by the augmentation of Iranamadu Reservoir. In addition, a water shortage in the Mi Oya Basin in the North Western Province has been included in the current development program.

8. The NCPCP envisaged augmenting 50,000 ha existing and 100,000 ha under the MDP and transfer of Mahaweli water to the North Central and Northern Provinces, through the Moragahakanda Reservoir. The construction of Moragahakanda Reservoir commenced in the second quarter of 2012 and presently the work is in progress. The construction of irrigation infrastructure facilities under Kalu Ganga Reservoir is in progress and the construction of headworks scheduled to commence in mid-2014.

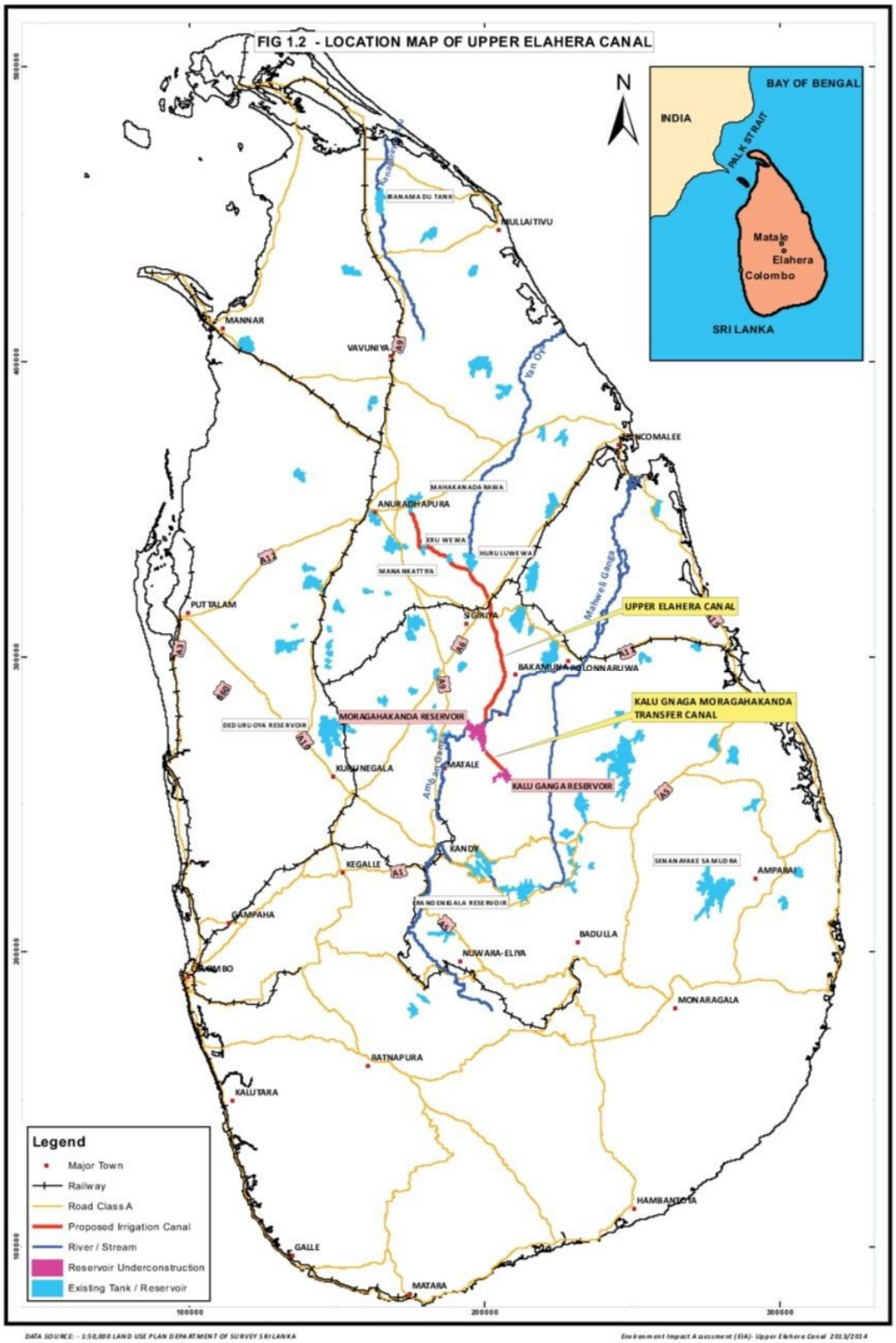
3. Feasibility Study Recommendations

9. For the balance of the MDP development a feasibility[2] study established the best technical option to be the diversion Mahaweli waters from Randenigala Reservoir via Kalu Ganga and Moragahakanda Reservoirs and the UEC. Water will be transferred between the reservoirs by the KMTC, and from the Moragahakanda Reservoir to the NCPC by the UEC, as shown in **Figure 1**.

10. The study[3] considered several route options for the KTMC and UEC and covered technical feasibility and minimum cost analyses. The recommendations of the study are summarized in the following sections.

[2] Feasibility Study, reference
[3] Proposed in the Lahmeyer International study[3]

Figure 1: KMTC-UEC Project Location



Source: MCB, 2014

a. Kalu Ganga Moragahakanda Transfer Canal

11. The modification of current left bank outlet structure to discharge 35 m^3/s to the KMTC. The amendments need to ensure the minimum water surface elevation at the beginning and end of the transfer canal to be 189.49 and 184.446 masl respectively.

12. Implementation of the KMTC route as proposed by the Mahaweli Consultancy Bureau (MCB) subject to a detailed environment assessment of both routes. **Figure 2** shows the general layout and location of the KMTC.

b. Upper Elahera Canal

13. The MCB proposed two options[4] for the alignment of the UEC that conform to the requirements of Department of Wildlife Conservation (DWC); these are:

- Option 1 satisfies all requirements of DWC and includes 14.84 km of open canal reaches 21.6 km of tunnels, 13.7 km of cut and fill reaches and 9.18 km of double conduits, and related structures at an estimated cost of Rs.35,241 million.

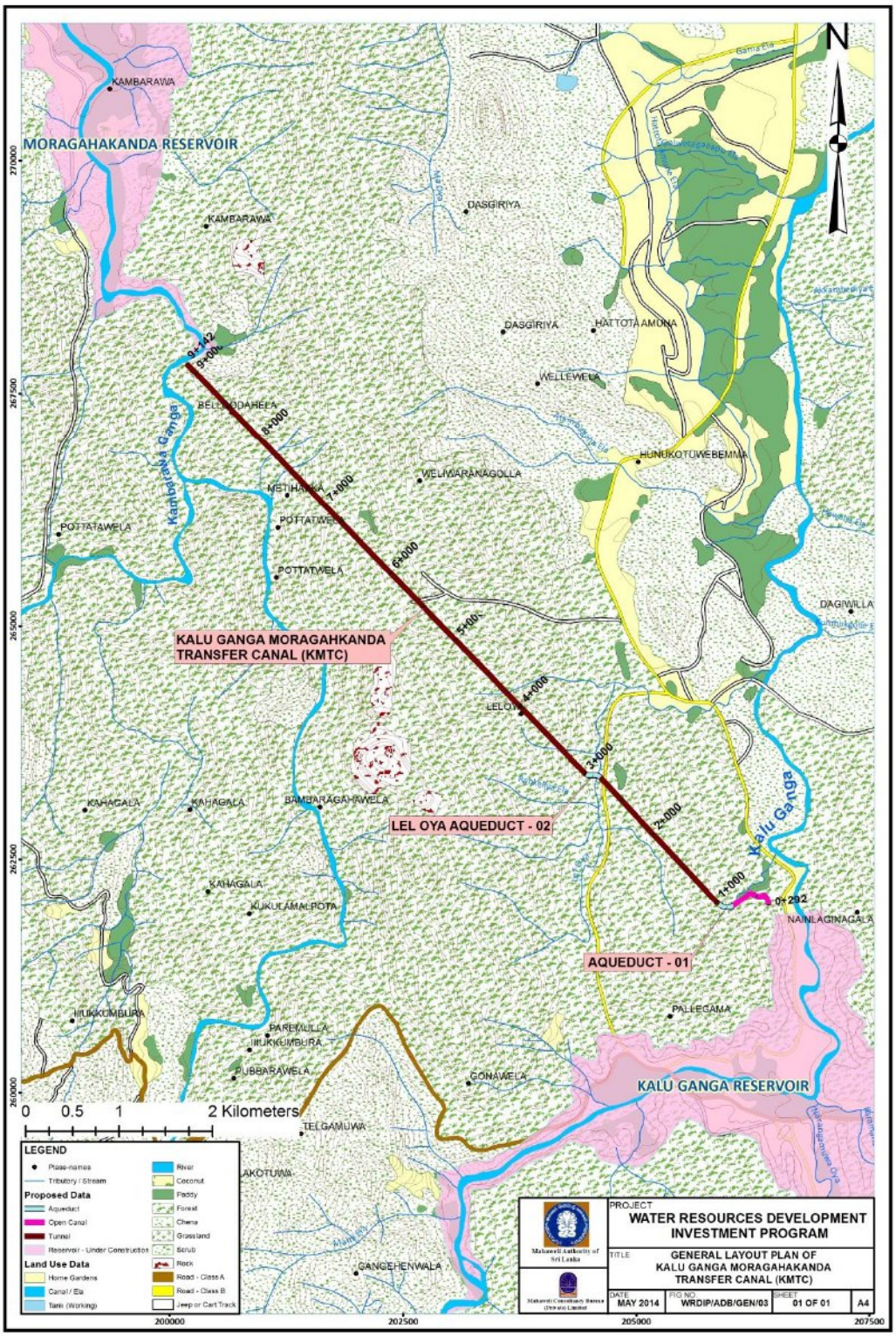
- Option 2 includes 31.90 km of open canal reaches 7.17 km of tunnels, 7.08 km of cut and fill reaches and 18.36 km of double conduits, and related structures at an estimated cost of Rs.27,665 million.

14. It also recommended modification to Moragahakanda Dam Headworks in terms of incorporating the powerhouse tail water level at 143.0 masl to enable gravity flow into Huruluwewa Reservoir

15. At detailed design stage, a comparison of above options with topographical surveys and taking into consideration the concerns of the forest reserves, wildlife reserves and human resettlement, a new route (Option 3) was finalized incorporating portions of both routes mentioned above. **Figure 3** shows the general layout map of the Upper Elahera Canal (note that 'Option 3' was adopted for the detailed design).

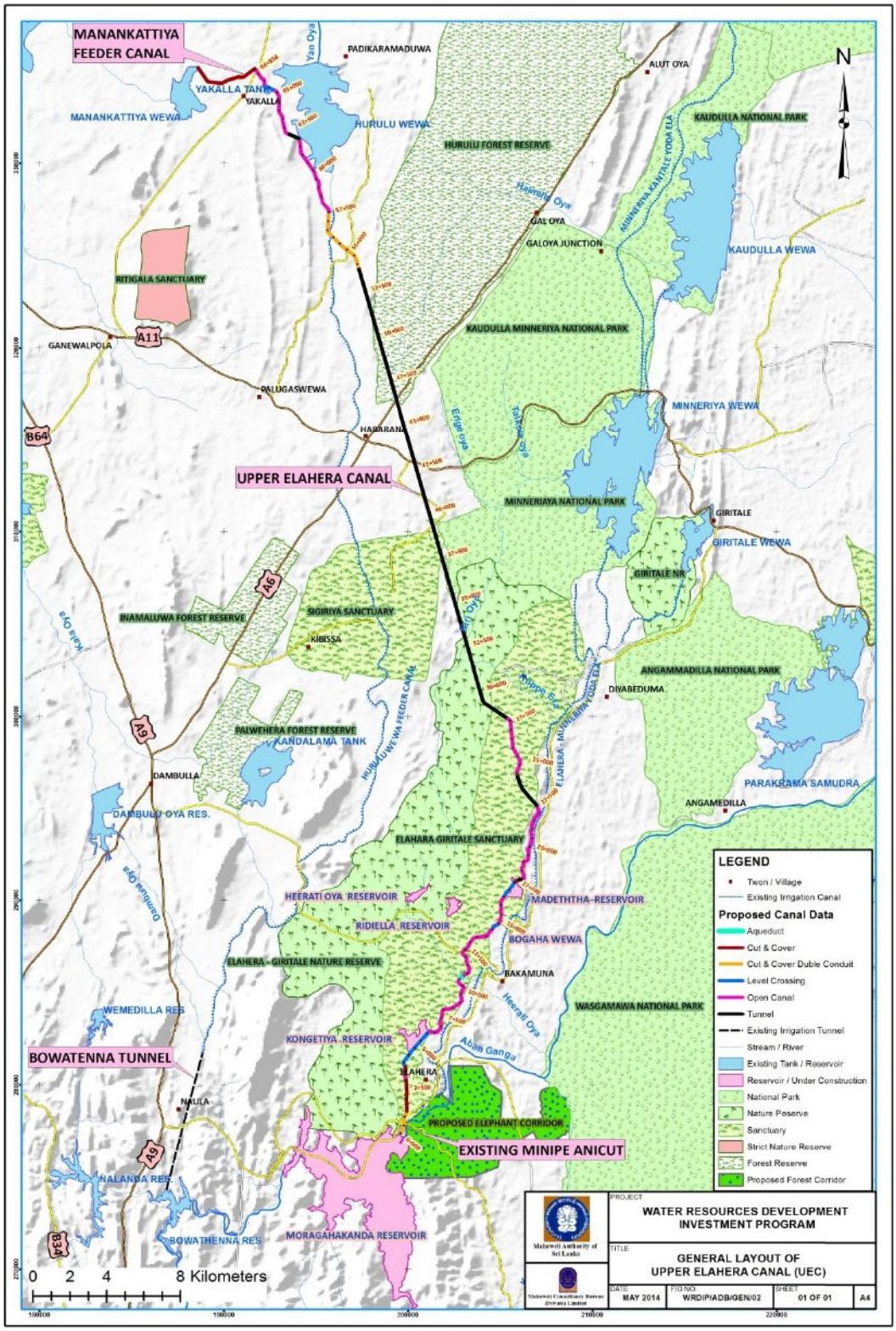
[4] Final Report – Modifications to Configuration of Moragahakanda- Kalu Ganga (M-K) Projects to Integrate NCP Canal Project Layout – May 2013

Figure 2: General Layout Plan of the KMTC



Source: MCB, 2014

Figure 3: General Layout Plan of the UEC



Source: MCB, 2014

II. PROJECT COMPONENTS

16. The water conveyance systems from Kalu Ganga to Moragahakanda Reservoirs and the UEC were designed as free flow conduits with open and closed reaches to be compatible with the natural topography of the route terrain.

A. Kalu Ganga Moragahakanda Transfer Canal

17. The KMTC transfers water between the Kalu Ganga and Moragahakanda reservoirs with a total length of approximately 8.8 km. The conveyance is comprised of predominately tunnel sections (7.8 km).

18. **Table 1** lists a summary of the KMTC and details including the locations, elevations and design parameters of canals and structures are listed in **Annex 4**.

Table 1: KMTC Canal

Type of Canal	No.	Length(m)
1. Trapezoidal Open Canal	1	472
2. Transitions	4	19
3. Bench flume	3	78
4. Aqueduct (Rectangular Twin Duct)	2	173
5. Rectangular Double Conduits	3	250
6. Tunnel – Drill and Blast	2	7,832
Total	**15**	**8,824**

B. Upper Elahera Canal

19. The UEC, with a design conveyance capacity of 40 m^3/s, commences immediately downstream of the left bank outlet of Moragahakanda Reservoir and discharging to the Huruluwewa reservoir and Manankattiya feeder canal, with a total length of approximately 65.5 km.

20. The irrigation infrastructure in the UEC comprises the following: (i) an intake regulator on the downstream of the power station discharge basin, (ii) a rectangular concrete lined canal from Moragahakanda Reservoir, (iii) concrete-lined trapezoidal open canal reaches, (iv) modified trapezoidal open canal sections to facilitate safe escapes for wildlife, (v) cut and covered conduit sections(circular or rectangular double conduits) to minimize disturbance to wildlife habitat, (vi) tunnels across hilly terrains, (vii) level crossings including embankments, sluices, and ogee spills, (viii) an aqueduct across Heerati Oya, a natural stream with deep embankments, (ix) self-priming siphon spills for regulated discharge of natural streams in the canal route across UEC, (x) drainage under crossing through Hume pipes, (xi) cross drainages/irrigation supply canals(from existing minor tanks) overflow through conduits, (xii) transitions, (xiii) Trifurcation at Yakalla incorporating two gated regulators to facilitate water issues to Huruluwewa and Manankattiya-Mahakanadarawa Reservoir complex, and a gated end regulator to facilitate water issue to NCP Canal.

21. A summary of project components is listed in **Table 2** and details including the locations, elevations and design parameters are given in **Annex 4**.

22. The outlet basin downstream of the Moragahakanda power station diverts water to the UEC and incorporates a spillway to discharge any flows over 44 m^3/s into the Amban Ganga, bulkhead gate to regulate the flows, as well as a second spillway in the UEC initial flume section as an additional safety precaution against overloading.

Table 2: Upper Elahera Canal Summary

Type of Canal	No.	Length (m)
1. Rectangular Open Canal	2	891
2. Trapezoidal Open Canal	8	25,849
3. Wild Animal Escapes	39	390
4. Closed Canal with Rectangular Double Conduits	2	2,132
5. Cut & Cover section with Circular Conduit	4	4764
6. Cut & Cover section with Horse-Shoe shape	3	270
7. Drill & Blast Tunnel with Horse-Shoe shape	4	760
8. Circular Tunnel by TBM	2	26,040
9. Level Crossing	1	3,968
10. Aqueduct (Rectangular Twin Duct)	3	240
11. Transitions	1	196
Total	**69**	**65,500**

23. Previously the proposed UEC route for option 2 from 27.25 to 54.00 km included two tunnels (with a total length of 23.5 km) and closed conduits (4.5 km) in between. Due to the outcome of the topographic surveying, which indicated that two sections of open canal would be required at places of low overburden, and to reduce the impacts from access roads and construction in the Wildlife and Forest Reserve, it is now proposed to replace this reach by single tunnel (26 km) on a deviated trace with two portals. The topographic and geotechnical surveys for the proposed deviated trace are scheduled to be completed by end October 2014.

1. Reservoirs under UEC

24. The UEC incorporates three reservoirs, namely, Kongetiya, Bogahawewa and Madheththewa in the buffer zones of the wildlife reserves at the request of DWC and the stakeholders living close to the canal route.[5] The design has incorporated an arrangement to reserve 50% of the storage capacity for the wildlife and the balance for the use of presently cultivated lands under the respective reservoirs.

25. Existing Kongetiya Reservoir shall be improved to conform to canal design parameters at 3+835 km. The existing embankment will be raised by 1.7 m and extended on the left bank by 480 m, raising the spill crest, forming a compound canal to link the extended water body with the existing.

[5]UEC TOR paper – WG/6/1/1252 of 14th September 2012

26. Bogahawewa Reservoir shall be improved to conform to the canal parameters at 14.542 km. The improvements involve raising the main embankment by 4.56 m, providing a flank embankment on the left bank, sluice and a spill.

27. Existing Madettawa Reservoir shall be improved to conform to the canal design parameters at 16.499 km, the embankment will be raised by 4.56 m and the sluice and the spill will be modified accordingly.

28. The natural topography and the prevailing land use patterns, necessitated introduction of a trifurcation at the end of UEC, 65.470 km at Yakalla, to regulate discharges to (i) Huruluwewa Reservoir on the east, (ii) Manankattiya system on the west, and (iii) NCP system on the north. This arrangement will facilitate easy regulation of discharges to the above three systems.

C. Upper Elahera Canal (at Yakalla) – Manankattiya Canal

29. A summary of project components of the UEC extension to Manankattiya are listed in **Table 3**. **Annex 4** including further details of the locations, elevations and design parameters of canals and structures.

Table 3: UEC (Yakalla – Manankattiya) Summary

Type of Canal	No.	Length (m)
Intake structure including the offset from UEC centerline	1	19
Rectangular Open Canal (BW=3.5m)	2	118
Cut & Cover – Rectangular Closed Conduit (BW=3.5m)	1	6,044
Transition	1	3
Total	**5**	**6,184**

III. BASE DATA

30. The designs adopted the recommendations of the water balance studies[6] (refer to **Annex 1**) for conveyance capacities of the KTMC and UEC and the data from topographic surveys, geotechnical investigations and environmental surveys as outlined below.

A. Topographic Surveys

31. The topographic surveys for canal longitudinal and sectional profiles included:

- KMTC: trace of the open canal reaches (completed)
- UEC: open canal reaches along the proposed canal trace from 0.00 to 65.50 km[7]

B. Site Surveys

32. Detailed site surveys included:

- KMTC: 2 inlet and 2 outlet portals for the tunnels (completed)
- UEC: at the locations of all self-priming siphon spillways, and the bridge site at the crossing of Dambulla – Elahera road, tunnel portals (in progress)
- Level crossings at Kongetiya, Bogahawewa, Madettawa and Yakalla (completed)

33. The detailed designs adopted the longitudinal profiles, layout plans, and established control point coordinates from the topographic surveys along the proposed canal trace. Site-specific topographic surveys facilitated the detailed design of structures including level crossings, regulators, aqueduct, siphons, spillways, tunnel portals, and bridges, etc. Results of some topographic surveys data included in **Annex 2.**

C. Geotechnical Investigations

34. The geotechnical investigations included:

- KMTC: (i) geophysical surveys conducted to determine the hard strata along the tunnel traces and (ii) core drilling investigations at the locations of structures to determine the foundation conditions.
- UEC: geophysical surveys are in progress to determine the hard strata along the canal and tunnel traces and core drilling investigations at selected locations of major structures and at level crossings to determine the foundation conditions.

[6] Comprehensive Hydrological / Water Balance Study and Finalization of Configuration of Proposed Randenigala- Kalu Ganga Transfer Canal Complex Encompassing Hasalaka and Heen Ganga together with Lower Uma Oya Complexes- December 2013.

[7] Topographic surveys for proposed canal trace deviation between 27.709 and 53.749 km and 61+300 and 64+300 km are in progress as of November 2014.

35. The data from the available geological maps are supplemented with geophysical investigations at regular intervals and core drilling at selected locations along the proposed canal trace. **Annex 2** provides a summary of the geological conditions along the route of the proposed canal and tunnel traces.

D. Quarry Sites and Borrow Area Surveys

36. The surveys for construction materials for the KMTC and UEC included:

- Identification of locations of the existing suitable quarry sites for coarse aggregates
- Fine aggregate has to be procured from the sources at Manampitiya.
- Burrow areas for earth fills are in the process of being identified.

E. Construction Materials

37. The assessment of construction materials included:

1. Coarse aggregate

38. Quarry sites, currently producing coarse aggregates for construction work in the project area, have been identified and the locations **Annex 2.** The coarse aggregate requirements could be procured from the above sites. In addition, part of the excavated rock from the tunnels may be used for producing coarse aggregates, depending on suitability.

2. Fine aggregate

39. The source of fine aggregate for construction work will be the Mahaweli River at Manampitiya. The fine aggregate requirements could be procured from the above source. In addition, part of the requirements could be obtained from Amban Ganga bed up stream of Moragahakanda Reservoir prior to impounding.

3. Steel

40. Requirements of steel for structural and other requirements will be procured from the local manufacturers or imported.

F. Waste Disposal Sites

41. The tunnel excavations may be used by the local construction industry for structural and other work depending on the quality and nature of excavated material. The waste disposal-site locations identified for the KMTC and UEC, has considered the above and the ease of transportation, and shown in **Annex 2**.

G. Other Considerations

42. Other considerations included:

- The Environmental Impact Assessment Studies for the KMTC and UEC have been completed and the recommendations adopted in the designs.
- The socio-economic surveys and environmental studies have identified the affected families in the existing settlements only in a few reaches of the UEC and the resettlement planning process has commenced.

IV. DESIGN CRITERIA

43. The detailed design of irrigation infrastructure adopted include for hydraulic designs the USBR canal design manuals and the design guidelines published by the Irrigation Department of Sir Lanka and data from the water balance study, and for structural designs BSS 8110. The design criteria adopted are listed in **Annex 3**.

A. Water Availability

44. Optimizing the available water resources in the Mahaweli Basin involved an analysis of water availability and allocation at major control points in the complex Mahaweli infrastructure system, with a focus on water allocations to different agriculture systems and hydro-power generation.

45. The water balance study[8] reviewed past and present records of system operations and projected the future operations for a time horizon of 30 years. It also included in the new infrastructure and operating policy changes required to accommodate new and evolving demands for water resources for hydropower, agriculture, drinking water and the environment. The study included the impacts of the Kalu Ganga and Moragahakanda Reservoirs and the diversion requirements for the Maduru Oya Right Bank Canal.

46. The study considering several diversion options based on minimum alteration to the existing infrastructure arrangements in Mahaweli systems as summarized below:

- Diversion via Polgolla to augment existing benefit areas in Systems H, G,IH and D and new areas in the NWP
- Diversion from Randenigala Reservoir, with supplementary inflows from the Lower Uma Oya, Hasalaka and Heen Ganga Reservoirs, via the Kalu Ganga Reservoir, Moragahakanda Reservoir and the UEC to enhance the benefits in existing Systems IH, MH, and the NCP area
- Pumping from Mahaweli Ganga at Kalinganuwara to augment Minneriya and Kantale Reservoirs

47. Adoption of above configuration in the future would lead to diversion of 555 MCM from Randenigala to RKTC canal for supplementing NCPCP and overall system gain of 33 GWh of energy generation annually.

48. The study considered the minimum river flows required to sustain the environmental requirements downstream and considered maintaining sufficient depth of water, flow velocity, and water quality for sustaining aquatic ecosystem requirements of all the flora and fauna in and around the river.

[8] Water Balance Study reference

49. It proposed diversion at Kalinga Nuwara by pumping 240 MCM for supplementing 33,000 ha under the NCPC has encompassed measures to mitigate adverse environmental impacts on the downstream of Mahaweli River and the forest reserve in the route of the conveyance system from Kalinga Nuwara to Angamedilla.

50. Considering past average diversions and future projected average diversions from the simulation studies, at the strategic localities in the system, the study recommends the diversion policy for Mahaweli Basin, as shown in **Table 4**.

Table 4: NPCP Water Balance

Control Point	Diversion (MCM)	D/S Flow (MCM)	Total Inflow (MCM)	% Diversion
Polgolla	858	1,243	2,101	41%
Randenigla	555	1,763	2,318	24%
Kalinga Nuwara	182	1,643	1,825	10%

51. The water balance simulation studies covered a period of 40 years from 1970 and considered annual inflows recommend annual average diversion and downstream flows at each of the main infrastructure components in the system, namely, Kotmale, Polgolla, Victoria, Randenigala, Rantambe, Minipe, Kalinga Nuwara, Bowatenna and Moragahakanda.

52. The study recommends a phased implementation program to minimize the technical and socioeconomic constraints and optimize benefits. The implementation of the balance of the MDP is divided into number of components as a basis for sequential implementation program for overall water resources development.

53. Diversion of Mahaweli water through the proposed Randenigala – Kalu Ganga Transfer Canal has the advantage of: (i) flexibility of operations in Amban Ganga system with three diversion routes, (ii) availability of at least two alternate routes to existing irrigation systems in Amban Ganga except for System H, (iii) easiness in handling crisis situation with alternate feeders, (iv) harnessing of unutilized water resources for multiple usage, (v) operating Randenigala above 215 m asl makes strengthening of the Victoria – Rantambe ecosystem, and (vi) better utilization of available infrastructure to their optimum.

54. Canal designs adopted the data from the previous hydrological and water balance studies. The outcome of the previous hydrological studies and the water balance studies are summarized in **Annex 1**.

B. Canal Design

55. **Annex 4** lists details adopted for the design of canal and conveyance structures.

56. **Annex 5** presents ‘typical’ design drawings for canals and structures.

57. The specifics of the tunnel design are presented in the Tunneling Technical Summary (**Appendix 6 Part D**).

V. PROJECT COSTS AND BENEFITS

A. Project Costs

58. The summary of total estimated cost for the construction of UEC and KMTC in three tranches is listed in **Table 5**. The estimate is based on the assumption of a single tunnel boring machine in the reach 27+509 to 54+249 km and adoption of drill and blast tunneling methods for the KMTC.

Table 5: Cost Estimate

	Description	Tranche	Cost (Rs. M)
1.	Upper Elahera Canal (0+100 to 6+226 km)	1	3,312
2.	Upper Elahera Canal (27+509 to 54+249 km)	2	31,087
3.	Kalu Ganga – Moragahakanda Transfer Canal (0+292 to 8+824 km)	2	5,441
4.	Upper Elahera Canal (6+226 to 27+509 km)	3	6,231
5.	Upper Elahera Canal (54+249 to 65+500 km)	3	5,730
6.	UEC- Manankattiya – Eruwewa – Mahakanadarawa Feeder Canal	3	2,597
	Total		**54,399**

B. Project Benefits

59. The development of the NCPCP has a multitude of direct and indirect benefits broadly categories as outlined below.

60. **Increase in Cropping Intensity**. Increase in assured water availability in the benefit areas in Maha and Yala seasons would increase the cropping intensities in both the minor and major irrigation systems in cascades leading to major economic benefits. Anticipated cropping intensities are:

- Minor reservoir systems increase from 0.8 to 1.8
- Major reservoir systems increase from 1.2 to 1.8

61. **Increased Irrigable Area**. Diversion of available Mahaweli water to the NCPC anticipates augmenting 49,716 ha of existing and 104,373 ha of new land partly from direct irrigation, and partly from indirect benefits arising from drainage flows. The amount of land existing and benefited are shown in **Table 6**.

Table 6: NCPCP Areas

Mahaweli System	NCPCP (ha)		
	Existing	New	Total
I	21,134	35,547	56,681
J	2,874	19,919	22,793
K	13,198	7,854	21,052
L	8,057	30,972	39,029
M	4,453	10,081	14,534
Total	**49,716**	**104,373**	**154,089**

62. **Environmental Improvement**. Water availability in both Maha and Yala seasons in the project areas would facilitate vegetative growth and improved environmental friendly habitat for the beneficiaries.

63. **Increased economic development opportunities**. Improved water availability and increased agriculture based activities would lead to more opportunities for economic development in the project areas.

64. **Provision of potable water supply to Jaffna peninsula**. Augmentation of Iranamadu Reservoir includes both, improvement of cropping intensity of existing command area land providing potable water supply to Jaffna peninsula.

VI. PROJECT IMPLEMENTATION

65. The project implementation period is proposed to span 10 years from 2015 to 2024 and summarized in **Table 7**.

Table 7: Implementation Schedule

Project	Description	Schedule
Tranche 1	UEC – non-tunnel segments (0+100 to 6+226 km)	Q1 2015 to Q2 2018
Tranche 2	UEC - tunnel section (27+509 to 54+249km)	Q1 2016 to Q4 2022
	KMTC	Q1 2023 to Q4 2024
Tranche 3	UEC – non-tunnel segments (6+226 to 27+509 and 54+249 to 65+500km)	Q1 2018 to Q4 2022
	UEC – Manankattiya – Eruwewa – Mahakanadarawa canal segments	Q1 2019 to Q4 2023

ANNEX 1: WATER BALANCE STUDY

1. Introduction

1. The MCB conducted detailed studies to optimize water resources in Mahaweli basin and to cater for the water demands in under MDP and the newly proposed upper Mi Oya Catchment in NWP, using the Acre's ARSP and AIDM models. The simulation studies proved the best option is to harness Mahaweli water at the lowest reservoir, namely Randenigala, and augmenting Moragahakanda Reservoir with supplemental augmentation from main Mahaweli River through Kalinga Nuwara pumping at a place downstream of Minipe.

2. The simulation study result no. A10A revealed the feasibility of diverting 973.5 MCM to UEC with peak discharge of 112.50 MCM in December, January, and March. The details of simulation studies are given in the Water Balance Study Report of June 2012 which included recommendations for water resources distribution and the infrastructure arrangements. The proposals for development of NCP, NP and NWP irrigation systems in the three provinces focus on harnessing the existing full water resources potential of Mahaweli river at Randenigala and as well as supplemental inflows to the Lower Uma Oya, Hasalaka, Heen Ganga, Kalu Ganga, and Moragahakanda reservoirs.

3. This scenario minimized loss of power generation within the Mahaweli system. When compared to diversion from Polgolla and enhancing HFC to augment NCP canal, the proposals for diversion from Randenigala and use of RKTC, KMTC, and UEC to augment NCP canal is superior in terms of water availability, power generation and availability of regulatory storage capacity en route.

4. The major irrigation infrastructure components identified to harness water resources in Mahaweli and the adjoining basins including the tributaries and transfer to targeted areas are summarized in **Table 1-1** below.

5. Thus the UEC, linking Moragahakanda reservoir to the start of NCPC at the Manankattiya bifurcation forms an integral and pre-requisite part of the NCPCP.

Table 1-1: Summary of Irrigation Infrastructure Development Proposals

No.	Description of Major Components	Length (km)	Diver-sion (MCM)	Duty (m^3/s)
1.	Randenigala - Kalu Ganga - Moragahakanda - Manankattiya tank outlet			
	a) Randenigala to Kalu Ganga with Uma Oya Diversion to Randenigala Reservoir			30
	• Route with 34.4 km Tunnels, 3.9 km Open Trapezoidal canals and 0.7 km Cut & Cover conduit canal.	40.0		
	b) Kalu Ganga to Moragahakanda			
	• Route suggested by Lahmeyer International	13.0		15
	• Alternate Route studied under this project (Approx. canal length 0.64km & tunnel length 7.6 km)	8.9		35
	c) Upper Elahera Canal from Moragahakanda Reservoir to cater for wider scope (Moragahakanda - Manankattiya outlet)	68	974	40
2.	NCP Canal - (From Manankattiya outlet of Upper Elahera Canal to Chemmadu kulam Tank)	92	640	30 - 15
3.	Upper Deduru Oya and Upper Mi Oya diversion canal (Dambulu Oya to Pothuwila Tank, Pothuwila Tank to Upper Mi Oya Cascade and Wavulewa Tank to Upper Mediyawa Oya Cascade)	76		15
4.	Kalinga Nuwara, Minneriya Tank Pumping Complex (3 Nos. 5 m^3/s and 3Nos 5m^3/s pump stations)	25		20

2. Randenigala – Kalu Ganga Transfer Canal Concept

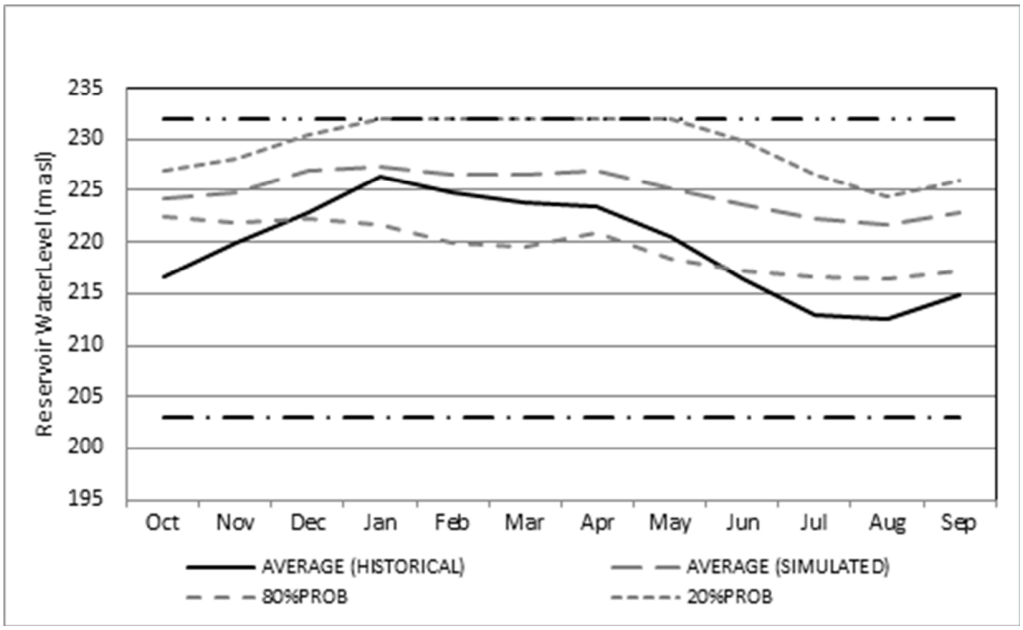
6. The purpose of the NCPCP is to optimize the use of water resources in Mahaweli Basin and all other adjoining basins, en route from Randenigala reservoir to Amban Ganga. The simulation studies[9] conducted for long term system operations considered the existing and proposed reservoir networks in Mahaweli and Amban Ganga basins and planned diversions using available historical rainfall and diversions records from 1986 to 2012 and statistical data for 40 years.

a. Water Levels in Randenigala Reservoir

7. **Figure 1-1** shows the monthly variations of the water surface elevation in Randenigala reservoir taking into consideration historical average and simulated average, 20%, and 80% probable data. The minimum water surface elevation of 212 masl had been observed in the historical average data curve during July and August whereas the simulated 80% probable water surface elevation during the same period is 216 masl. Considering the results of simulation studies, the minimum operation level for RKTC had been considered at 215 masl will ensure 80% probable success in delivery of water to Kalu Ganga Reservoir.

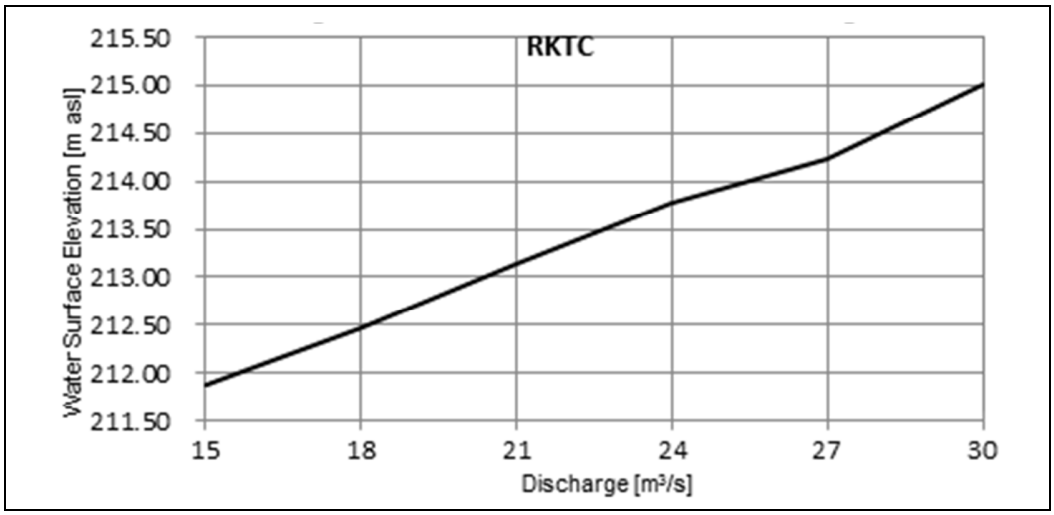
[9] The details of the studies are given in Final Water Balance Report – August 2012 (Appendix A).

Figure 1-1: Historical and Simulated Levels - Randenigala Reservoir



8. In the event of a severe drought in the upper watershed of Mahaweli, the water surface elevation in Randenigala can fall below 215 masl and quantities of water diverted to RKTC could be reduced and the adjustments need to be made in the cropping patterns and cropped areas in proposed new development areas only, to optimize the use of available water. However this would not compromise water supply to the existing developed area. Consequently the seasonal operation plan of the system needs to be adjusted compromising the targets in the original long term project plan. **Figure 1-2** below shows the feasible diversions to RKTC with reservoir water levels below 215 masl.

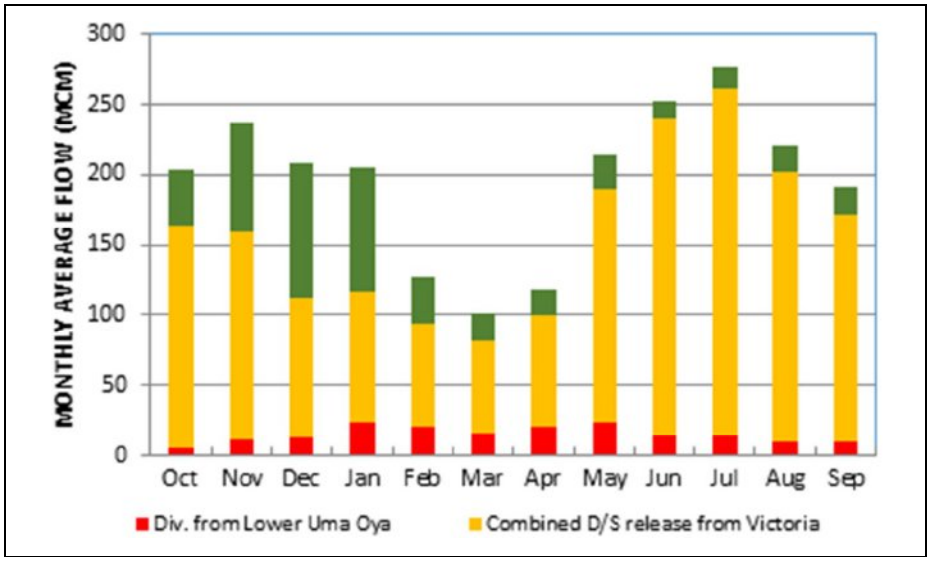
Figure 1-2: Randenigala Discharges



b. Diversion capacity at Randenigala Reservoir

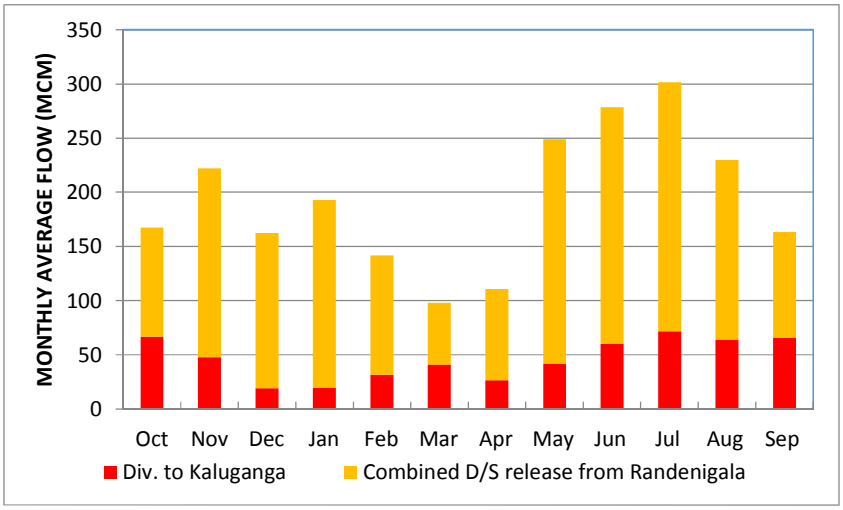
9. Randenigala Reservoir receives inflows from its net catchment, power flow releases from Victoria and Lower Uma Oya reservoirs. **Figure 1-3** below shows the monthly variations in the total inflows with maximum inflow occurring in July and minimum in March. Maximum flow from Victoria occurs in July and Lower Uma Oya in December.

Figure 1-3: Randenigala Reservoir Monthly Inflows



10. Randenigala reservoir releases mainly for power generation and in the future will also (under the NCPC project) augment the Kalu Ganga Reservoir via RKTC. **Figure 1-4** below shows the monthly variations in the total outflows with maximum outflow occurring in July and minimum in March. Maximum power flows occur in July and maximum Randenigala Kalu Ganga Transfer Canal (RKTC) discharges occurring from June to October.

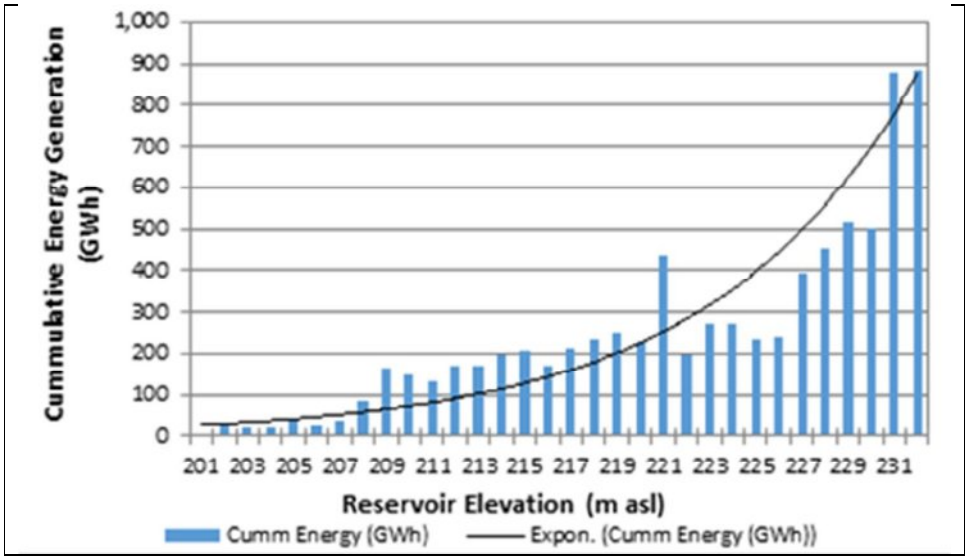
Figure 1-4: Randenigala Monthly Outflows



c. Power Generation at Randenigala Reservoir

11. The historical records from Ceylon Electricity Board and Water Management Secretariat of MASL show large variations in power generation depending on both the reservoir water level and hours of operations in each day. The historical records, from 1986 to 2012, show that the powerhouse had operated 81% of the time between reservoirs levels 232 to 215 masl and generated 6381 GWh of power, and that 11% of the time between reservoirs levels 215 and 210 masl and generated 878 GWh. They also show that 7% of the time between reservoirs levels 210 and 204 masl generated 584.87 GWh. **Figure 1-5** depicts the trends in cumulative energy generated, using historical data at different water levels in the reservoir.

Figure 1-5: Cumulative Power Production



d. Conclusions

12. The foregoing confirms that the Randenigala reservoir has potential for servicing the requirements for both power generation and diversions to RKTC simultaneously. Major highlights are: (a) the reservoir could operate with water surface at 215 masl for 80% of the time as in the past, (b) there is no constraint in the quantity of water available for diversion to RKTC, and (c) there is no hindrance to power generation up to a water surface elevation of 210m asl, as currently practiced.

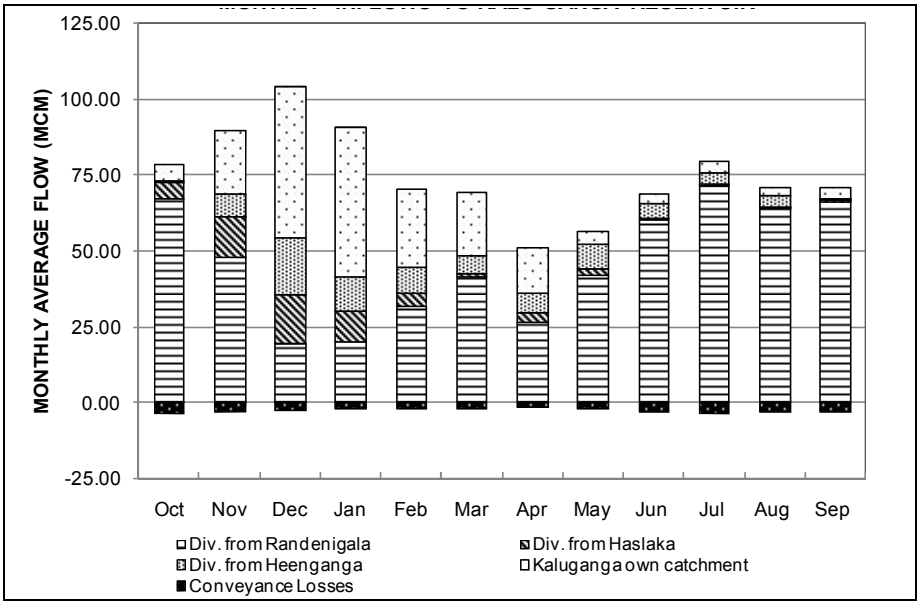
13. However a major change in Randenigala reservoir operations policy is required to ensure optimization of available water resources for diversions to RKTC for domestic and agriculture uses and generation of power with emphasis on diversions to ensure the success of the NCP canal project.

3. Kalu Ganga Reservoir

14. The hydrologic behavior of Kalu Ganga reservoir was studied in detail in the simulation studies conducted using the Acre's model for optimizing use of available water resources. Several trial runs were conducted for different operational scenarios for optimizing use of water resources and the results of the trial run A10A had been accepted as one of the most appropriate and used in this report[10].

15. The simulation studies for Kalu Ganga reservoir was based on: (a) diversions from Lower Uma Oya, Randenigala, Hasalaka, and Heen Ganga reservoirs, (b) inflows from its own watershed, and (c) outflows to system F command area, Moragahakanda and river discharges for supplying Angamedilla to meet the water demands under Parakrama Samudra for early cultivation in November and peak water demands in July. The studies show that the reservoir water level will be always above the minimum operations level of 190 masl and minor monthly fluctuations in the storage and reservoir water level. The inflows to Kalu Ganga reservoir from Randenigala via Hasalaka and Heen Ganga reservoirs are shown in **Figure 1-6**.

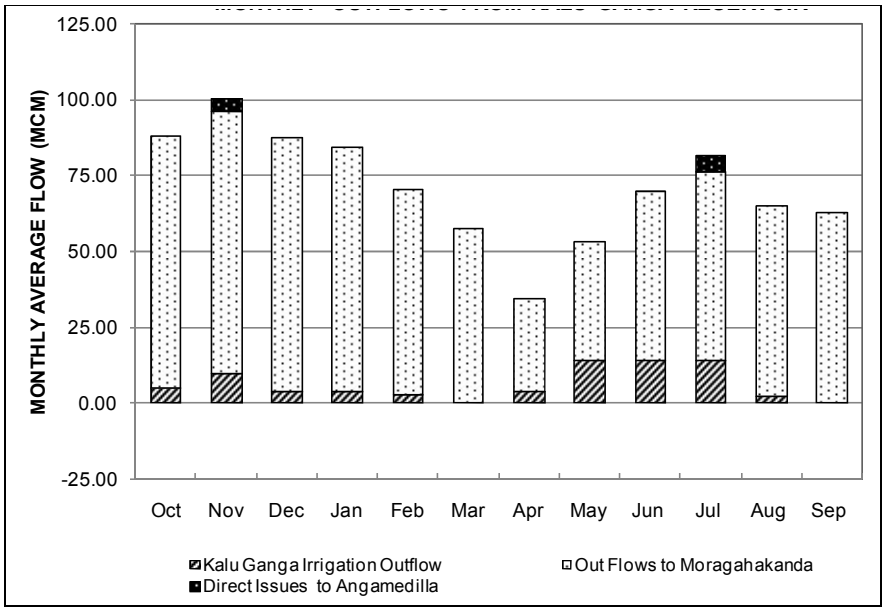
Figure 1-6: Monthly Inflows to Kalu Ganga Reservoir



16. The outflows to System F, Moragahakanda and Angamedilla from Kalu Ganga reservoir are shown in **Figure 1-7**.

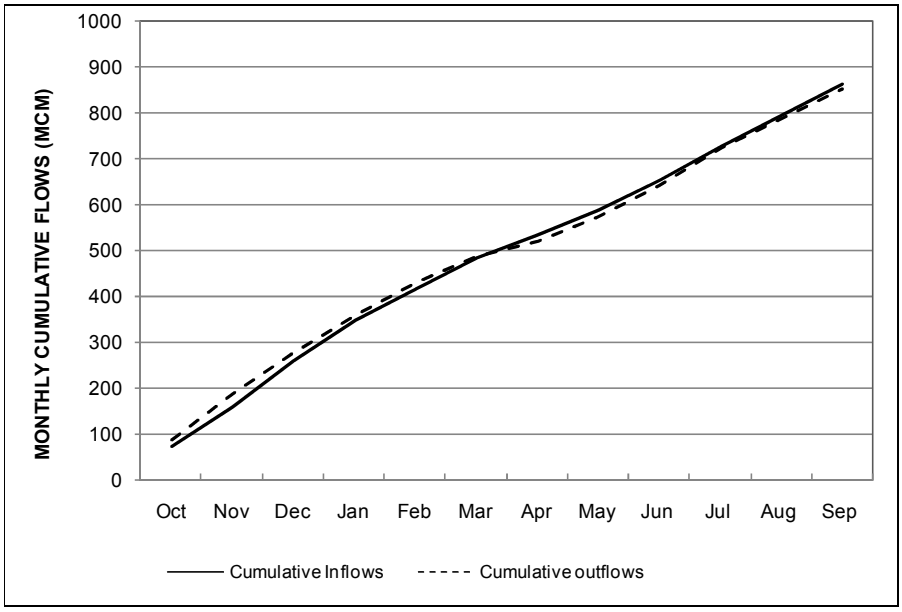
[10] The details of the simulation studies are given in "Final Water Balance Report – June 2012".

Figure 1-7: Monthly Outflows from Kalu Ganga Reservoir



17. Monthly cumulative inflows to and outflows from Kalu Ganga reservoir, as shown in **Figure 1-8**, indicate that the reservoir will function as a balancing reservoir while maintaining the water surface level above the minimum operation elevation of 190 masl.

Figure 1-8: Kalu Ganga Reservoir Cumulative Inflows and Outflows

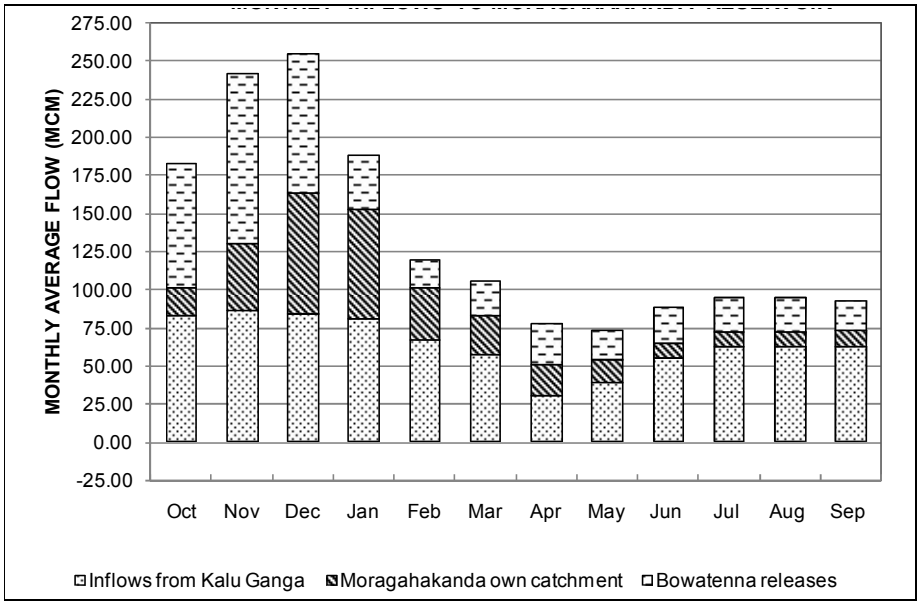


4. Moragahakanda Reservoir

18. The water balance studies included assessment of the need for and operation of the Moragahakanda Reservoir, including augmentation from the Randenigala Reservoir.

19. The studies included delivery of water to cater the irrigation and domestic demands identified under command of the Upper Elahera Canal and available resources in the Mahaweli and Amban Ganga Basins.[11] The inflow to Moragahakanda Reservoir from Randenigala via Kalu Ganga, Amban Ganga and Bowatenna is shown in **Figure 1-9**.

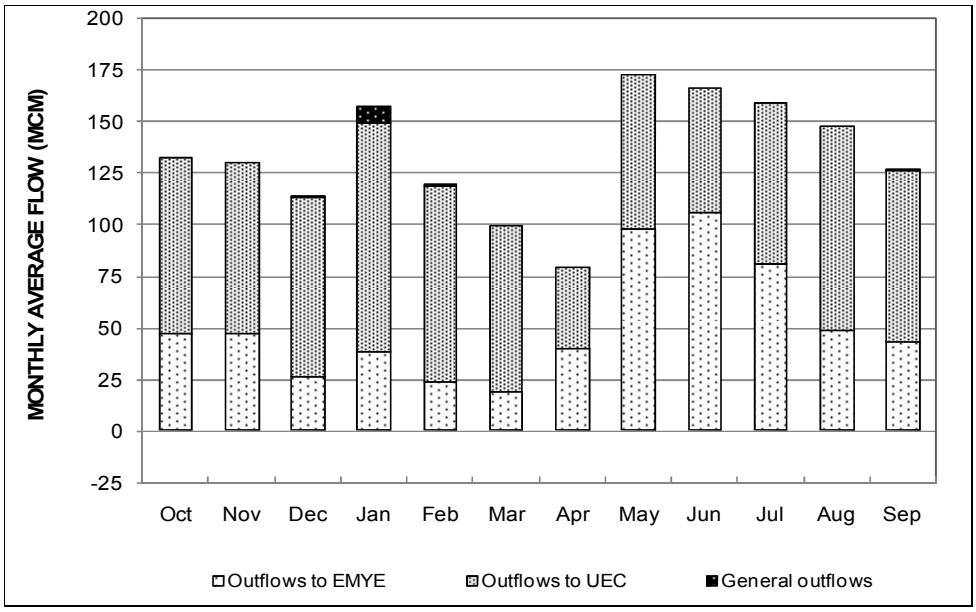
Figure 1-9: Monthly Inflows to Moragahakanda Reservoir



20. The studies show that the supplementary requirement to areas catered to by the EMYE from the Amban Ganga water resources could be decreased from 715 MCM in without project scenario to 617 MCM in with project scenario with Randenigala and Kalinga Nuwara diversions coming into effect at the final stage (beyond 2022). The above simulation runs for UEC shows an increase of available water resources from 234 MCM for without project scenario to 974 MCM for with project scenario. **Figure 1-10** below shows the monthly variations in the water demands from Moragahakanda Reservoir with Project and includes diversions from Randenigala and Kalinga Nuwara.[12]

[11] The details are given in the Water Balance Study Report June 2012.
[12] Water Balance Study Report June 2012 -simulation run A10A

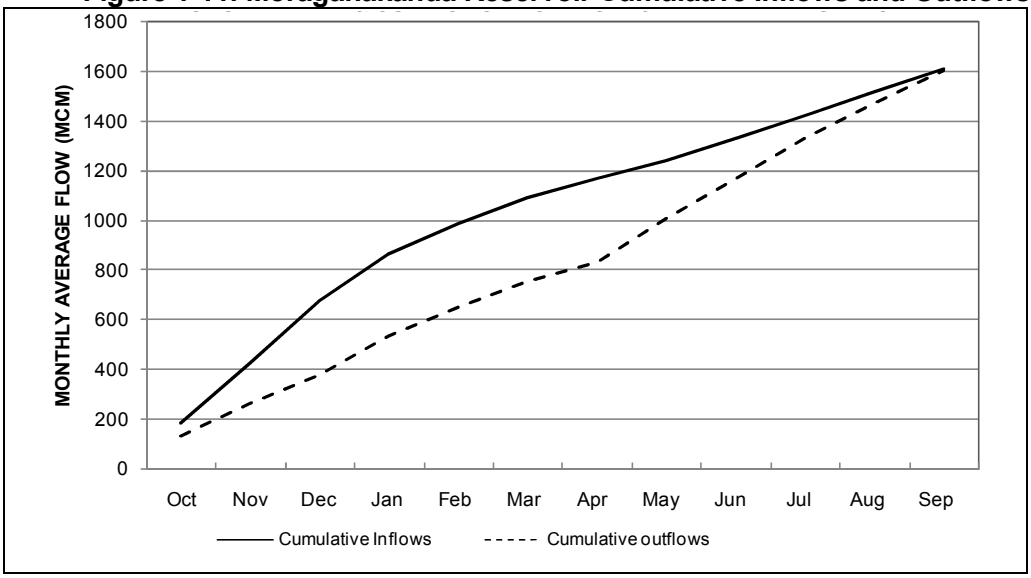
Figure 1-10: Monthly Outflows from Moragahakanda Reservoir



21. The study has shown an increase in the diversion capacity at Moragahakanda to 974 MCM annually, required for the UEC and NCP canals in addition to 617MCM to the EMYE. The supplemental diversions from Kalu Ganga (772 MCM) Bowatenna (496 MCM) reservoirs and its own watershed (344 MCM) are adequate to cater the water demands under UEC.

22. **Figure 1-11** shows the total monthly and cumulative variations in the inflows into Moragahakanda reservoir, and the outflows into Upper Elahera Canal. High monthly inflows from October to February during the rainfall in Maha season and high monthly water demand from March to September confirms the need for storage during excess rainfall period. The cumulative inflows and outflows balance showing clearly the adequacy of water available to meet the demands. The differences in the ordinates of the cumulative inflow and outflow curves reflect the monthly storage requirements for the reservoir.

Figure 1-11: Moragahakanda Reservoir Cumulative Inflows and Outflows



5. Simulation Results and Hydropower Generation

23. The results of the water balance simulation study are presented in **Table 1-2**. As shown for simulation run A10A, annual flow in the UEC is 974 MCM and 617 MCM in the Elahera-Minneria Yoda Ela (EMYE) system. The EMYE canal is taking off at 138 masl at a discharge capacity of 45 m^3/sec and the Upper Elahera Canal at 140 masl at a discharge capacity of 40 m^3/sec with the latter having a higher potential for power generation. Thus with augmentation from Randenigala and Kalu Ganga has increased the power generation capacity at Moragahakanda to 25MW,[13] with 10 MW plant (2 x 5 MW) for the existing EMYE Canal and 15 MW plant (1 x 10MW & 1 x 5MW) for the UEC. The averaged energy computed in simulation A10A shows the estimated annual energy generation at Moragahakanda to be 107 GWh.

24. Simulation Results for EMYE Canal Hydropower Analysis 'with project' show the optimum power generation to be 10MW of power at a plant factor of 41%. The total annual estimated discharge from the reservoir for LEC system including spillage is 609 MCM and the estimated energy generated is 36 GWH. **Table 1-3** summarizes the outcome of the analysis and **Figure 1-12** depicts the variations of hydropower generation and the plant factor.

[13] Increase from 15 MW as originally proposed in the 2010 feasibility study by Lahmeyer International

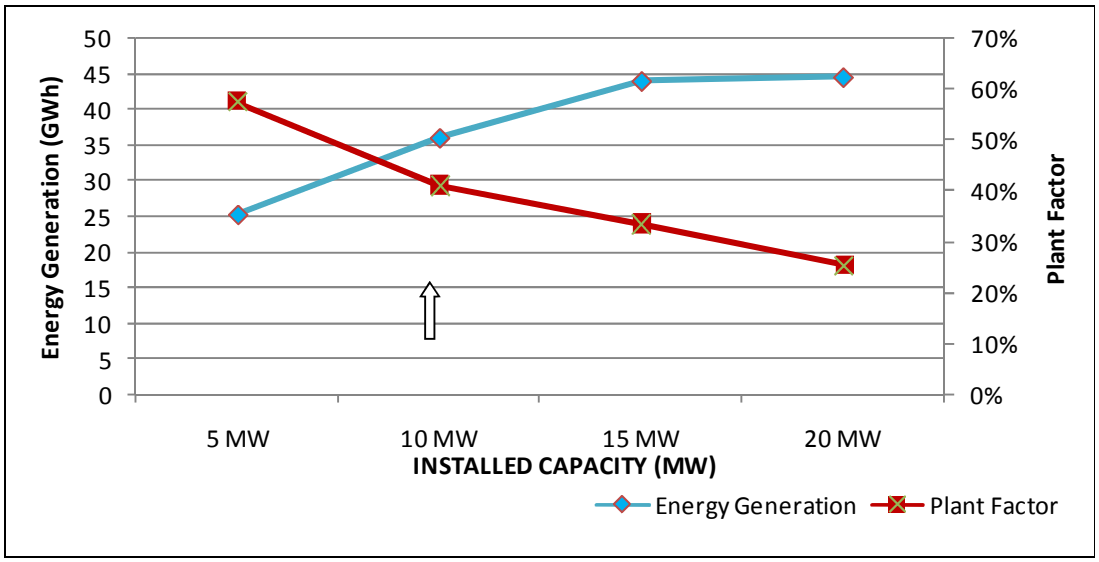
Table 1-2: Summary of Simulation Studies

Features	Station\Run No \STAGE	Actual (2006-2010)	A1A W/O MORA	A2A Stage 1 WI MORA	A3A Stage 1	A4A Stage 1	A5A Stage I	A6A Stage II	A7A Stage III	A8A Stage III	A9A Stage III	A10A Stage III	A11A Stage III (1991-2010)
	Time frame			2018-22	2018-22	2018-22	2018-22	2023-27	2028-32	2028-32	2028-32	2028-32	2028-32
Proposed Irrigation Developments													
NCP	Under minor tanks						5,000 180%	25,000 180%	25,000 ha 180%	33,000 ha 180%	33,000 ha 180%	33,000 ha 180%	33,000 ha 180%
	under major tanks					5,500 ha 180%	5,500 180%	10,000 180%	10,000 ha 180%	20,000 ha 180%	20,000 ha 180%	20,000 ha 180%	20,000 ha 180%
	Kantale (sugarcane)					5,120 ha 200%	5,120 200%	5,120 200%	5,120 ha 200%	6,576 ha 200%	6,576 ha 200%	6,576 ha 200%	6,576 ha 200%
NWP	Under minor tanks				9,000 ha 180%	9,000 ha 180%	9,000 180%	9,000 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%	11,000 ha 180%
Maduru Oya RB					10,000 ha	10,000 ha	10,000 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%	10,000 ha 180%
Proposed WS Demand (overall)							###	66%	100%	100%	100%	100%	100%
Target Diversions (mcm)													
	Polgolla	875	875	875	875+100	875+300	875+300	875+375	875	875	875	875	875
	Randenigala								600	200+400	200+400	200+400	200+400
	Heen/Hasalaka Res						100	150	150	150	150	150	150
	Angamedilla-Minneriya							54	75		75		
	Kalinga Nuwara+Angamedilla									225		225	225
	Kalinga Nuwara-UEC										150		
New Features added													
	Cropping Pattern	Type I	Type I	Type II	Type II	Type II	Type II	Type II	Type II	Type II	Type III	Type III	Type III
	Moragaha+Kalu Res			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Upper Elahera canal			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Lower Uma Oya Res					yes	yes	yes	yes	yes	yes	yes	yes
	Randenigala Diver								yes	yes	yes	yes	yes
	Heen Ganga Res						yes	yes	yes	yes	yes	yes	yes
	Hasalaka Oya Res							yes	yes	yes	yes	yes	yes
	div UEC to MH+IH			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	div UEC to I			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
SIMULATION RESULTS													
Diversion	**Polgolla**	882	941	849	934	1185	1207	1244	871	853	854	868	808
	Nalanda (Wemedilla)		0	0	56	56	56	55	54	54	54	53	50
	to Bowatenna		0	74	18	18	17	19	20	20	20	21	27
(mcm)	**Bowatenna**	570	725	603	644	637	626	586	643	642	636	658	653
	KH Canal	196	211	143	141	142	141	136	136	136	136	135	132
	NWP	0	0	0	68	67	67	53	94	95	95	99	99
	Dambulu Oya	382	514	460	435	428	418	397	413	411	405	425	422
	Nachchaduwa	35	96	13	11	8	9	12	10	10	9	15	18
	Tisawewa	14	16	16	16	16	16	15	15	15	15	15	15
	Upper Elahera Canal	0	0	234	236	348	488	725	778	987	844	974	961
	NCP	0	0	0	0	0	144	414	452	647	661	640	632
	Mannan/Hurulu	0	0	222	225	331	322	277	289	294	301	287	281
	Huruluwewa	41	61	82	82	144	143	126	128	128	130	128	126
	Mannakattiya	0	0	141	143	186	179	151	161	166	171	159	155
	Mahakandara	0	0	42	41	72	70	62	64	64	65	64	63
	Nachchaduwa	0	0	103	105	109	103	87	103	99	103	93	91
	EMYE	620	705	715	718	851	840	746	765	598	756	617	606
	Minneriya	415	377	390	393	515	507	432	448	284	429	300	295
	Kaudulla	0	103	103	121	121	118	113	119	116	113	119	114
	Kantale	0	126	133	119	238	232	234	240	253	246	278	268
	Giritale	104	79	76	76	75	75	68	69	79	79	81	80
	Angamedilla	398	341	328	328	331	330	309	311	331	347	306	303
	Randenigala-Heen	0	0	0	0	0	0	0	590	544	551	555	534
	Heen-Kalu Ganga	0	0	0	0	0	71	136	686	646	654	659	645
	Kalu Ganga-Moraga	0	0	91	90	90	167	241	779	768	775	771	756
	Minipe LB	342	347	349	349	349	328	320	318	318	318	318	311
	Minpe RB	1137	1062	1107	1351	1325	1324	1251	1226	1228	1227	1239	1204
	Maduru Oya	432	455	464	726	713	712	639	623	628	627	632	616
	Kalinga to UEC/MIN										166 UEC	182 Min	174 Min
	Kalinga Nuwara-Anga	0	0	0	0	0	0	0	0	241			
	Angamedilla-Minneriya	0	0	0	0	0	0	58	54	230	74	61	51
Mahaweli	**Div to Amban Ganga**	882	941	849	934	1185	1278	1380	1557	1739	1674	1709	1626
SPILL FLOWS	Polgolla	1116	1174	1266	1181	931	908	872	1244	1263	1261	1247	1085
(mcm)	Minipe	910	1039	933	606	391	391	430	253	307	300	280	169
	Elahera	311	201	57	41	54	36	40	70	11	12	10	4
	Angamedilla		479	194	177	198	177	135	177	120	33	84	89
	Kalinga Nuwara		2503	2416	2089	1873	1873	1906	1729	1541	1608	1643	1453
Power Flows	Kotmale	810	856	846	847	856	856	854	859	856	858	858	785
(mcm)	Victoria	1454	1502	1592	1514	1304	1282	1234	1645	1634	1638	1630	1509
	Randenigala	1919	1941	2016	2124	1919	1898	1841	1658	1722	1718	1694	1590
	Rantembe	2182	2304	2253	2174	1972	1951	1900	1733	1773	1769	1766	1668
	Polgolla	882	941	849	934	1185	1207	1244	871	853	854	868	808
	Bowatenna	492	533	562	550	809	843	919	487	469	476	469	437
	Moragahakanda			789	776	1100	1160	1292	1562	1547	1559	1542	1538
	Lower Uma Oya				181	188	188	181	170	193	193	183	196
	Upper Uma Oya			152	152	151	151	151	151	151	150	146	152
	Heen Ganga						75	82	75	78	78	79	83
	Hasalaka							62	56	58	59	59	61
Energy	Kotmale	426	451	448	447	443	443	439	447	444	444	445	408
(GWh)	Victoria	684	723	758	714	579	569	558	690	701	698	696	643
	Randenigala	319	388	403	422	366	362	356	303	321	319	309	290
	Rantembe	171	188	184	177	152	151	150	125	132	131	131	125
	Polgolla	166	172	156	171	216	220	226	159	156	157	159	149
	Bowatenna	57	69	73	71	105	109	119	63	61	62	61	57
	Moragahakanda	0	0	59	56	82	85	98	133	111	112	107	107
	Lower Uma Oya	0	0	0	24	25	25	25	21	25	25	26	27
	Heen Ganga						4	5	6	6	6	6	7
	Hasalaka							35	33	34	34	35	36
	Total (Project)	1823	1992	2081	2083	1969	1968	2010	1981	1990	1987	1975	1849
	Upper Uma Oya	0	0	294	294	293	293	294	293	293	292	284	297
Moragaha-	Power Flow	0	0	789	776	1100	1160	1292	1562	1547	1559	1542	1538
Kanda	Spill Flow	0	91	13	8	12	9	10	13	9	10	8	4
(mcm)	Bottom outlet	0	814	203	211	140	196	210	38	41	43	51	30
Water Supply	under Moragaha/Kalu	0	92	39	39	39	39	56	92	92	92	92	92
(mcm)	Under NCP Project	0	45	45	45	45	70	47	70	70	70	70	70

Table 1-3: Summary of the Simulated Lower Elahera Canal Hydropower Analysis

Description	Unit	Generation Capacity			
		5 MW	10 MW	15 MW	20 MW
Annual Power Flow	MCM	297.3	481.6	568.7	576.4
Spill & Bottom Outlet Release	MCM	301.7	127.4	46.7	45.6
% of Power Flow	%	50%	79%	92%	93%
Avg. Res Water Level	masl	174.0	173.8	173.5	173.4
Energy Generation	GWh	25.2	36.0	44.0	44.5
Plant Factor	%	57%	41%	33%	25%
Proposed Generator units	Nos.	1 of 5 MW	2 of 5 MW	1 x 5MW +1 x 10MW	2 x 10 MW

Figure 1-12: Variation of Hydropower Generation and Plant Factor – LEC

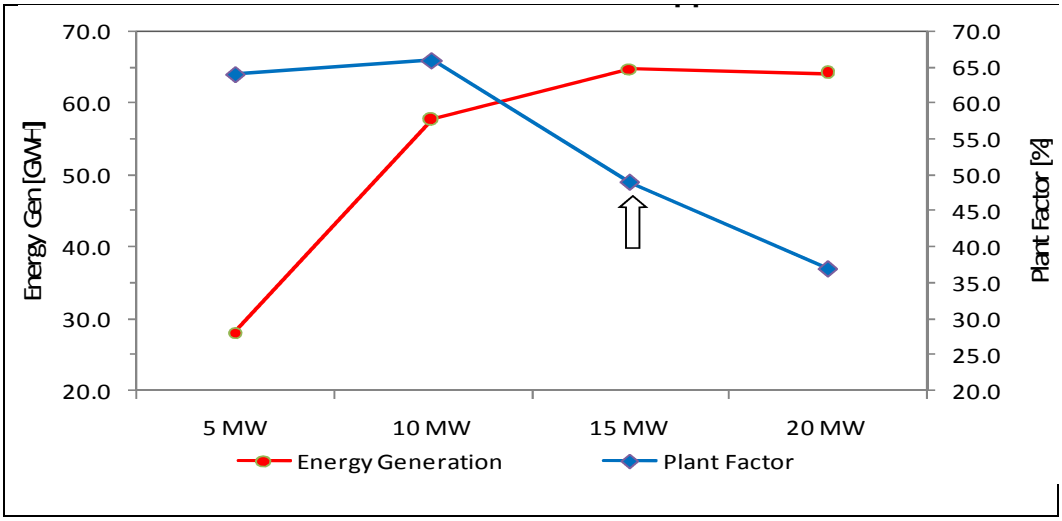


25. Simulation results for the UEC hydropower analysis 'with project' show the optimum power generation to be 15 MW of power at a plant factor of 35%. The total annual estimated discharge from the reservoir for UEC system including spillage is 1,000 MCM and the estimated energy generated is 64.8 GWH. **Table 1-4** below summarizes the outcome of the analysis and **Figure 1-13** depicts the variations of hydropower generation and the plant factor.

Table 1-4: UEC Hydropower Analysis with Project

Description	Unit	Generation Capacity			
		5 MW	10 MW	15 MW	20 MW
Annual Power Flow	MCM	354.3	748.5	946.0	972.3
Spill & Bottom Outlet Release	MCM	599.9	223.2	54.2	37.1
% of power Flow	%	37.0	77.0	95.0	96.0
Avg. Res. Water Level	m ASL	176.3	175.8	174.6	173.0
Energy Generation	GWH	28.1	57.7	64.8	64.1
Plant Factor	%	64.0	66.0	49.0	37.0
Proposed Generator units	Nos.	1 x 5 MW	2 x 5 MW	1 x 5MW +1 x 10MW	2 x 10 MW

Figure 1-13: UEC Hydropower Generation and Plant Factor



a. Rule Curve for Operation of Moragahakanda Reservoir

26. The simulation results established the viability of transferring 550 MCM annually from Randenigala to Kalu Ganga including the water resources from Heen Ganga & Hasalaka while maintaining Randenigala at 215 masl. In addition, the simulation studies showed that the peak discharge of 71.48 MCM from Randenigala to Kalu Ganga occurs in July.

Figure 1-14: Moragahakanda Reservoir Rule Curve

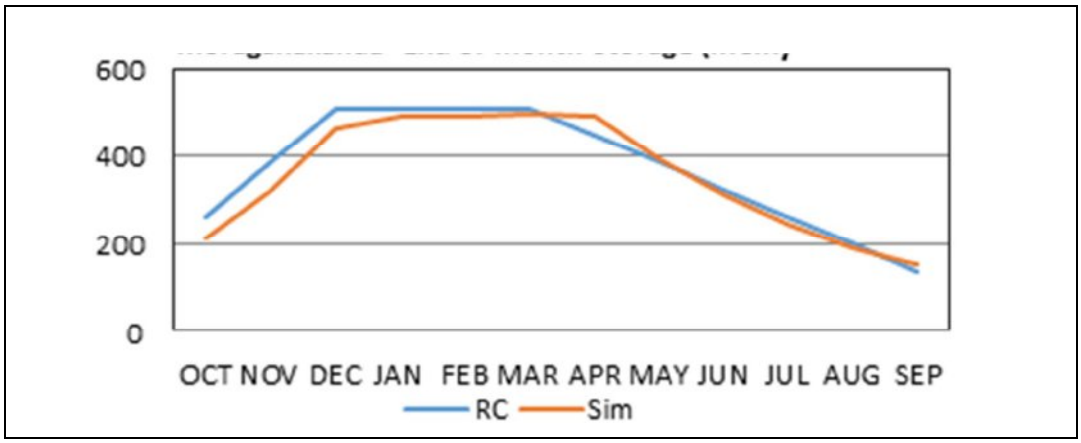
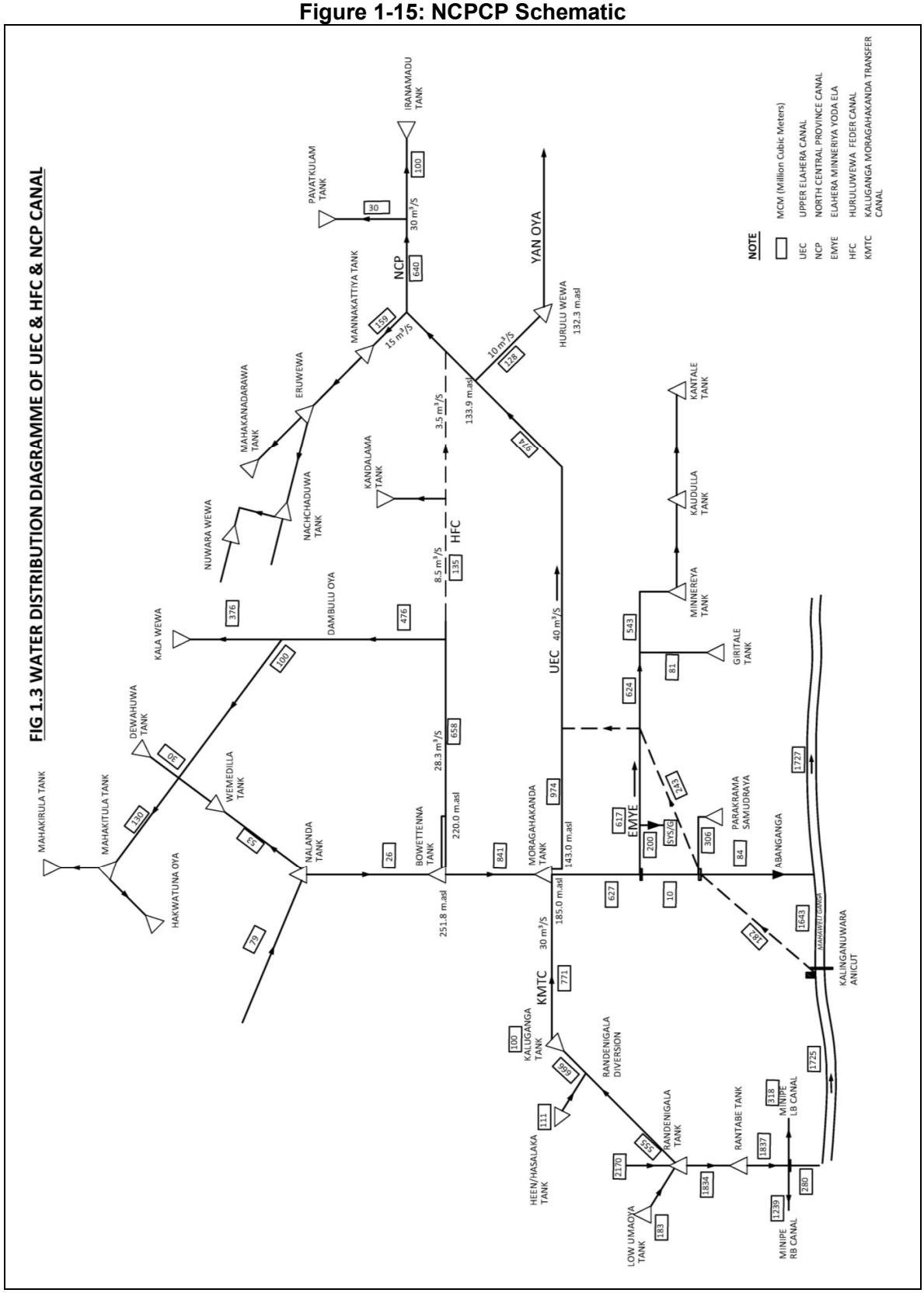


Figure 1-15: NCPCP Schematic



ANNEX 2: SURVEYS AND INVESTIGATIONS

1. This annex presents information related to the topographical and site surveys.

Figure 2-1: KMTC Longitudinal Section

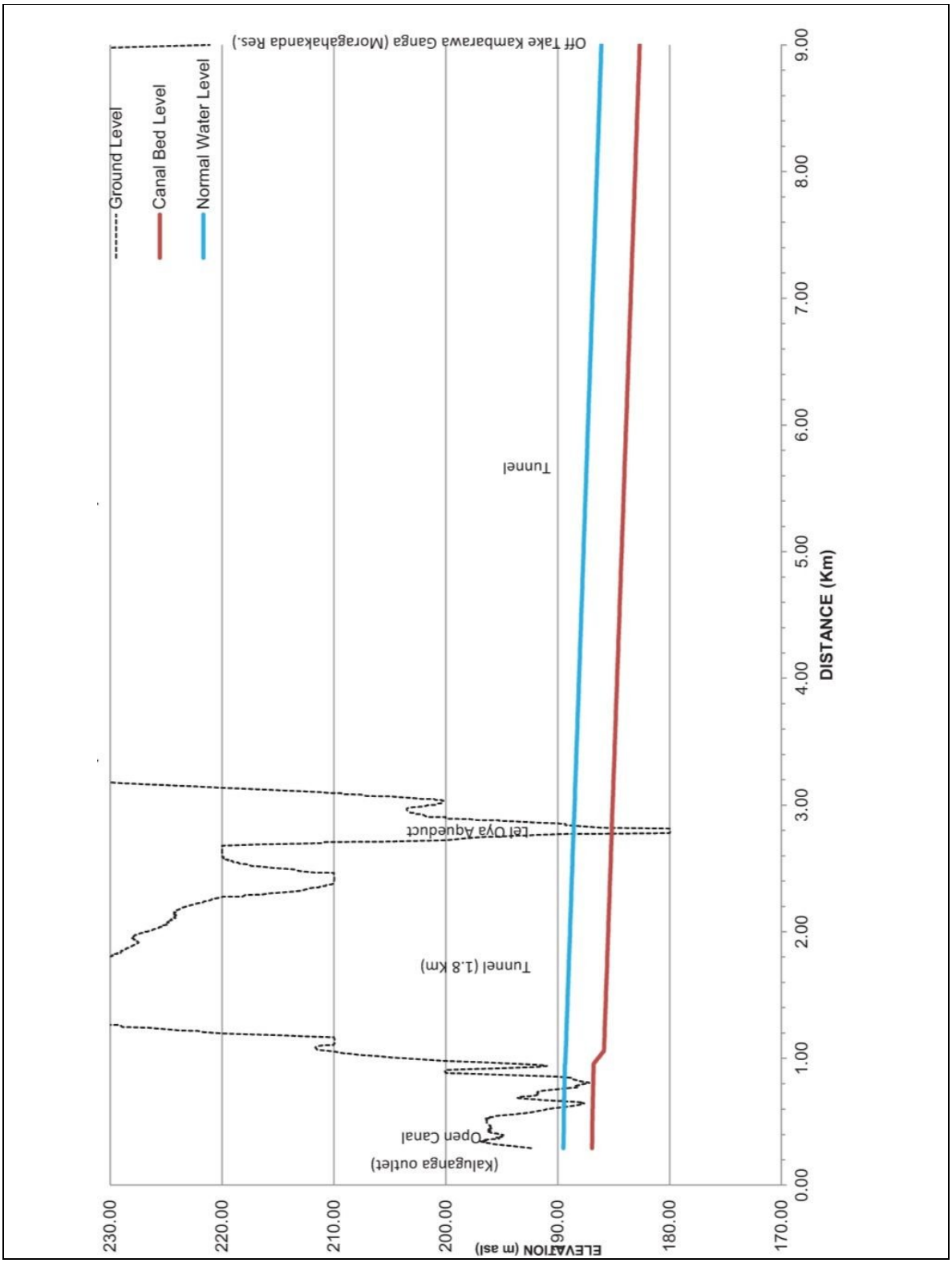


Figure 2: UEC Longitudinal Section

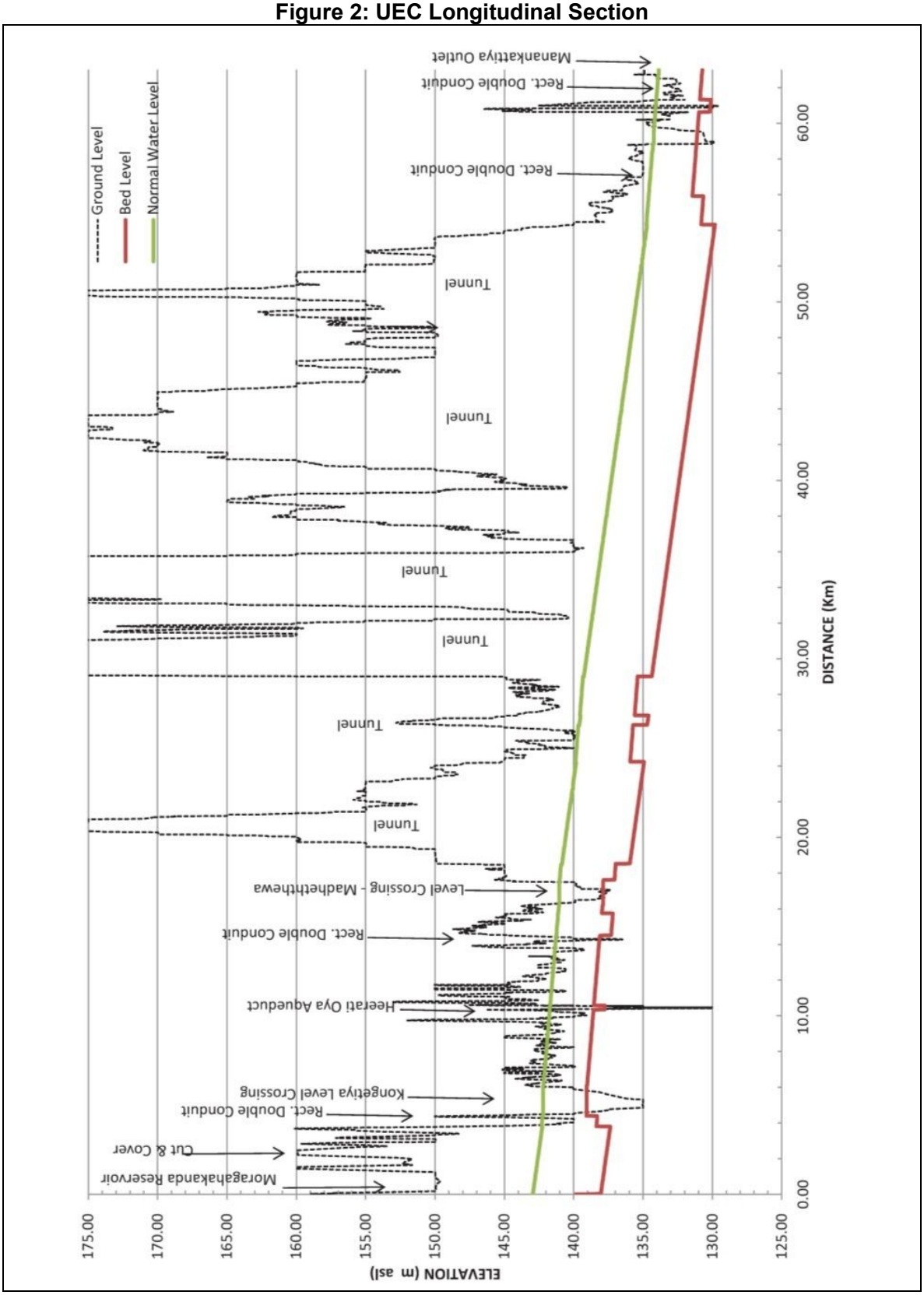


Figure 3: KMTC Geological Profile

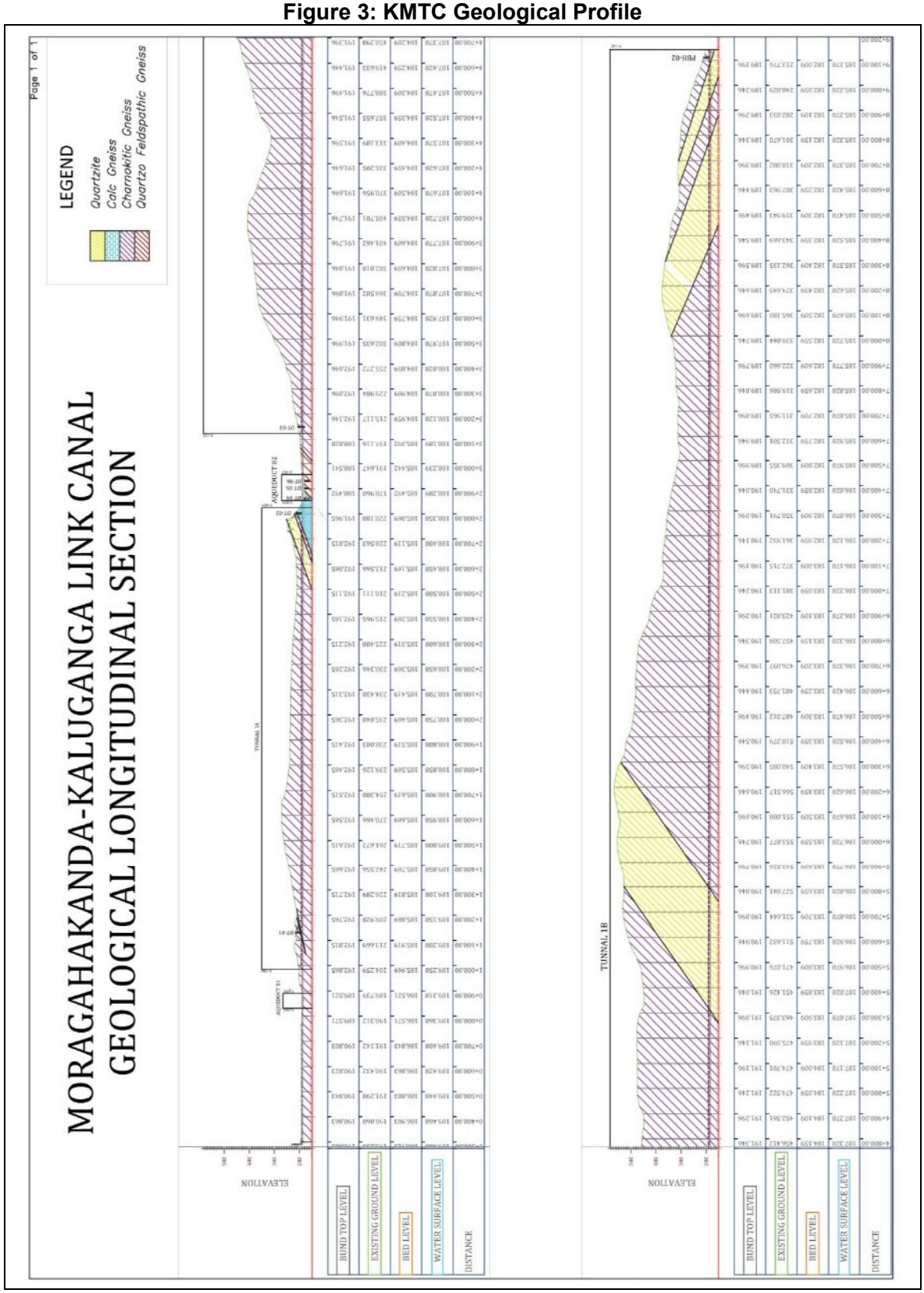


Figure 4: UEC Geological Profile

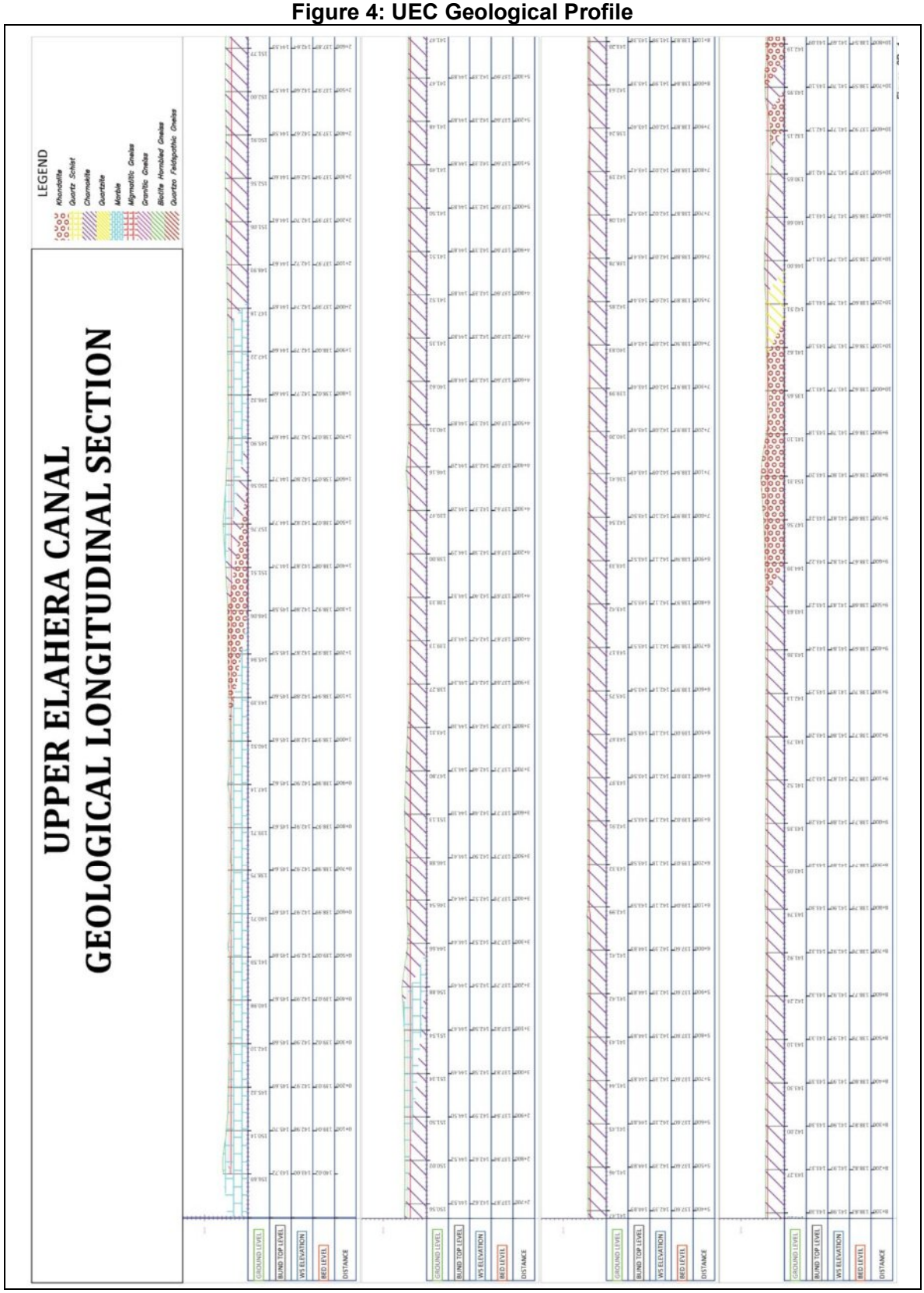
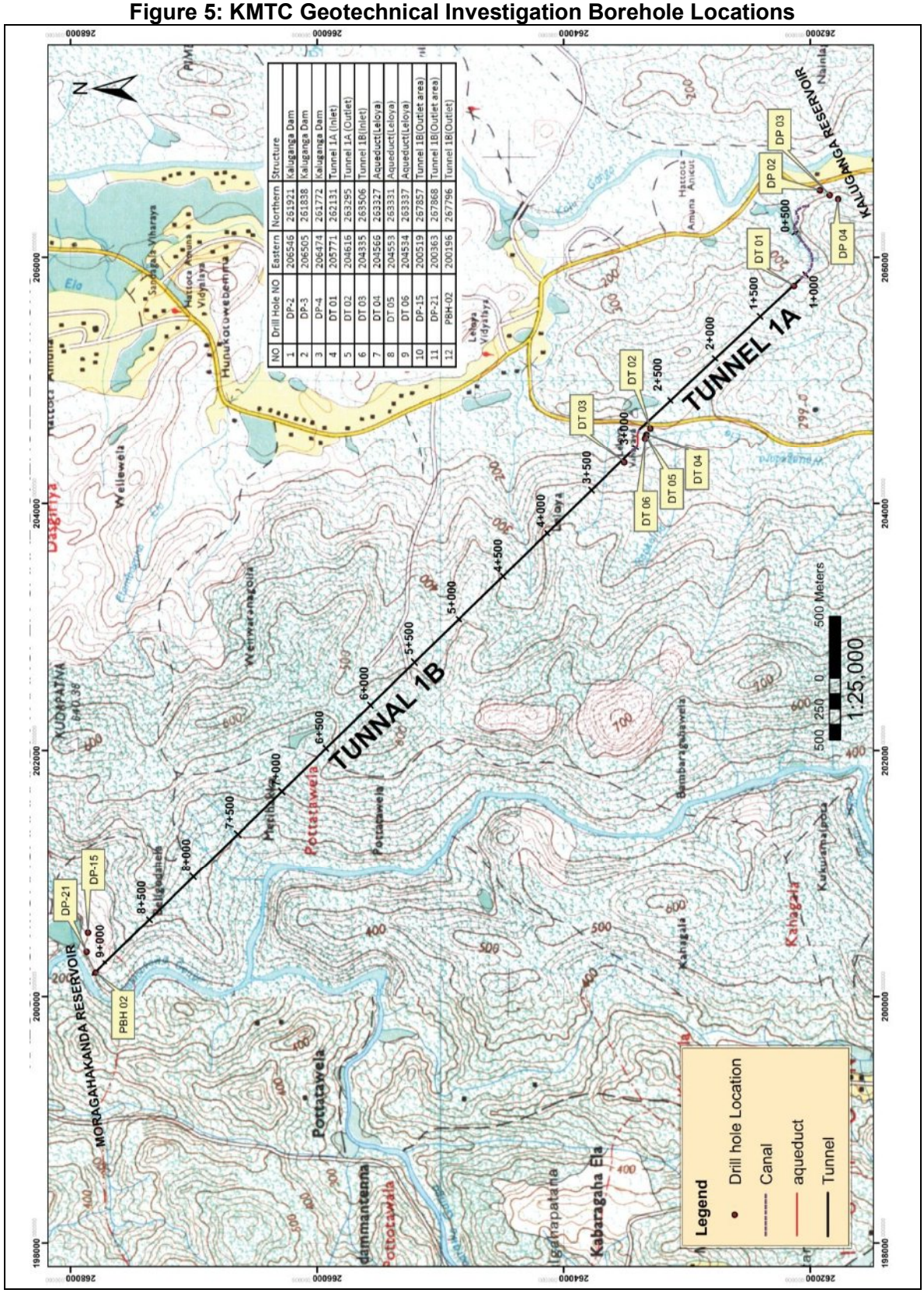
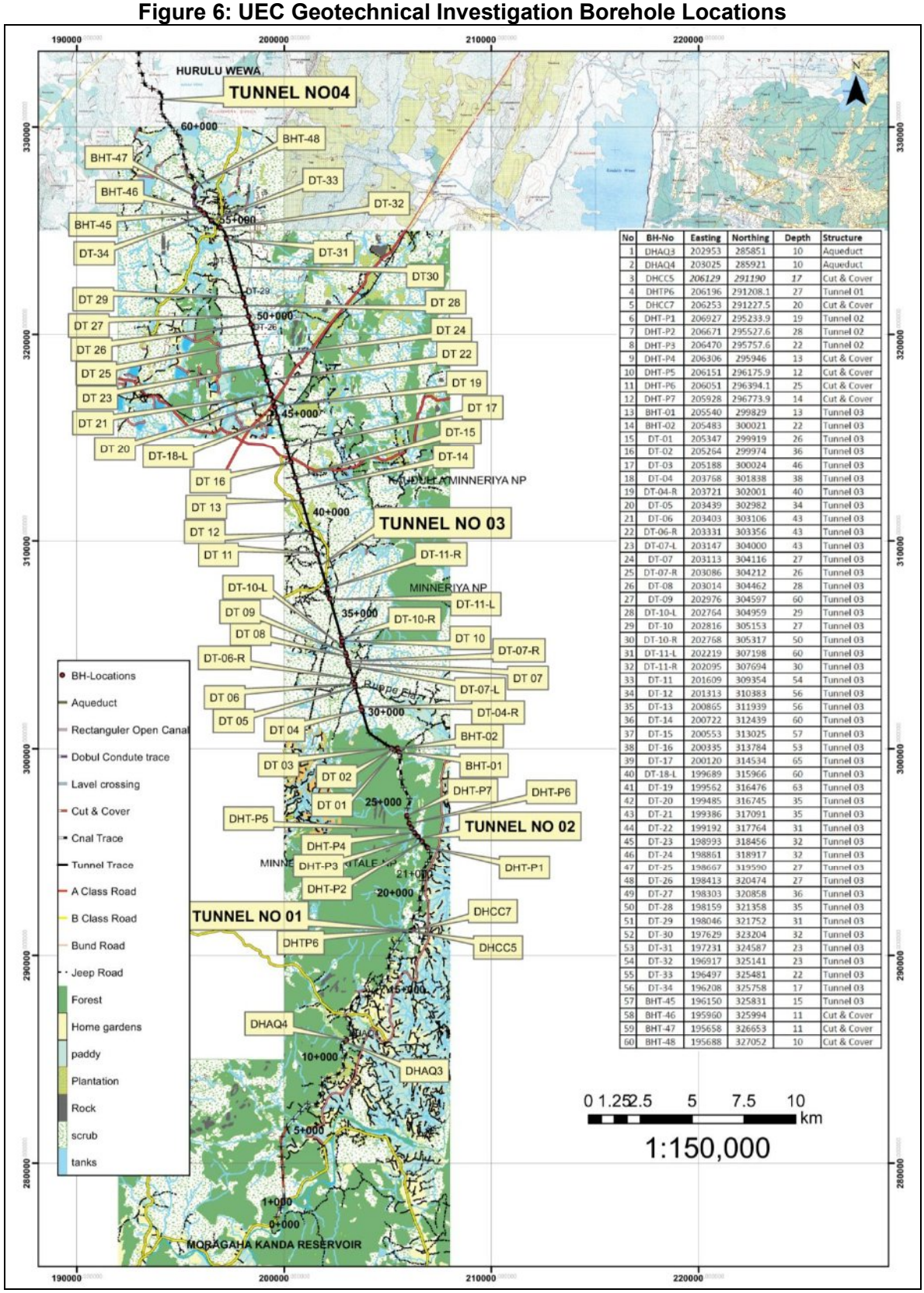


Figure 5: KMTC Geotechnical Investigation Borehole Locations



NO	Drill Hole NO	Eastern	Northern	Structure
1	DP-2	206546	261921	Kaluganga Dam
2	DP-3	206505	261838	Kaluganga Dam
3	DP-4	206474	261772	Kaluganga Dam
4	DT 01	205771	262131	Tunnel 1A (Inlet)
5	DT 02	204616	263295	Tunnel 1A (Outlet)
6	DT 03	204335	263506	Tunnel 1B(Inlet)
7	DT 04	204566	263327	Aqueduct(Leloya)
8	DT 05	204553	263331	Aqueduct(Leloya)
9	DT 06	204534	263337	Aqueduct(Leloya)
10	DP-15	200519	267857	Tunnel 1B(Outlet area)
11	DP-21	200363	267868	Tunnel 1B(Outlet area)
12	PBH-02	200196	267796	Tunnel 1B(Outlet)

Figure 6: UEC Geotechnical Investigation Borehole Locations



No	BH-No	Easting	Northing	Depth	Structure
1	DHAQ3	202953	285851	10	Aqueduct
2	DHAQ4	203025	285921	10	Aqueduct
3	DHCC5	206129	291190	17	Cut & Cover
4	DHTP6	206196	291208.1	27	Tunnel 01
5	DHCC7	206253	291227.5	20	Cut & Cover
6	DHT-P1	206927	295233.9	19	Tunnel 02
7	DHT-P2	206671	295527.6	28	Tunnel 02
8	DHT-P3	206470	295757.6	22	Tunnel 02
9	DHT-P4	206306	295946	13	Cut & Cover
10	DHT-P5	206151	296175.9	12	Cut & Cover
11	DHT-P6	206051	296394.1	25	Cut & Cover
12	DHT-P7	205928	296773.9	14	Cut & Cover
13	BHT-01	205540	299829	13	Tunnel 03
14	BHT-02	205483	300021	22	Tunnel 03
15	DT-01	205347	299919	26	Tunnel 03
16	DT-02	205264	299974	36	Tunnel 03
17	DT-03	205188	300024	46	Tunnel 03
18	DT-04	203768	301838	38	Tunnel 03
19	DT-04-R	203721	302001	40	Tunnel 03
20	DT-05	203439	302982	34	Tunnel 03
21	DT-06	203403	303106	43	Tunnel 03
22	DT-06-R	203331	303356	43	Tunnel 03
23	DT-07-L	203147	304000	43	Tunnel 03
24	DT-07	203113	304116	27	Tunnel 03
25	DT-07-R	203086	304212	26	Tunnel 03
26	DT-08	203014	304462	28	Tunnel 03
27	DT-09	202976	304597	60	Tunnel 03
28	DT-10-L	202764	304959	29	Tunnel 03
29	DT-10	202816	305153	27	Tunnel 03
30	DT-10-R	202768	305317	50	Tunnel 03
31	DT-11-L	202219	307198	60	Tunnel 03
32	DT-11-R	202095	307694	30	Tunnel 03
33	DT-11	201609	309354	54	Tunnel 03
34	DT-12	201313	310383	56	Tunnel 03
35	DT-13	200865	311939	56	Tunnel 03
36	DT-14	200722	312439	60	Tunnel 03
37	DT-15	200553	313025	57	Tunnel 03
38	DT-16	200335	313784	53	Tunnel 03
39	DT-17	200120	314534	65	Tunnel 03
40	DT-18-L	199689	315966	60	Tunnel 03
41	DT-19	199562	316476	63	Tunnel 03
42	DT-20	199485	316745	35	Tunnel 03
43	DT-21	199386	317091	35	Tunnel 03
44	DT-22	199192	317764	31	Tunnel 03
45	DT-23	198993	318456	32	Tunnel 03
46	DT-24	198861	318917	32	Tunnel 03
47	DT-25	198667	319590	27	Tunnel 03
48	DT-26	198413	320474	27	Tunnel 03
49	DT-27	198303	320858	36	Tunnel 03
50	DT-28	198159	321358	35	Tunnel 03
51	DT-29	198046	321752	31	Tunnel 03
52	DT-30	197629	323204	32	Tunnel 03
53	DT-31	197231	324587	23	Tunnel 03
54	DT-32	196917	325141	23	Tunnel 03
55	DT-33	196497	325481	22	Tunnel 03
56	DT-34	196208	325758	17	Tunnel 03
57	BHT-45	196150	325831	15	Tunnel 03
58	BHT-46	195960	325994	11	Cut & Cover
59	BHT-47	195658	326653	11	Cut & Cover
60	BHT-48	195688	327052	10	Cut & Cover

Figure 7: UEC Quarry Sites

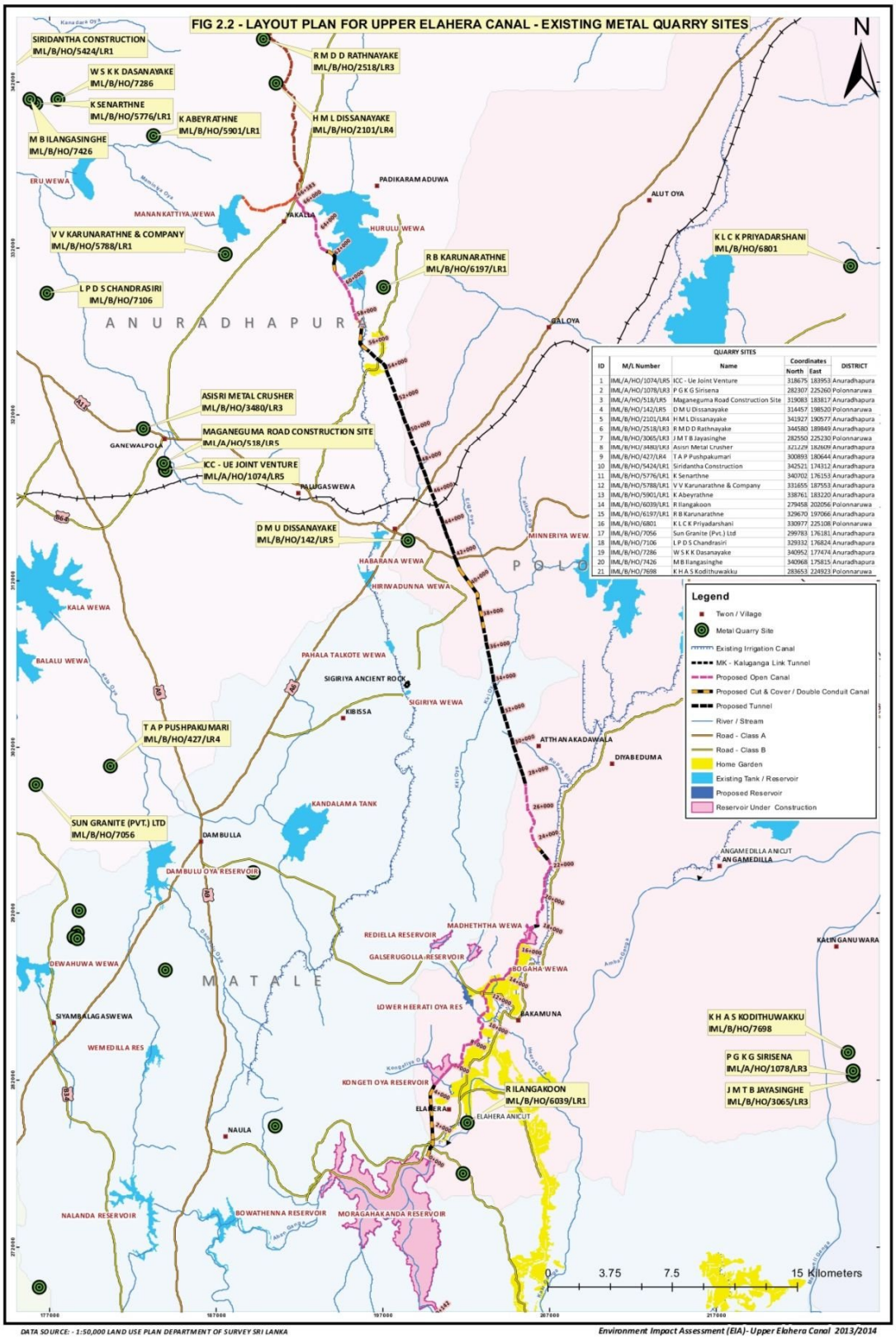


Figure 8: UEC- Waste Disposal Sites (Chainage 0+000 to 23+500 km)

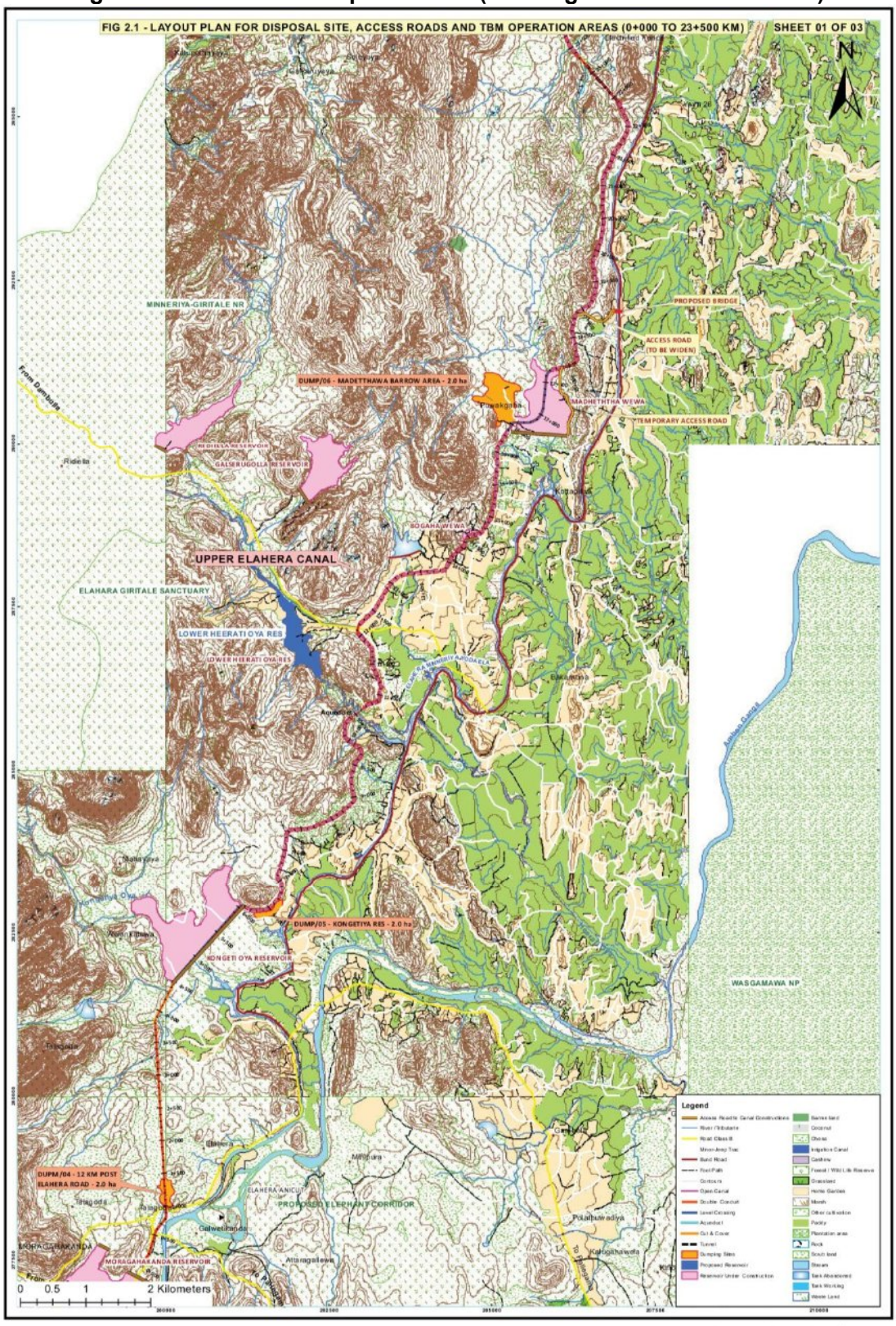


Figure 9: UEC- Waste Disposal Sites (Chainage 23+500 to 44+000 km)

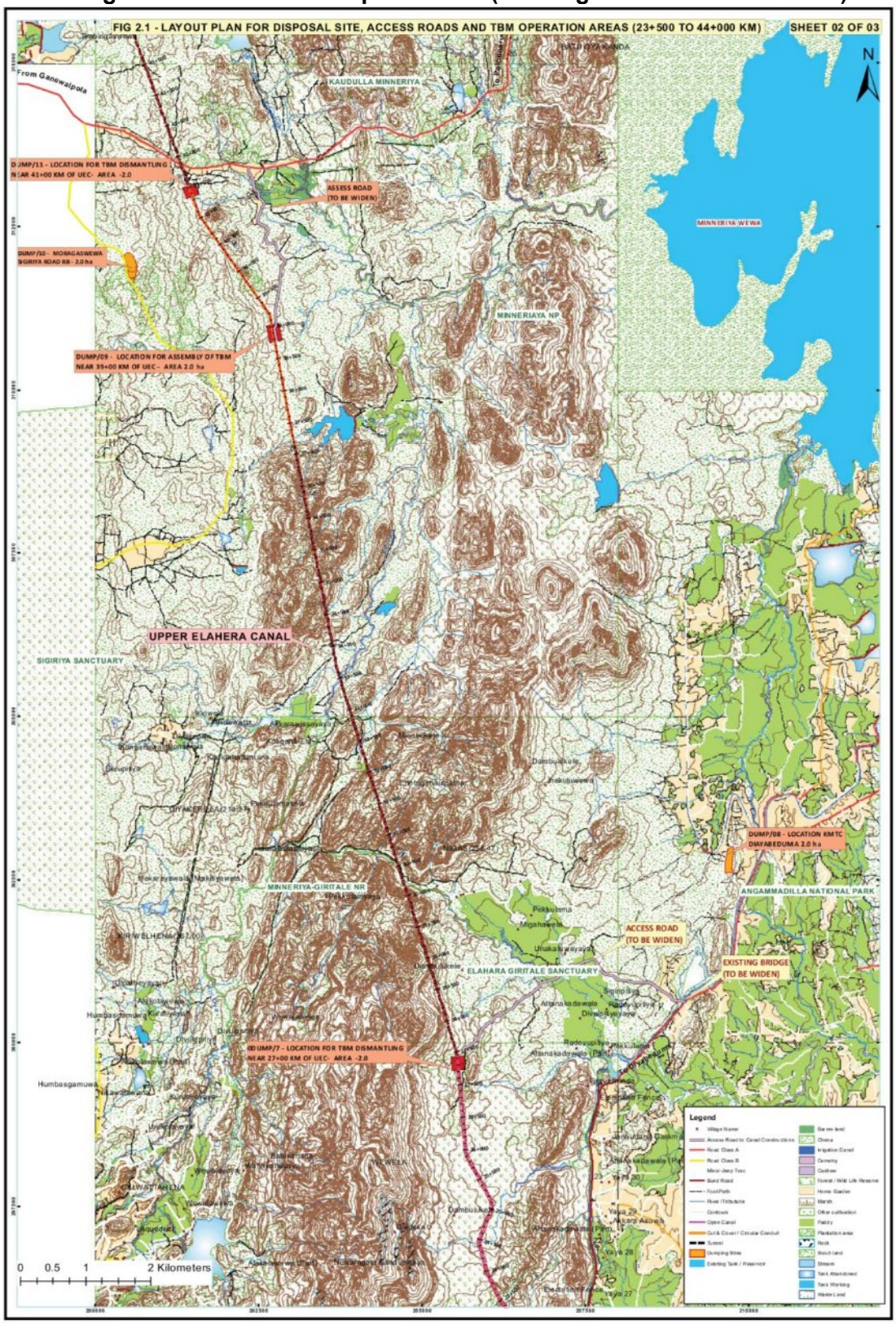
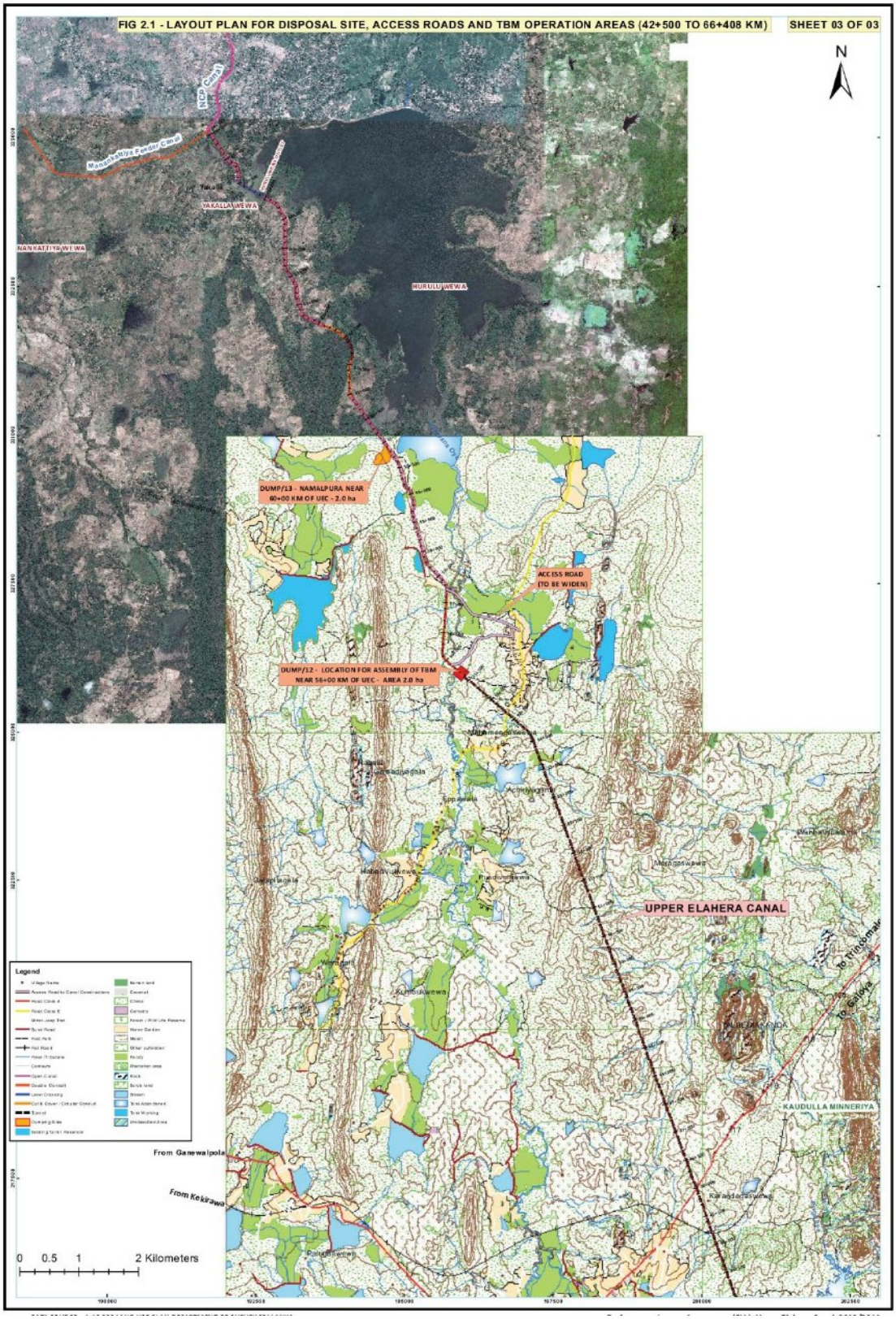


Figure10: UEC- Waste Disposal Sites (Chainage 42+500 to 66+400 km)



ANNEX 3: DESIGN CRITERIA

1. This annex presents a summary of the criteria adopted for the design

1. Canal Design

1. **Design Duties**. Canal capacities (design duty) as determined from the water balance study: 35 m^3/s for KMTC and 40 m^3/s for UEC.

2. **Radius of Horizontal Curve**. The centerline curvature radius of 50 m has been adopted.

3. **Berm on Canal Excavation**. Berm width of 2.0 m is maintained in deep cut open canal reaches for reducing transmission of canal bund loads and mitigating earth slides into the canal.

4. **Free Board**. A freeboard of 0.70m is allowed in concrete lined open canal reaches. The freeboard permitted in the aqueducts the freeboard was limited to permit 5% overloading.

5. **Bund Top Width**. Either banks of open canal reaches include embankments for the maintenance road, demarcating the canal slope boundary, and mitigate flow of rainfall runoff flows into the canal maintained on either bank of the open canal reaches. The minimum embankment top width of 5 m is allowed for the maintenance road and 3.0 m on the opposite side. The minimum height of the embankment is 0.70 m.

6. **Canal Gradient**. The canal bed gradient was determined from the maximum available head between the downstream sluice water level and delivery point.

7. **Cross Section**. The canal cross sectional dimensions were determined adopting the above criteria and the Manning's formula,

$$v = \frac{Q}{A} = \frac{1}{n} R^{⅔} S^{½}$$

Where:

V - flow velocity (m/s)
Q - discharge (m^3/s)
A - cross sectional area of water flow (m^2)
P - wetted perimeter (m)
n - coefficient of roughness (Manning's 'n')
R - hydraulic radius (m) = A / P
S - slope of energy line = canal slope (for normal flow)

8. **Coefficient of Roughness**. **Table 2-1** lists the coefficients of roughness adopted for the canal sections.

Table 2-1: Coefficients of Roughness

Type of Canals	Manning's "n" value
Open lined canal, Conduit, Aqueduct	0.015 / 0.016
Circular Tunnel (lined with concrete segments) with 3 m width flat base at bottom by mechanized method (TBM)	0.016
Circular Tunnel (unlined section with shotcrete &rock bolt) with 3 m width flat base at bottom by mechanized method (TBM)	0.018
Circular Tunnel (with shotcrete & rock bolt) with 3 m width flat base at bottom by conventional method (Controlled blasting)	0.018

9. **Side Slopes**. The side slopes for open canals of:

- Trapezoidal Lined canal in soil: 1:2 (vertical: horizontal)
- Canal in rock: 1:2 considering the safety and continuity.
- Aqueduct: Rectangular concrete section.

10. **Energy Loss**. The energy loss is calculated as:

Friction Loss along the Canal, $h_f = s\ L$

Where:

s –slope of energy line (Mostly Canal Bed Gradient)

L – length of the Canal

11. **Energy Loss in Transitions (Gradual Variation)**. The transition design incorporates adequate length and appropriate shape to permit the smooth transition of discharge between the two sections. The geometric profiles of the transitions depend on the discharge and the location and the types generally adopted are, straight line, broken back and streamlined warp.

12. Neglecting the transition friction loss, which is usually small the energy losses for straight line transitions with flare angle "α" convergence/ divergence the energy losses are computed adopting the following formulae.

Energy loss in the contraction, $H_{Lc} = C_c\, \Delta h_v$

Energy loss in the expansion, $H_{Le} = C_e\, \Delta h_v$

Where:

Cc - contraction loss coefficient = 0.3

Ce - expansion loss coefficient = 0.5

Δhv - difference in velocity head (m)

Flare Angle in transitions has been determined by $\tan\alpha = \frac{1}{3F_r}$

Where:

α - angular variation of the sidewall with respect to the channel centerline

F_r - Froude number at the start of the transition

13. Usually the angle of flare in a transition is 22.5° [1:2.5 (lateral : longitudinal) or smaller].

14. At the level crossings, adopted total energy loss of 0.15 m at exit location to account for head losses in the inlet & outlet structures.

15. Head loss at the inlet to conduits calculated as:

$$h_{e1} = f_{e1}\, h_v$$

Where:

he1 - Head Loss at entry / inlet (m)

fe1 - Coefficient of entry Loss

hv - Velocity Head in the conduit (m)

fe1 = 0.5(maximum for perpendicular opening)

16. Head Loss at the exit from conduits calculated from:

$$h_{e2} = f_{e2}\, h_v$$

Where:

he2 - Head Loss at exit / outlet (m)

fe2 - Coefficient of exit Loss

hv - Velocity Head in the conduit (m)

fe2 = 1.0 (for sudden expansion)

17. Head loss in conduits with full flow calculated from the Manning-Stickler equation.

a. Circular Conduits

$$h_f = \frac{124.5n^2}{D^{1/3}} \frac{L}{D} \frac{V^2}{2g}$$

b. Rectangular Conduits

$$h_f = \frac{2gn^2}{R^{1/3}} \frac{L}{R} \frac{V^2}{2g}$$

Where:

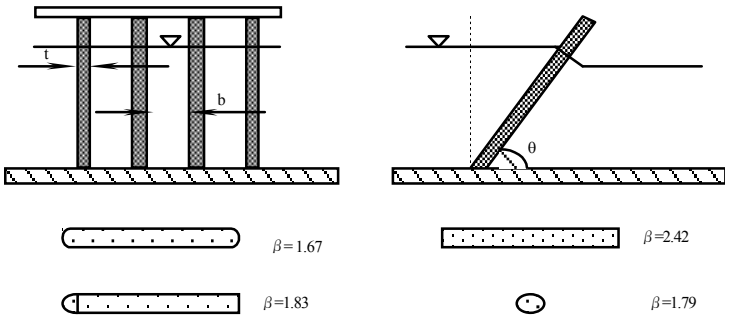
- n - Manning's Roughness Coefficient
- D - Diameter of the Circular Conduit (m)
- L - Length of Conduit (m)
- V - Mean Velocity (m/s)
- g - Acceleration of gravity (m/s/s)
- R - Hydraulic Radius (m)

18. Head Loss in trash-racks calculated from:

$$h_{tr} = \beta \frac{V^2}{2g} \left(\frac{t}{b}\right)^{4/3} \sin\theta$$

Where

- h_{tr} - Head loss at trash-rack (m)
- V - Approach velocity ahead of the rack(m/s)
- β - coefficient to be determined according to shape of element bars
- t - Thickness of bars (m)
- b - Clear space between bars (m)
- θ - Angle with floor (degree)



19. Flow in over weirs calculated as:

(a) Sharp Crested Weirs

$$Q = \frac{2}{3} C_d \sqrt{2g}\, L H_1^{3/2}$$

$$C_d = 0.611 + 0.08 \frac{H_1}{P}$$

Where:

Q - Flow Discharge over the Weir (m3/s)

L - Length of the weir (m)

H1 - Flow afflux over weir (m)

Cd - Discharge Coefficient

P - Height of Weir from U/S Bed (m)

Note: This Formulae is valid if the value of H1/P is < 5

(b) Labyrinth Weirs as:

$$Q = C\ L\ h^{1.5}$$

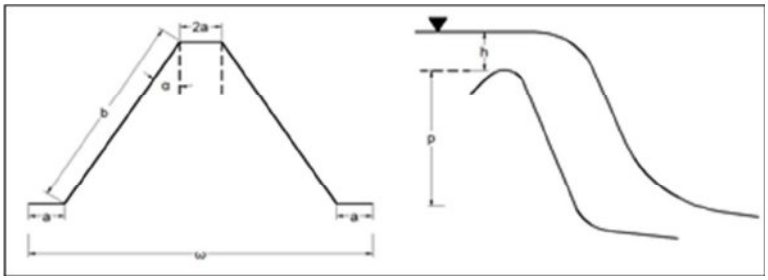
Where:

Q - Outflow in m^3/s

L - Length of the spill in m

h - Design afflux in m

For concrete weirs C= 1.9 accounts for reduction in effective length of the weir.



w = 2b Sin a + 4a = width of one cycle

l = 2b + 4a = Developed crest length

20. **Flood Estimation**. For the sub catchments along the LB of UEC from the flood runoff for small catchments [Rational Formulae]:

$$Q = C\ I\ A$$

Where:

Q = Catchment flood run-off

C = Runoff coefficient

I = Rainfall Intensity (as below)

A = Catchment Area

Run-off Coefficients

Catchment Slope	Run Off Coefficient C
0% to < 2%	0.3
2% to < 4%	0.4
4% and Steeper	0.5

21. **The Intensity of Rainfall** - I25. Calculated as:

$$I_{25} = X\,(T+t)^{-Y}$$

Where:

I_{25} - RF Intensity (mm/hr) for Flood of 25yr Return Period

T - Rain Fall Duration (minutes) = Time of Concentration in this case

	Y	
	0.93239	15 < T < 4320
	1.10502	15 < T < 1440

Time of Concentration -T_c-

$T_c = \left(\frac{11.9L^3}{H}\right)^{0.385}$
Where,
T_c - Time of Concentration in hrs
L - Length of longest Water Course in miles
H - Elevation Difference in ft

22. **Canal Reservation**. The strip of land reserved for construction and maintenance of open canal varies with the size. The reservation identified for different canal reaches as 40 meters for both trapezoidal open canal and cut and cover canal.

23. **Safe Escapes for Wildlife.** Safe escapes for wild life were provided at regular selected locations in the wild life reserves to facilitate access from the canal to the outside in the event an animal accidently falls into the canal. The existing canal side slope of 1:2 is amended on one side to 1:3 and incorporated steps (thread 1.5m and rise 0.5m) and on the opposite side the slope was maintained at 1:2 to deter animals from crossing over. This arrangement is adopted in the buffer zones of the wildlife reserves. The canal reaches within the wildlife reserves adopt side slope of 1:3 with steps on both banks.

24. **Self-Priming Siphon Spills**. Self-priming siphons are incorporated in the canal at the interceptions of small streams for independent conveyance of catchment flood

discharges (up to a return period of 50 years) across the canal. The structure incorporate (a) a small pool of water on the upstream outside canal for wild life, (b), an inverted siphon with adequate capacity to discharge the flood flows from the watershed, (c) an undercrossing across the canal, and (d) flank embankments to high ground as precaution against catchment flows into the canal.

25. **Pressure Relief Valves.** The canal lining is protected from external hydrostatic pressures by weep holes above full supply water level and none return rubber valves below full supply level.

ANNEX 4: DESIGN PARAMETERS

1. This annex presents a summary of the system parameters for the KMTC and UEC project.

1. Kalu Ganga – Moragahakanda Trans-Basin Canal

2. KMTC Canal components and the corresponding locations and design elevations are summarized below.

Table 4-1: KMTC Sections and Structures

Station (km)	Length (km)	Type of Structure / Canal Section	Water Level (masl)	Bed Level (masl)
0.2915		Start of transfer canal	189.490	186.925
0.7650	0.4735	Trapezoidal open Canal	189.395	186.830
0.7750	0.0100	Transition (Trap. Canal to Bench flume)	189.381	186.584
0.8320	0.0570	Bench flume	189.352	186.555
0.8900	0.0580	Aqueduct	189.323	186.526
0.9000	0.0100	Bench flume	189.318	186.521
0.9830	0.0830	Double Conduit	189.277	186.480
0.9860	0.0030	Transition (Double Conduit to Circular Tunnel)	189.265	185.976
2.8260	1.8400	Circular tunnel (by Controlled Blasting)	188.345	185.056
2.8290	0.0030	Transition (Circular Tunnel to Double Conduit)	188.325	185.528
2.8450	0.0160	Double Conduit	188.317	185.520
2.8540	0.0090	Bench flume	188.312	185.515
2.9570	0.1030	Aqueduct - LelOya	188.261	185.464
2.9700	0.0130	Bench flume	188.254	185.457
3.1220	0.1520	Double Conduit	188.178	185.381
3.1250	0.0030	Transition (Double Conduit to Circular Tunnel)	188.166	184.997
9.1420	6.0170	Circular tunnel (by TBM)	185.157	181.988
9.1620	0.0200	Transition (Circular Tunnel-Moragahakanda reservoir)	184.992	181.823

3. KMTC Section Parameters for the designed discharge of 35m^3/s

Table 4-2: KMTC Parameters

Section Type	Bed Slope	'n' value	Bed width Diameter (m)	FSD (m)	V (m/s)	LFB (m)	Free Space (m)
1. Canal (Trapezoidal)	0.0002	0.016	6.0	2.57	1.23	0.70	
2. Blasted Tunnel (Unlined with Shotcrete& rock bolt)	0.0005	0.018	7.0	3.29	1.80		3.37
3. TBM Excavated Tunnel (Lined with concrete Segment)	0.0005	0.016	7.0	3.06	1.97		3.61
4. TBM Excavated Tunnel (Unlined with Shotcrete& rock bolt)	0.0005	0.018	7.5	3.17	1.80		4.02

Section Type	Bed Slope	'n' value	Bed width Diameter (m)	FSD (m)	V (m/s)	LFB (m)	Free Space (m)
5. Double Rect. Conduit	0.0005	0.016	2/4.0	2.80	1.56		0.70
6. Aqueduct/Bench Flume	0.0005	0.016	2/4.0	2.80	1.56	0.20	

4. Upper Elahera Canal components and the corresponding locations and design elevations are summarized below.

Table 4-3: UEC Parameters

Station (km)	Length (km)	Type of Structure / Canal Section	Water Level (masl)	Bed Level (masl)
0.0000			143.0000	139.920
0.1780	0.1780	Rectangular Open Canal From MK Reservoir Outlet	142.9822	139.902
0.1826	0.0046	Bulk Head Gated Control with U/S Trash Rack	142.8822	139.802
0.6000	0.4174	Rectangular Open Canal From MK Reservoir Outlet	142.8405	139.760
0.6020	0.0020	Transition with Trash Rack (Rect Canal - Double Conduit)	142.8204	139.150
1.4200	0.8180	Rect. Double Conduit	142.7222	139.052
1.4260	0.0060	Transition(Double Conduit - Circular Conduit)	142.7088	137.959
3.8300	2.4040	Circular Conduit: Cut & Cover	142.3242	137.574
3.8350	0.0050	Transition(Circular Conduit - Level Crossing)	142.3242	137.574
6.2100	2.3750	Kongetiya Level Crossing	142.3242	137.574
6.2260	0.0160	Transition with Bulk Head Gates (Level Crossing - Trap Canal)	142.1742	139.024
6.5090	0.2830	Trapezoidal Canal (Type 2)	142.1459	138.996
6.5190	0.0100	Wild Animal's Escape - LB	142.1415	138.992
6.8590	0.3400	Trapezoidal Canal (Type 2)	142.1075	138.958
6.8690	0.0100	Wild Animal's Escape - LB	142.1031	138.953
7.1290	0.2600	Trapezoidal Canal (Type 2)	142.0771	138.927
7.1390	0.0100	Wild Animal's Escape - LB	142.0727	138.923
7.5690	0.4300	Trapezoidal Canal (Type 2)	142.0297	138.880
7.5790	0.0100	Wild Animal's Escape - LB	142.0253	138.875
7.9090	0.3300	Trapezoidal Canal (Type 2)	141.9923	138.842
7.9190	0.0100	Wild Animal's Escape - LB	141.9879	138.838
8.4690	0.5500	Trapezoidal Canal (Type 2)	141.9329	138.783
8.4790	0.0100	Wild Animal's Escape - LB	141.9285	138.779
8.9290	0.4500	Trapezoidal Canal (Type 2)	141.8835	138.734
8.9390	0.0100	Wild Animal's Escape - LB	141.8791	138.729
9.4090	0.4700	Trapezoidal Canal (Type 2)	141.8321	138.682
9.4190	0.0100	Wild Animal's Escape - LB	141.8278	138.678
9.7290	0.3100	Trapezoidal Canal (Type 2)	141.7968	138.647
9.7390	0.0100	Wild Animal's Escape - LB	141.7924	138.642
10.2490	0.5100	Trapezoidal Canal (Type 2)	141.7414	138.591
10.2590	0.0100	Wild Animal's Escape - LB	141.7370	138.587

Station (km)	Length (km)	Type of Structure / Canal Section	Water Level (masl)	Bed Level (masl)
10.5330	0.2740	Trapezoidal Canal (Type 2)	141.7096	138.560
10.5420	0.0090	*Transition(Trap Canal -Aqueduct)*	141.7065	137.917
10.7820	0.2400	*Aqueduct - Heerati Oya*	141.6801	137.890
10.7910	0.0090	*Transition(Aqueduct - Trap Canal)*	141.6783	138.528
11.0690	0.2780	Trapezoidal Canal (Type 1)	141.6505	138.500
11.0790	0.0100	Wild Animal's Escape - LB	141.6461	138.496
11.4890	0.4100	Trapezoidal Canal (Type 1)	141.6051	138.455
11.4990	0.0100	Wild Animal's Escape - LB	141.6007	138.451
11.7890	0.2900	Trapezoidal Canal (Type 1)	141.5717	138.422
11.7990	0.0100	Wild Animal's Escape - LB	141.5673	138.417
12.0290	0.2300	Trapezoidal Canal (Type 1)	141.5443	138.394
12.0380	0.0090	*Transition(Trap Canal -Rect Canal)*	141.5427	138.463
12.3290	0.2910	Rect. Open Canal {across Dambulla-Bakamuna Rd}	141.5136	138.434
12.3380	0.0090	*Transition(Rect Canal - Trap Canal)*	141.5109	138.361
14.5260	2.1880	Trapezoidal Canal (Type 3)	141.2921	138.142
14.5420	0.0160	Transition(Trap Canal - Level Crossing)	141.2921	138.142
14.8000	0.2580	Level Crossing - Bogahawewa (Tank Exists)	141.2921	138.142
14.8160	0.0160	*Transition(Level Crossing - Trap Canal)*	141.1421	137.992
15.2090	0.3930	Trapezoidal Canal (Type 1)	141.1028	137.953
15.2190	0.0100	Wild Animal's Escape - LB	141.0984	137.948
15.6290	0.4100	Trapezoidal Canal (Type 1)	141.0574	137.907
15.6390	0.0100	Wild Animal's Escape - LB	141.0530	137.903
16.0290	0.3900	Trapezoidal Canal (Type 1)	141.0140	137.864
16.0390	0.0100	Wild Animal's Escape - LB	141.0096	137.860
16.4830	0.4440	Trapezoidal Canal (Type 1)	140.9652	137.815
16.4990	0.0160	Transition(Trap Canal - Level Crossing)	140.9652	137.815
17.8340	1.3350	Level Crossing - Madheththewa	140.9652	137.815
17.8390	0.0050	*Transition(Level Crossing - Cut & Cover)*	140.8152	136.135
17.9190	0.0800	Cut & Cover (Horse-Shoe shape)	140.7992	136.119
17.9890	0.0700	Drill & Blast Tunnel	140.7852	136.105
18.0290	0.0400	Cut & Cover (Horse-Shoe shape)	140.7772	136.097
18.0450	0.0160	Transition(Cut & Cover - Trap Canal)	140.7521	137.602
18.4690	0.4240	Trapezoidal Canal (Type 1)	140.7097	137.560
18.4790	0.0100	Wild Animal's Escape - LB	140.7053	137.555
18.8090	0.3300	Trapezoidal Canal (Type 1)	140.6723	137.522
18.8190	0.0100	Wild Animal's Escape - RB	140.6680	137.518
19.3490	0.5300	Trapezoidal Canal (Type 1)	140.6150	137.465
19.3590	0.0100	Wild Animal's Escape - LB	140.6106	137.461
19.8090	0.4500	Trapezoidal Canal (Type 1)	140.5656	137.416
19.8190	0.0100	Wild Animal's Escape - RB	140.5612	137.411
20.1890	0.3700	Trapezoidal Canal (Type 1)	140.5242	137.374
20.1990	0.0100	Wild Animal's Escape - LB	140.5198	137.370

Station (km)	Length (km)	Type of Structure / Canal Section	Water Level (masl)	Bed Level (masl)
20.5090	0.3100	Trapezoidal Canal (Type 1)	140.4888	137.339
20.5190	0.0100	Wild Animal's Escape - RB	140.4844	137.334
20.9690	0.4500	Trapezoidal Canal (Type 1)	140.4394	137.289
20.9790	0.0100	Wild Animal's Escape - LB	140.4350	137.285
21.4690	0.4900	Trapezoidal Canal (Type 1)	140.3860	137.236
21.4790	0.0100	Wild Animal's Escape - RB	140.3816	137.232
22.0090	0.5300	Trapezoidal Canal (Type 1)	140.3286	137.179
22.0190	0.0100	Wild Animal's Escape - LB	140.3242	137.174
22.4130	0.3940	Trapezoidal Canal (Type 1)	140.2848	137.135
22.4290	0.0160	Transition(Trap Canal - Cut & Cover)	140.2266	135.547
22.4790	0.0500	Cut & Cover (Horse-Shoe shape)	140.2166	135.537
23.1690	0.6900	Drill & Blast Tunnel	140.0786	135.399
23.2690	0.1000	Cut & Cover (Horse-Shoe shape)	140.0586	135.379
23.2850	0.0160	Transition(Cut & Cover - Trap Canal)	140.0335	136.884
23.7090	0.4240	Trapezoidal Canal (Type 1)	139.9911	136.841
23.7190	0.0100	Wild Animal's Escape - LB	139.9867	136.837
24.4290	0.7100	Trapezoidal Canal (Type 1)	139.9157	136.766
24.4390	0.0100	Wild Animal's Escape - RB	139.9113	136.761
24.8290	0.3900	Trapezoidal Canal (Type 1)	139.8723	136.722
24.8390	0.0100	Wild Animal's Escape - LB	139.8679	136.718
25.2090	0.3700	Trapezoidal Canal (Type 1)	139.8309	136.681
25.2190	0.0100	Wild Animal's Escape - RB	139.8265	136.677
25.5990	0.3800	Trapezoidal Canal (Type 1)	139.7885	136.639
25.6090	0.0100	Wild Animal's Escape - LB	139.7842	136.634
25.9890	0.3800	Trapezoidal Canal (Type 1)	139.7462	136.596
25.9990	0.0100	Wild Animal's Escape - RB	139.7418	136.592
26.4490	0.4500	Trapezoidal Canal (Type 1)	139.6968	136.547
26.4590	0.0100	Wild Animal's Escape - LB	139.6924	136.542
26.9290	0.4700	Trapezoidal Canal (Type 1)	139.6454	136.495
26.9390	0.0100	Wild Animal's Escape - RB	139.6410	136.491
27.2940	0.3550	Trapezoidal Canal (Type 1)	139.6055	136.455
27.3090	0.0150	Transition(Trap Canal - Circular Conduit)	139.5498	134.800
27.7090	0.4000	Circular Conduit: Cut & Cover	139.4858	134.736
53.7490	26.0400	Circular Tunnel (TBM)	134.7986	130.029
55.7090	1.9600	Circular Conduit: Cut & Cover	134.4850	129.735
55.7150	0.0060	Transition(Circular Conduit - Rect. Double Conduit)	134.4627	130.793
57.0290	1.3140	Rect. Double Conduit	134.3050	130.635
57.0380	0.0090	Transition(Rect. Double Conduit - Trap Canal)	134.3041	131.154
57.9890	0.9510	Trapezoidal Canal (Type 1)	134.2090	131.059
57.9990	0.0100	Wild Animal's Escape - LB	134.2046	131.055
58.3890	0.3900	Trapezoidal Canal (Type 1)	134.1656	131.016
58.3990	0.0100	Wild Animal's Escape - RB	134.1612	131.011

Station (km)	Length (km)	Type of Structure / Canal Section	Water Level (masl)	Bed Level (masl)
58.8890	0.4900	Trapezoidal Canal (Type 1)	134.1122	130.962
58.8990	0.0100	Wild Animal's Escape - LB	134.1078	130.958
59.4290	0.5300	Trapezoidal Canal (Type 1)	134.0548	130.905
59.4390	0.0100	Wild Animal's Escape - RB	134.0504	130.900
59.7490	0.3100	Trapezoidal Canal (Type 1)	134.0194	130.869
59.7590	0.0100	Wild Animal's Escape - LB	134.0150	130.865
60.1390	0.3800	Trapezoidal Canal (Type 1)	133.9770	130.827
60.1490	0.0100	Wild Animal's Escape - LB	133.9726	130.823
60.1500	0.0010	Trapezoidal Canal (Type 1)	133.9725	130.823
60.3300	0.1800	Trapezoidal Canal (Type 5)	133.9545	130.805
60.3390	0.0090	Transition(Trap Canal - Rect. Double Conduit)	133.9530	130.803
60.3500	0.0110	Rect. Double Conduit	133.9516	130.282
60.3532	0.0031	Inlet to Siphon	133.9516	129.953
60.3635	0.0104	Slope Down	129.6038	125.775
60.4365	0.0730	Inverted Siphon	129.3061	125.756
60.4468	0.0103	Slope Up	133.7316	129.903
60.4500	0.0032	Outlet from Siphon	133.9016	130.232
60.4600	0.0100	Rect. Double Conduit	133.9004	130.230
60.4690	0.0090	Transition(Rect. Double Conduit - Trap Canal)	133.8995	130.750
65.4400	4.9710	Trapezoidal Canal (Type 5)	133.4024	130.252
65.4510	0.0110	*Transition(Trap Canal - Rect. Open Canal)*	133.4021	130.252
65.4850	0.0340	Rect. Open Canal {BW = 12.3m}	133.3991	130.249
65.4918	0.0068	Bulk Head Gated End Regulator with 150mm Drop	133.2491	130.099
65.5000	0.0082	Rect. Open Canal {BW = 12.3m}	133.2483	130.098

5. UEC Section Parameters for the designed discharge of 40 m^3/s

Table 4-4: UEC Sections

Section Type	Bed Slope	'n' value	Bed width Diameter (m)	FSD (m)	V (m/s)	LFB (m)	Free Space (m)
Trapezoidal Open Canal	0.00010	0.015	6.0	3.15	1.03	0.70	
Rect. Open Canal	0.00011	0.015	12.0	2.98	1.12	0.42	
Rect. Double Conduit	0.00010	0.015	2/5.475	3.94	0.93		1.51
Circular Conduit	0.00016	0.015	7.0	4.75	1.37		1.91
Aqueduct	0.00011	0.015	2/5.475	3.79	0.97	0.31	
TBM Excavated Tunnel (Lined with concrete Segment)	0.00018	0.016	7.0	4.77	1.36		1.89
TBM Excavated Tunnel (Unlined with Shotcrete & rock bolt)	0.00018	0.018	7.5	4.87	1.25		2.32
Blasted Tunnel (Unlined with Shotcrete & rock bolt)	0.00023	0.018	7.0	4.75	1.37		1.91

ANNEX 5: TYPICAL DESIGNS

1. The following figures present a range of typical designs of the KMTC and UEC.

Figure 5-1: UEC Power house and head regulator

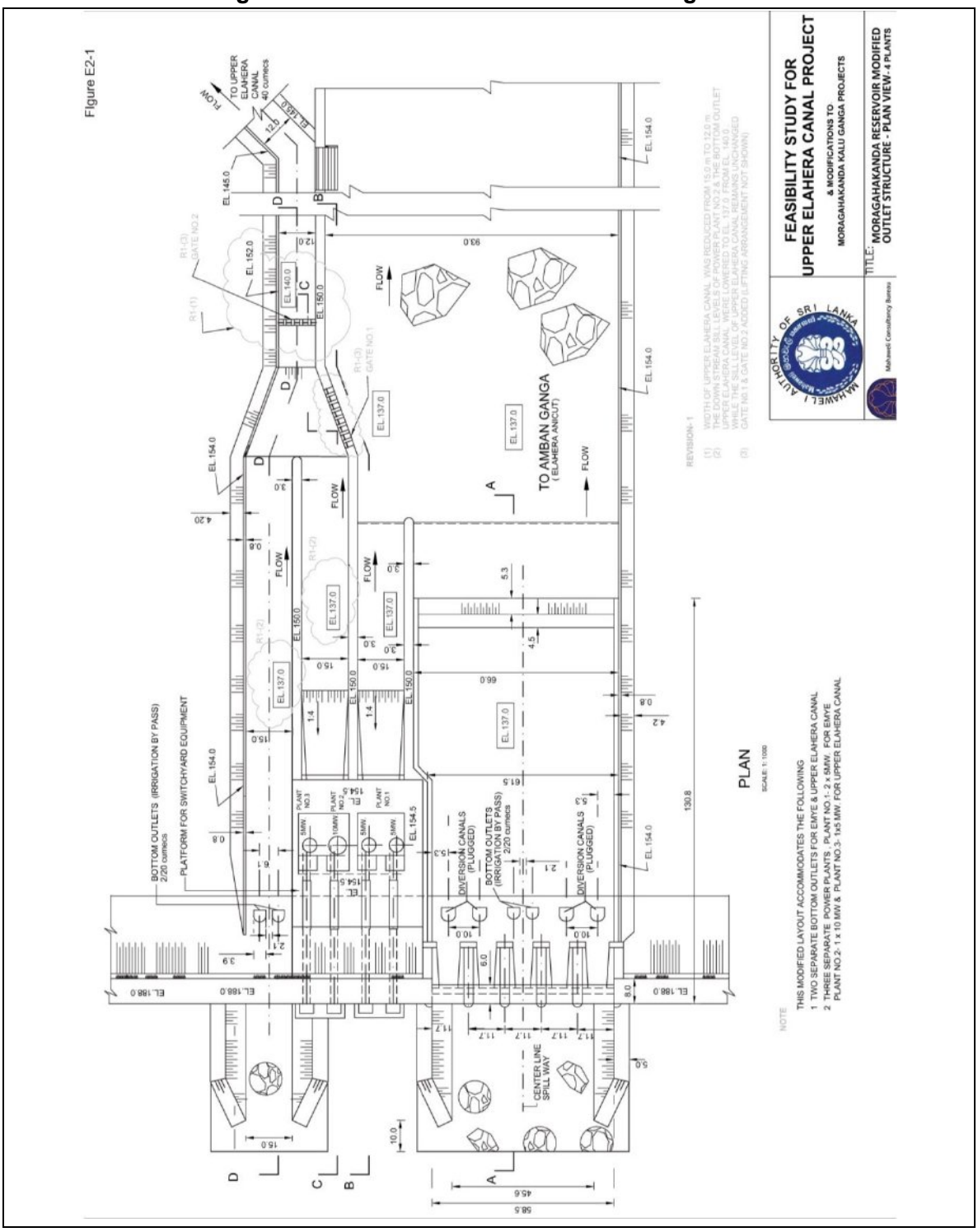


Figure 5-2: Typical Canal Sections – Tunnel

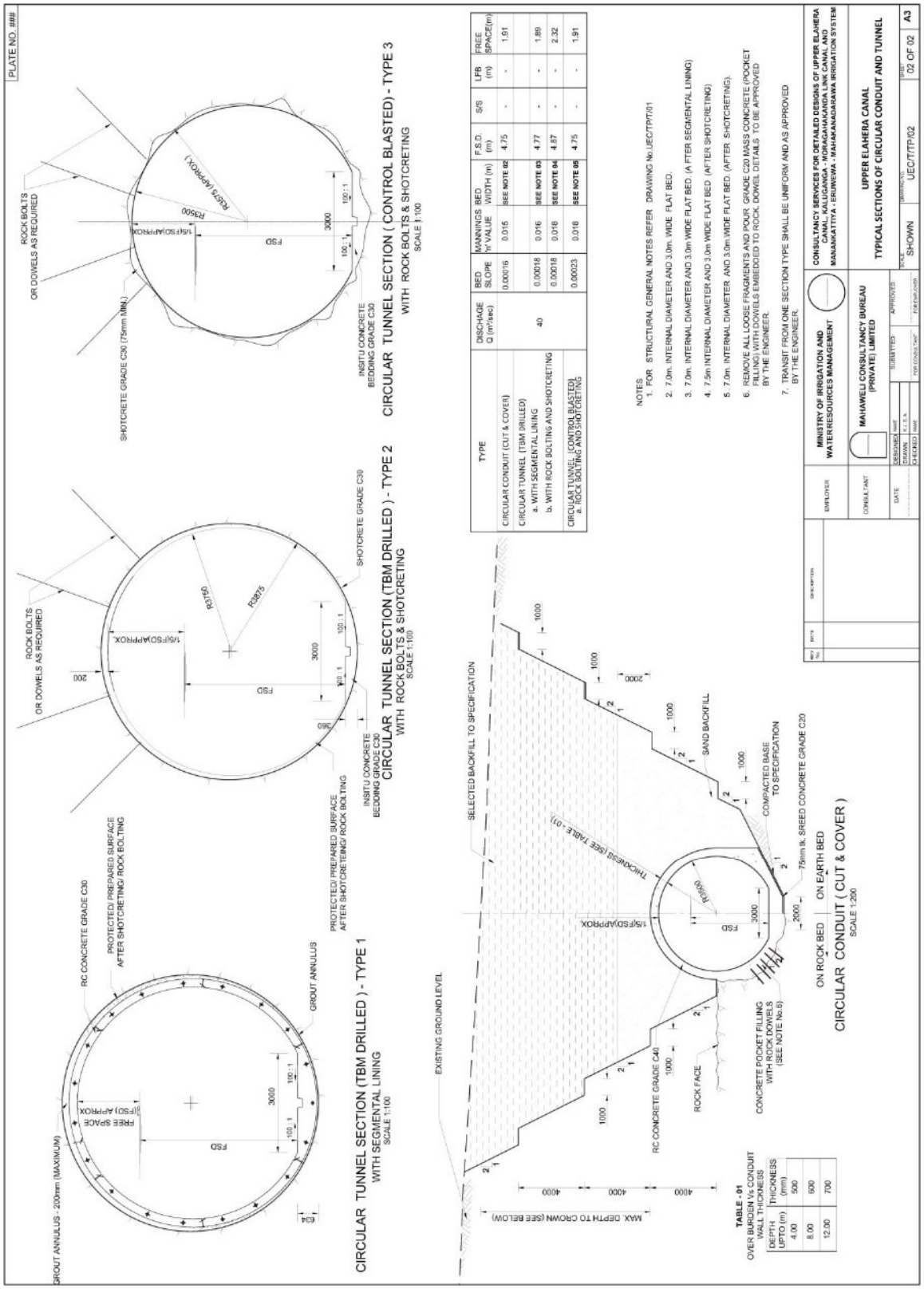


Figure 5-3: Typical Canal Sections – Open and Cut and Cover

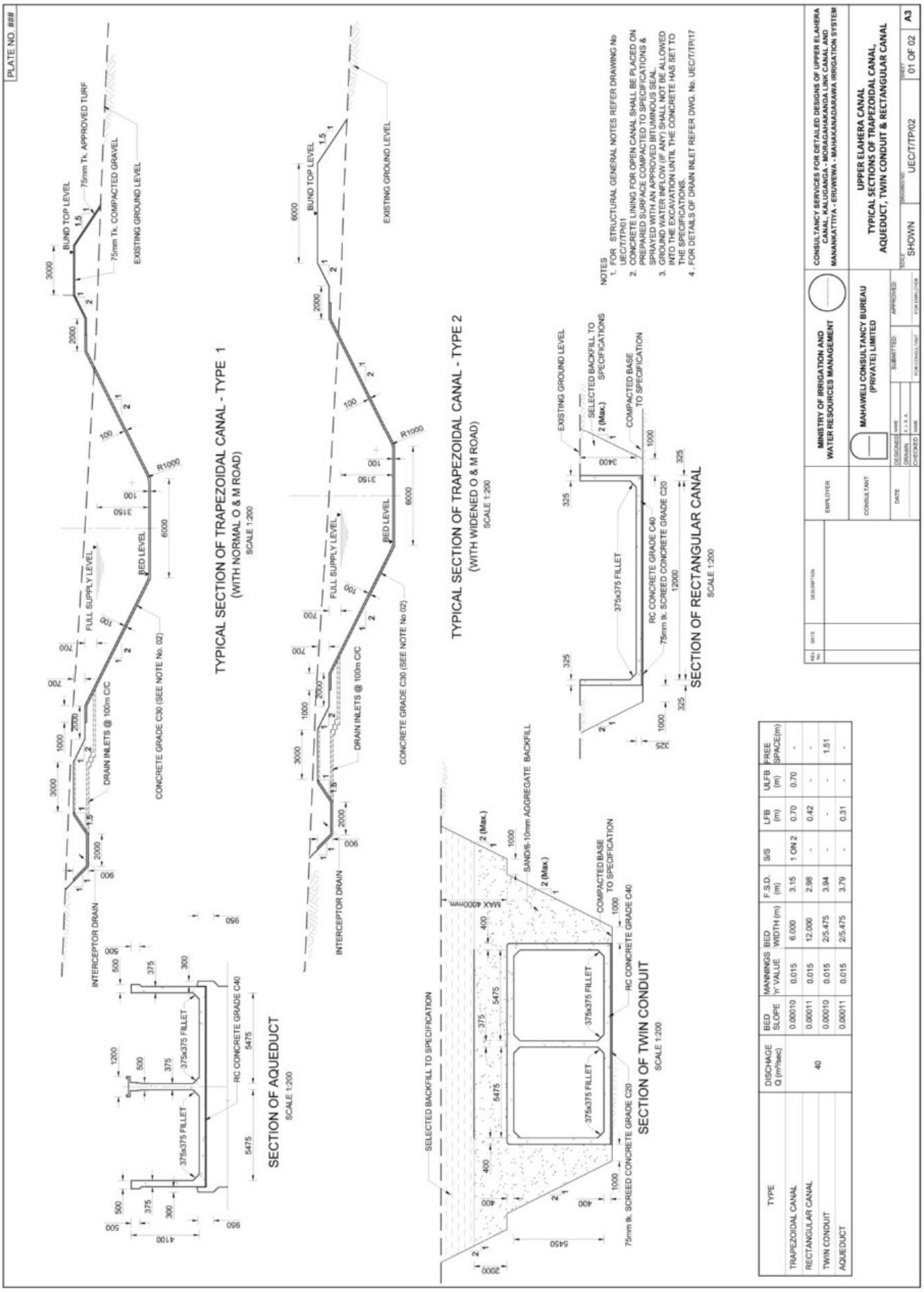


PLATE NO. ###
TYPICAL SECTION OF TRAPEZOIDAL CANAL - TYPE 1
(WITH NORMAL O & M ROAD)
SCALE 1:200
TYPICAL SECTION OF TRAPEZOIDAL CANAL - TYPE 2
(WITH WIDENED O & M ROAD)
SCALE 1:200
SECTION OF RECTANGULAR CANAL
SCALE 1:200
SECTION OF AQUEDUCT
SCALE 1:200
SECTION OF TWIN CONDUIT
SCALE 1:200
BUND TOP LEVEL
75mm Tk. APPROVED TURF
75mm Tk. COMPACTED GRAVEL
EXISTING GROUND LEVEL
FULL SUPPLY LEVEL
BED LEVEL
INTERCEPTOR DRAIN
DRAIN INLETS @ 100m C/C
CONCRETE GRADE C30 (SEE NOTE No. 02)
SELECTED BACKFILL TO SPECIFICATIONS
COMPACTED BASE TO SPECIFICATION
375x375 FILLET
RC CONCRETE GRADE C40
75mm tk. SCREED CONCRETE GRADE C20
SELECTED BACKFILL TO SPECIFICATION
SAND/6-10mm AGGREGATE BACKFILL
NOTES
1. FOR STRUCTURAL GENERAL NOTES REFER DRAWING No UEC/T/TP/01
2. CONCRETE LINING FOR OPEN CANAL SHALL BE PLACED ON PREPARED SURFACE COMPACTED TO SPECIFICATIONS & SPRAYED WITH AN APPROVED BITUMINOUS SEAL.
3. GROUND WATER INFLOW (IF ANY) SHALL NOT BE ALLOWED INTO THE EXCAVATION UNTIL THE CONCRETE HAS SET TO THE SPECIFICATIONS.
4. FOR DETAILS OF DRAIN INLET REFER DWG. No. UEC/T/TP/17
MINISTRY OF IRRIGATION AND WATER RESOURCES MANAGEMENT
MAHAWELI CONSULTANCY BUREAU (PRIVATE) LIMITED
CONSULTANCY SERVICES FOR DETAILED DESIGNS OF UPPER ELAHERA CANAL, KALUGANGA - MORAGAHAKANDA LINK CANAL AND MANANKATTIYA - ERUWEWA - MAHAKANADARAWA IRRIGATION SYSTEM
UPPER ELAHERA CANAL
TYPICAL SECTIONS OF TRAPEZOIDAL CANAL, AQUEDUCT, TWIN CONDUIT & RECTANGULAR CANAL
SHOWN
UEC/T/TP/02
01 OF 02
A3

TYPE	DISCHAGE Q (m³/sec)	BED SLOPE	MANNINGS 'n' VALUE	BED WIDTH (m)	F.S.D. (m)	S/S	LFB (m)	ULFB (m)	FREE SPACE(m)
TRAPEZOIDAL CANAL	40	0.00010	0.015	6.000	3.15	1 ON 2	0.70	0.70	-
RECTANGULAR CANAL		0.00011	0.015	12.000	2.98	-	0.42	-	-
TWIN CONDUIT		0.00010	0.015	2/5.475	3.94	-	-	-	1.51
AQUEDUCT		0.00011	0.015	2/5.475	3.79	-	0.31	-	-

Figure 5-4: Animal Escape

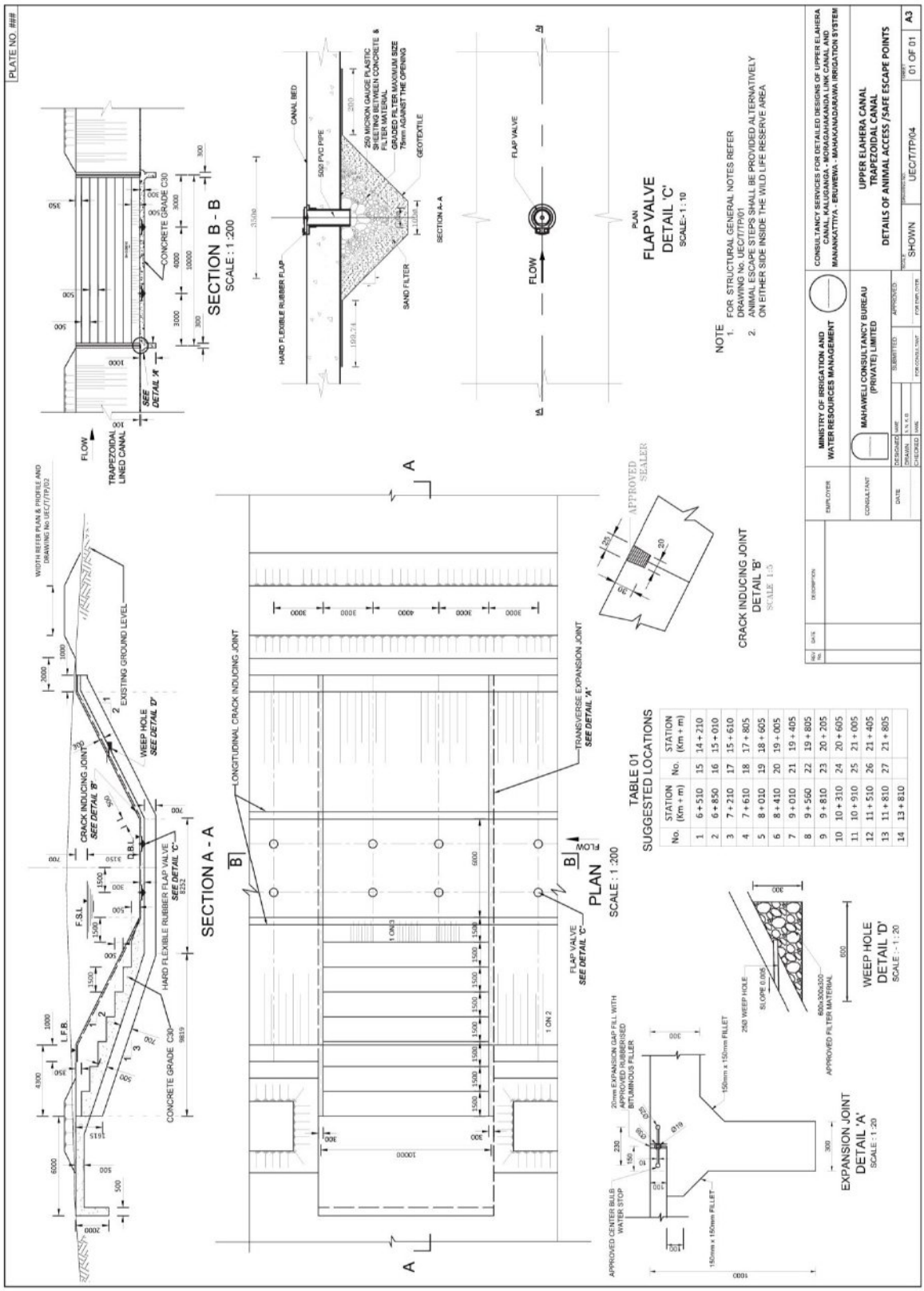


Figure 5-5: Aqueduct - Heerati

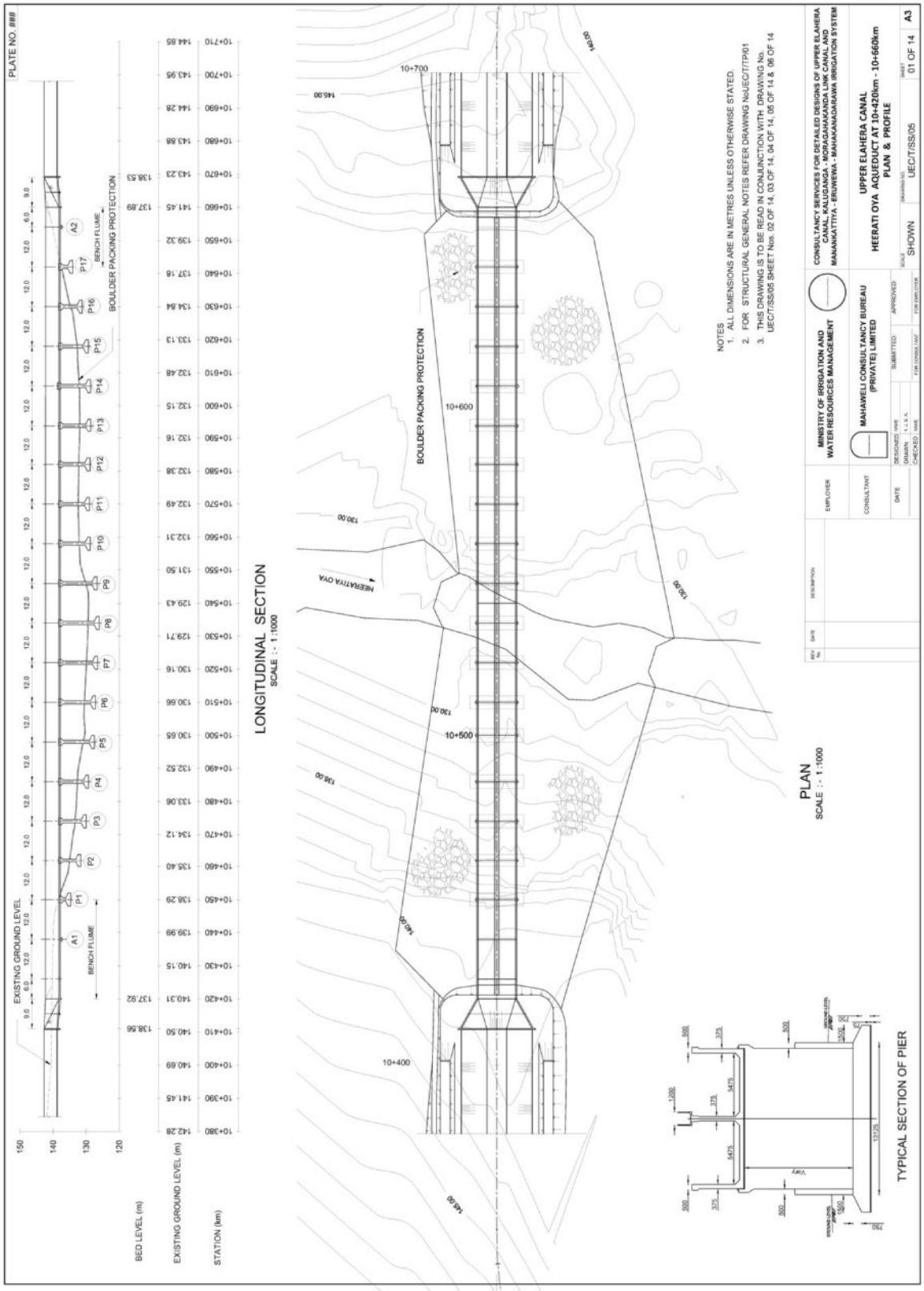


Figure 5-6: End Trifurcation

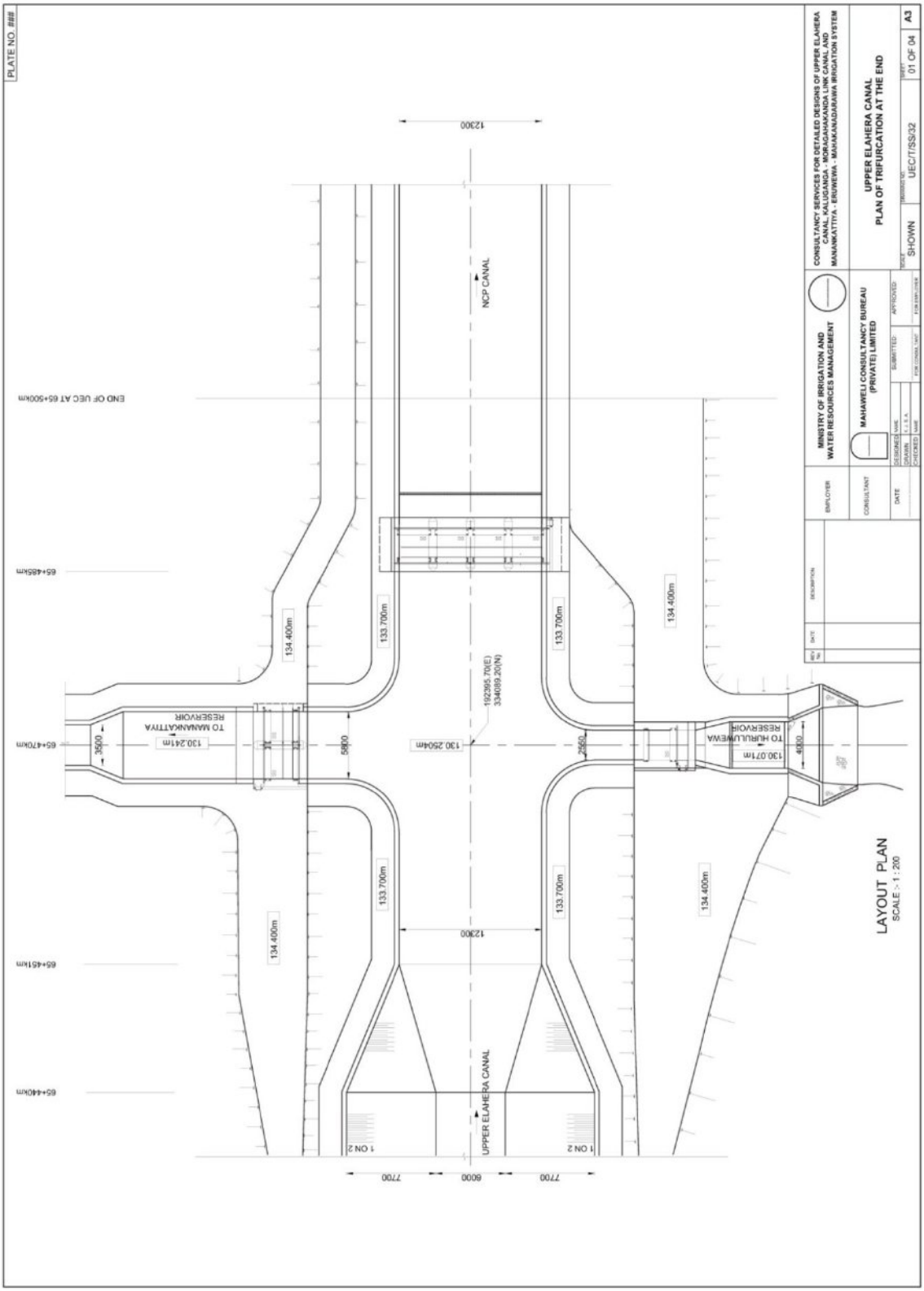


Figure 5-7: Turnout – Huruluwewa

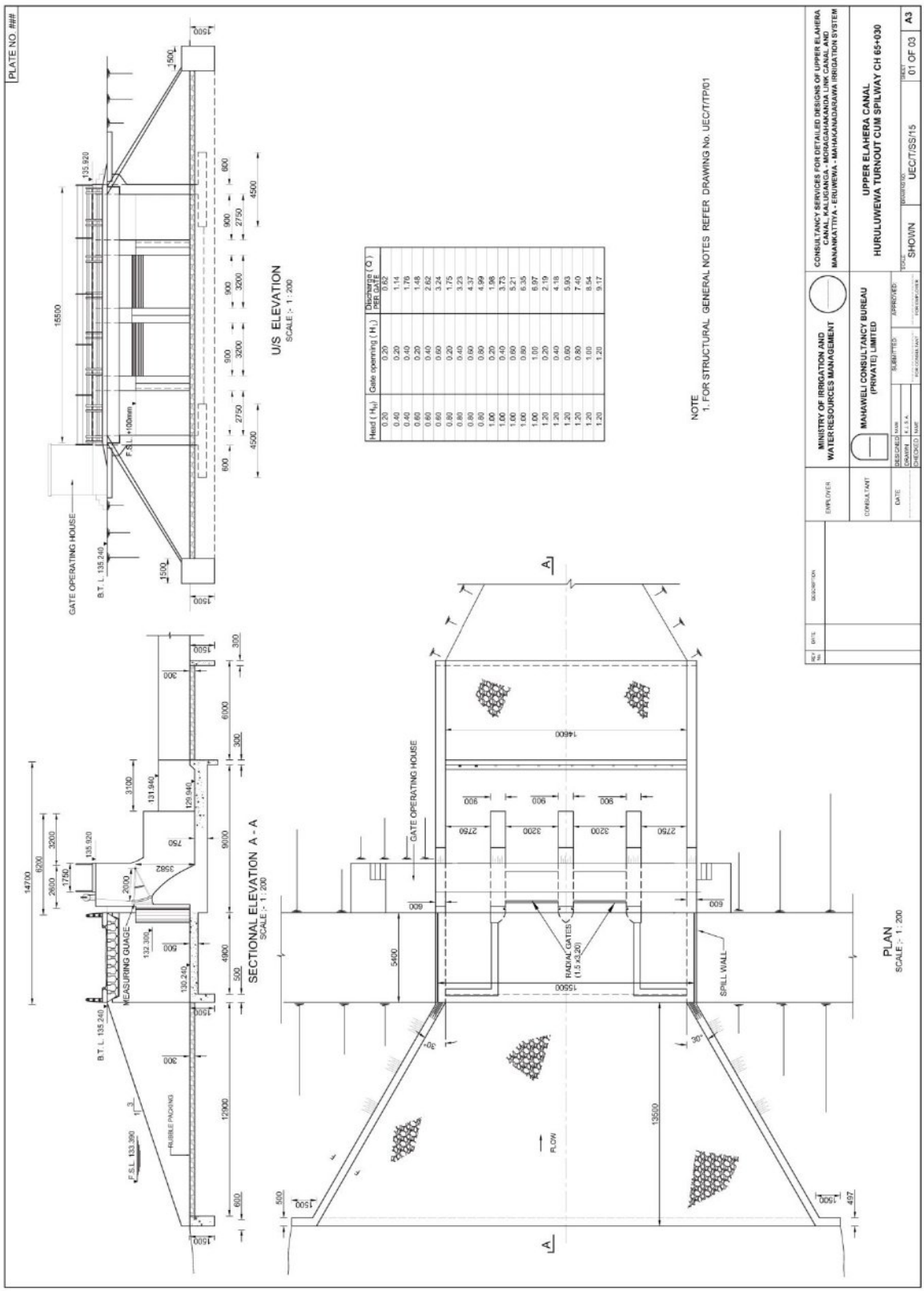


Figure 5-8: Typical Syphon

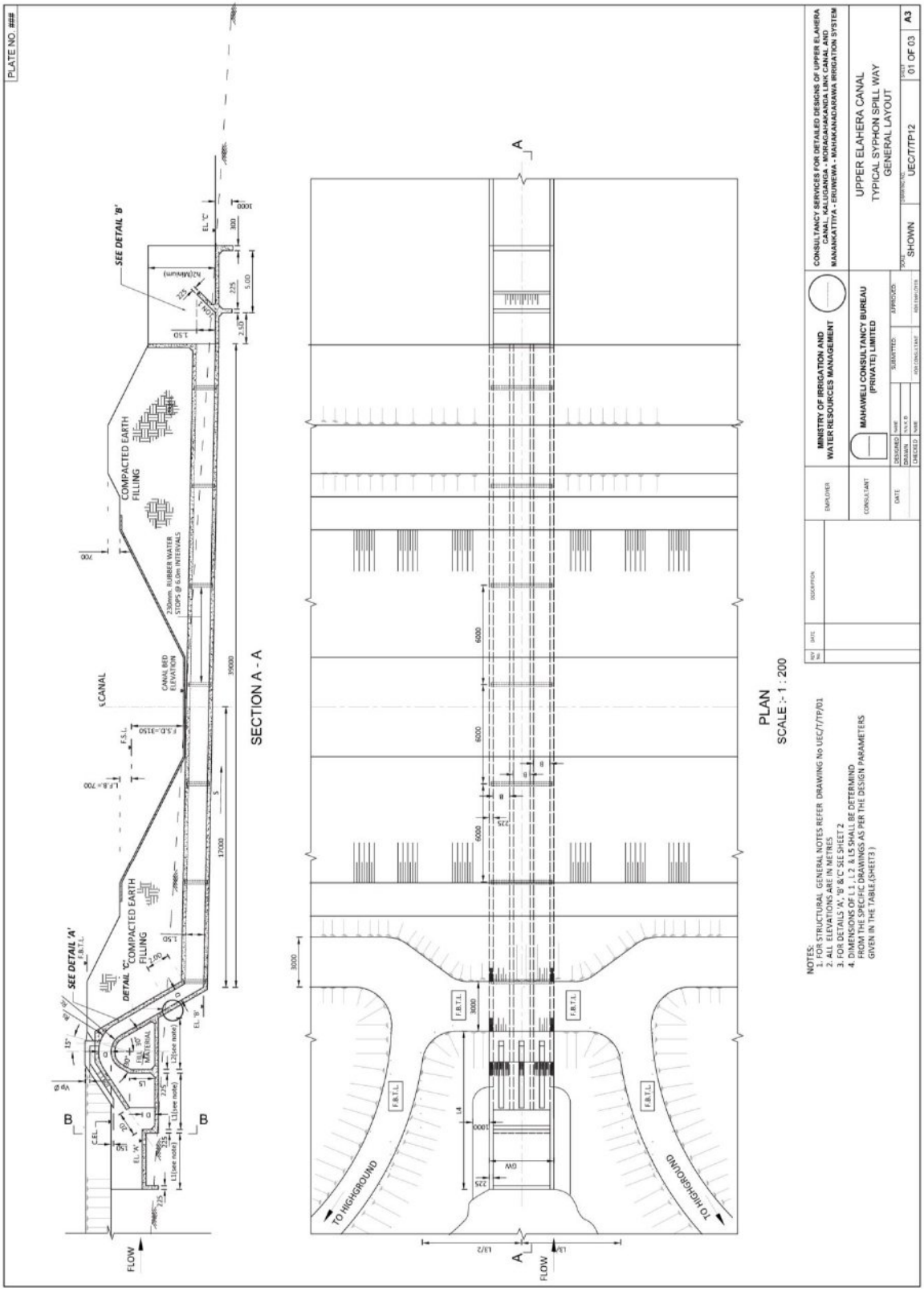


Figure 5-9: Transition – Open Canal to Double Conduit

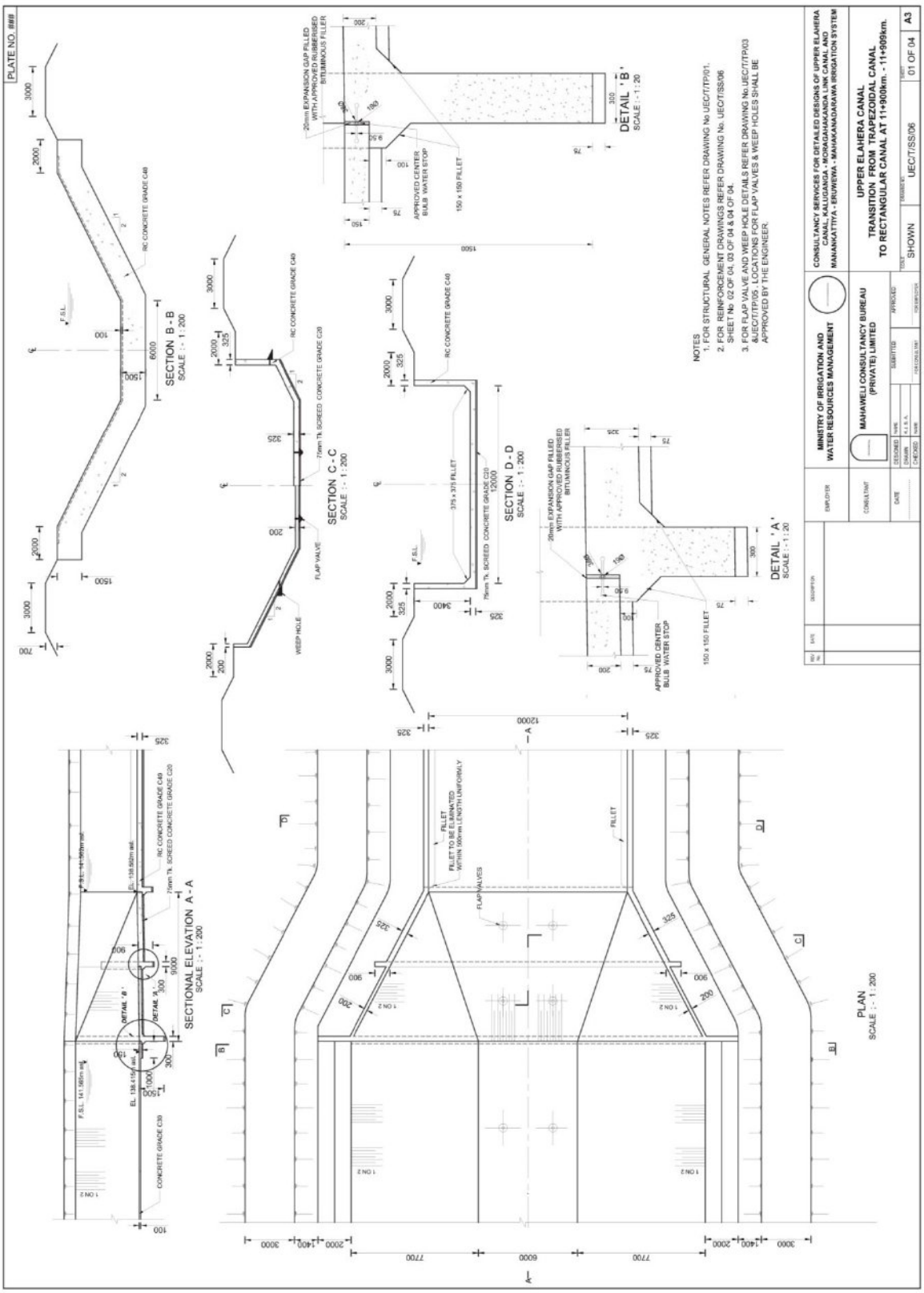


Figure 5-10: Typical Bridge

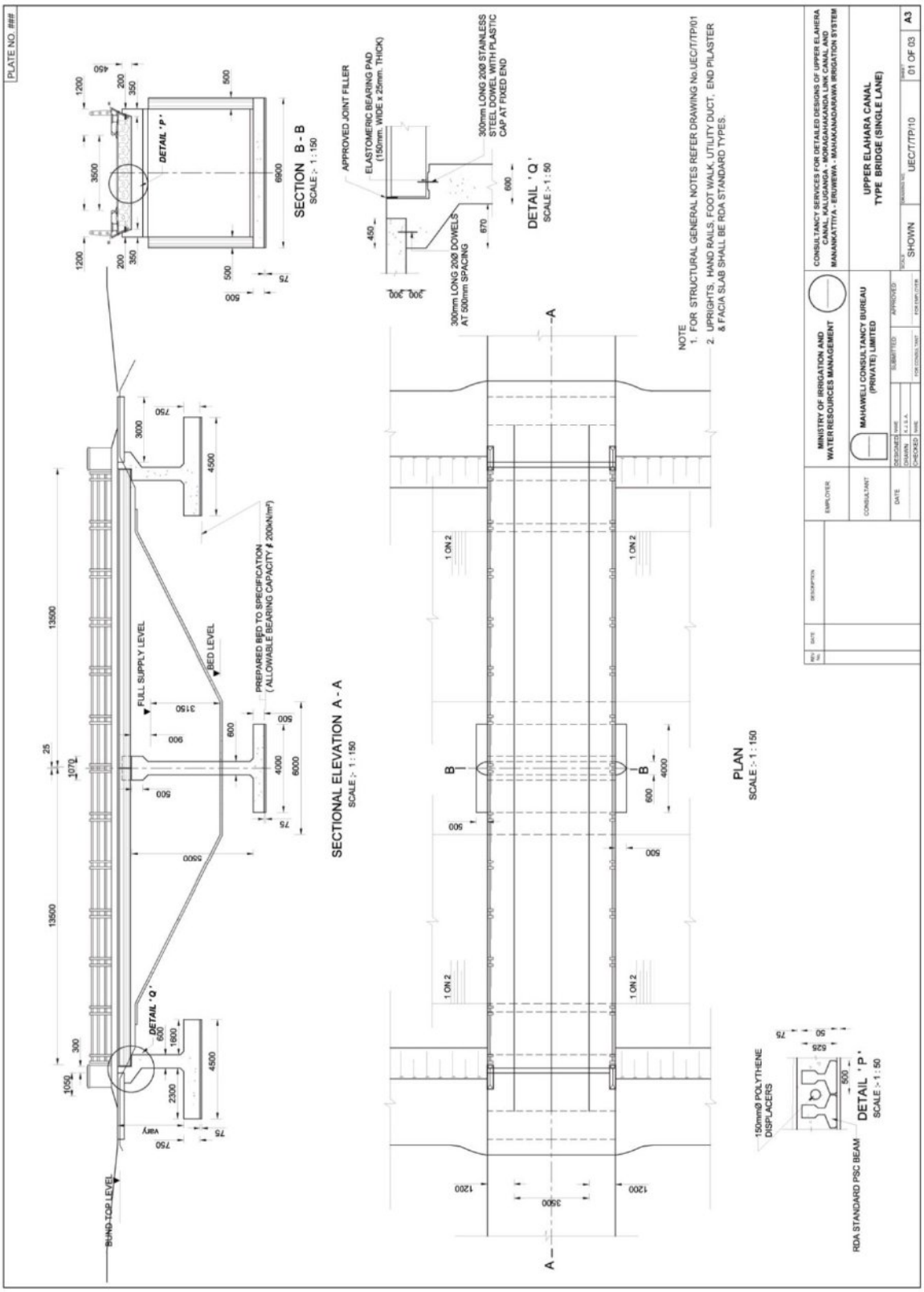
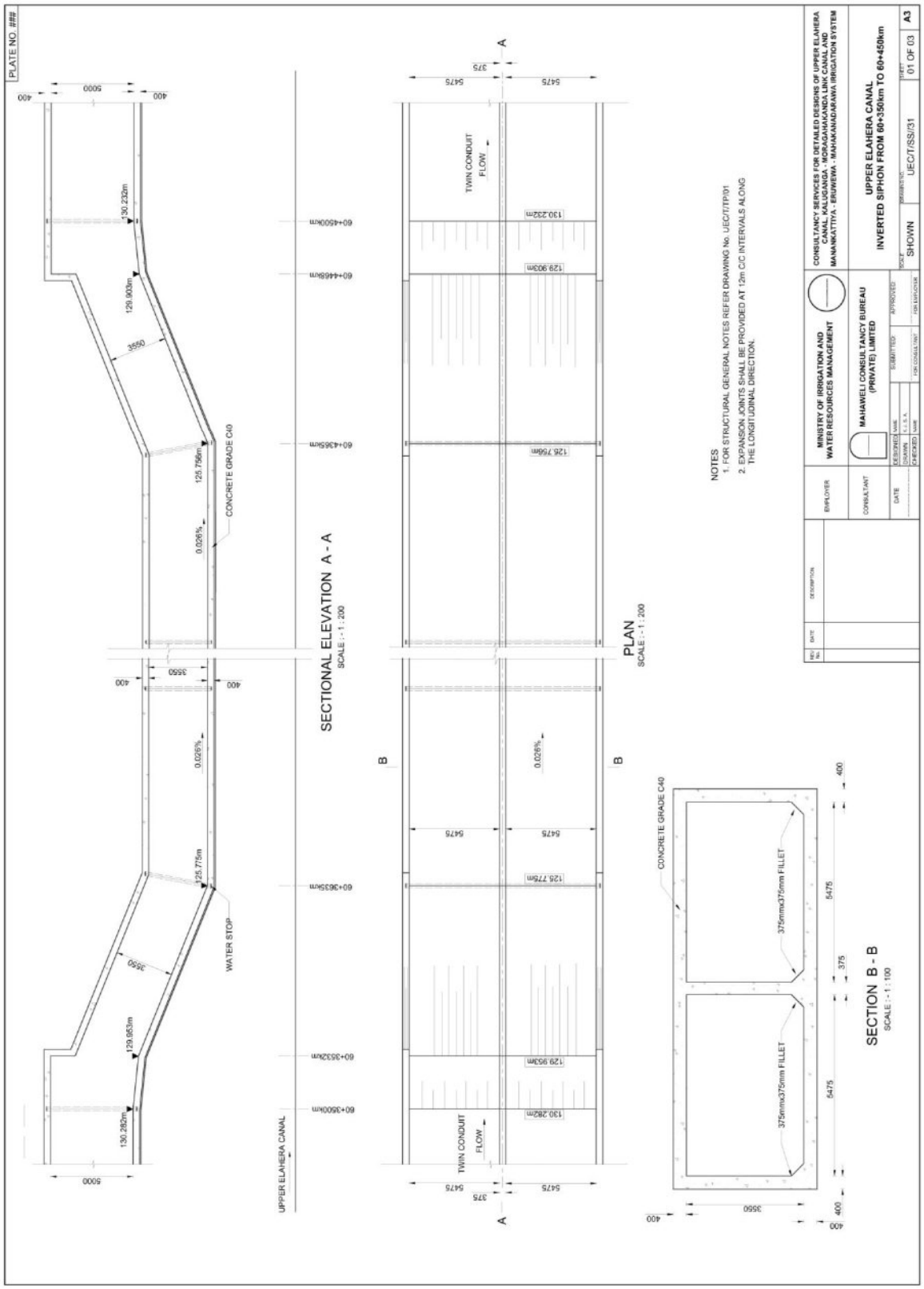


Figure 5-11: Typical Inverted Siphon



TECHNICAL DESIGN REVIEW AND ASSESSMENT
NORTH WESTERN PROVINCE CANAL

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 6

TECHNICAL SUMMARY

NORTH WEST PROVINCE CANAL

NOVEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
AIDM	–	Acres Irrigation Demand Model
ARSP	–	Acres Reservoir Simulation Program
BTL	–	Bund Top Level
BW	–	Bed Width
CECB	–	Ceylon Engineering Consultancy Bureau
CI	–	Cropping Intensity
CSS	–	Cross Sections
DAD	–	Department of Agrarian Development
DDF	–	Depth Duration Frequency
DSWRPP	–	Dam Safety and Water Resources Planning Project
FOS	–	Factor of Safety
fb	–	free board
fsl	–	full supply level
GOSL	–	Government of Sri Lanka
HFL	–	High Flood Level
HEC	–	Human Elephant Conflict
HFC	–	Huruluwewa Feeder Canal
ID	–	Irrigation Department
JICA	–	Japan International Cooperation Agency
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
LBMC	–	Left Bank Main Canal
LSS	–	Longitudinal Sections
MASL	–	Mahaweli Authority of Sri Lanka
masl	–	metres above sea level
MCB	–	Mahaweli Consultancy Bureau
MCM	–	Millions of Cubic Metres
MDP	–	Mahaweli Development Project
MIWRM	–	Ministry of Irrigation and Water Resources Management
NCPC	–	North Central Province Canal
NWPC	–	North West Province Canal
RDA	–	Rural Development Authority
WMS	–	Water Management Secretariat

WEIGHTS AND MEASURES

ha	–	ha
GW	–	gigawatt
Km	–	kilometre
Km^2	–	square kilometre
km^3	–	cubic kilometre
MCM	–	million cubic meters
mm	–	millimeter
m^3	–	cubic meter
MW	–	megawatt

CONTENTS

I. INTRODUCTION

A. Technical Summary

1. The purpose of this appendix[1] is to present a summary of the key technical elements of the North West Province Canal Project (NWPCP). The project forms part of the planned expansion of the Mahaweli Development Project (MDP) under the Water Resources Development Investment Program (WRDIP).

2. The following sections present an outline of the rationale for the development of the NWPCP, the main works components of the project and the criteria adopted for engineering design. This information is drawn from the project feasibility studies and from more recent and on-going work on detailed design and costing.

B. Background

3. The North West Province Canal project (NWPC) is located within the river basins of the Mi Oya and Deduru Oya, which are in turn mostly located within the North West Province (see **Figure 1**).

4. The Mi Oya Irrigation Systems (minor and medium) and Hakwatuna Oya Irrigation Scheme in the Deduru Oya Basin suffer from water shortages and the cropping intensities have reduced to 1.2 for major irrigation schemes and less than 1.0 for minor irrigation schemes. The Hakwatuna Oya Scheme, one of the major irrigation schemes in the North Western Province (NWP), at times experiences severe water shortages leading to heavy extraction of groundwater for irrigation and blocking of natural streams in the catchment area of the reservoir located in the Kahalla-Pallekele forest reserve. The Mi Oya Irrigation Systems (Abakolawewa, Attaragalla, and Palukadawala) are able to cultivate only one season (Maha) and the Upper Mi Oya basin minor irrigation schemes some year have insufficient water to cultivate even one season.

5. This situation has led to farmers in these schemes to request the authorities to divert water from adjacent System “H” of the MDP. In the past trans-basin diversion studies have been carried out to examine options for diverting Mahaweli water to Mi Oya Irrigation Systems and it was determined not to be feasible due to a shortage of water in the adjacent System H area and also due to high cost associated with such a water transfer.

6. However with the commitment to construction of the Moragahakanda and Kalu Ganga reservoirs, the last two reservoirs of the Mahaweli Development Project (MDP), requests for the diversion of Mahaweli waters to NWP intensified. As a result in 2000 the MIWRM contracted the Ceylon Engineering Consultancy Bureau (CECB) to conduct a feasibility study for diverting Mahaweli water to NWP. The feasibility study proposed two routes for diversion of water: (i) with second Bowatenna tunnel option, a diversion tunnel to Welamitiya Oya from Bowatenna Reservoir and diversion canal to upper Mi Oya.; and (ii) with UEC option, diversion through

[1] This appendix was prepared by the Mahaweli Consultancy Bureau (MCB) based on information from past feasibility studies and current and on-going tender design work, and reviewed and edited by the PPTA consultants.

Dambulu Oya to Upper Mi Oya through Dewahuwa feeder canal and of new diversion canal and short tunnel of length 450 meters to Pothuwila reservoir, the most upstream reservoir in the Mi Oya Basin and diversion to Hakwatuna Oya Reservoir through an existing natural stream. No storage reservoirs were proposed under this study and provision of water to minor reservoir cascades was not anticipated.

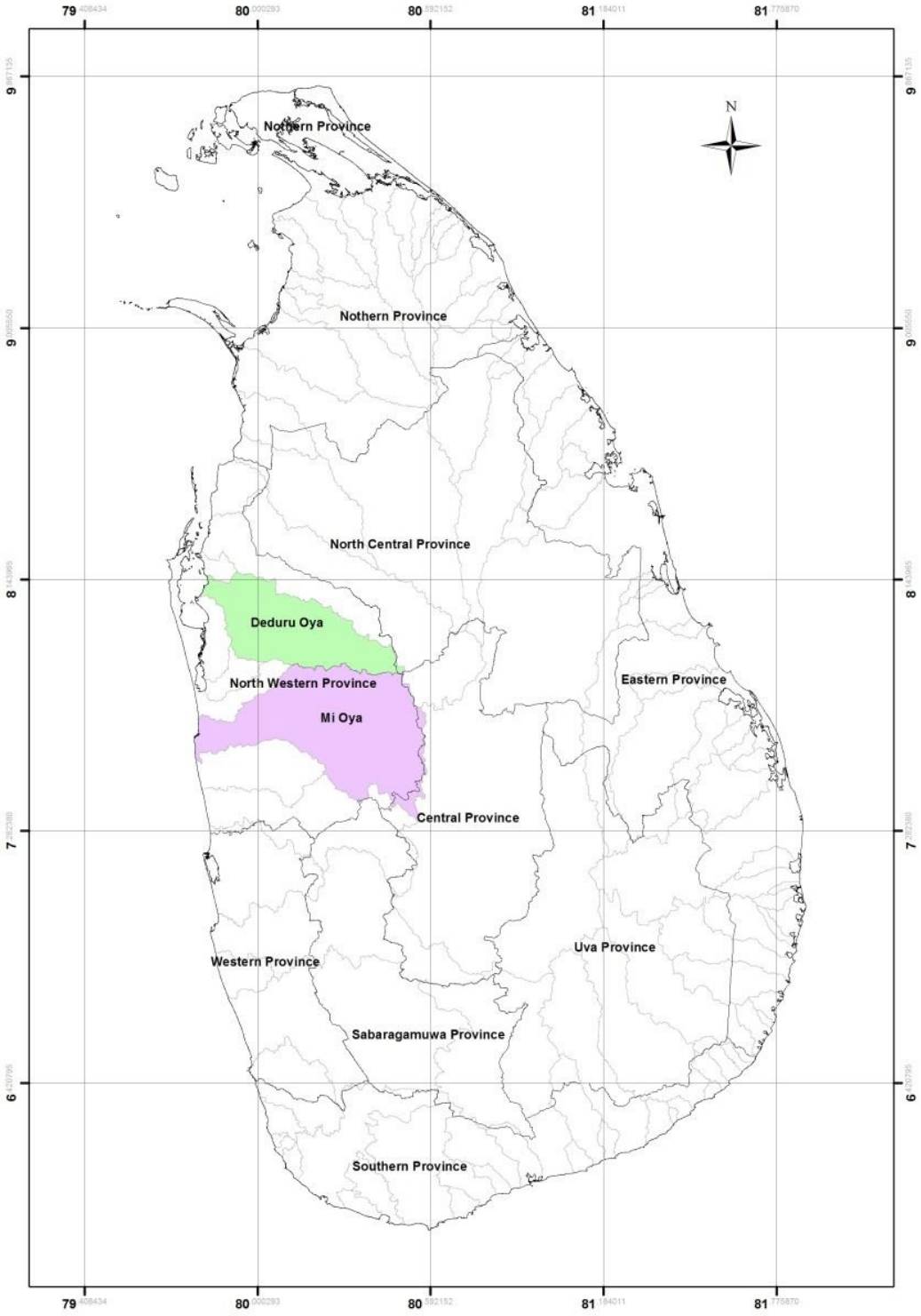
7. In 2012 the Ministry of Irrigation and Water Resource Management (MIWRM) commissioned a further feasibility study of the project. This study[2] included investigations and surveys along with a comprehensive water balance for the study area combined with NCP canal project. The project configuration identified two water sources, namely Nalanda Reservoir and the diversion of Mahaweli water from Dambulu Oya[3]. The associated water balance study revealed the need for storage in the Upper Mi Oya System to store diverted water and to distribute to existing systems as required. Accordingly two medium-sized reservoirs – Mahakithula and Mahakirula – were proposed in the Upper Mi Oya Basin.

8. **Figure 2** shows the NWPC layout of which the main features are:

- Diversion canal of length 8.6 km from Dambulu Oya Diversion Weir to Wemedilla LB Main Canal.
- New Sluice from Wemedilla and Improvements to Dewahuwa Feeder Canal 5.1 km to transfer increased discharge capacity to 12 m^3/s.
- New diversion canal of length 18.4 km from Dewahuwa Wemedilla reservoir outlet with 940 m long tunnel to new Mahakithula reservoir.
- New diversion canal of length 4 km through Kahalla-Pallekele forest reserve from Mahakithula to Mahakirula through Mahadambe reservoir (existing augmented).
- Right Bank Supply canal (RB1) from Mahakirula to feed minor reservoir cascades in Upper Mi Oya.
- Extension of same canal as RB2 around the Galgiriyagama forest reserve to Kaduru Wewa with improvements to existing earthen bunds and canals.
- Diversion/Supply canal from Mahakithula to transfer water through a bifurcation structure to Hakwatuna Oya through natural stream and transfer to Mi Oya through Pothuwila-Wawulewa reservoirs.
- Diversion/supply canal to feed Mediyawa reservoir and minor reservoir cascade.

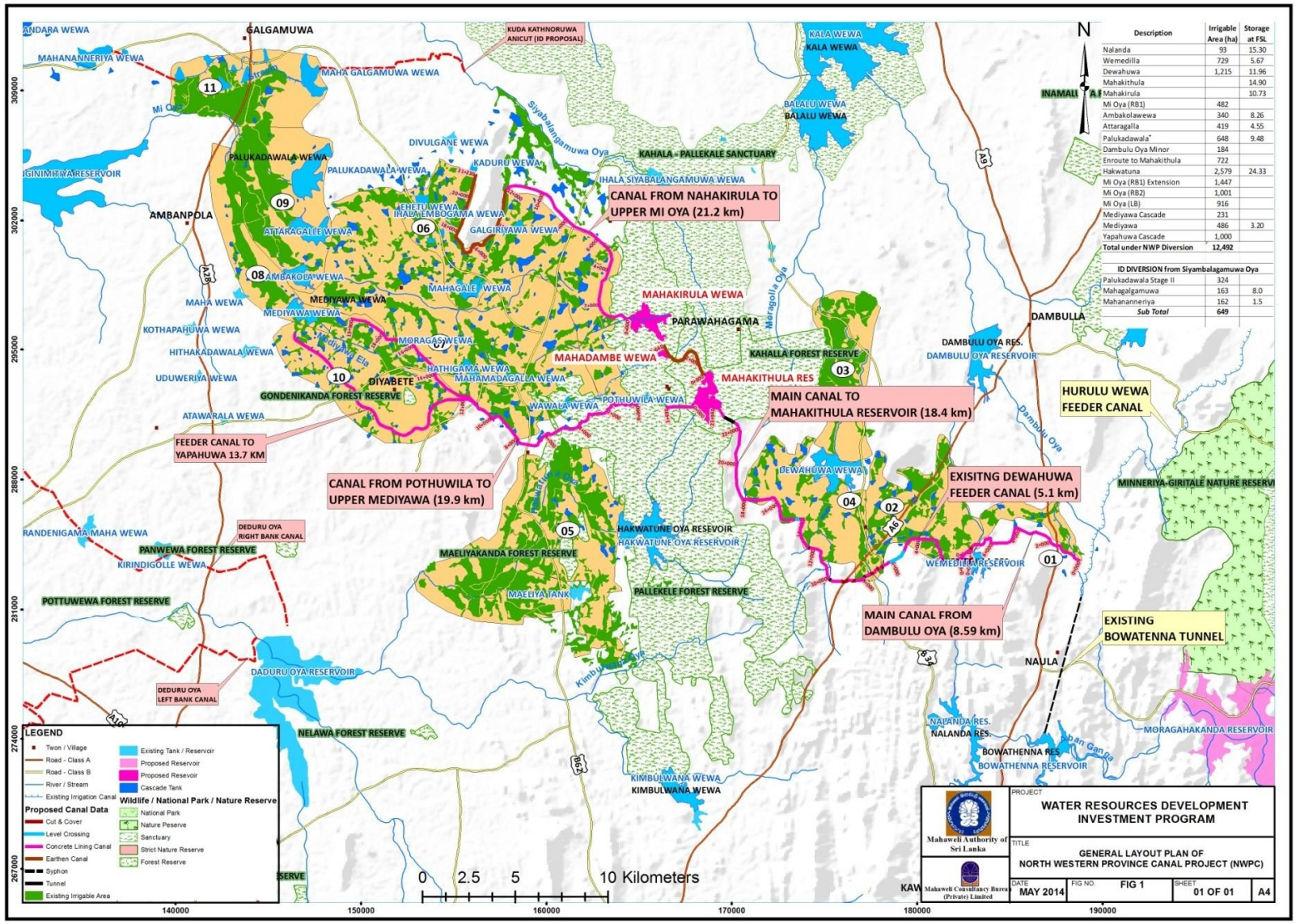
[2] Feasibility Study, Final Report, Volume 2, Part 1, October 2013.
[3] Note: the present Mahaweli diversion to Kalawewa in System “H” is through Dambulu Oya.

Figure 1: North Western Province Canal Location Map



Source: MIWRM, 2014

Figure 2: North Western Province Canal Project Layout



9. In 2014 MIWRM commissioned the Mahaweli Consultancy Bureau (MCB) to proceed with the detailed design and additional topographical and geotechnical investigations.

10. It is currently proposed that construction of the NWPC will occur in two stages as outlined below, to feed a total of 12,492 ha of existing lands in Mi Oya and Hakwatuna Oya basins, Nalanda, Wemedilla, Devahuwa Schemes and lands under minor schemes en route.

11. Stage 1 will divert of 30 MCM annually from Nalanda Reservoir for supply augmentation (as well as increased supply from the Mahakithula and Mahakirula reservoirs) to about 6,505 ha, and includes the following works:

- Improvements to Wemedilla Left Bank Main Canal (LBMC) up to Nebadagahawatta (0+145 to 5+250 km) and construction of a new sluice and tail canal on the Wemedilla reservoir
- Construction of the Main Canal from Nebadagahawatta to Mahakithula Reservoir.
- Construction of the inlet tunnel to the Mahakithula reservoir, Mahakithula and Mahakirula reservoirs (with all appurtenant structures) and feeder canal from Mahakithula reservoir to Mahakirula reservoir

12. Stage 2 will divert an additional 100 MCM of Mahaweli water annually from Dambulu Oya to augment water supply to 12,492 ha of existing lands, with the following works:

- Construction of the main diversion weir across the Dambulu Oya, and diversion canal to the Wemedilla LB Canal (0+000 to 8+590 km)
- Construction of the Mi Oya RB1 canal, from Mahakirula Reservoir to Galgiriyawa (0+000 to 13+731 km)
- Construction of the Mi Oya RB2 canal, from Galgiriyawa to Kaduruwewa (13+731 to 21+231 km)
- Construction of the main canal from Mahakithula reservoir to Potuwila tank (0+000 to 1+491 km) and from Potuwila tank to the Upper Mediyawa reservoir (0+000 to 19+980 km)
- Construction of the Yapahuwa Canal with all appurtenant structures, from the Mediyawa reservoir (0+000 to 11+200 km)

II. WATER BALANCE STUDY

13. The feasibility study (2013) included a comprehensive water balance study. The objective of which was to: (i) assess the new storage requirements to regulate and store the catchment inflows and new diversions from Nalanda and Mahaweli water downstream of Bowatenna Tunnel, (ii) to determine the suitable conveyance canal network alignments and duties, and (iii) determine the extent of the area that could be commanded during Maha and Yala seasons with a reasonable degree of reliability.

14. **Meteorological and Hydrological Data:** The metrological and hydrological data for the study was computed from several sources. The monthly rainfall data from 1971 to 2010 was collected from the Water Management Secretariat (WMS), Department of Irrigation (DOI) and the Meteorological Department. This included data from 6 meteorological stations in and adjacent to the study area, namely Millwana in the Hakwatuna Oya Basin, Galgamuwa and Mediyawa in the Mi Oya Basin, Nalanda in the Amban Ganga Basin and Kalawewa and Pelwehera in the Kala Oya Basin. The regression coefficients derived for Mahauswewa in Mi Oya and Horowpothana in Yan Oya by the WMS were used together with the corresponding areal rainfall series to compute the local inflows to the irrigation reservoirs in the study area. The evapotranspiration and evaporation (monthly average) was determined from data from nearby meteorological stations. For the reservoir evaporation data was used from Kalawewa, Batalagoa and Tabbowa stations.

15. **New Reservoirs:** It is proposed to construction two new reservoirs, the Mahakithula (14.8 MCM) and Mahakirula (10.7 MCM). The Mahakithula is located upstream of Hakwatuna Oya reservoir, to regulate and store excess diverted water from the Nalanda and Lenadora (Mahaweli water). The reservoir would intercept 17% of the catchment area of Hakwatuna Oya reservoir. A part of diverted water will be transferred to Hakwatuna reservoir while the balance will be diverted to the Mahakirula reservoir in the upper reach of Mi Oya via Mahadambe Wewa. Both the Mahakirula and Mahakithula reservoirs are located in the Kahalla-Pallekele hill range/forest reserve. The main advantage of these two reservoirs in the proposed development is their ability to divert continuous supply of irrigation water for minor reservoir cascade systems of Upper Mediyawa, Mi Oya LB, Mi Oya RB1 and RB2 especially during the Yala season, which consists of 36% of total irrigation area under the NWPC project.

16. **Method of Analysis:** The Water Balance Study analysis was carried out using Acres Reservoir Simulation Program (ARSP).[4] The irrigation demand series for the irrigation systems[5] included in NWPC project was computed using Acres Irrigation Demand Model (AIDM) for the cropping pattern selected and the irrigation time demand series (40 years).

17. **Cropping Patterns:** The assumed cropping pattern is based on paddy in both the Maha and Yala seasons (paddy-paddy), with combinations of long, medium and short duration crops (concurrently per season) (see **Table 1**). However it was assumed that over time there

[4] Developed by Acres International as part of the Mahaweli Development Project, in addition to the feasibility study, the program is used by the Mahaweli Authority of Sri Lanka (MASL) for management of the MDP.
[5] Which are inputs to the ARSP.

would be a shift to shorter duration paddy varieties and cash crops during the Yala season, as indicated by Cases A, B and C scenarios.

18. With the increase in cash crops, the cropping intensity in cascade systems could be increased from 1.5 to 1.8. At present only the majority of farmers of Dewahuwa system and those in Hakwatuna system in smaller proportions are involved producing cash crops. The future assumed cropping pattern is 20% cash crops under major and medium tanks systems and 80% that of minor cascade systems during Yala. The proposed cropping pattern consists of 20% banana (this extent will extend to Maha too), 12% vegetable, 22% green gram, 17% ground nuts, 17% chilies and 12% big onions.

Table 1: Cropping Patterns

Item	CASE A	CASE B	CASE C
	MAHA	MAHA	MAHA
Total Area	3,000	3,000	3,000
Paddy 135 days	1,000	1,000	
Paddy 105 days	2,000	2,000	2,000
Paddy 90 days			1,000
Sub total	3,000	3,000	3,000
	YALA	YALA	YALA
Paddy 135 days			
Paddy 105 days	1,600	1,600	800
Paddy 90 days	800	800	1,600
Sub total	2,400	2,400	2,400
Canal eff - Maha	0.55	0.60	0.60
Canal eff - Yala	0.65	0.75	0.75
Starting Date -M	Nov-01	Oct-15	Oct-15
Starting Date -Y	May-15	1-May	1-May

Source: MCB, 2014

19. **Irrigation Failure Criteria:** The following irrigation failure criteria (3) have been used in the simulation analysis over the simulation period of 40 years from 1971-2010. This simulation period covers a series of dry and wet spells. The failure criteria are:

- An ***'Irrigation failure'*** was assumed to have occurred in a given simulated year if the sum of the Yala season deficits in an irrigation system, as a whole, exceeded 5% of the total Yala demand. In an operating situation, such a shortage would probably be handled by 'tightening up' on water deliveries, with no significant agricultural losses.

- A ***'significant irrigation failure'*** was assumed to have occurred in a given simulated year if the sum of the Yala season deficits in an irrigation system, as a whole, exceeded 10% of the total Yala demand. In an operating situation, such a shortage would probably result in agricultural losses, either planned (Yala crop cut-backs) or unplanned.

- A ***'total irrigation failure'*** was assumed to have occurred in a given simulated year if the sum of the Yala season deficits in an irrigation system, as a whole, exceeded 20% of the total Yala demand. In an operating situation, such a shortage would probably result in total agricultural losses, either planned (Yala crop cut-backs) or unplanned.

20. **Reliability Criteria:** The criterion of 'acceptable' reliability was then defined as incorporating frequency of occurrence of such failures to be:

- Less than 20% of simulation period in the case of ***'irrigation failure'***
- Less than 10% of simulation period in the case of ***'significant failure'***
- Less than 5% of simulation period in the case of ***'total failure'***

21. With this definition of acceptable reliability, and the cropping pattern, the system simulation model has been used to determine the irrigation area, which could be supported in each irrigation system, (medium scale individual reservoir systems and small scale minor reservoir cascade systems), given the constraints imposed by water availability.

22. **Table *2*** lists details for the irrigation systems under Stage 1 of the project, including irrigated and cropped areas, annual water issues, irrigation duty and cropping intensity. Total required irrigation issues are just over 100 MCM for 6,505 ha at a cropping intensity of 152%. The average annual duty is about 97 ha per MCM, or the equivalent of 10,300 m^3 per ha.

Table 2: Average Water Issues - Stage 1

River Basin	Principal Reservoir	Net Irrigated Area (ha)	Annual cropped Area (ha)	Estimated Annual Water Issue (MCM)	Estimated Annual Water Duty (ha/MCM)	Cropping Intensity (%)
Amban Ganga	Nalanda	93	186	2.1	89.5	2.00
Dambulu Oya	Wemedilla	729	1,458	16.4	89.0	2.00
	Dewahuwa	1,215	2,430	27.4	88.6	2.00
	Sub total	1,944	3,888	43.8	88.8	2.00
Deduru Oya	Mahakithula Hakwatuna	2,579	2,579	20.5	125.8	1.00
Mi Oya	Mahakirula Mi Oya RB1	482	723	7.9	91.5	1.50
	Abakolawewa	340	612	6.8	90.0	1.80
	Attaragalla	419	754	8.4	89.8	1.80
	Palukadawala	648	1,166	13.0	89.7	1.80
	Sub total	1,889	3,256	36.1	90.2	1.72
Grand total		6,505	9,909	102.5	96.7	1.52

Source: MCB, 2014

23. As indicated in Table 3 irrigated area increases to 12,492 ha at full development (Stage II) with a cropping intensity of 169%. The average annual water issues are about 194 MCM. The annual duty is about 108 ha per MCM, which is about 9,300 m^3 per ha.

Table 3: Average Water Issues – Full Development

River Basin	Principal Reservoir	Net Irrigated Area (ha)	Annual cropped Area (ha)	Estimated Annual Water Issue (MCM)	Estimated Annual Water Duty (ha/MCM)	Cropping Intensity (%)
Amban Ganga	Nalanda	93	186	1.9	97.9	2.00
Dambulu Oya	Dambulu Oya - minor	184	276	2.6	106.2	1.50
	Wemedilla	729	1,458	14.3	102.0	2.00
	Dewahuwa	1,215	2,430	25.0	97.2	2.00
	Enroute to Mahakithula	722	1,083	10.0	108.3	1.50
	Sub total	2,850	5,247	51.9	101.1	1.84
Deduru Oya	Mahakithula Hakwatuna	2,579	4,642	36.9	125.8	1.80
	Yapahuwa	1,000	1,500	13.8	108.7	1.50
	Sub total	3,579	6,142	50.7	121.1	1.72
Mi Oya	Mahakirula					
	Mi Oya RB1	1,929	2,894	26.7	108.4	1.50
	Mi Oya RB2	1,001	1,502	13.9	108.0	1.50
	Mi Oya LB	916	1,374	12.7	108.2	1.50
	Mediyawa Cascade	231	347	3.2	108.3	1.50
	Mediyawa	486	875	8.4	104.1	1.80
	Abakolawewa	340	612	5.9	103.7	1.80
	Attaragalla	419	754	7.3	103.3	1.80
	Palukadawala	648	1,166	11.3	103.2	1.80
	Sub total	5,970	9,523	89.4	106.5	1.60
Grand total		12,492	21,098	193.9	108.8	1.69

Source: MCB, 2014

24. Figure 3 shows the monthly diversions from the Nalanda and Dambulu Oya, which range from more than 16 MCM per month in the period Nov-Jan to less than 4 MCM in the March-April period. Average annual diversions are 125 MCM, which is 5 MCM less than the design value of 130 MCM.

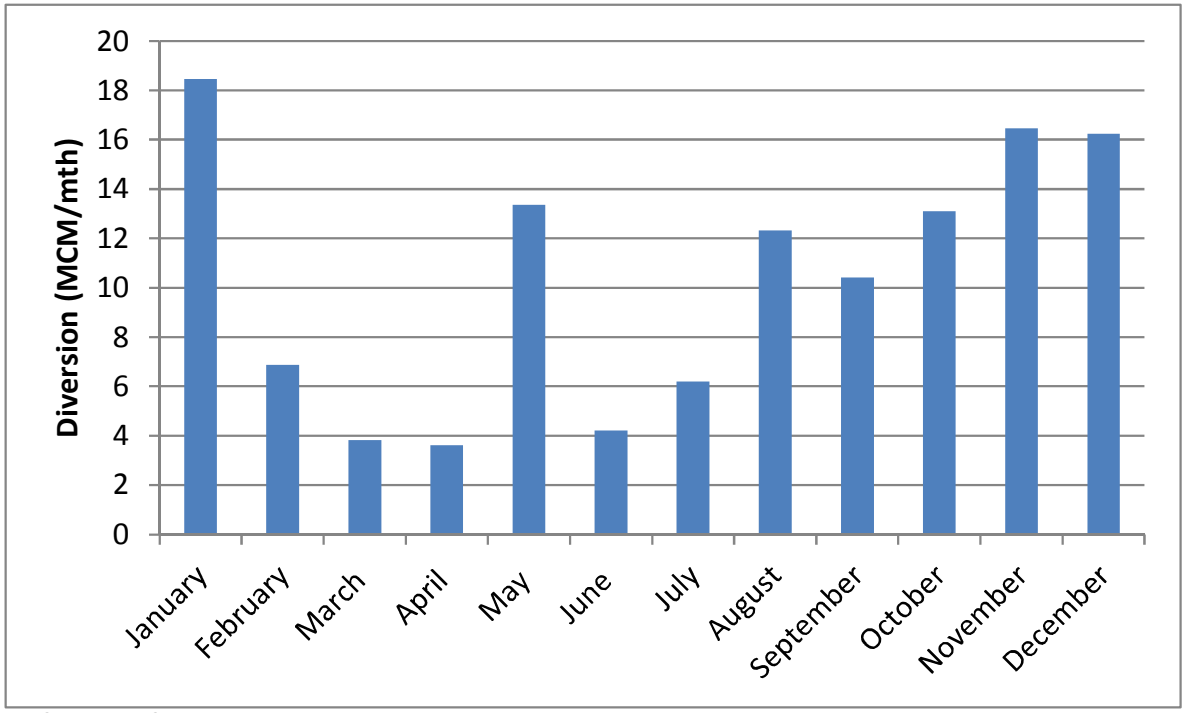
25. Main feature of the NWPC Project is the provision of water to the cascade systems in the project area, including those situated along the main transfer routes. Water will be issued to cascades from the NWPC network to reservoirs in the upper reach of the cascade so that other reservoirs in the cascade will receive water from upstream reservoir.

26. Under the Project, seven (7) Major / Medium irrigation schemes and about 192 Minor reservoirs in three river basins, namely Kala Oya, Deduru Oya and Mi Oya will accrue direct and indirect benefits.

27. Within the first reach of the main transfer canal, about 19 minor reservoirs are located in the Dambulu Oya sub-basin will be fed, while about another 42 minor reservoirs in Hewanhella sub-basin will be fed in the second reach. Finally, in the Upper Mi Oya basin, there will be 125 and 67 minor reservoirs to be fed in RB and LB respectively. Under detail design stage it is proposed to carry out further studies with regard to distribution of water within

the catchment area, change in the cropping pattern to get the maximum benefit from the diverted water and most importantly the sharing of water among the reservoir cascade. It is proposed to select two minor reservoir cascades within the project area and carry out detail study with regard to allocation of water from NWP Canal network and distribution of water within the cascade along with improved cropping patterns especially during Yala season to get maximum benefit from the project.

Figure 3: Average Monthly Diversions



Source: MCB, 2014

28. **Table 4** lists a summary of the principal reservoirs within the project, along with storage capacity and water full supply level (fsl).

Table 4: Reservoir Capacity and FSLs

Name	Status	Capacity (MCM)	FSL (masl)
Nalanda	existing	15.3	367
Wemedilla	existing	5.7	221
Mahakithula	new	14.8	201
Mahadambe	existing		187
Dewahuwa	existing	12.0	183
Mahakirula	improved	10.7	180
Hakwatuna	existing	24.3	142

Source: MIWRM, 2014

29. **Conclusions:** The water balance study showed that an additional 30 MCM annual diversion could be transferred from Nalanda reservoir to Upper Mi Oya and Hakwatuna Oya basin after meeting the irrigation requirement of Wemedilla and Dewahuwa irrigation scheme. A further 100 MCM annual average diversion could be diverted from Dambulu Oya (Mahaweli water) on completion of UEC and transfers irrigation requirement of Nachchaduwa and Nuwarawewa through UEC. The proposed project well provide irrigation requirement of total of 12,500 ha with a canal network and two new reservoirs (Mahakithula (14.8 MCM) and Mahakirula (10.7 MCM) in the Upper Mi Oya basins).

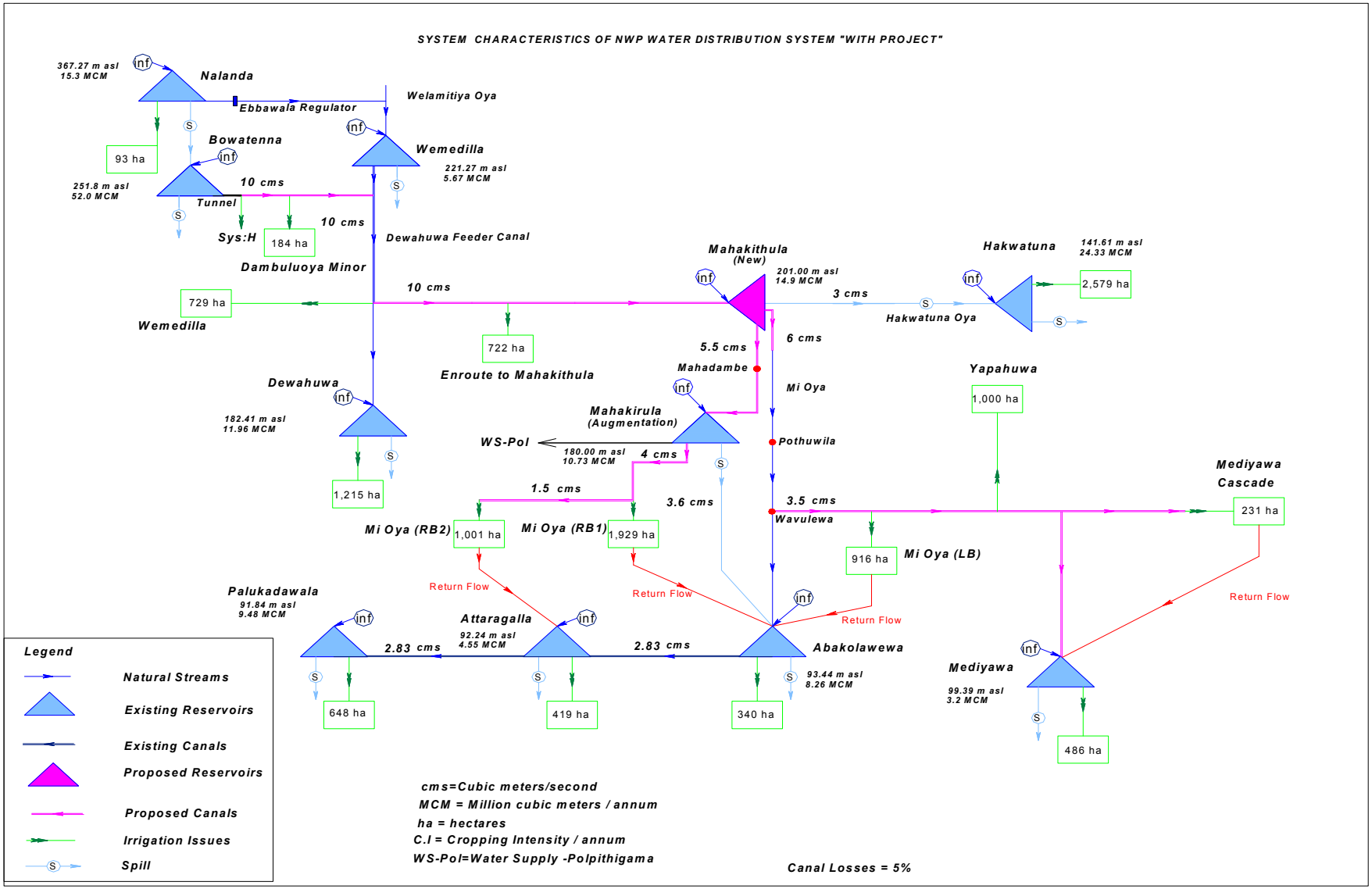
III. PROJECT COMPONENTS

30. Figure 4 shows the schematic layout of the NWPC project, including the irrigated areas and annual flow and storage volumes for canals and reservoirs.

31. The major components for construction and improvement under the project are:

- A new diversion structure across Dambulu Oya downstream of the mini hydropower station and an intake structure to convey water along a new 8.59 km long main diversion canal of design duty of 12 m^3/s, connecting to LBMC of Wemedilla reservoir at 0+145m downstream of the exiting LB Main Sluice.
- Construction of a new additional LB Sluice in Wemedilla reservoir and a Tail Canal to deliver 8 m^3/s to Devahuwa feeder canal since the existing LB Main Sluice can only deliver a maximum of 4-5 m^3/s approximately.
- Improvements, modifications and development of the existing LB Main Canal of Wemedilla reservoir from 0.145 km to 5.1 km to match design discharge requirements and ruling levels of the existing irrigation system under this canal stretch, which will also be concrete lined.
- A new Diversion structure at 5.1 km downstream of the Wemedilla LB Main Sluice, and a new concrete lined canal, level crossing the nearby Nebadagahawatta minor reservoir. This new canal traverses about 18.45 Km (through a 700 m long tunnel) to fall into Mahakithula wewa (abandoned) inside the Kahalla-Pallekelle wildlife reserve.
- Construction of Mahakithula Wewa (14.8 MCM), a new Bifurcation Structure downstream, new short feeder canal (156 m) to Hakwatuna Oya stream and another 1.34 km long link canal to Mi Oya through Pothuwila reservoir.
- Augmentation of Mahakirula (10.7 MCM) and Improvements to Mahadambe and the canal system linking Mahakithula – Mahadambe-Mahakirula.
- A 2 km long canal from Mahakirula LB sluice to Abakolawewa system.
- Improvements to Pothuwila (new sluice & improvements) and a new 20 km long Feeder canal to Mediyawa feeding minor cascades in the upper basin.
- A 21.2 km long canal from Mahakirula to Kaduru Wewa feeding the minor cascade system in RB upper Mi Oya.
- A 13.6 km long canal to feed 1000 ha under minor reservoirs in Yapahuwa cascade.

Figure 4: Project Schematic Layout



IV. DESIGN PARAMETERS

32. The main parameters and criteria adopted for design of water storage and conveyance infrastructure are summarised below.

A. Water Supply Levels

33. The following controlling levels of the existing system are considered in the design of project components.

(i) The water surface level of the diversion canal from Dambulu Oya is governed by the tailrace level 212.0 masl of the newly constructed power house in Dambulu Oya below the Bowatenna Diversion.

(ii) The full supply level of Wemedilla at 221.3 m asl prevented transferring this canal through Wemedilla. Instead, the canal will be taken below and joins with the LBMC of Wemedilla.

(iii) The design bed gradient of the Canal from Dambulu Oya need to match with the existing bed level (208.2 m asl) and water surface level (209.7 m asl) of Dewahuwa Feeder Canal (Presently named as Wemedilla LB Canal).

(iv) As the bed width of the Wemedilla LBMC need to be increased to accommodate higher discharge from diversion, cross regulators be introduced at suitable locations in the Wemedilla LB canal to maintain the FSL of the Canal to feed existing off take structures under the Wemedilla LBMC.

(v) As the existing sluice capacity of Wemedilla is about 4-5 m^3/s, a new sluice with a capacity of 8.5 m^3/s has been incorporated with a tail canal to Wemedilla LB Canal.

(vi) The new canal deviates from the existing Wemedilla LBMC at Nebadagahawatta and traverses to Mahakithula reservoir. Some sections of this canal had to be modified to rectangular sections to minimize damage to houses, and some to cut and cover sections and for safety purposes.

(vii) The FSL of Mahakithula (new) needs to match with the design level of the diversion canal from Wemedilla LB Canal.

(viii) The FSL level of Mahakirula (augmented) need to match with the design level of the diversion canal from Mahakithula to Mahakirula.

B. Design Criteria

34. A summary of the design criteria[6] adopted for the canals and main structures is presented in the following sections.

[6] Details are given in the "Design Criteria Report – April 2014" and the manning's 'n' values are based on "Technical Guide Lines for Irrigation Works - A.J.P. Ponrajah – October 98" published by the DOI.

1. Canals

35. There are 96 kilometres of new and rehabilitated canals on the project of which about 80 kilometres are concrete lined. **Table 5** lists a summary of the canals reaches (14) along with type, design duty and length.

Table 5: Design discharges of Diversion/Supply Canals Proposed

Description	Type	Duty (m^3/s)	Length (km)	Structures (#)
1. Dambulu Oya to Wemedilla LB Canal	Concrete lined	12	8.59	42
2. Wemedilla LBMC to Nebadagahawatta (Devahuwa Feeder Canal)	Concrete lined	12	5.11	43
3. Tail Canal from Wemedilla new Sluice to Main Canal	Concrete lined	8	0.60	6
4. Nebadagahawatta to Mahakithula Tunnel Inlet	Concrete lined	12	18.39	76
5. Tunnel to Mahakithula	Earth	12	0.94	1
6. Earth Feeder Canal from Mahakithula Saddle Dam to Mahakirula	Earth	6.5	3.66	5
7. Mi Oya RB1 Canal from Mahakirula RB Sluice to Galgiriyawa	Concrete lined + Earth	6	13.73	62
8. Mi Oya RB2 Canal from Galgiriyawa to Kaduruwewa	Earth	2	7.50	19
9. Feeder Canal from Mahakirula RB Sluice to Abakolawewa System	Concrete lined	5.5	2.00	9
10. Mahakithula Main Dam to Bifurcation	Concrete lined	10	0.16	1
11. Earth Canal from Mahakithula Bifurcation to Hakwatuna Oya stream	Earth	7	0.50	
12. Mahakithula Bifurcation to Mi Oya U/S of Pothuwila Reservoir	Concrete lined	7	1.34	12
13. Feeder Canal from Pothuwila to Upper Mediyawa	Concrete lined	5.5	19.98	93
14. Feeder Canal to Yapahuwa Cascade	Concrete lined	2.25	13.70	
Total			**96.20**	**369**

Source: MCB, 2014

36. **Annex 3** lists further details of the canal dimensions and design parameters. For concrete lined canals the 'n' value is 0.015 and for earth lined canals 0.025.

2. Tunnel

37. There is a tunnel section between Nebadagahawatta to Mahakithula with a length of about 1.2 kilometres. The tunnel is designed for free flow (12 m^3/s), with a RCC rectangular flow section and circular top arch with sufficient free board. The dimensions are selected to facilitate easy and simple construction, with: RCC rectangular section with BW = 4.0 m; FSD = 3.12 m; FB = 0.16 m; Vel = 1.2 m/s; n = 0.015; Bed Slope = 0.00025 (steeper slope for faster flow into Mahakithula reservoir).

38. Standard structural design methods will be used for the rectangular section. The requirement for structural lining, rock bolting and treatment will be finalized after completion of on-going geological investigations and mapping of the new tunnel alignment.

C. Canal Structures

39. There are a total of about 370 canal structures as listed in **Annex 4** and outlined in the following sections.

1. Aqueduct

40. There is an aqueduct on the Wemedilla Left Bank Main Canal (LBMC) with the following design features:

- Location selected to match topography and alignment of the canal.
- Structure consists of rectangular RCC section on pre-stressed inverted 'T' beams resting on concrete piers, as constructed recently in Deduru Oya Project.
- For Mala Oya Aqueduct: BW = 5.0 m; FSD = 2.27 m; Vel = 1.2 m/s; n = 0.015; Bed Slope = 0.0002; FB = 0.47 m.
- Piers: Design as solid rectangular column. Allowable bearing pressure, settlement characteristics, scour depth etc. depend on foundation material.

2. Siphons

41. There are three siphons located on the Main Canal on the reach between the Dewahuwa Feeder Canal and the tunnel section for which the design features are:

- Rectangular RCC section selected for barrels.
- Standard methods for computation of head losses in inlet / outlet transitions, bends and trash racks.
- Other factors such as, (a) hydraulic seal, (b) minimum earth cover below stream bed, (c) drop in level in inlet transition (d) rise in level in outlet transition, (e) submergence at outlet, (f) intermediate joints in the barrel etc. will be considered.
- Syphon barrel will be done for the worst case of load conditions under (a) maximum water in in syphon without any soil support, (b) maximum soil loading with barrel empty, (c) maximum flood with barrel empty.
- Factor of safety against floating also will be checked.
- Joints with water bars are provided at important sections.

3. Transitions

42. The limited elevation difference from Dambulu Oya to Mahakithula imposes restrictions on the allowable head loss in structures. Hence, it is necessary to minimize head losses. Provision of smooth transitions eliminates chances of (a) eddy formation at the inlet and (b) flow separation at the outlet. For better performance, a common transition angle of 12.5° (4.5:1) for both inlets and outlets. And use of Grade 25 concrete with broken-back type (K1=0.3, K2=0.6) is recommended to enable easy of construction with smooth surfaces.

4. Drainage Undercrossings

43. Calculations of flood runoff for small drainage basins are based on IDF Tables and Rational Formula as given in "*Design of Irrigation Head Works for Small Catchments*" – 2nd Edition (Revised) – May 1984 that A.J.P. Ponrajah published by the DOI. Return periods from 10-25 years are selected depending upon catchment characteristics, as adopted in Sri Lanka.

5. Regulators

44. Canal regulators are designed as duckbill weir or diagonal weir, for effective water regulation and to absorb water level fluctuations in the canal system, based on the following criteria:

- Gates are installed for flushing silt and operating the canal below FSL.
- These are particularly required to regulate the issues to existing offtakes between Wemedilla LBMC and Nebadagahawatta.
- Two basic considerations in designing a long crested weir: (a) Turnout head to the canal weir head ratio (Hto/Hc) should be maximized within the practical limits, and (2) To obtain maximum performance from the expanded weir length.
- Other important parameters are Weir coefficient (C) and effective weir length (Le).

6. Drops

45. There are 38 drops on five canal reaches, for which the design considerations are:

- Selection of type of drop (i.e. Vertical or Chute) mainly based on drop height and discharge in the canal.
- Energy dissipater is governed by the Froude Number (Fr) and designed as per USBR standards as given in "*Design of Small Dams*", USBR, Third Edition (1987).
- Standard methods adopted in the design of Abutments.
- Cut off walls are designed with due considerations to the exit gradient.
- Downstream protection provided to minimize erosion.

7. Main Bridges

46. There are four main bridges on 4 canal reaches, based on the following criteria:

- Since the main canal bed with is 3.5 m or less, with 1 on 2 side slopes, bridges are designed with one span (without piers).
- The abutments are placed outside flow area to minimize head losses due to obstructions.
- Standard pre-stressed inverted “T” bridge beams (13.5 m) are used.
- The design of bridge and abutments is done as per guidelines of the RDA.

D. Main Reservoirs

47. Following storage reservoirs to be designed: Mahakithula (new), Mahakirula (new) and Mahadambe (improvements) based on the following:

- The DOI has completed borrow area investigations and laboratory tests for material properties such as bulk density, friction angle and cohesion which are used in the design of (i) center clay core, (ii) main dam (earth), (iii) filter systems, and (iv) toe drains.
- Stability analysis for 5 loading cases, (i) u/s slope under steady seepage (ii) d/s slope under steady seepage, (iii) flood rise, (iv) rapid drawdown and (v) seismic loading.
- Determining minimum factors of safety for above five cases and comparison with allowable limits. The minimum factor of safety required for the 5 loading cases is given in **Table 6.**

1. Minimum Factors of Safety Required

48. The minimum factors of safety (FOS) required under different loadings are summarized in Table 6.

Table 6: Minimum Factors of Safety (FOS) Required

Load Case	Load Conditions	Description	Factor of Safety
1	Steady State Seepage	Long term loading with reservoir at full supply level FSL, for downstream slope stability	1.5
2	Steady State Seepage	Long term loading with reservoir at full supply level FSL for upstream slope stability	1.3
3	Flood rise to HFL	Short term loading condition with reservoir level at HFL	1.4
4	Rapid Draw Down	RDD of Reservoir water level from FSL to the drawdown level	1.3
5	Seismic Load	seismic loading added, stability of both upstream and downstream slopes at FSL	1.0

Source: MIWRM, 2014

49. For this analysis, design peak ground acceleration (pga) of 0.15 g was adopted. This value was selected based on the available seismicity information.

50. The stability analysis conducted for the Mahakithula & Mahakirula reservoirs are given in **Annex 6.**

2. Dam Spillways

51. The design of dam spillways and energy dissipaters is based on the following:

- Aspects involved in the design of Spillways: (i) Hydrology, (ii) Topography & Geology, (iii) Operational, and (iv) constructional and structural.
- Considering the topography, site conditions and the design flood outflow, it was decided to provide chute spills for both Mahakithula and Mahakirula reservoirs.
- The chute spillway is located in the flanks of the dam.
- Two main hydraulic considerations in the design of approach channel: (i) length and layout of approach channel selected to result in minimum head loss, and (ii) uniformly distributed flow approaching the spillway. Approach velocity for design discharge should not be more than 3 m/s.
- Standard ogee shaped crest profile is adopted. Crest height is kept low to take advantage of high ground levels on the flank.
- Alignment and the chute slopes of the spillway decided to suite topography and site conditions to achieve stable flow conditions, avoiding cavitation.
- Rectangular chute or discharge carrier is designed considering ground elevations to maintain super critical flow conditions.

- Depending on flow conditions, suitable energy dissipaters are used as per USBR standards.
- Standard methods of stability analysis, structural and foundation designs will be used (main structure and abutments).
- Design is checked with allowable factors of safety.

3. Reservoir Sluices

52. The design of reservoir sluices is based on the following:[7]

- The hydraulic design is based on the standard Manning's formula, energy balancing, head losses (entrance, trash rack, convergence and divergence etc.) and DOI Technical Guidelines.
- The design discharge is based on water balance study with additional allowance to cater for higher peak flows that might be needed for short periods.
- Other parameters such as BTL, HFL, and FSL are also pre-determined from flood routing, allowable free board, topography, storage requirements etc.
- Sill level of the sluice is normally determined in relation to the irrigable area, storage requirement etc. In the case of above 3 reservoirs, the sluice outlet discharges into natural streams or canals at a low elevation, and hence the alignment of the sluice is fixed to suit smooth transition of flow.
- Sluice barrel is designed considering free flow conditions, with standard sizes for easy access for inspection and repairs.
- Number of sluice barrels is then determined.
- Water depth in the barrel is computed, assuming a maximum allowable velocity of 2.5 m/s in the barrel and checked with allowable depth ratio and critical depth (as per DOI Technical Guidelines).
- Other important parameters to be considered are (a) minimum operating level, (b) peak release under HFL condition, height and location of hydraulic jump, gradually varied flow profile etc.
- Stilling basin is designed based on USBR standards.
- Standard methods of stability analysis under different load conditions, structural and foundation designs will be used.

[7] Details of the design criteria adopted in the NWP Project design are given in the "Design Criteria Report" – Detailed Designs, April 2014.

V. PROJECT COST AND BENEFITS

A. Project Costs

53. The project engineering costs are summaries in **Table 7**. The total cost is of the order of SLR 15,500 million for civil works.

Table 7: Project Cost Summary

#	Description	Cost Rs M
	Civil Works – Tranche 1	
1	Main Canal from Wemedilla LBMC to Nabadagahawatta wewa (0+000 to 5+250km) & construction of new sluice & tail canal (0+000 to 0+600km)	744
2	Mahakithula Inlet Tunnel, Mahakithula and Mahakirula Reservoir, Feeder Canal Length 3.66km from Mahakithula to Mahakirula Reservoir	6,398
3	Main Canal from Nebadagahawatta wewa to Mahakithula reservoir Inlet Tunnel (5+250 to 22+460km)	2,864
	Sub-total	**10,006**
	Civil Works – Tranche 3	
4	Mi Oya RB 1 Canal, Mahakirula Resorvoir to Galgiriyawa (0+000km to 13+731km)	1,131
5	Mi Oya RB 2 Main Canal From Galgiriyawa to Kaduruwewa (13+731km to 21+231km)	460
6	Main Canal From Mahakithula Reservoir to Potuwila Tank (0+000 to 1+491km) and Potuwila tank to Upper Mediyawa (0+000 to 19+980km)	1,518
7	Yapahuwa Canal From Mediyawa Canal (0+000 to 11+200km)	790
8	Main Canal From Dambulu Oya to Wemedilla LBMC including Dambulu Oya Diversion Structure (0+000 to 8+590km)	1,604
	Sub-total	**5,503**
	Total	**15,509**

B. Project Benefits

54. The overall economic impact of the total NWP canal project which costs Rs. 14.5 billion, had been evaluated considering the impacts without and with project scenarios. The direct project benefits are primarily from the irrigated agriculture in 12,500 ha under major, medium and minor reservoirs. The supplementary benefits are from the supply of water to domestic users in towns and villages in the project area, and local industries.

55. **Agriculture Benefits:** The project direct benefits are the increase in cropping intensity with provision of water from Nalanda and Mahaweli. The Table below shows the increase in CI with the project. The increase CI given in this table is based on Paddy-paddy cropping pattern. However with the project it is proposed to introduce other crops with less water requirement and high value compared to paddy. This will definitely increase the CI in minor irrigation systems to 2.0. The water balance study will be carried out presently taking into consideration of the less water consumption short duration crops in the minor reservoir systems.

56. **Drinking Water:** The project will provide about 5 MCM of annual water requirement for the Polpithigama DS area presently designated as an area with high incidence of CKD.

57. **Increased Water Spread Area:** The increase in water spread area due to supply of water to minor medium and major reservoirs in the area will improve the environment in the area with increased ground water, use of reservoirs for social requirement of community, increased fishing in reservoir systems etc.

Table 8: Average Water Issues and Cropping Intensities before and after Project

River Basin	Principal Reservoir	Irrigable Area	CI Without Project	CI With Project
Amban Ganga	Nalanda	93	2.00	2.00
Dambulu Oya	Dambulu Oya – minor	184	0.90	1.50
	Wemedilla	729	2.00	2.00
	Dewahuwa	1,215	1.90	2.00
	Enroute to Mahakithula	722	0.90	1.50
	Sub Total	2,850	-	1.84
Daduru Oya	Mahakithula			
	Hakwatuna	2,579	1.00	1.80
	Yapahuwa	1,000	0.90	1.50
	Sub Total	3,579	-	1.72
Mi Oya	Mahakirula	-	-	-
	Mi Oya RB1	1,929	< 1	1.50
	Mi Oya RB2	1,001	0.90	1.50
	Mi Oya LB	916	0.90	1.50
	Mediiyawa Cascade	231	-	1.80
	Mediyawa	486	1.26	1.80
	Abakolawewa	340	1.33	1.80
	Attaragalla	419	1.29	1.80
	Palukadawala	648	1.04	1.80
	Sub Total	5,970	-	1.60
	Grand Total	12,492	-	1.69

Source: MIWRM, 2014

VI. PROJECT OPERATION ASPECTS

58. Taking consideration of the distribution of water to minor medium and major irrigation systems under the project require high degree of planning and operation of the water allocation and distribution.

59. Once the NWP system becomes fully operational, the following operational procedure needs to be established without any disturbance to the operation of the Mahaweli system

60. The operation of Nalanda reservoir could be carried out by DOI independently to get maximum diversion possible, whereas the diversion form Mahaweli need to be carefully controlled in consultation with the WMS as per other Mahaweli systems.

- The operation of Nalanda will be such that diversion to NWP system should be maximized while keeping the Nalanda water level as high as possible until the months of June and July to divert during lean period of the Bowatenna diversion.
- The balance water requirements to keep Mahakithula and Mahakirula as high as possible should be made from the Bowatenna diversion.
- After Mahakithula reaches 196.5 m asl, the diversion to Mahakirula should commence. The diversion to Hakwatuna should commence after Mahakithula is full. The diversion to Hakwatuna could be done through spillway at high water levels and through bottom outlet at low water levels.
- Maintain Wemedilla reservoir also as high as possible until June and July.
- The operation rule curves of Nalanda, Wemedilla, Mahakithula and Mahakirula are such that they should be flat and at FSL for requesting diversion from upstream reservoirs/diversion points. When it comes to releasing water to downstream reservoirs releases to fill up to the rule curve.
- Dewahuwa, Hakwatuna, Abakolawewa, Attaragalla, Palukadawala and Mediyawa should be operated taking only the irrigation requirements from the upstream reservoirs.
- The allocation of irrigation systems to the two main reservoirs have been done according to the storage to irrigation area ratios. Extent under Mahakithula is named as Zone A and that of Mahakirula as Zone B. Under average hydrologic situation Extent to Storage Ratio for Zone A is 99.3 ha/MCM while that of Zone B is 108.3 ha/MCM. This is leaving future expansion of about 1,000 ha in the Yapahuwa system under Mahakithula reservoir system. All the irrigation systems except the Abakolawewa-Palukadawala system have been correctly assigned to the two main reservoirs by virtue of their situation. The existing three reservoir system has the advantage of feeding from both reservoirs. Nevertheless, it is assigned to Mahakirula due to technical difficulty of increasing the Mahakithula storage above present level. The Mahakithula RB sluice is kept at 6 m^3/s capacity to feed this three reservoir system too, in case of emergency (under dry hydrologic situation).

As such, the RB sluice capacity is over and above Mi Oya LB and Mediyawa system (3.5 m^3/s).

61. In order to operate the system as planned, it is necessary to measure water at key diversion locations such as downstream of Dambulu Oya diversion, Wemedilla LB Canal, diversion to Dewahuwa outlet tunnel to Mahakirula reservoir and diversions from Mahakithula and Mahakirula along with water levels of major reservoir in the system. The water measurements could be carried out with installation of Automated Water Recorders and transmitted data to a control center. This decision support system will be included to project operations directly Stage 2.

ANNEX 1: BASE DATA

1. This annex presents a summary of the sources of data and surveys carried out in support of the feasibility study and detailed design, as well as on-going site surveys in support of tender design.

2. **Cropping Data**: Cropping intensities of existing reservoirs were collected from the Department of Irrigation (DOI) and Department of Agrarian Development (DAD). In addition field and walk through surveys were conducted.

3. **Meteorological and Inflow Data:** The basic data includes computed long-term inflow series for the existing and proposed irrigation reservoirs and the climatic and meteorological data for the irrigations systems. Six meteorological stations in and around the study area have been selected and their monthly average rainfall, Thiessen weighted average monthly rainfall and monthly average Reservoir evaporation data were used in the study. The recommended diversions and releases have been decided with proper considerations to maintain environmental flows in the system.

4. **Flood Study**: Flood studies were completed for:

- Proposed Mahakithula reservoir (medium).
- Proposed Mahakirula reservoir (medium)
- Dambulu Oya main diversion anicut

5. Although sufficiently long rainfall records are available, flow records are not available even in nearby catchments to develop rainfall-runoff relationships. Furthermore, no flood frequency studies have been carried out and inevitably one has to depend on empirical methods such as traditional Synthetic Unit Hydrograph and DDF tables which are suitable for small catchments. The Snyder method which is very popular will be adopted using coefficients and other relevant parameters developed by the Hydrology Division of the Irrigation Department for Sri Lankan catchments. Selection of design storms for 500 and 200 years will be based on more recent DDF studies of the Hydrology Division. Inflow flood estimation for Mahakithula and Mahakirula was done using the traditional UH analysis and HEC-HMS method based on such recent DDF studies. Similarly, for Dambulu Oya diversion, the inflow flood estimation will be done using the traditional UH analysis and HEC-RAS.

6. **Topographic Surveys**: Limited surveys were carried for the following canal alignments:

- Main Canal from Dambulu Oya to Wemedilla LBMC: 8.48 km
- Main Canal from Wemedilla LBMC to Mahakithula Wewa: 23.70 km.
- Earth Feeder Canal from Mahakithula Saddle Dam to Mahakirula: 3.66 km.
- Feeder Canal from Mahakirula to Upper Mi Oya Kaduruwewa: 21.23 km.
- Feeder Canal from Mahakithula to Mi Oya U/S of Pothuwila: 1.49 km.
- Feeder Canal from Waulewa to Upper Mediyawa: 14.98 km.
- Tail Canal from Wemedilla New Sluice to LB Main Canal: 0.6 km.

7. **Reservoir Site Surveys**: Site surveys were conducted for the following major tanks; Mahadambe, Nebadagahawatta, Palugama, Hathigamuwa, Wavulewa, Mahakithula Dam & Saddle Dam, Mahakirula Dam, Dambulu Oya, Mala Oya and Welamitiyawa Oya. Also surveys were conducted on all minor reservoirs (tanks) receiving water from the project to determine the FSL and BTL.

8. **Geophysical Investigations**: Investigation included:

- Tunnel Axis
- Mahakithula Dam Axis
- Mahakirula Dam Axis
- Mahadambe Dam Axis

9. **Geological Investigations**: Investigations included:

- Mahadambe Dam Axis
- Mahakithula Dam Axis
- Mahakirula Dam Axis

10. **Insitu Tests**: Tests included: Natural Moisture Content, Atterberg's Limits, Specific Gravity, Dry Density and Particle Size Distribution, including fine fraction.

11. **In-Progress**: Geological investigations in progress for detail designs (Structures) include:

- Dambulu Oya – Wemedilla – Nebadagahawatta canal reach
- Nebadagahawatta – Tunnel – Mahakithula canal reach
- Mahakirula – RB Upper Mi Oya canal reach
- Pothuwila - Upper Mediyawa canal reach

ANNEX 2: NWPC DESCRIPTION

1. The final construction of the project in the blending of existing features such as irrigation reservoirs, canals, natural streams etc. with new features such as storage reservoirs and downstream canals and control structures. This is described in the sections below.

A. **Existing Features**

2. The key structures and features existing dam and canal infrastructures are outlined below.

3. **Bowatenna Dam and Diversion Tunnel**: In 1970, the GOSL initiated the implementation of the MDP as planned by the UNDP to complete within 30 years. Under this program, Polgolla - Bowatenna - Dambulu Oya and Huruluwewa diversions started with Polgolla barrage, diversion tunnel, Ukuwela Power project and Bowatenna Reservoir with Powerhouse and Irrigation tunnel to Divert water to Dambulu Oya and Huruluwewa reservoir benefiting systems “H” and part of System “I” and System “M” designating benefited areas as Systems IH and MH respectively. With this program, System D1 and D2 also benefited partly.

4. The Bowatenna irrigation tunnel is 6.85 km long with a discharge capacity of 28.3 m^3/s. From the tunnel end, a 1.27 km long concrete lined open channel starts and part of the flow diverted to Kandalama reservoir. Subsequently this canal was extended with design discharge 2.83 m^3/s as Huruluwewa Feeder Canal (HFC) as an interim measure till completion of NCP Canal Projected. The balance is released downstream to the Dambulu Oya delivering water to Kalawewa.

5. Detailed water balance studies reveals that about 100 MCM of water could be diverted to the NWP only after the completion of Moragahakanda-Kaluganga complex and the UEC.

6. **Power House in Dambulu Oya below Bowatenna Tunnel:** During the NWP feasibility study, a new mini-hydro-power station was under construction at Lenadora across Dambulu Oya at the end of the Bowatenna irrigation canal. Hence, location of the NWP diversion structure was shifted to downstream to allow for the design tail race level. This imposed limitations to the head available for diversion to Mahakithula. The power house includes:

- Two Kaplan Turbines generating a total of 1.4 MW and average energy of 5.7 GWH.
- Design flow 20 m^3/s with 8 m of gross head.
- Concrete canal 3 mx3.5 mx308 m with a 30 m spillway.
- Maximum tail water level is 212.4 masl.

7. **Nalanda Reservoir.** The Nalanda reservoir (21m high concrete gravity dam, capacity 15.3 MCM, FSL 367.3m asl, irrigable area 93 ha), was constructed by the Irrigation Department in 1957, to transfer catchment inflow intercepted by the Dam to Kalawewa to meet its irrigation requirement. With transfer of Mahaweli water to Kalawewa through Bowatenna dam tunnel with diverted water from Mahaweli river at Polgolla, the Nalanda dam became redundant. Subsequently the DOI used the part of Nalanda water to meet irrigation deficit of Dewahuwa reservoir by lowering one bay of Ebbawala Regulator of Nalanda reservoir and construction of Welamitiyawa anicut and feeder canal to feed Dewahuwa Reservoir. The Nalanda reservoir was the first high concrete dam constructed by the DOI and found to be in distress due to cracks developed in dam body. Since the 1980's the Nalanda water level was maintained at low level due to weak condition of the dam body. The total inflow to this reservoir from a catchment area of 125 km^2 is estimated to be 72.6 MCM and it is proposed to divert part of this water to NWP project after meeting the irrigation demand of Dewahuwa and Wemedilla anicut systems. The irrigation requirements for the existing irrigation systems are computed in the simulation study based on existing cropping patterns. The cropping intensities of these existing irrigation systems would be made 200% "with project". The Nalanda dam body is now being strengthened under the Dam Safety and Water Resources Planning Project (DSWRPP), funded by the World Bank.

8. **Wemedilla Reservoir and Dewahuwa Feeder Canal**. In 2007, the DOI constructed Wemedilla reservoir (capacity 5.7 MCM, FSL 221.3 m asl, irrigable area 729 ha) to meet irrigation deficit of anicut system below Wemedilla , replacing Welamitiyawa anicut and Dewahuwa Feeder Canal became the LB Canal of Wemedilla .

9. **Dewahuwa Reservoir**. This reservoir of capacity 12 MCM, FSL 182 m asl is receiving Nalanda water through Dewahuwa feeder canal. With the construction of Wemedilla reservoir constructed across Welamitiya Oya in 2008 replacing Welamitiyawa anicut has made to increase the CI of Dewahuwa scheme to 200%.

10. **Hakwatuna Oya Reservoir**. The Hakwatuna Oya Recover (capacity 24.3 MCM, FSL 141.6 m asl) was constructed by DOI in 1960's across Hakwatuna Oya, a major tributary of Deduru Oya. The present irrigable are under the reservoir is 2579 ha and cropping intensity is about 1.3. This reservoir suffers from severe shortage of water due to uncontrolled extraction of ground water for agriculture in the upper basin. The situation has been further aggravated by destruction of forest cover in Kahalla – Pallekelle reserve, illicit settlements, Teak plantations etc.

11. **Abakolawewa, Attaragalla and Palukadawala Irrigation System (Mi Oya reservoir System).** Abakolawewa reservoir constructed across Mi Oya to regulate 27.9 MCM inflow from a catchment area of 171 KM^2. However with the restoration of minor reservoir in Mi Oya LB (20 .2 KM^2) and Mi Oya RB (59.6 KM^2) and proposed Mahakithula (7 KM^2) reduces its effective catchment area to 84.2 KM^2) and the corresponding inflow is now about 13.4 MCM. In order to divert excess flow in the Abakolawewa link canal connecting Attaragalla (4.6 MCM) and Palukadawala (9.5 MCM) was constructed by the

DOI in fifties. However the present CI of Abakolawewa, Attaragalla, Palukadawala amounting to 133%, 129 % and 104% respectively justify the transfer of water to this Reservoir system.

12. **Mediyawa Reservoir**. This reservoir constructed in fifties across Mediyawa Ela, a major tributary of Mi Oya, intercepts a catchment area of 28.5 KM^2. Subsequent development of Mediyawa cascade system (5.5 KM^2) has reduced its inflow and its present annul inflow is estimated around 3.7 MCM. The CI of 486 ha cultivated under this Reservoir is about 126%.

13. **Mahadambe Reservoir.** This is minor reservoir is located in the Kahalla - Pallekelle forest reserve. It acts as a level crossing along the proposed canal from Mahakithula to Mahakirula. This reservoir, with the FSL at 186.76 m asl and the BTL at 187.8 m asl, will be improved with upstream rip-rap, downstream toe filter, repairs to spill and sluice etc.

14. **Pothuwila Reservoir.** The Pothuwila Reservoir (minor Reservoir) is the uppermost Reservoir in the Mi Oya basin, feeding about 40 ha with the FSL at 163.0 m asl. This is an important link in the NWP project as it is designed to feed the upper Mediyawa cascade.

15. **Minor Reservoir Cascade System.** A special and unique feature of this project is to incorporate all minor reservoir systems as an integral part of the project by providing an outlet to each cascade along the canal route. Accordingly it consists of 6 minor cascade systems namely; i) Dambulu Oya Wemedilla route, ii) Dewahuwa Mahakithula route, iii) Mahakirula –Galgiriyagama route (RB1), iv) Galgiriyagama –Kaduruwewa system (RB2), v) Mediyawa cascade and vi) Yapahuwa cascade.

16. **Dambulu Oya- Wemedilla System.** This irrigation system situated besides the Lenadora – Wemedilla Feeder Canal consists of 184 ha of irrigable area. At present the water availability is sufficient for doing a Maha cultivation only. Nevertheless, in Stage II of NWP development project 3 – 4 MCM of water allocation is proposed for 150% cultivation per annum.

17. **Dewahuwa- Mahakithula Reservoir System.** This irrigation system intercepts 3.4 km^2 of catchment area of Dewahuwa and situated besides the Mahakithula Feeder Canal consisting of 722 ha of irrigable area. At present the water availability is sufficient for doing a Maha cultivation only. Nevertheless, in Stage II of NWP development project 10 - 12 MCM of water allocation is proposed for 150% cultivation per annum.

18. **Mahakirula- Galgiriyagama System (RB1).** This consists of series of minor Reservoir cascades of reservoir covering 14.9 KM^2 of Abakolawewa reservoir catchment areas in tributaries of main Mi Oya. At present, there is an acute shortage of water in the reservoir system that farmers of this area manage to do cultivation only during the Maha season. The lack of water for a successful Yala cultivation in this system is the main reason for high poverty level of the farmer community and stagnate development of this area compared to the rest of the province. The existing irrigation area is 1,929 ha and the

estimated additional annual water requirement is estimated to be 17 - 20 MCM. This area is proposed to irrigate from RB1 canal (13.73 Km) from Mahakirula to Galgiriyagama system abutting Galgiriyagama hillock forest area.

19. **Galgiriyagama- Kaduruwewa System (RB2).** This cascade, covering 31.7 KM^2 of Attaragalla reservoir catchment area, consists of large number of small reservoirs in sub tributaries and main tributary of Mi Oya. At present, there is an acute shortage of water in this reservoir system and farmers of this area manage only to do cultivation during the Maha season. This area is fed from Mahakirula by extension of RB1 canal as RB2 further length of 7.5 km ending at Kaduru Wewa. The existing irrigation area is 1,001 ha and the estimated additional annual water requirement is estimated to be 9 - 10 MCM.

20. **Mediyawa Upper Catchment Cascade System.** This cascade, covering 5.5 KM^2 of Mediyawa catchment area lying on south most major tributary of Mi Oya, receive about 0.9 MCM of water annually to manage only a Maha cultivation. The available irrigation extent under the small reservoirs is around 231 ha.

21. **Yapahuwa Minor reservoir Cascade Systems.** This area also becomes another isolated area between Proposed Deduru Oya reservoir project and Mi Oya and Hakwatuna Oya development under NCP canal project. Therefore, allocating Mahaweli water for 1,000 ha of existing irrigable extent is proposed under this project with improved cropping patterns and better water management practices.

B. **New Features**

22. The new features incorporated in to the project are summarized below.

23. **Diversion Canal from Dambulu Oya to Wemedilla**. This canal takes off from proposed main diversion weir across Dambulu Oya, downstream of irrigation tunnel and mini hydro power station, and joins the existing Wemedilla LB Main Canal (LBMC). This section comes under Stage II of the project. The concrete lined trapezoidal canal of length 8.6 km with a design discharge 12 m^3/s will transfer Mahaweli water to existing Dewahuwa feeder canal. The main features of this canal are the radial gated diversion weir across Dambulu Oya and aqueduct across Welamitiyawa Oya below Wemedilla reservoir.

24. **Improved Dewahuwa Feeder Canal.** The existing earth canal of length 5 km with 4-5 m^3/s presently divert Nalanda water to Dewahuwa . With additional diversions form Nalanda and Mahaweli diversion, this canal need to be redesigned for design discharge 12 m^3/s as a trapezoidal concrete lined canal with side slopes 1:2 new FSD 1.78 m. This canal will transfer water to Dewahuwa reservoir as well as existing irrigable area along its length. This canal is presently named as Wemedilla LB Main Canal.

25. **New Sluice from Wemedilla reservoir and Connecting Canal to Wemedilla LBMC.** A new sluice with design capacity 8 m^3/s will be provided in the Wemedilla reservoir to divert excess water diverted from Nalanda to Wemedilla LBMC as the existing

sluice capacity is around 4 to 5 m^3/s. This new sluice will be connected to Wemedilla LBMC with a new tail canal of length 600 m.

26. **Canal to Mahakithula Reservoir.** A new concrete lined trapezoidal canal BW 3.5 m, design discharge 12 m^3/s, FSD 1.78 m, length 23.6 km will transfer water from Nalanda and Mahaweli water from Dambulu Oya to proposed new Mahakithula located in the Upper Mi Oya basin. A tunnel of length 1200 m at the end of canal will take this water from Kala Oya basin to upper Mi Oya basin.

27. **Mahakithula reservoir.** This reservoir will be constructed to store diverted water from Nalanda and Mahaweli water from Dambulu Oya. The bifurcation structure located about 150 m D/S of sluice will transfer water to existing Hakwatuna Oya reservoir via a natural stream and to Pothuwila reservoir in the Mi Oya basin. The design parameters of the reservoirs are:

- A new earth fill dam of capacity 14.8 MCM
- Catchment area 6.6 sq km
- Main embankment length 1,690 m
- Saddle dam length 476 m
- Maximum height 26.43.m
- Bund top level 203.5 m asl
- U/S and D/S slope 1:2.5,
- FSL 201 m asl, HFL 201.5 m asl,
- Water spread area 172 ha
- Sluice design discharge 10 m^3/s
- Chute spillway

28. **Mahakirula Reservoir**. This reservoir will be constructed immediately upstream of existing Mahakirula reservoir dam to form a reservoir also in the Mi Oya basin to store transferred diverted water from Nalanda and Dambulu Oya. This will form an additional storage connected to Mahakithula. This reservoir is also located in the Kahalla-Pallekele forest reserve. The key parameters are:

- New earth fill dam of capacity 10.7 MCM,
- Catchment area 7.15 sq km,
- Embankment length 408 m,
- Maximum height 23.08 m,
- Bund top level 182.5 m asl,
- U/S and D/S slope 1:2.5,
- FSL 180 m asl,
- HFL 180.5 m asl,
- Water spread area 153 ha
- Sluice of design discharge 5.5 m^3/s

29. **Diversion Canal from Mahakithula to Mahakirula.** Mahakithula will be connected to Mahakirula via Mahadambe by a natural stream which would be improved, and a part of

this will be a cut and cover section. The length of this improved canal is 3.6 km, with a design discharge of 6.5 m^3/s, BW 3 m. The entire length of this canal is located in the Kahalla-Pallekele forest.

30. **Diversion Canal to Galkiriyawa Reservoir System (Mi Oya RB1).** This is the first part of the Mi Oya RB system. It is a 13.7 km long starting from Mahakirula to feed minor cascades in RB 1 of Mi Oya. The entire area under RB1 cascade consists of 1929 ha. It is proposed to feed 482 ha of the cascade under Stage I, while the balance 1447 ha is to be taken up under Stage II. This canal will take water to minor reservoir system abutting the Galgiriyagama forest area with series of earthen bunds. The main design features are: Concrete trapezoidal; Q=6 m^3/s; BW=2.0 m; S/S= 1 on 2; Bed slope=0.0003; FSD=1.32 m.

31. **Extension of Galkiriyawa System to Kaduruwewa (Mi Oya RB2).** This 7.5 km long canal is the continuation from RB1, and feeds 1001 ha of lands under the neighbouring minor systems. This is also to be taken up under Stage II. Design features include: Earthen trapezoidal; Q=2 m^3/s; BW=1.7 m; S/S= 1 on 2; Bed slope=0.0004; FSD=0.98 m.

32. **Improvements to Hakwatuna Oya Feeder Canal.** A new earthen trapezoidal canal of length 1 km, design discharge 4 m^3/s, BW 2.5 m, S/S 1:2, Bed slope 0.0004, FSD 1.22 m will take Mahakithula water from Mahakithula Bifurcation structure to a natural stream of length about 5 km feeding Hakwatuna Oya reservoir irrigating 2579 ha.

33. **Diversion Canal to Mediyawa Reservoir and Upper Mediyawa Cascade.** A new concrete lined trapezoidal diversion canal from Pothuwila reservoir (LB) of length 19.8 km with a design discharge 5.5 m^3/s, BW 2 m, S/S 1:2, FSD 1.27 m to feed 486 ha of land in upper Mediyawa basin and finally to Mediyawa reservoir irrigating 486 ha of land.

34. **Diversion Canal to Yapahuwa Minor Reservoir Cascade.** New concrete lined canal of 13.7 km long canal, taking off from the proposed upper Mediyawa feeder canal, design discharge 3.5 m^3/s. BW 2.0 m, side slopes (S/S) 1:2; bed slope 0.0003; FSD 1.02 m to feed around 1000 ha of existing lands under minor cascade with improved water management practices in the area.

ANNEX 3: CANAL PARAMETERS

1. This annex lists the parameters for the 14 canal reaches for the NWPC.

Canal No:	Description	Length (km)	Q (cumec)	Q overload	BW (m)	D (m)	Conc FB (m)	Earth FB (m)	V (m/s)	Bed Slope	S/S	Remarks
1	Dambulu Oya to Wemedilla LBMC	8.59	10	12	3.5	1.78	0.45	0.6	0.95	0.00018	1 on 2	CTZ, CC, CA, OTHER
2	Wemedilla LBMC to Nebadagahawatta (Devahuwa Feeder Canal)	5.11	10	12	3.5	1.78	0.45	0.6	0.95	0.00018	1 on 2	CTZ, CC, CA, OTHER
3	Tail Canal from Wemedilla new Sluice to Main Canal	0.60	7	8	2.5	1.34	0.51	0.6	1.05	0.0003	1 on 2	CTZ
4	Nebadagahawatta to Mahakithula Tunnel Inlet	18.39	10	12	3.5	1.78	0.45	0.6	0.95	0.00018	1 on 2	CTZ, CC, CA, OTHER
5	Tunnel to Mahakithula	0.70	10	12	5	1.78	0.38		1.35	0.00039	Vert	T
6	Earth Feeder Canal from Mahakithula Saddle Dam to Mahakirula	3.66	5.5	6.5	3	1.46	-	0.75	0.75	0.0004	1 on 2	E, CC
7	Mi Oya RB1 Canal from Mahakirula RB Sluice to Galgiriyawa	13.73	5.5	6	1.5	1.41	0.55	0.6	0.98	0.0003	1 on 2	CTZ, E, OTHER
8	Mi Oya RB2 Canal from Galgiriyawa to Kaduruwewa	7.50	1.5	2	2	0.98	-	0.47	0.56	0.0004	1 on 2	CTZ, E, OTHER
9	Feeder Canal from Mahakirula RB Sluice to Abakolawewa System	2.00	4	5.5	1.5	1.3	0.17	0.3	0.94	0.0003	1 on 2	CTZ
10	Mahakithula Main Dam to Bifurcation	0.16	9	10	3	1.51	0.52	0.6	1.10	0.0003	1 on 2	CTZ
11	Earth Canal from Mahakithula Bifurcation to Hakwatuna Oya stream	0.50	6	7	2	1.69	-	0.48	0.77	0.0004	1 on 2	E
12	Mahakithula Bifurcation to Mi Oya U/S of Pothuwila tank	1.34	6	7	2	1.42	0.5	0.6	1.02	0.0003	1 on 2	CTZ
13	Feeder Canal from Pothuwila to Upper Mediyawa	19.98	4	5.5	1.5	1.36	0.42	0.6	0.96	0.0003	1 on 2	CTZ
14	Feeder Canal to Yapahuwa Cascade	13.70	2	2.25	1.5	0.9	0.55	0	0.76	0.0003	1 on 2	CTZ
TOTAL		95.96										

For Concrete Canal, n = 0.015

For Earthen Canal, n = 0.025

Parameters shown in the table refer to CTZ only.

Concrete Trapezoidal	CTZ
Concrete Aqueduct	CA
Cut & Cover	CC
Earth Trapezoidal	E
Tunnel	T
Other (syphon, Level Crossing etc.)	OTHER

ANNEX 4: CANAL STRUCTURES

1. This annex lists a summary of the canal structures for the 14 canal reaches on the NWPC.

Canal No:	Canal Route	Canal Length km	Diversion / Inlet Struct.	Bifurcation	T/O	Drops	DUC	DOC	Reg cum Bridge	Road Crossings	Main Bridges	Aqueduct	Offtake	Others (Bathing Steps, Cut/Cover, Foot Brdg, Causeways etc.)	Syphon	Level Crossings (Inlets & Outlets)	Railway Crossing	Tunnel	Sluice	Spillway	Dam	Remarks	Total
1	Dambulu Oya to Wemedilla LBMC	8.59	1		4		12		1	9	2	1		12								Main Diversion, Intake, Main Canal & Outlet to Wemedilla LBMC	42
2	Wemedilla LBMC to Nebadagahawatta (Devahuwa Feeder Canal)	5.11			13	1	2	6	2	5		1	1	12								Improvements to Existing Canal & Nebadagawatta improvements	43
3	Tail Canal from Wemedilla new Sluice to Main Canal	0.60				3	1			1									1			New Sluice & Tail Canal	6
4	Nebadagahawatta to Mahakithula Tunnel Inlet	18.39			13	-	13	2	4	12	2	1		26	3							Canal to Tunnel Inlet	76
5	Tunnel to Mahakithula	0.70																1				Tunnel	1
6	Earth Feeder Canal from Mahakithula Saddle Dam to Mahakirula	3.66																	2	1	2	Main & Saddle Dam + Spild + Sluices + Feeder Canals	5
7	Mi Oya RB1 Canal from Mahakirula RB Sluice to Galgiriyawa	13.73			18	11	4			13	2			13			1					Mi Oya RB1 + Structs	62
8	Mi Oya RB2 Canal from Galgiriyawa to Kaduruwewa	7.50			11		4			3				1								Mi Oya RB2 + Structs	19
9	Feeder Canal from Mahakirula RB Sluice to Abakolawewa System	2.00		1										4		1			1	1	1	Link Canal + Structs + Mahadambe Level Crossing Improvements	9
10	Mahakithula Main Dam to Bifurcation	0.16		1																		Hakwatuna/Pothuwila Bifurcation	1
11	Earth Canal from Mahakithula Bifurcation to Hakwatuna Oya stream	0.50																				From Main sluice	-
12	Mahakithula Bifurcation to Mi Oya U/S of Pothuwila tank	1.34				8				2				2								Link Canal + Structs	12
13	Feeder Canal from Pothuwila to Upper Mediyawa	19.98			28	15	3			16	3			16		10	1		1			Feeder Canal + Sluice + Improvements to Pothuwila Tank	93
14	Feeder Canal to Yapahuwa Cascade	13.70																				Designs in progress	
		95.96	1	2	87	38	39	8	7	61	9	3	1	86	3	11	2	1	5	2	3		
			359																10			TOTAL	369
			Canal Structures																Reservor Structures				

ANNEX 5: MAJOR STRUCTURES

1. The tables below list a summary of the major canal and reservoir structures respectively.

Table 1: Summary of Major Structures

ROUTE / LOCATION	STRUCTURE	NOS	LOCATION	DESCRIPTION
Dambulu Oya to Wemedilla LBMC	Main Diversion Structure across the Dambulu Oya & Intake Structure With Bridge	1	0 +000 - Across Dambulu Oya	3 Nos. Radial Gates; Size: W = 5 m; H= 4.4 m
	Main Bridges	2	At 0 + 730 - For **Lenadora - Nayakumbura Road (PRDA)**	2 Lanes; Length of Pre Cast Beam - 13.5m
			At1 + 460 - **Kandy - Jaffna Main Road - A 009 (RDA)**	
	Aqueduct	1	Between 7 + 764 - 7 + 881 Across the **Welamitiya Oya**	Q = 12 cumec; BW = 3.5 m; L = 117 m
	Cut & Cover Sections	1	Between 7 + 602 - 7 + 738	No of Barrels - 02 Bed Width - 3.25m Per Barrel FSD - 1.800m FB - 0.45m
Wemedilla LBMC to Nebadagahawatte	Aqueduct	1	At 1 + 423 - **Across the Malawa Oya**	Q = 12 cumec; BW = 3.5 m; L = 74m
	Off Take Structures	1	At 5 + 060 For **Dewahuwa Feeder Canal**	Q = $10m^3/s$
Nebadagahawatte to Mahakithula	Main Bridges	2	At 8 + 634 - For **Ambepussa - Kurunegala -Dambulla** - Road **(RDA)**	2 Lanes; Length of Pre Cast Beam - 13.5m
			At 12 + 238 - For **Galewela - Moragolla** Road **(PRDA)**	
	Aqueduct	1	Between 13 + 770 - 14 + 140	Q = 12 cumec; BW = 3.5 m; L = 370 m
	Syphon	3	At 7 + 800	Q = 12 cumec; Size: 3.5 m (W)x2.6 m (H); L=43 m
			At 9 + 770	Q = 12 cumec; Size: 3.5 m (W)x2.6 m (H); L=45 m
			At 12 + 165	Q = 12 cumec; Size: 3.5 m (W)x2.6 m (H); L=45 m
	Cut & Cover Sections	9	Between 6 + 300 - 6 + 340	No of Barrels - 02; Bed Width = 3.25m Per Barrel; FSD = 1.80m; FB = 0.45m
			Between 6 + 680 - 6 + 790	
			Between 6 + 920 -7 + 040	
			Between 7 + 127 - 7 + 172	
			Between 7 + 300 - 7 + 500	
			Between 8 + 390 - 8 + 600	
			Between 8 + 800 - 9 + 200	
			Between 13 + 185 - 13 + 195	
			Between 13 + 390 - 13 + 396	
	Tunnel	1	Between 22 + 460 - 23 + 400	
Mahakithula Main Dam to Mi Oya (US	Bifurcation Structure	1	At 0 + 156 For Pothuwila and Hakwatuna	**Hakwatuna** - Q = 4 cumec
				Pothuwila - Q = 6 cumec

ROUTE / LOCATION	STRUCTURE	NOS	LOCATION	DESCRIPTION
Earth Feeder Canal from Mahakithula Saddle Dam to Mahakirula (From 0+000km to 3+660km)	Cut & Cover Sections	1	Between 0 + 147 - 2 + 448	No of Barrels - 02 Bed Width - 2.25m FSD - 1.66m FB - 0.45m
Mahakirula to 13 + 731 km (Upper Mi - Oya RB1)	Main Bridges	2	At 6 + 940 - For **Maho - Moragollagama - Road B - 326 (RDA)** At 11 + 900 - For **Galnewa Road (PRDA)**	2 Lanes; Length of Pre Cast Beam - 9.5m
	Railway Crossings	1	At 5 + 778 - Maho - Gal Oya Junction	Culvert Q = 6.0 cumec
	Bifurcation Structure	1	At 0 + 300 For Upper Mi Oya and Abakolawewa	**Abakolawewa** - Q - 4.5 cumec **Mi Oya** - Q = 6 cumec
Pothuwila LB new sluice to Upper Mediyawa (From 0+000 to 19+978)	Aqueduct	2	At 0 + 580 - Over Stream At 1 + 215 - Over Stream	Q = 5.5 cumec; BW = 3.1 m
	Main Bridges	3	At 3 + 765 - For **Pothuwila - Polpithigama Road** At 6 + 979 - For **Ibbagamuwa - Madagalla Road** At 14 + 107 - For Maho - Madagalla **Road**	2 Lanes; Length of Pre Cast Beam - 9.5m
	Railway Crossings	1	At 14 + 950 - **Maho - Gal Oya Junction**	Culvert Q = 5.5 cumec
Feeder Canal from Upper Mediyawa canal to Yapahuwa	Cut & Cover Sections	1	Between 3 + 575 - 4 + 451	No of Barrels - 01 Bed Width - 2.4m FSD - 0.865m FB - 0.885m
	Railway Crossings	1	At 8 + 416 - **Maho - Gal Oya Junction**	Culvert Q = 1.75 cumec

Table 2: Summary of Reservoir Structures

NAME OF TANK	STRUCTURE	NOS	LOCATION	DESCRIPTION
Wemedilla Tank	New Sluice Structure	1.00	Saddle near LB end of Tank	Discharge - 8.5 cumec
				No of Barrels - 2
				Length of Barrel - 70m
				Barrel Size: 1.45m (W) x 1.8m (H)
Mahakithula Tank	Main Dam Sluice to Hakwatuna reservoir and Pothuwila	1.00	RB of Main Dam	Discharge - 12 Cumec
				No of Barrels - 02
				Length of Barrel - 67m
				Barrel Size: - 1.8m (W) x 2.1m (H)
	Saddle Dam Sluice to Mahakirula	1.00	LB of Saddle Dam	Discharge - 6.5 Cumec
				No of Barrels - 02
				Length of Barrel - 39m
				Internal Size of Barrel - Width - 1.375m , Height - 1.75m
	Spill	1.00	In Main Dam	Type - Ungated Chute Spillway
				Max Discharge - 28 Cumec
				Spill Length - 41.12m
	Main Dam	1.00		Length - 1734 m
				Max Height - 26m
				Top Width - 5m
				FSL - 201 masl
				Side Slopes - 1 on 2.5 U/S & D/S
	Saddle Dam	1.00		Length - 572m
				Max Height - 11.2m
				Top Width - 5m
				FSL - 201 masl
				Side Slopes - 1 on 2.5 U/S & D/S
Mahakirula Tank	Main Dam Sluice Structure to Abakolawewa and Upper Mi Oya	1.00	RB of Main Dam	Discharge - 10.5 cumec
				No of Barrels - 02
				Length of Barrel - 58m
				Barrel Size: 1.75m (W) x 2.1m (H)
	Spill	1.00	In Main Dam	Type - Ungated Chute Spillway
				Max Discharge - 28 Cumec
				Spill Length - 41.12m
	Main Dam	1.00		Length - 333.5m
				Max Height - 24.12m
				Top Width - 5m
				FSL - 180 masl
				Side Slopes - 1 on 2.5 U/S & D/S
Pothuwila Tank	Main Dam Sluice Structure to Upper Mediyawa	1.00	LB of Main Dam	Discharge - 5.5 cumec
				No of Barrels - To be Designed
				Barrel Length -To be Designed
				Size of Barrel - To be Designed

ROUTE / LOCATION	STRUCTURE	NOS	LOCATION	DESCRIPTION
Dambulu Oya to Wemedilla LBMC	Main Diversion Structure across the Dambulu Oya & Intake Structure With Bridge	1	0 +000 - Across Dambulu Oya	3 Nos. Radial Gates; Size: W = 5 m; H= 4.4 m
	Main Bridges	2	At 0 + 730 - For **Lenadora - Nayakumbura Road (PRDA)**	2 Lanes; Length of Pre Cast Beam - 13.5m
			At1 + 460 - **Kandy - Jaffna Main Road - A 009 (RDA)**	
	Aqueduct	1	Between 7 + 764 - 7 + 881 Across the **Welamitiya Oya**	Q = 12 cumec; BW = 3.5 m; L = 117 m
	Cut & Cover Sections	1	Between 7 + 602 - 7 + 738	No of Barrels - 02 Bed Width - 3.25m Per Barrel FSD - 1.800m FB - 0.45m
Wemedilla LBMC to Nebadagahawatte	Aqueduct	1	At 1 + 423 - **Across the Malawa Oya**	Q = 12 cumec; BW = 3.5 m; L = 74m
	Off Take Structures	1	At 5 + 060 For **Dewahuwa Feeder Canal**	Q = 10m^3/s
Nebadagahawatte to Mahakithula	Main Bridges	2	At 8 + 634 - For **Ambepussa - Kurunegala -Dambulla** - Road **(RDA)**	2 Lanes; Length of Pre Cast Beam - 13.5m
			At 12 + 238 - For **Galewela - Moragolla** Road **(PRDA)**	
	Aqueduct	1	Between 13 + 770 - 14 + 140	Q = 12 cumec; BW = 3.5 m; L = 370 m
	Syphon	3	At 7 + 800	Q = 12 cumec; Size: 3.5 m (W)x2.6 m (H); L=43 m
			At 9 + 770	Q = 12 cumec; Size: 3.5 m (W)x2.6 m (H); L=45 m
			At 12 + 165	Q = 12 cumec; Size: 3.5 m (W)x2.6 m (H); L=45 m
	Cut & Cover Sections	9	Between 6 + 300 - 6 + 340	No of Barrels - 02; Bed Width = 3.25m Per Barrel; FSD = 1.80m; FB = 0.45m
			Between 6 + 680 - 6 + 790	
			Between 6 + 920 -7 + 040	
			Between 7 + 127 - 7 + 172	
			Between 7 + 300 - 7 + 500	
			Between 8 + 390 - 8 + 600	
			Between 8 + 800 - 9 + 200	
			Between 13 + 185 - 13 + 195	
			Between 13 + 390 - 13 + 396	
	Tunnel	1	Between 22 + 460 - 23 + 400	
Mahakithula Main Dam to Mi Oya (US	Bifurcation Structure	1	At 0 + 156 For Pothuwila and Hakwatuna	**Hakwatuna** - Q = 4 cumec
				Pothuwila - Q = 6 cumec
Earth Feeder Canal from Mahakithula Saddle Dam to Mahakirula (From 0+000km to 3+660km)	Cut & Cover Sections	1	Between 0 + 147 - 2 + 448	No of Barrels - 02 Bed Width - 2.25m FSD - 1.66m FB - 0.45m
Mahakirula to 13 + 731 km (Upper Mi - Oya RB1)	Main Bridges	2	At 6 + 940 - For **Maho - Moragollagama - Road B - 326 (RDA)**	2 Lanes; Length of Pre Cast Beam - 9.5m
			At 11 + 900 - For **Galnewa Road (PRDA)**	
	Railway Crossings	1	At 5 + 778 - Maho - Gal Oya Junction	Culvert Q = 6.0 cumec
	Bifurcation Structure	1	At 0 + 300 For Upper Mi Oya and Abakolawewa	**Abakolawewa** - Q - 4.5 cumec
				Mi Oya - Q = 6 cumec
Pothuwila LB new sluice to Upper Mediyawa (From 0+000 to 19+978)	Aqueduct	2	At 0 + 580 - Over Stream	Q = 5.5 cumec; BW = 3.1 m
			At 1 + 215 - Over Stream	
	Main Bridges	3	At 3 + 765 - For **Pothuwila - Polpithigama Road**	2 Lanes; Length of Pre Cast Beam - 9.5m
			At 6 + 979 - For **Ibbagamuwa - Madagalla Road**	
			At 14 + 107 - For Maho - Madagalla **Road**	
	Railway Crossings	1	At 14 + 950 - **Maho - Gal Oya Junction**	Culvert Q = 5.5 cumec
Feeder Canal from	Cut & Cover Sections	1	Between 3 + 575 - 4 + 451	No of Barrels - 01 Bed Width - 2.4m FSD - 0.865m

ANNEX 6: STABILITY ANALYSIS

1. This annex lists details of the stability analysis for the construction of reservoirs on the NWPC.

2. The three reservoirs (dams) are:

    - Mahakithula: abandoned and breached minor tank to be restored and capacity increased to 14.7 MCM.
    - Mahakirula: working tank to be redesigned and increased to 10 MCM capacity
    - Mahadambe: working tank to be improved as a level crossing in between Mahakithula and Mahakirula.

3. The following sections present details of the stability analysis for the Mahakithula and Mahakirula reservoirs.

1. Mahakithula Dam

4. The salient features for the Mahakithula embankment are presented below:

    - Embankment Type: Earth fill with puddle core
    - Maximum height: 26.43 m
    - Length: 1725 m
    - Crest level: 203.5 masl
    - Full Supply Level: 201.0 masl
    - High Flood Level: 201.5 masl
    - Proposed U/S slope: 1 in 3
    - Proposed D/S slope: 1 in 3

5. The stability analysis were undertaken using the computer program, SLOPE/W, developed by Geo-Slope International Ltd using Morgenstern and Price method of 2-dimensional simplified limit equilibrium method. The assessment considers stability in both the upstream and downstream direction under:

    - Steady seepage conditions
    - Flood rise
    - Rapid drawdown
    - Seismic loading

6. For the purpose of stability analysis the highest cross section of the dam is taken. The upstream and downstream slopes are assumed as 1 in 3.

7. **Material Properties**: The material parameters adopted for the various embankment zones for the stability analyses are summarized in Table 1.

Table 1: Material Properties for the Mahakithula Embankment

Description of Material Zone	Bulk Density kN/m^3		Shear Strength Parameters	
	Above Water Table (moist)	Saturated	Friction angle (deg)	Cohesion (kPa)
Puddle Core	16	16	20	5
Proposed Earth fill Material	19	20	40 D/S 35 U/S	15
Proposed Filter Material	20	21	35	0
Foundation residual soil	-	21	35	5
Foundation weathered rock	-	21	45	0

8. **Minimum Factors of Safety**: The minimum Factors of safety required under different loadings are summarized in Table 2.

Table 2: Minimum Factors of Safety (FOS)

Load Case	Loading Condition	Description	Factor of Safety (FOS)
1	Steady State Seepage	Long term loading with reservoir at full supply level FSL, for downstream slope stability	1.5
2	Steady State Seepage	Long term loading with reservoir at full supply level FSL for upstream slope stability	1.3
3	Flood rise to HFL	Short term loading condition with reservoir level at HFL	1.4
4	Rapid Draw down	RDD of Reservoir water level from FSL to the drawdown level	1.3
5	Seismic Load	seismic loading added, stability of both upstream and downstream slopes at FSL	1.0

9. For this analysis, design peak ground acceleration (pga) of 0.15 g was adopted. This value was selected based on the available seismicity information.

10. **Loading Cases**: The embankment will be analysed for the six (6) load cases as described below:

- **Load Case 1**: Steady state seepage condition; that is conditions typically existing within the dam and the foundation with the reservoir operating at FSL; downstream slope stability.

- **Load Case 2**: Steady state seepage condition; that is conditions typically existing within the dam and the foundation with the reservoir operating at FSL; upstream slope stability,
- **Load Case 3:** Flood rise, short term loading condition; with the reservoir level rising from FSL to maximum pool or HFL level,
- **Load Case 4:** Rapid drawdown, with the reservoir level lowered from FSL to the sill level of the sluice in a relatively short time.
- **Load Case 5:** Steady state seepage under seismic load; both upstream and downstream slope stability with reservoir at FSL.

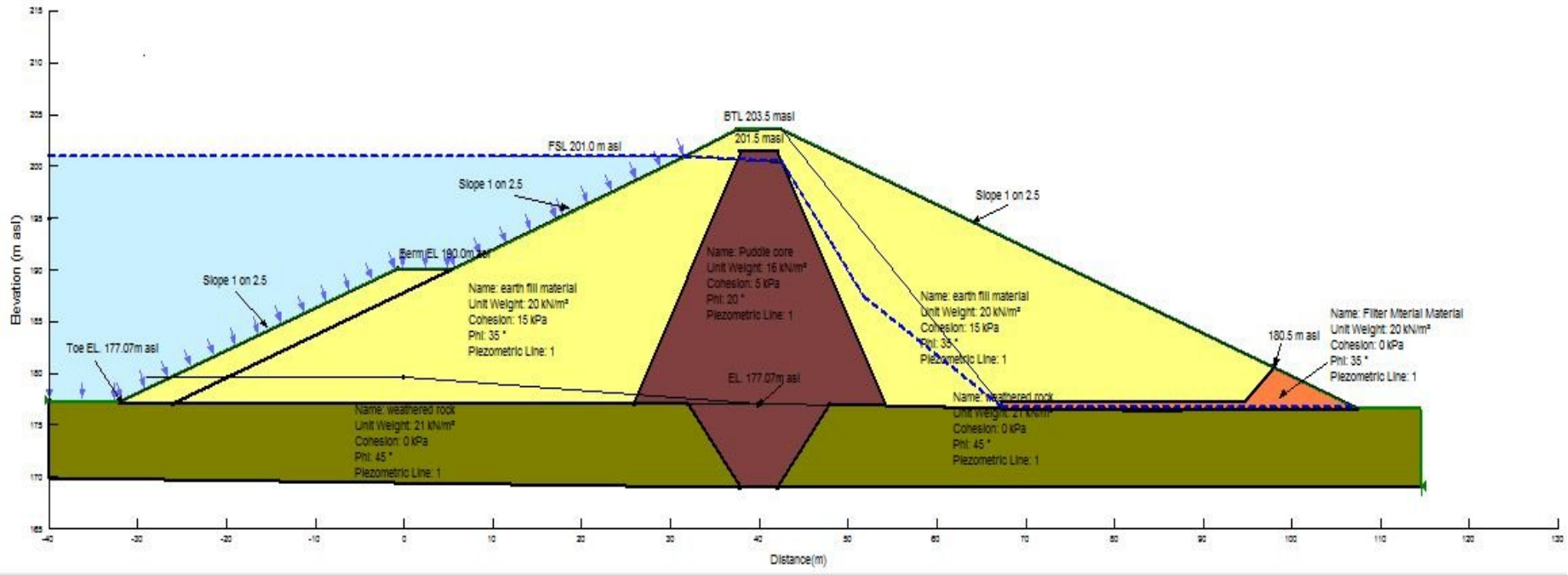
11. Results of the Stability Analysis: Table 3 shows that the calculated factors of safety are larger than the minimum required values for the various loading conditions. Therefore it is concluded that the static and seismic slope stability of the embankment dam section are adequate.

Table 3: Summary of Results of Stability Analysis of Mahakithula Embankment[8]

Load Case	Direction of Failure	Reservoir Level	Acceptable Minimum FOS	FOS of the Failure Circle with friction angle 35 deg
1	D/S	FSL	1.5	2.35
2	U/S	FSL	1.3	2.67
3	D/S	HFL	1.4	2.34
4	U/S	Drawdown	1.3	1.92
5	D/S with earthquake loading	FSL	1.0	1.66
6	U/S with earthquake loading	FSL	1.0	1.53

[8] Typical Section at Ch.1242 m

Figure 1: Mahakithula Dam Embankment Section



Notes:

- To satisfy the design criteria the upstream and downstream slopes are kept at 1 in 3.
- A berm on 1 in 3 has been added on the downstream side up to EL.190.0 m asl to satisfy the design criteria under all loadings conditions.
- An inverted filter has been added at the downstream toe to safely collect and dispose of any seepage.
- The upstream face of the dam will be protected by a riprap layer on its outer face, to guard against erosion due to wave action. The riprap will be underlain by layer of gravel to serve as a filter between fill material and the rip rap.

2. Mahakirula Dam

12. The salient features of the Mahakirula dam are:

- Embankment Type: Earth fill with puddle core
- Maximum height: 23.08m
- Length: 330m
- Crest level: 182.5 masl
- Full Supply Level: 180.0 masl
- High Flood Level: 180.5 m asl
- Proposed U/S slope: 1 in 3
- Proposed D/S slope: 1 in 3

13. The method of analysis is same as that of the Mahakithula dam, as presented above.

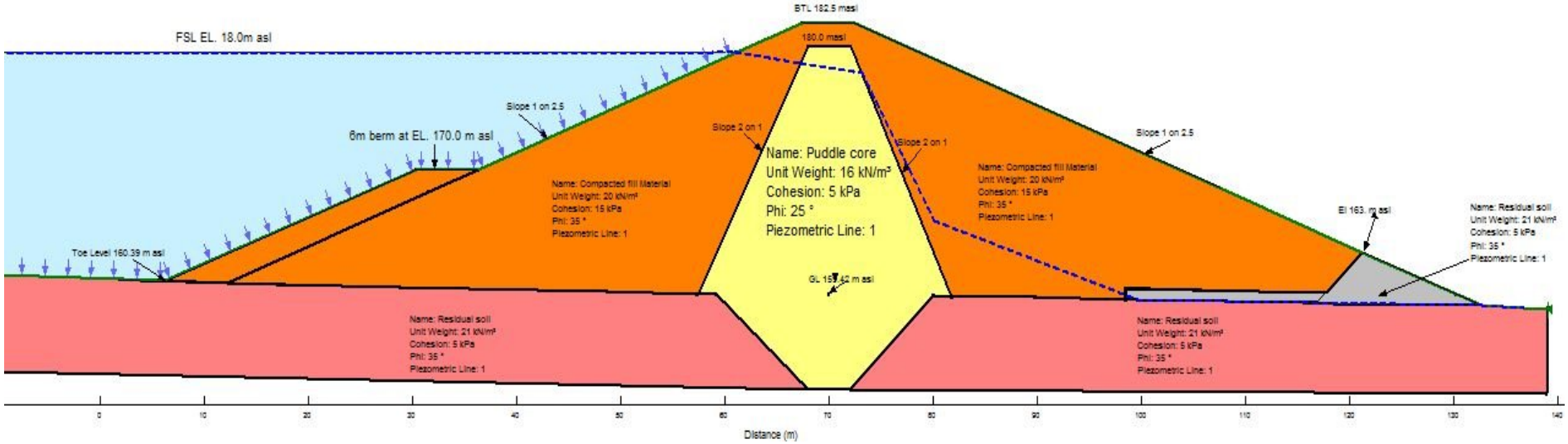
14. **Results of the Stability Analysis**: The analysis shows that the calculated factors of safety are larger than the minimum required values for the various loading conditions. Therefore it is concluded that the static and seismic slope stability of the embankment dam section adequate.

Table 4: Summary of Results of Stability Analysis of Mahakirula Dam Embankment[9]

Load Case	Direction of Failure	Reservoir Level	Acceptable Minimum FOS
1	D/S	FSL	1.5
2	U/S	FSL	1.3
3	D/S	HFL	1.4
4	U/S	Drawdown	1.3
5	D/S with earthquake loading	FSL	1.0
6	U/S with earthquake loading	FSL	1.0

[9] Typical Section at Ch.1242 m

Figure 2: Mahakirula Dam Embankment Section



Notes:

- To satisfy the design criteria the upstream and downstream slopes are kept at 1 in 3.
- A berm on 1 in 3 has been added on the downstream side up to EL.170.0 m asl to satisfy the design criteria under all loadings conditions.
- An inverted filter has been added at the downstream toe to safely collect and dispose of any seepage.
- The upstream face of the dam will be protected by a riprap layer on its outer face, to guard against erosion due to wave action. The riprap will be underlain by layer of gravel to serve as a filter between fill material and the rip rap.

TECHNICAL DESIGN REVIEW AND ASSESSMENT
MINIPE LEFT BANK CANAL REHABILITATION

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 6

TECHNICAL SUMMARY

MINIPE LEFT BANK CANAL

NOVEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
AIDM	–	Acres Irrigation Demand Model
ARSP	–	Acres Reservoir Simulation Program
BTL	–	Bund Top Level
BW	–	Bed Width
CEB	–	Ceylon Electricity Board
CECB	–	Ceylon Engineering Consultancy Bureau
CI	–	Cropping Intensity
CSS	–	Cross Sections
DAD	–	Department of Agrarian Development
DDF	–	Depth Duration Frequency
DSWRPP	–	Dam Safety and Water Resources Planning Project
FOS	–	Factor of Safety
fb	–	free board
fsl	–	full supply level
GOSL	–	Government of Sri Lanka
HFL	–	High Flood Level
HEC	–	Human Elephant Conflict
HFC	–	Huruluwewa Feeder Canal
ID	–	Irrigation Department
JICA	–	Japan International Cooperation Agency
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
LB	–	Left Bank
LBMC	–	Left Bank Main Canal
LSS	–	Longitudinal Sections
MASL	–	Mahaweli Authority of Sri Lanka
masl	–	metres above sea level
MCB	–	Mahaweli Consultancy Bureau
MDP	–	Mahaweli Development Project
MLBC	–	Minipe Left Bank Canal
MIWRM	–	Ministry of Irrigation and Water Resources Management
PMF	–	Peak Maximum Flood
RB	–	Right Bank
RDA	–	Rural Development Authority
SOP	–	Seasonal Operational Plan
WMS	–	Water Management Secretariat

WEIGHTS AND MEASURES

ha	–	hectares
GW	–	gigawatt
km	–	kilometer
km^2	–	square kilometer
km^3	–	cubic kilometer
MCM	–	million cubic metres
mm	–	millimeter
m^3	–	cubic meter
m^3/s	–	cubic meter per second
MW	–	megawatt

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ANNEXES

FIGURES

TABLES

I. INTRODUCTION

A. Technical Summary

1. The purpose of this appendix[1] is to present a summary of the key technical elements of the Minipe Left Bank Canal Rehabilitation Project (MLBCRP). The Project forms part of the planned North Central Province Canal Project (NCPCP) and expansion of the Mahaweli Development Project (MDP).

2. The following sections present an outline of the rationale for the project, the main works components, and the criteria adopted for engineering design. This information is drawn from the project feasibility study and from more recent and on-going work on detailed design and costing.

B. Background

3. In 2011 the Ministry of Irrigation and Water Resources Management (MIWRM) carried out a pre-feasibility study[2] to revive the NCPCP as a solution to scarcity of irrigation and drinking water in the Northern Provinces.[3] The study recommended augmenting water supplies to the provinces by transfers from the Mahaweli River Basin (by transfer from Randenigala Reservoir to Kalu Ganga Reservoir and then to Moragahakanda Reservoir and thence a transfer canal(s) to the north). The MLBCRP is one of a number of projects identified in the above study and for which a feasibility study was commissioned.

4. The scope of the feasibility[4] study included:

(i) To plan and design modifications needed to; raise the existing Minipe Anicut, structural changes to the Left Bank (LB) sluice, LB silt excluder, a new silt excluder based on results of a physical model study including detailed designs and cost estimates.

(ii) To prepare detailed rehabilitation proposals of the Minipe Left Bank Canal with relevant designs, cost estimates and specimen tender documents.

(iii) To study the impacts on Right Bank (RB) canal sluice, RB Canal and RB silt excluder and to give recommendations for preventive measures.

(iv) To prepare an agricultural productivity enhancement proposal considering present land use, agriculture practices and soil fertility etc. (The main target area are paddy lands in Stages I to IV).

(v) To prepare an Operation and Maintenance (O&M) manual for the Minipe Anicut and LB canal and make recommendations for O&M equipment.

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[1] This appendix was prepared by the Mahaweli Consultancy Bureau (MCB) from information from past feasibility studies and current and on-going tender design work, and reviewed and edited by the PPTA consultants.

[2] Prefeasibility Study for North Central Province Canal Project Water Resources Development Plan for NCP, NP and NWP – October 2011

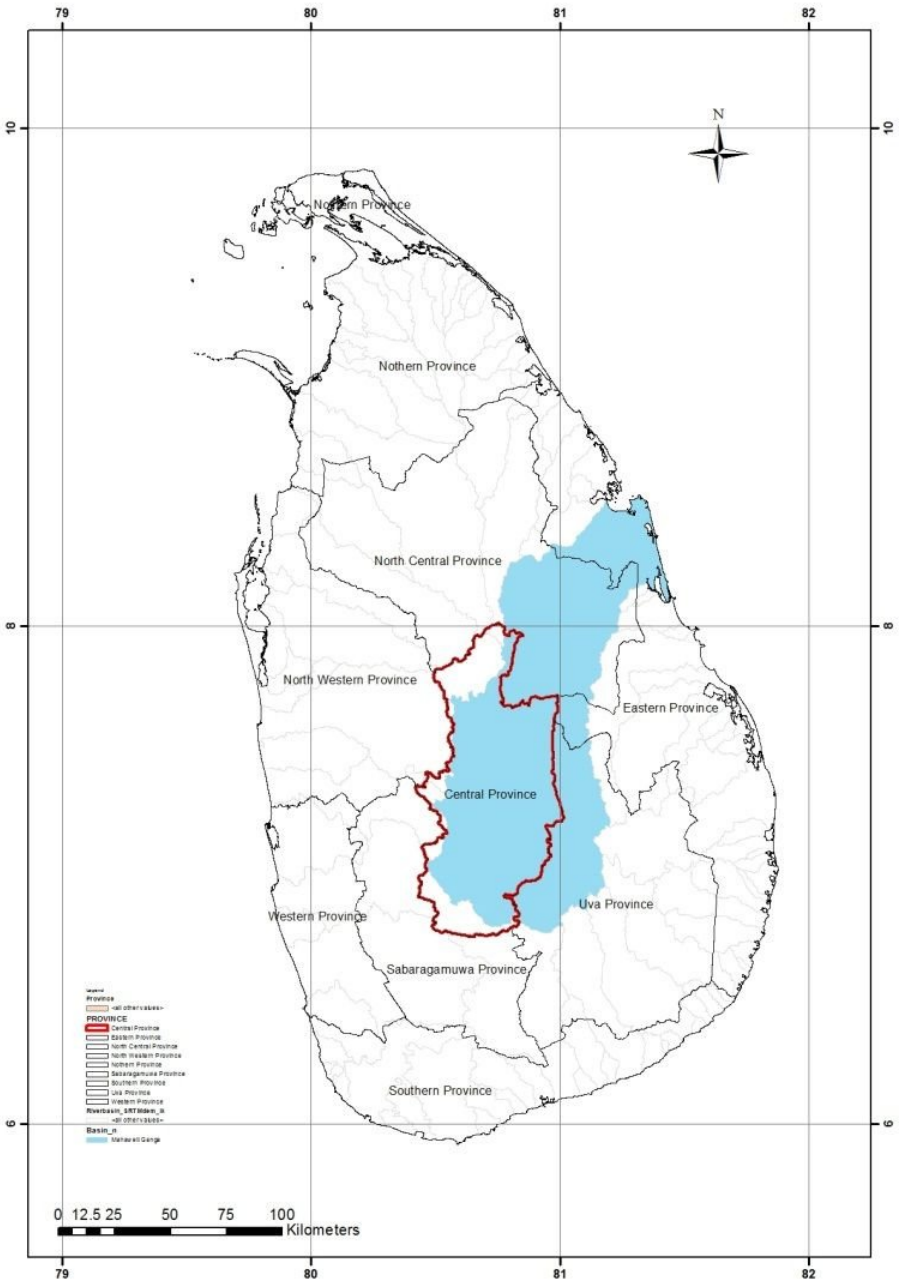
[3] North Central Province (NCP), North Province (NP) and Upper Mi Oya Basin in the North Western Province

[4] Feasibility Studies and Detailed Design of Raising/Modifications to Minipe Anicut and Rehabilitation of Minipe Left Bank Canal – March 2013

II. PROJECT OVERVIEW

5. The Minipe Irrigation System is located in the Mahaweli River Basin and the North East Province. The system is located on the left bank of the Mahaweli Ganga and commands an irrigated area of about 7,500 hectares and with a main canal (MLBC) of approximately 75 kilometers in length. The irrigation system (called “System E”) forms part of the group of systems under the Mahaweli Development Program (MDP).

Figure 1: Minipe System Location



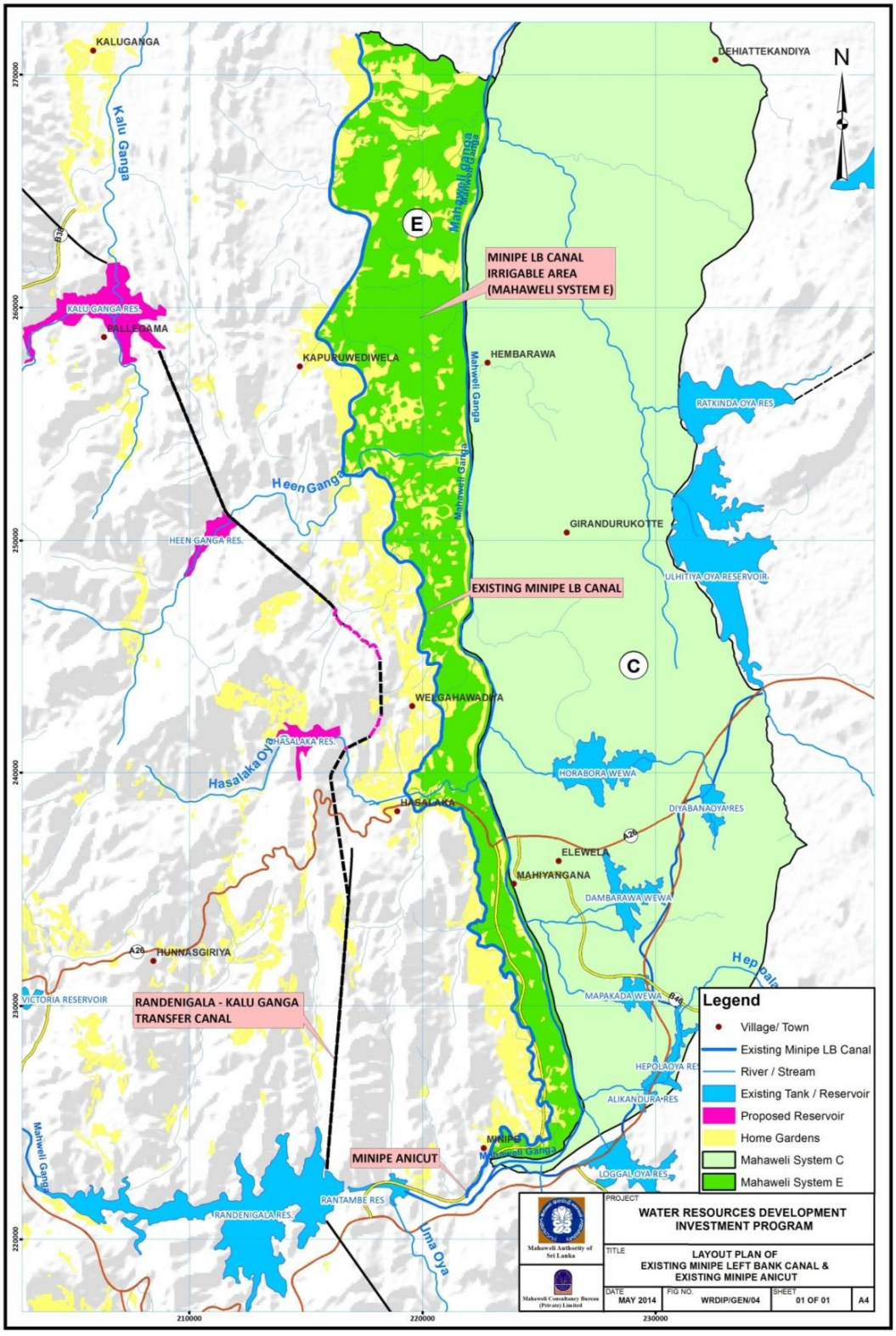
Source: MCB, 2014

A. Project Objectives

6. The principal project objective is to sustain water supply reliability to the Minipe System under conditions of increased upstream diversions within the Mahaweli River Basin (as discussed below) as part of the NCPCP and facilitate a move to peaking power generation in the upstream hydropower cascade. The objectives also include increasing water use efficiency (WUE) and productivity of agricultural lands within the system.

7. Water resources developments upstream of the Rantambe Reservoir under the NCPCP will reduce the inflows to Rantambe and thence the System E. In addition, Hasalaka Oya and Heen Ganga, which are tributaries of Mahaweli River which supplement System E, will also be developed to augment water supply to NCPCP target areas (see **Figure 2**). Also it is planned to operate the hydropower cascade on the Mahaweli Ganga upstream of the Minipe Anicut under peaking conditions, which will create greater daily variations in river flows.

Figure 2: Layout of the Minipe Irrigation System (System E)



Source: MCB, 2014

8. Therefore as a result of the development of the NCPCP, it is required to make the optimum use of water releases from Rantambe Reservoir by reducing spills at the anicut through increasing upstream storage. The existing storage capacity is small (at 0.18 MCM). The raising of the anicut will reduce spillage and increase water availability for irrigation and maintenance of downstream environmental flows.

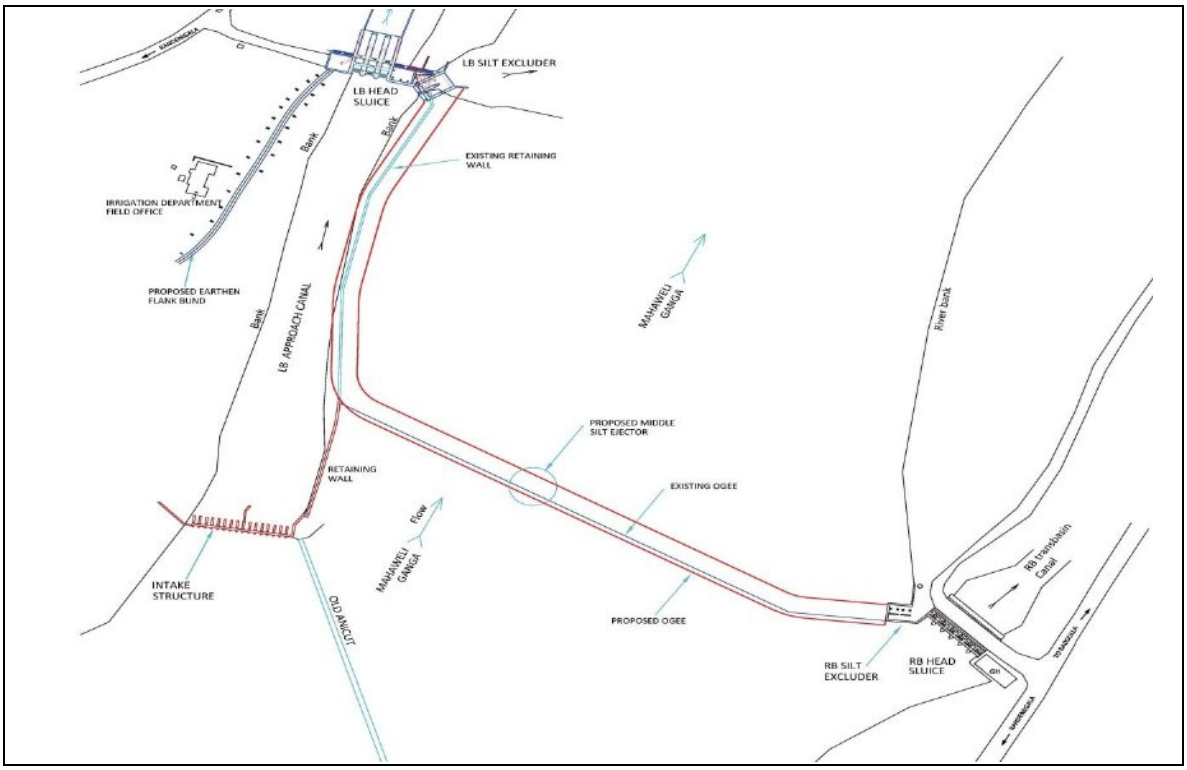
9. System E is an old irrigation system, originally constructed in 459 AD by the ancient kings. In 1941, the Department of Irrigation (DOI) restored the Minipe Anicut by constructing a low flow weir with an intake structure to divert water to the MLBC. This system was improved in 1963 with a new head sluice and a silt excluder, along with an extension of the MLBC and expansion of irrigation area. In 1983 a new anicut was constructed immediately downstream of the previous anicut under the Accelerated Mahaweli Development Program (AMDP) and the Right Bank (RB) trans-basin canal was constructed to augment irrigation systems in the Maduru Oya river Basin (Systems B and C).

10. **Annex 1** lists the base data and surveys carried out in support of the feasibility study and detailed design.

1. Minipe Anicut

11. The existing Minipe Anicut includes a head sluice incorporated with silt excluder gates in right bank and left banks. **Figure 3** shows anicut layout including MLBC and RB canal intakes. It is a weir constructed across Mahaweli River, located about 3.2 km downstream of the Rantambe Reservoir, the lower most hydropower scheme in Mahaweli River. The existing weir consists of two sections, a main weir and a side weir. The main weir is an ogee section of 225 m length with a crest level of 114.0 masl. This ogee section was constructed under the AMDP in 1983. The side weir is a rubble masonry wall of 150 m length with a crest level of 115.0 masl. This retaining wall had been constructed in 1940s during restoration of ancient Minipe anicut as the LB head sluice approach canal right bank.

Figure 3: Minipe Anicut



Source: MCB, 2014

12. The water releases from Rantambe power station flows to Minipe Anicut and then are diverted to MLBC and RBC for irrigation purposes. The 74-km long MLBC runs parallel to Mahaweli River and feeds 7,472 ha of irrigable lands. The RBC canal augments a few major/medium irrigation reservoirs in Mahaweli River Basin and flows up to Ulhitiya/ Rathkinda Reservoirs. The length of the RBC is 30.5 km. From Rathkinda Reservoir water is transferred to Maduru Oya Reservoir in the Maduru Oya River Basin through a tunnel.

13. Minipe pool receives water from Rantambe power releases during peak generating hours and day-time generations. During day-time, only one turbine runs and the releases are mainly to meet the irrigation demand at Minipe Anicut. The current practice of power generation pattern at Rantambe is that both turbines run at peak generation time and only one turbine runs during day time. Depending on the irrigation requirement and availability of water, day-time running time varies. The maximum capacity of turbines is 25 MW and the corresponding power (design) flow is 90 m^3/s. Sometimes these turbines run at low capacities of 20 MW and 15 MW with corresponding flows of 70 and 55 m^3/s. According to the different generation pattern and turbine capacities, the water level at Minipe pool varies throughout the day. **Table 1** shows an average generation pattern at Rantambe.

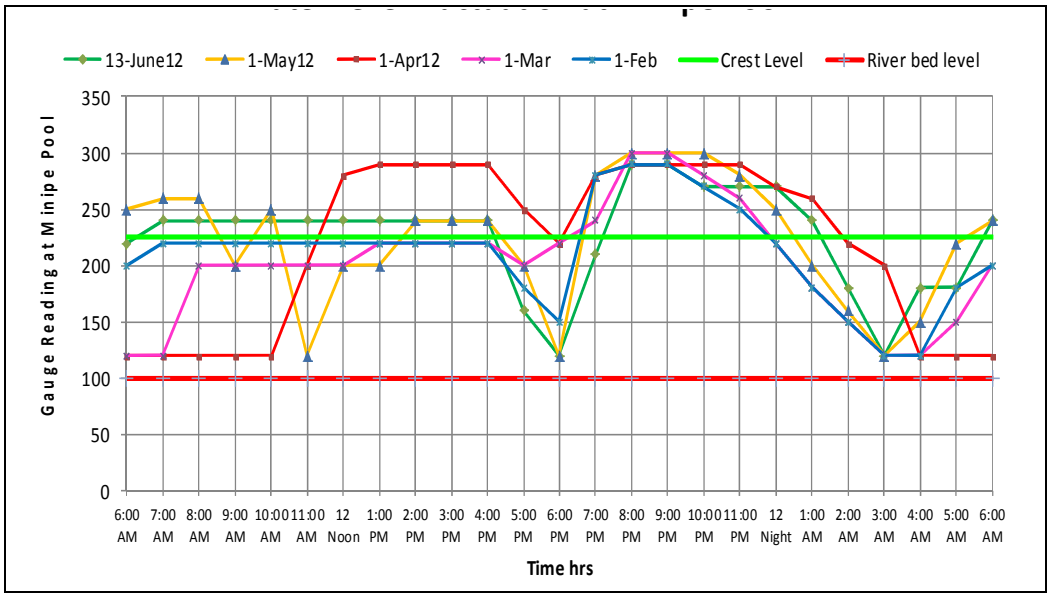
Table 1: Power Generation Pattern at Rantambe

Time	Turbine 1	Trubine 2	Running Time
4:00 AM			
5:00 AM			1 Trubine - for irrigation demand
6:00 AM			Two trubines during morning peak
7:00 AM			
8:00 AM			1 Trubine - for irrigation demand
9:00 AM			1 Trubine - for irrigation demand
10:00 AM			1 Trubine - for irrigation demand
11:00 AM			1 Trubine - for irrigation demand
12:00 Noon			1 Trubine - for irrigation demand
1:00 PM			1 Trubine - for irrigation demand
2:00 PM			1 Trubine - for irrigation demand
3:00 PM			1 Trubine - for irrigation demand
4:00 PM			1 Trubine - for irrigation demand
5:00 PM			1 Trubine - for irrigation demand
6:00 PM			Two trubines during morning peak
7:00 PM			
8:00 PM			
9:00 PM			
10:00 PM			1 Trubine - for irrigation demand
11:00 PM			1 Trubine - for irrigation demand
12:00 Night			1 Trubine - for irrigation demand
1:00 AM			
2:00 AM			
3:00 AM			

Source: MCB, 2014

14. As a result of this power generation pattern there is a large variation in the quantity of water flowing to the Minipe pool and especially to MLBC due to its high sill level compared to RBC. **Figure 4** shows the hourly fluctuation of water level at Minipe on five days from different months. From the graph it can be seen that there is water spilling at Minipe Anicut in the evening from around 7:00 pm to 11:00 pm daily and pool starts to drop from around 2:00 am. In the morning the pool level comes to minimum.

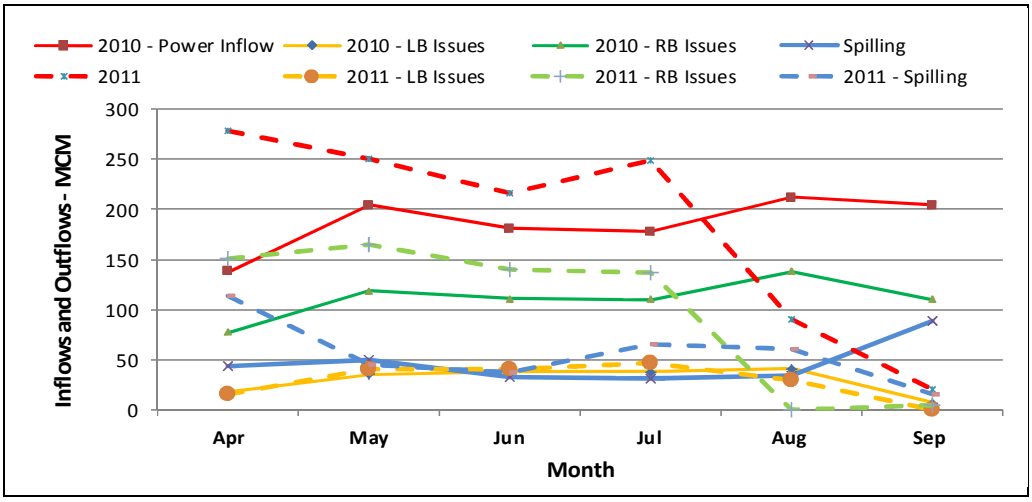
Figure 4: Water Level Fluctuation at Minipe Anicut



Source: MCB, 2014

15. The monthly inflows and outflows were analyzed by obtaining data from the seasonal performance plan prepared by the Water Management Secretariat (WMS) of MASL. **Figure 5** shows monthly inflows and outflows at Minipe Anicut during two Yala seasons 2010 and 2011. It can be seen that the total spilling is greater than or almost equal to LBMC releases in both years.

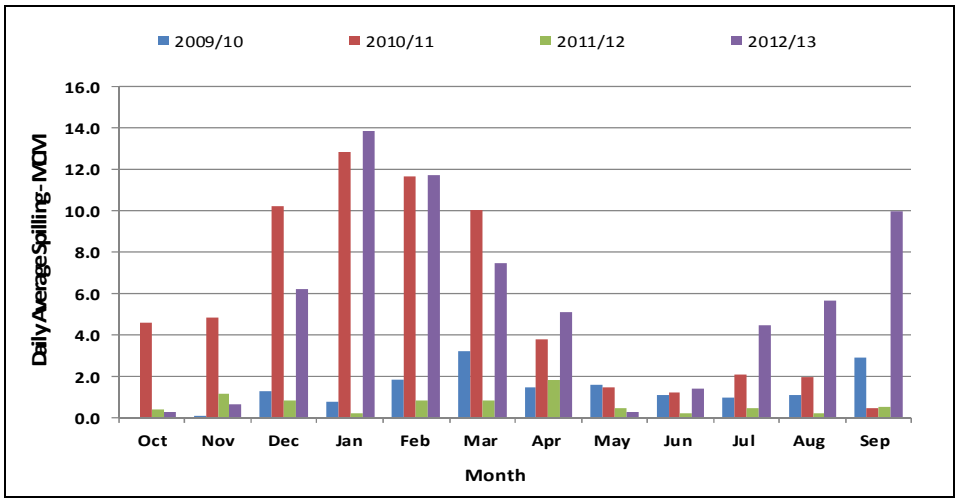
Figure 5: Monthly Inflows and Outflows at Minipe Anicut



Source: MCB, 2014

16. From the monthly spilling values, the average daily spilling was computed for each month and **Figure 6** shows the daily spilling for each month for four consecutive years. Year 2011 and 2012 were very wet years. From this graph it can be seen that the linear trend line is around 1.0 MCM for 2009/10, a normal year. Therefore, having a storage capacity around 1.0 MCM at Minipe pool, the spilling could be minimized, during dry periods especially.

Figure 6: Daily Spill Volumes for Each Calendar Month (2009-2013)



Source: MCB, 2014

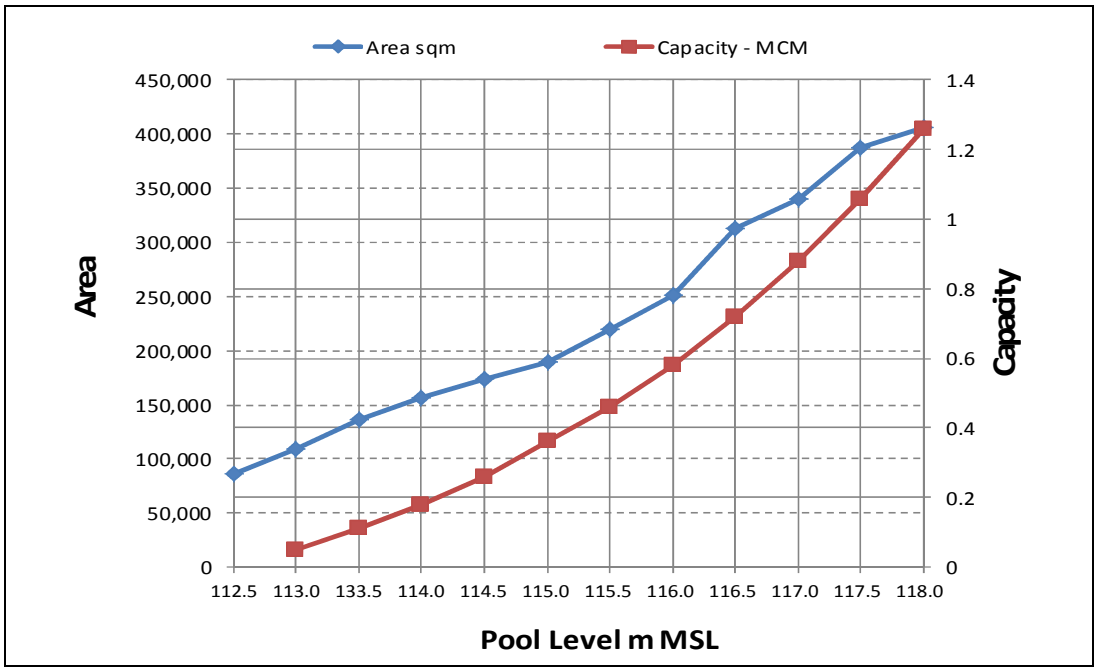
2. Anicut Heightening

17. During the current detailed design the crest level of Minipe Anicut was increased to 117.5 masl, based on the following considerations:

- Normal operating level of Rantambe power outlet is 118.5 masl
- At peak power generation times, two turbines will be operating for 4-5 hours with combined discharge of 180 m^3/s
- Combined conveyance capacity of LB and RB canals = 22 + 64 = 86 m^3/s
- Environmental flow requirement = 1.4 m^3/s
- Discharge in excess (spilling) = 180 - 86 - 1.4 = 92.6 m^3/s
- The additional minimum storage needed to minimize the spilling = 92.6 * 4 * $3600/10^6$ = 1.33 MCM

18. An area – capacity curve was developed under the feasibility study based on the surveys carried out in pooling area (see **Figure 7**). It shows that at 118.0 masl the capacity is 1.22 MCM. The maximum height of the pool is 118 masl based on the outlet elevation from Rantambe of 118.5 masl.

Figure 7: Area Capacity Curve for Minipe Pool



Source: MCB, 2014

3. Left Bank Canal

19. The MLBC is an unlined contour canal that runs parallel to Mahaweli River. It receives water from eleven streams coming from uphill side. The majority of these streams are located in the first half of the canal. Other than drainage inflows from streams, there is a considerable inflow to canal from non-point sources along the canal during rainy days. Out of the eleven streams, five streams namely Hasalaka Oya, Berabun Oya, Ulpathagama Oya, Gamburu Oya and Dunuwila Oya flow to level crossings. The location, catchment areas, and annual flows are shown in **Table 2**. Annual flows were computed using Average Yield Curve available in "Technical Guidelines of Irrigation Department".

Table 2: Details of Major Streams joining Level Crossings

Name	Bund Location		Catchment	Inflows - MCM		Spill Type
	From	To	Area - sqkm	Maha	Yala	
Hasalaka Oya	30 + 200	31 + 800	88.4	67.3	7.8	Radial Gated
Berabun Oya	35 + 300	35 + 800	2.4	1.8	0.2	No spill
Ulpathagama Oya	38 + 000	38 + 800	20.1	15.3	1.8	Natural Spill
Gamburu Oya	66 +700	67 + 500	15.1	11.5	1.3	Radial Gated
Dunuwila tank	68 + 600	69 + 600	16.4	12.5	1.5	Radial Gated

Source: MCB, 2014

20. The Heenganga is a tributary of Mahaweli Ganga that lies within the catchment of MLBC. It has a catchment area of 112 km^2 and has an annual flow of 95.7 MCM. The Heenganga does not directly flow into the MLBC as it flows at a lower elevation than the canal. The MLBC passes over the Heenganga through a trough starting at 49+820 km and has a length of 164 m. In the upstream of Heenganga there is an anicut constructed across the river to divert part of the water to MLBC through a feeder canal. This feeder canal joins MLBC immediately downstream of the trough and has a discharge capacity of 1.0 m^3/s.

21. The 74 km long MLBC feeds 7,472 ha of irrigable lands through 153 turnouts. The updated issue tree of MLBC is given in **Annex 2**, which gives the location and number of turnout structures and extent under each turnout area. There are a large number of canal spills along the canal to pass away the drainage inflows during the rainy season. Along the canal there are cross regulators to control the water surface and to maintain the required control water surface, but some of these structures are not properly functioning at present. There are a few drainage crossings such as siphons and culverts at the initial reach of the canal. **Annex 3** gives the schematic diagram of structures along the MLBC.

22. The discharge of the MLBC fluctuates corresponding to the water level in Minipe pool. This fluctuation affects the discharge in distributary canals especially in the initial reaches of the canal as the head varies. Currently the discharge at highest pool elevation is about 21 m^3/s. This discharge is measured at the beginning of the canal using a gauge post. Even though several numbers of gauging stations are located at different locations along the canal, no records are available.

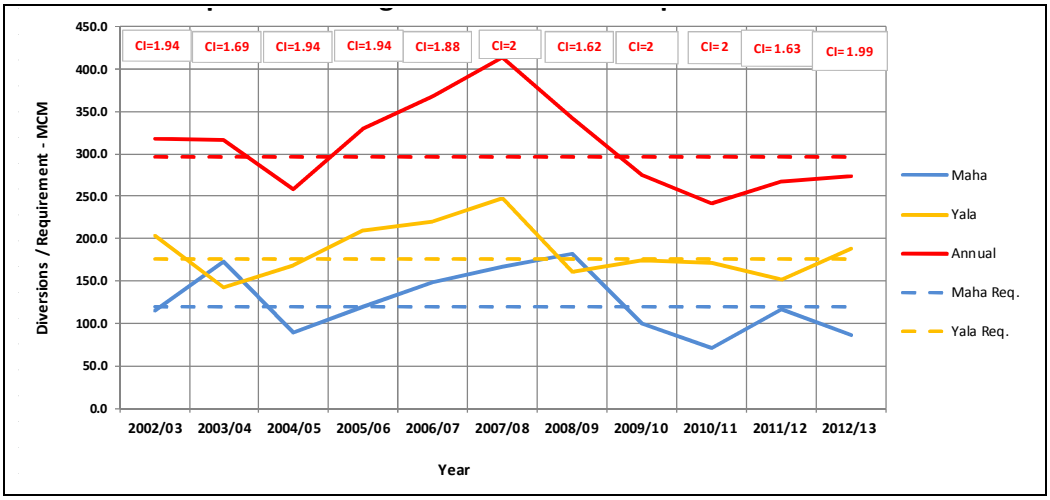
23. Conveyance capacity of the canal is substantially reduced due to silting of the canal bed and growth of water weeds especially at the downstream reaches of the canal, resulting in very low flow velocities. As the canal is an unlined contour canal, along the canal there are several locations where water is spread over large areas, making water pools. This has resulted in excessive lag time for water to reach the downstream, especially after the rotations. Deteriorated canal structures due to poor and neglected maintenance and inadequacy of regulation structures make the operation of irrigation system less efficient. As a result, the command area, especially the area downstream of Heenganga, faces serious water shortages. Therefore, present average annual diversion volume is around 340 MCM which augmented by local inflows to the canal.

24. **Water Usage and Cropping Intensity**. The water usage during Yala and Maha seasons for last 11 years and cropping intensities is shown in **Figure 8**. Cropping intensity is 2 in all years, except 3 years. 2010 and 2011 were comparatively wet years and therefore the cropping intensities was 2. When the long term cropping intensity is generally around 1.8 to 1.9. However, there are also years in which the cropping intensity dropped to 1.62.

25. Except years 2009/10 and 2010/11 years the diversions to MLBC during Yala season is higher than the estimated water requirement which include crop water requirements and all system losses for total extent. Even in some years, Maha season water usage is higher than the requirement. This may be due to the high wastages in the deteriorated system and due to poor water management practices.

26. **Figure 8** shows that the water diversions are high during four years from 2005/06 to 2008/09 period. The average usage during this four year period is 363.8 MCM which is 122% of the estimated water requirement. The annual highest usage is in year 2007/08 with a cropping intensity of 2. This amount is 40% higher than the estimated water requirement.

Figure 8: Water Usage and Cropping Intensities



Source: MCB, 2014

4. Proposed Rehabilitation Canal Works

27. With the proposed rehabilitation project, it is expected to increase the water productivity and land productivity through canal improvements, structural improvements, improving the water management practices and introduction of an organized water measuring systems.

28. The conveyance of the canal will be improved with improvements such as canal desilting, canal lining at identified locations, construction of definition walls which reduce the water spread areas in pools, seepage trappings, improvements to turnout structures and other structures, construction of new regulators and providing Automatic Water Level Recorders (AWLRs) at flow measuring points.

29. According to the water balance study of entire MDP, the annual allocation for System E is 318 MCM.[5] Therefore, with the rehabilitation project it is expected to reduce the annual diversion of 340 MCM to 318 MCM with improved operation system and water management practices including farmers' participation in improving irrigation applications.

30. **Estimated Irrigation Requirement**. Weekly irrigation requirements were estimated considering the reference crop evapotranspiration, crop growth factors, effective rainfall, farm losses and system losses as outlined below.

[5] Final Report: Comprehensive Hydrological/Water Balance Study and Finalization of proposed Randenigala – Kalu Ganga Canal Complex Encompassing Hasalaka and Heen Ganga together with Lower Uma Oya Complexes – Page 25 of 84)

- Reference crop evapotranspiration: Monthly ET_0 values were taken from "Technical Guidelines of Irrigation Department" for the Maha Iluppallama station. These values are used for all irrigation schemes in the dry zone and intermediate zones in Sri Lanka.
- Monthly effective rainfall: This values also obtained from the "Technical Guidelines of Irrigation Department" for agro-ecological zone IL2
- Farm losses (infiltration and deep percolation): A value of 125 mm/month as per the guidelines, though this could be high for the soil types in Minipe area as no actual measurements were made.
- Losses in distribution system: Twenty percent losses are assumed for distribution system
- Losses in main canal: Seepage and percolation losses were computed based on empirical formulas and it was taken as 4.0m^3/s for the main canal.

31. The computation of estimated irrigation requirement for Maha and Yala seasons are shown in **Annexes 4** and **5**. According to above computations, the estimated irrigation requirements are:

- Maha season: 119.7 MCM
- Yala season: 176 MCM
- Annual : 295.7 MCM

III. OPERATIONAL CONCEPT

A. Minipe Anicut

32. At the Minipe Anicut the RB head sluice, silt excluder and canal are operated by the Mahaweli Authority of Sri Lanka (MASL) whereas the Minipe LB head sluice, silt excluder and canal are operated by the DOI. The gate settings of both head sluices are adjusted according to the water level variations at Minipe pool to maintain a continuous flow in main diversion canals and to minimize the fluctuations especially in the MLBC. Currently the RB head sluice gates are electrified and LB sluice gates are manually operated. It is intended to electrify the LB sluice gates under the project.

33. The RBC is basically an augmenting canal supplying irrigation reservoirs whereas the MLBC is a distribution canal where it directly feeds irrigation lands. Therefore, the fluctuations in the pool water levels have a direct effect on efficiency of Minipe irrigation system.

34. Using HECRAS model simulations the amount and timing of gate settings was assessed to meet the irrigation demand after raising the anicut to 118.0 masl level. Targeting the irrigation requirement at MLBC several power generation patterns (flow patterns) were assessed with the HECRAS model as follows:

(i) One turbine working for 20 hrs, and the other working for 5 hrs, with 60 m^3/s discharge per turbine

(ii) One turbine working for 18 hrs with 60 m^3/s discharge per turbine (no peak hrs)

(iii) One turbine working for 18 hrs and the other working for 4 hrs, with 80 m^3/s discharge per turbine

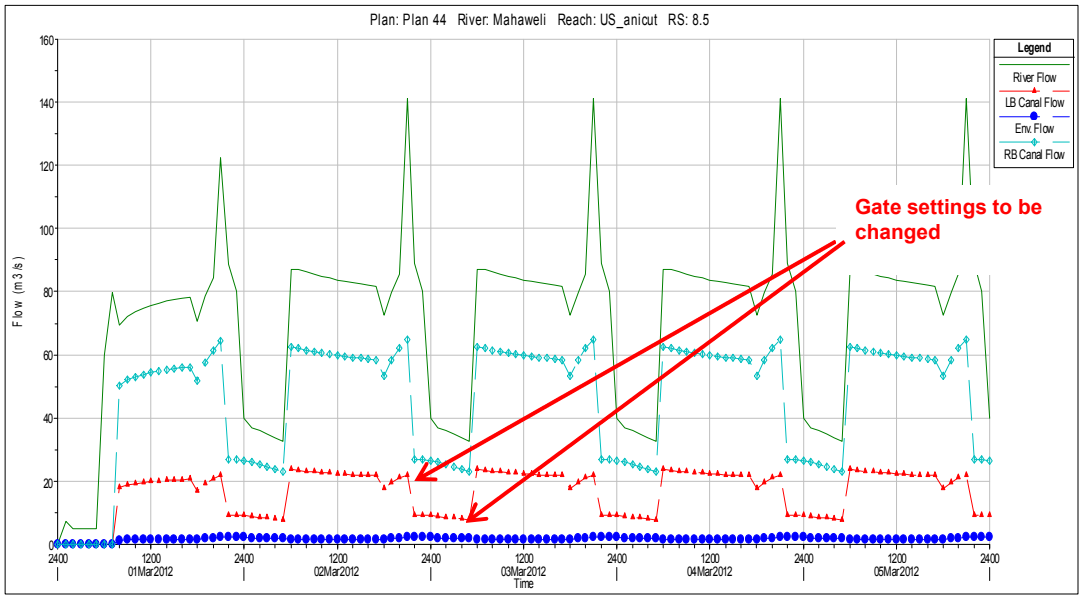
35. The available literature indicates that the maximum design discharge through a single turbine would be 90 m^3/s. But the data obtained from the Ceylon Electricity Board (CEB) Rantambe office indicates that the discharge through a turbine is around 60-65 m^3/s during most periods. As such the model was operated at 60 and 80 m^3/s discharges.

36. The outputs show that the seasonal irrigation requirements of the Minipe system can be generally satisfied with the operating pattern (a) and (b) or (a) and (c), depending on the discharge through a turbine (whether it is 60 m^3/s or more). In **Figure 9** shows the comparison between the HECRAS model results, and the current and projected 2018-22 seasonal requirements (of the Minipe LB and RB Canals).[6]

37. It is noted that the irrigation schedule proposed by this study corresponds to the peak requirement. Inflows from Heenganga and Hasalaka reservoirs and other small streams have not been accounted for, therefore the seasonal and annual demands of Minipe LB Canal can be easily met with the suggested power generation patterns, within normal irrigation seasons. The demand from RB can also be met but within longer period of operation than the LB Canal.

[6] Interim Report of the *Feasibility Study on Proposed Randenigala-Kaluganga Transfer Canal*.

Figure 9: Power Generation[7]



Source: MCB, 2014

38. The HECRAS model was run for two turbine discharges- 80 m^3/s and 60 m^3/s. The outputs showed that when the discharge through a turbine is 60 m^3/s, it requires one turbine to operate for 20 hrs and the other to operate for 5 hrs, to meet the daily irrigation demand. For Sundays, the turbines need to operate for 18 hrs only in response to the LB canal demand. This pattern has to be adjusted according to the power generation requirements and different irrigation demands in the LB and the RB. When the discharge through a turbine is about 80 m^3/s or more, there is little difficulty in sending the near-maximum discharge to both the LB and RB Canals[8].

39. A new irrigation schedule for the MLBC was proposed under the rehabilitation program. The model was operated in response to the proposed irrigation schedule and was subsequently compared with the RB canal requirements. Consideration was given to the power generation patterns and limitations at the Rantambe power house as well. However, when the discharge through a turbine is 60 m^3/s, and if the irrigation requirement is at the peak value, it is difficult to meet the LB canal irrigation requirement in five days. Meeting the deficit on those 5 days is possible by giving priority to the LB canal diversions at the Anicut. However, to meet the demand entirely from the Minipe diversions, the canal would have to run full for 24 hours. Considering the likelihood of wastage during the night and the safety of the canal, this option is not recommended.

[7] For 18 hours with both turbines working for 4 hours to meet the peak evening demand with 80 m3/s discharge per turbine

[8] A detailed analysis is given in the Volume 2 of the Final Report of Feasibility Study.

40. As such, it is recommended to arrange for meeting a part of the deficit by giving priority to the LB canal diversions. The options for meeting the rest of the deficit include extra flows from the proposed Heenganga and Hasalaka reservoirs and by improving the water management. The intermediate reservoirs also have to be operated in an optimum manner, to capture the night time flows and release them early in the morning to reduce the lag time for the increased discharges from the main sluice to arrive.

B. Minipe Left Bank Canal

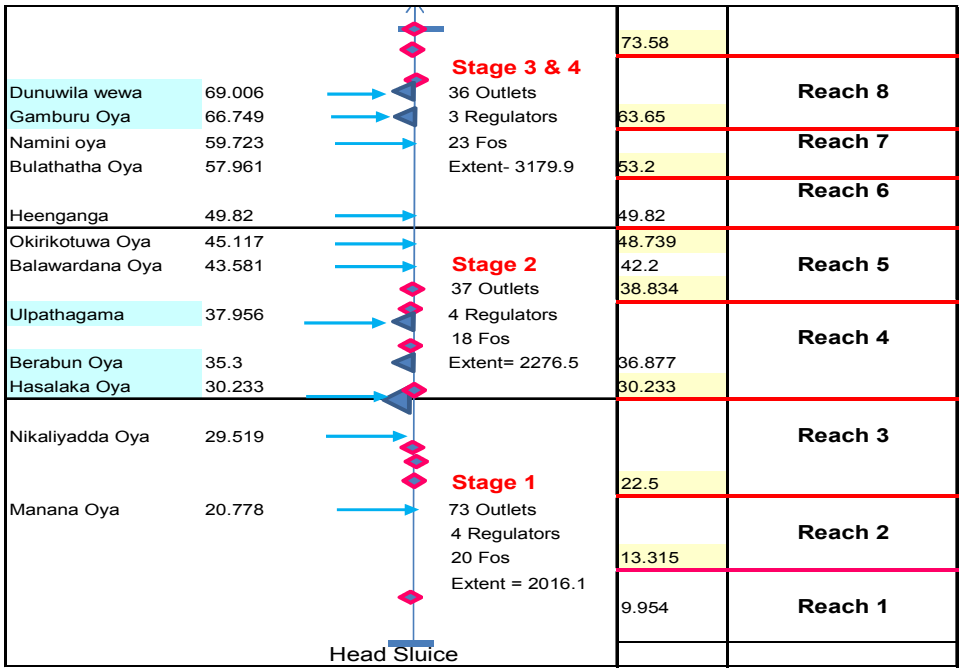
41. Currently the canal operates under four stages (see **Figure 10**). Stage 1 ends at Hasalaka Oya level crossing at 31.8 km and Stage 2 at Heenganga aqueduct at 50.0 km. Diversions from Heenganga anicut join MLBC at the beginning of Stages 3 and 4. With these diversions, Stages 3 and 4 commence their cultivation 15 days ahead of Stages 1 and 2.

42. There are 153 outlets from MLBC to supply to distributary canals and one minor tank cascade. The distributary canals are operated by 61 Farmer Organizations (FOs).

43. There are 11 cross regulators provided along the canal, many of these are not functioning at present. Some of these are located to maintain the water head in the canal and some are to control the water levels in intermediate storage tanks.

44. There are many canal spills, incorporating with silt ejecting gates, along the LB canal especially in initial reaches to release the excess drainage water flowing in to canal and to remove silt deposited in the canal.

Figure 10: Stages and Reaches in Left Bank Main Canal



Source: MCB, 2014

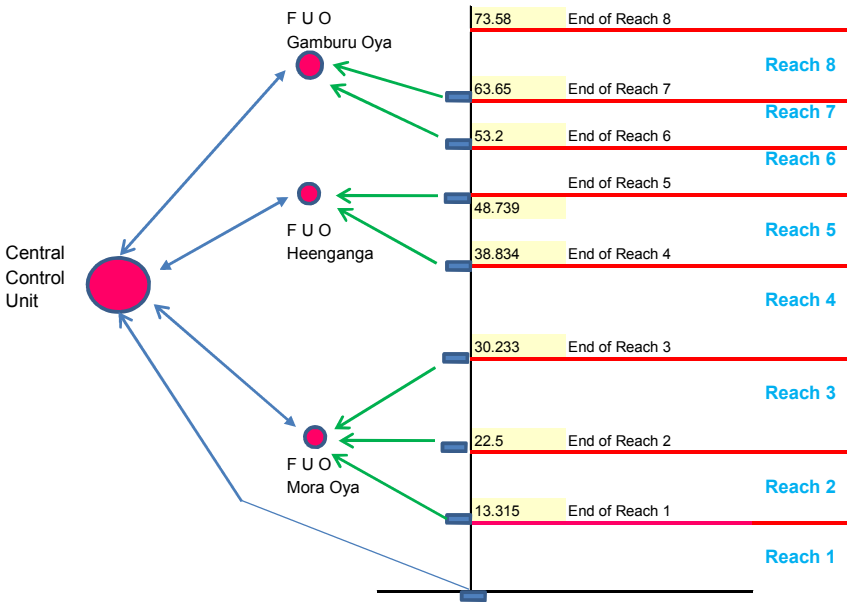
45. With the project it is expected to introduce a new operational system. For design and operational purposes the canal was divided into 8 reaches and the discharge required for each reach was computed for continuous flow during maximum demand. Each reach will receive a bulk allocation. Cross regulators will be provided at end of each reach to ensure that the correct quantity is delivered to the upper reach and correct quantity is flowing to down reach. It is decided to establish AWLRs at these flow monitoring points, which will be connected to field units and to the central coordination unit. FOs will be educated on this new system.

46. All cross regulators and turn outs to distribution system will be operated by the DOI.

47. It is proposed to establish three field unit offices at Mora Yaya for the initial reaches, at Heenganga for middle reaches and at Gamburu Oya for last reaches (see **Figure 11**). These field offices will receive the daily water levels through AWLRs from flow measuring points from different reaches. The three field unit offices are connected to Central Control Unit which will be functioning under Irrigation Engineer in-Charge of Minipe irrigation system.

48. Under the project it is proposed to establish 3 automatic weather stations at Mora Oya, Irrigation Engineer's office at Hasalaka and at Heenganga FUO.

Figure 11: Monitoring System



Source: MCB, 2014

49. During the feasibility study the existing rotation schedule was studied and some inconsistencies were identified. The discharge required on some days is higher than the canals carrying capacity. Therefore the a modified rotation schedule is proposed, based on the following factors:

- In the modernization designs, the canal control structures (regulators) and the flow measuring stations were located with respect to the canal reach boundaries. Therefore the irrigation schedule was made to match with the canal reaches, so that the flow measuring stations could be made use of during the operation
- The schedule corresponds to the designated areas under each FO as well (i.e. no splitting of FO areas during operations), so that a proper coordination with FOs can be maintained.
- The reaches to be supplied with water were selected so that the Main Canal is not overloaded in any particular day
- At the same time, the schedule would not result in partial-emptying of a canal reach or temporary storage reservoirs. This will avoid an increase in lag time.
- The schedule is prepared for the dry conditions when the inflow from Heen Ganga and the other tributaries are a minimum. Therefore, it has to be adjusted to suit the wet conditions.
- The proposed rotation has a 7-day rotation interval

50. The proposed detailed rotational schedule is given in Volume 2, Part 3 (Operation and Maintenance Manual for Minipe Left Bank Main Canal and Headworks) of Final Report of Feasibility Study.

51. Based on the new rotational schedule, the discharge requirement for each reach was computed and the summary as shown in **Table 3**. The rotational schedule was prepared such that the Saturday and Sunday requirement is less as the power flow release at Rantambe is low due to less power demand during weekends.

52. The Seasonal Operation Plan (SOP) for all irrigation schemes benefitting under Mahaweli water is prepared by the Water Management Secretariat (WMS) of Mahaweli Authority of Sri Lanka. Once the full SOP is prepared the plan is presented and explained to all stakeholders at a macro level meeting normally held in Kandy before each season. The farmer representatives from all irrigation schemes under Mahaweli system attend this meeting.

53. This SOP gives the extent to be cultivated under each irrigation scheme, commencing and ending date of cultivation, monthly water allocation for each scheme, operational rule curves for each irrigation reservoirs and also for all hydropower reservoirs etc.

54. The SOP is monitored by the WMS weekly at the weekly water panel meeting held at WMS with the participation of representatives of MASL, Irrigation Department, Ceylon Electricity Board, National Water Supply and Drainage Board.

55. Based on this SOP, the Irrigation Engineer will propose the seasonal plan to all farmers at the Kanna Meeting. In any case of water shortage during the cultivation season the Irrigation Engineer will coordinate with the WMS through the Irrigation Department representative.

Table 3: Rotation Discharges per Reach (m^3/s)

Reach	Mon	Tue	Wed	Thu	Fri	Sat	Sun
R1	3.27	3.27	1.90	1.27	1.27	0.00	0.00
With losses	**4.25**	**4.25**	**2.88**	**2.25**	**2.25**	**0.98**	**0.98**
R2	4.04	4.04	1.68	0.00	0.00	0.00	0.00
With losses	**4.70**	**4.70**	**2.34**	**0.66**	**0.66**	**0.66**	**0.66**
R3	1.19	1.44	3.12	1.67	0.00	0.00	0.00
With losses	**1.70**	**1.96**	**3.63**	**2.18**	**0.51**	**0.51**	**0.51**
Hasalaka Storage Tank							
R4	0.85	0.85	0.85	3.18	3.47	0.71	0.71
With losses	**1.26**	**1.26**	**1.26**	**3.59**	**3.88**	**1.13**	**1.13**
R5	2.24	2.24	2.59	2.95	3.00	4.10	4.25
With losses	**2.87**	**2.87**	**3.22**	**3.58**	**3.63**	**4.73**	**4.88**
Heenganga Aquaduct							
R6	1.34	1.34	1.34	1.34	1.34	0.78	0.78
With losses	**1.47**	**1.47**	**1.47**	**1.47**	**1.47**	**0.91**	**0.91**
R7	0.54	1.66	3.04	2.99	1.93	2.94	3.07
With losses	**1.00**	**2.12**	**3.49**	**3.44**	**2.39**	**3.40**	**3.53**
R8	3.31	1.95	0.66	2.17	2.17	2.17	1.36
With losses	**3.53**	**2.17**	**0.89**	**2.39**	**2.39**	**2.39**	**1.59**
Total Discharge with Losses	**20.78**	**20.79**	**19.18**	**19.57**	**17.17**	**14.71**	**14.18**

Source: MCB, 2014

IV. PROJECT COMPONENTS

56. The MLBC project includes two main components, raising (heightening) of the existing Anicut and rehabilitation of LB canal. The major works proposed under each main component are outlined below.

A. Minipe Anicut Raising: Weir, RB and LB Head Sluices

57. The following improvement works were identified and proposed during the feasibility study and discussed at the Technical Review Committee (TRC) meetings to obtain the views and recommendations of the TRC members.

- Combining the existing ogee main weir and side weir to a monolithic ogee weir with a crest level of 118.0 masl.
- Improvements to left bank head sluice to raise the existing piers from 118.3 masl to high flood level of 121.5 masl, widening and lengthening the piers.
- Electrification of lifting gates.
- Construction of a stilling pool to LB head sluice for energy dissipation.
- Demolishing the existing left bank silt excluder and construction of a new silt excluder with 2 vertical gates and with a lowered sill level of 109.5 masl.
- Construction of flank bund at left bank side to prevent the inundation of low ground due to raised pool level
- Installation of automatic water level recorder to anicut pool
- Construction of an additional silt ejector to improve silt removal
- Construction of a 1 m high protection wall at the upstream edge of the RB head sluice to protect the RB head sluice operation system
- Construction of gabion wall protection along right bank at upstream of RB head sluice to prevent any slope failures due to water level fluctuation in the pool

58. In discussions with the ADB PPTA Consultants, some issues were raised regarding raising the anicut on how to minimize the fluctuations in the MLBC. In the PPTA Inception Report it was recommended:

- Instead of having a side weir, lengthen the main weir to left bank high ground and take the LB head sluice to forward and to construct a the LB silt excluder with radial gates to send the flood discharge through it.
- Right bank alignment to be shifted left to make the head race narrower, to minimize silt accumulation in the approach canal to head sluice.
- Mechanization of LB head sluice with automatic gates to minimize the fluctuations in the LBMC by sending a reasonable constant discharge with a constant head.

1. Piano Key Weir

59. The above recommendations were taken into consideration by the MCB, with the introduction of a Piano Key Weir (PKW) to lengthen the spilling length and therefore reduce the afflux over the weir.

60. The changes to originally proposed modifications were presented and discussed with the PPTA Consultants and the TRC.

61. In the design of Minipe Anicut, the flood discharge was taken as 1 in 1000 year flood discharge at Rantambe Reservoir which is 5,552 m^3/s. The Peak Maximum Flood (PMF) at Rantambe Reservoir is 8,500 m^3/s according to the recently prepared Dam Safety Water Resources Planning Project Report. However this PMF was not considered for the Minipe Anicut as the risk is comparatively at a low level than a reservoir.

62. The afflux for the PKW was computed theoretically and verified from the sectional model test carried out at the Hydraulics Research Laboratory of the Irrigation Department. **Table 4** shows the calculated afflux levels which are considerably lower than those for the proposed heightening of the ogee weir (more than 5 m at 8,500 m^3/s). Based on these results the crest level of the PKW was reduced to 117.5 masl (from the initial design value of 118.0 masl). This also eliminated the need for the protection wall (1 meter) at the RB canal sluice gates.

Table 4: PKW Afflux

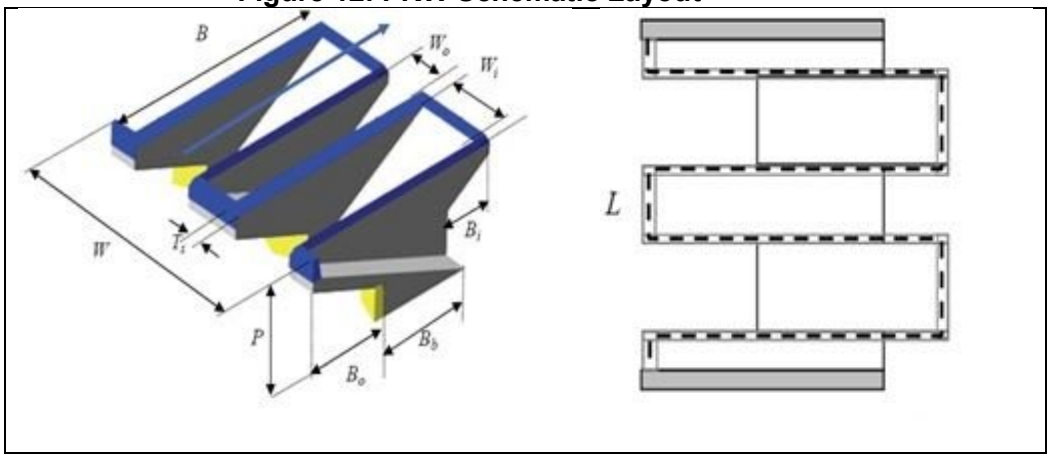
Flood Discharge (m3/s)	Afflux (m)
5,500	2.5
8,500	3.5
10,000	4.6

Source: MCB, 2014

63. In addition to lower afflux levels, the PKW is more effective (than an ogee weir) in reducing upstream silt deposition due to its structural configuration.

64. **Figure 12** shows the schematic configuration of the PKW, and **Table 5** the key parameters.

Figure 12: PKW Schematic Layout



Source: MCB, 2014

Table 5: Piano Key Weir Parameters

Parameter	Dimension (mm)
P	5,000
Bb	5,000
Bi	2,279
Wi	3,334
Wo	2,633
Ts	350
L	46,259
W	13,334

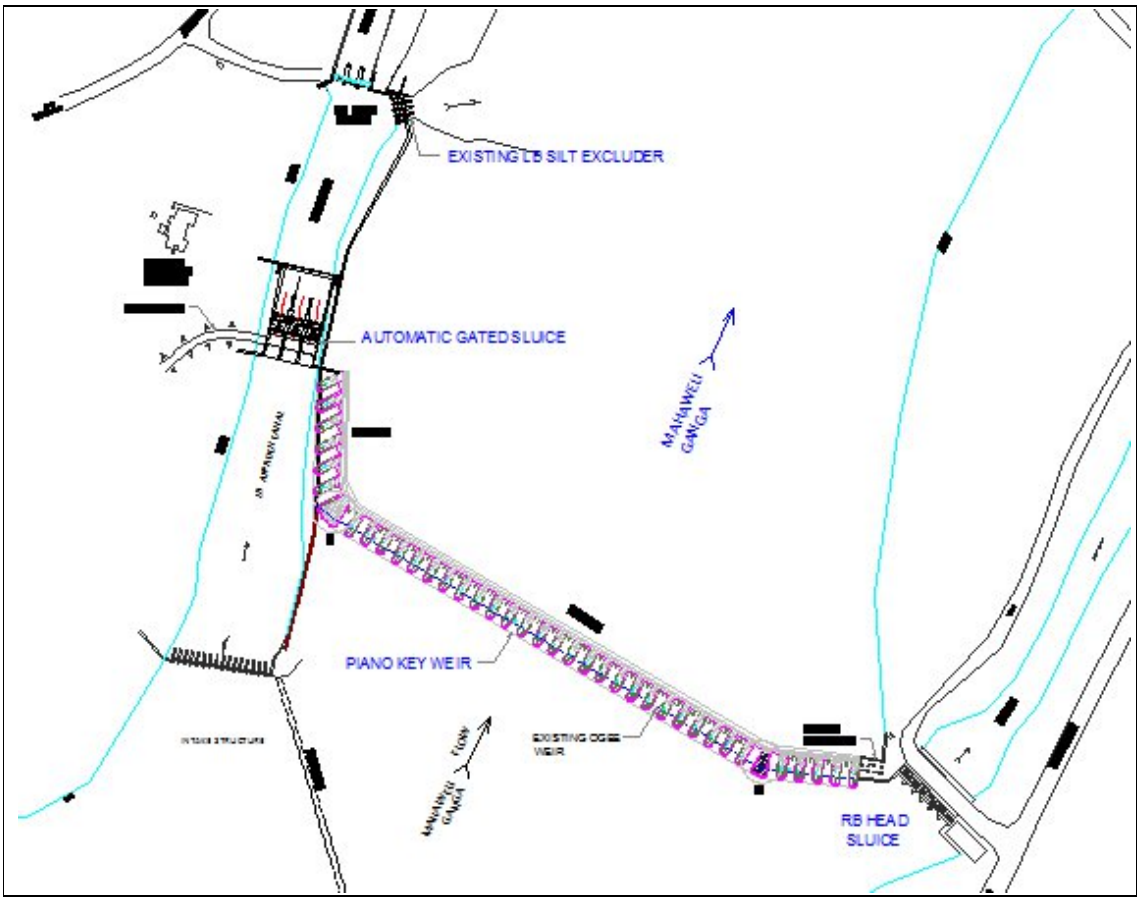
Source: MCB, 2014

2. Automatic Gated Headworks

65. The MCB also took into consideration the recommendations for mechanizing the LB sluice with the addition of automatic sluice gates as the existing LB sluice is not suitable to incorporate automatic gates. Therefore, a new sluice is located about 50 m upstream of existing LB sluice.

66. **Figure 13** shows the layout of the PKW and automated sluice gates.

Figure 13: Anicut and Piano Key Weir Plan



Source: MCB, 2014

B. Modernization of Left Bank Main Canal

67. The following modernization needs have been identified during field surveys and discussions with farmers and other stakeholders. The rehabilitation proposals were presented to the Project Management Coordination Committee meeting held in June 2012 at Ulpathagama and discussed in detail. The key components and activities are:

(i) De-silting the canal bed, removing water weeds, canal cleaning.

(ii) Making the canal cross section more efficient in terms of conveyance by introducing cost-effective and environment-friendly definition walls with gabion boxes in pooling areas of total length of nearly 2.0 km.

(iii) Canal lining to minimize growth of water weeds in selected section of about 6 km from 58.821 km to 64.90 km.

(iv) Providing clay cutoff walls at locations identified as having excessive seepage from the canal bund in Stage 2 at 35+040 km and 37+217 km locations.

(v) Improving the storage and spill capacity of some major pool areas by raising the spill crest level (intermediate storage reservoirs) located at confluences of main streams with the LB Canal with repairs and modifications to the radial gated canal spills.

(vi) Upgrading the feeder canal to village tank cascade (Bogahawewa, Maraka Wewa, Radunna).

(vii) De-silting/dredging some of the level crossings and Heenganga feeder canal.

(viii) Improving the O&M Bund Road including the repairs to causeways where necessary.

68. In addition two components were included as per the discussions held with PPTA consultants, these are:

- Improve the downstream stilling basin of right bank sluice by incorporating baffles
- Construction of a broad crested weir in right bank canal and a canal spill before the Badulu Oya aqueduct for the safety of the aqueduct.

1. Structural Improvements and Repairs

69. The proposed improvements and repairs to existing infrastructure includes:

(i) Canal spills: Improving the efficiency of canal spills and silt-ejecting structures with necessary repairs and modifications. The details of improvements to canal spills are given in **Annex 6**.

(ii) Siphons: The repairs and modifications include providing trash-racks, repairing the wing walls and de-silting at the entrance and exit where necessary.

(iii) Turnout Structures: Identified improvements include constructing wing walls with back filling to provide access to head wall for operations, constructing steps from bund top or the wing walls to the head wall for operating the gate. A standard type headwall with lifting arrangements was introduced for all Turnout structures to facilitate operation and maintenance. The downstream of most of the turnout structures are to be reconstructed due to their poor condition.

(iv) Radial-gated spill structures: There are seven radial gated spill structures along the main canal located at intermediate reservoirs and at locations where major streams confluence the canal. Rehabilitation activities include repair/replacement of mechanical parts, electrification, modifications to the gate leaf, and the concrete structure where necessary.

(v) Cross Regulators: Improving and modifying the existing cross-regulators. The locations and details of regulators are given in **Annex 7**.

2. New Construction

70. The new constructions include:

(i) New regulators. The locations are given in **Annex 7**. Out of the 14 regulators 5 are new. Out of the 5 new structures 3 will be incorporated within existing bridge crossings. The new regulator at 63.65 km, end of Reach 7 will be a "duck bill" type cross regulator. The structural drawing for this type of weir is given in Drawing No: MINIPE/LBMC/STR/19.

(ii) Drain Inlets. The construction of side drain inlets to act as silt traps to trap silt from drainage flows coming from uphill side through small drains. Structural details are shown in drawing number: MINIPE/LBMC/S`TR/01. Total number is 18. (Stage 1: 2 Nos, Stage 2: 4 Nos, Stages 3 and 4: 12 Nos)

(iii) Parallel canal. The construction of a 1,000 m long parallel canal starting from 58+400 km to collect waste water coming from Hettipola township area and dispose it to a downstream area away from the canal. Structural details are shown in Drawing No: MINIPE/LBMC/STR/13

(iv) Retaining Wall. The construction of a retaining walls for bund road canal side slope to ensure the safety of the canal bund

3. Water Management Improvements

71. The proposed works to aid improved system operation and water management include:

(i) Construction of a broad crested weir at the beginning of the LBMC

(ii) Provision of seven AWLRs at flow measuring points

(iii) Provision of Automatic Weather Stations (3) at Irrigation Engineer's office, Mora Oya and Heenganga Field Unit Offices

72. The location, type of work and other details of rehabilitation works are given in the Final Report, Volume 3 – Part 2, the Engineer's Estimate as "List of Works".

V. DESIGN PARAMETERS

73. This section presents a summary of the design parameters adopted for heightening the anicut and rehabilitation of the MLBC.

A. Anicut Design

1. Design Discharge, Afflux and Maximum Flood Level

74. As discussed above the original concept, as proposed in the feasibility study, was for a heightening and lengthening of the existing ogee weir. However, as a result of discussion with the ADB PPTA Consultants, this was subsequently changed to PKW with the purpose of reducing the cost of the structure and lower the head variation in the upstream pond (and thereby reducing the head variation to be regulated at the LB and RB canal intake gates).

75. The Anicut was designed for a flood discharge of 5,552 m^3/s, which is the 1,000 year flood discharge of the Rantambe Reservoir.[9] The flood discharge from its own catchment of 2.1 km^2 was neglected as the drainage flow is comparatively small.

76. Two methods were used to assess the maximum flood level at river section from downstream of Rantambe up to Minipe Anicut. Initially the computations were carried out for the river section using Manning's formula taking Manning's coefficient as 0.035. The head over weir crest for the design discharge was computed using weir formula. Coefficient of discharge for an ogee weir was computed referring to "Design of Small Dams" considering the height of the weir, approach velocity, upstream face slope and downstream submergence. A value of 3.90 in ft/s units, equivalent to 2.17 in the metric system, was used as Cd for the total length of the ogee weir for the initial calculations even though the Cd value is different for side weir section.

77. **Design of PKW.** The most hydraulically feasible section for the PKW was computed considering the existing ogee section parameters and by using different values for the specific PKW design parameters. The discharge over the PKW was computed considering the discharge enhancement ratio (r) and the discharge over a normal weir. The r value was computed using discharge enhancement ratio formula for different heads. Afflux over the weir was obtained from the graph plotted hydraulic head vs specific discharge

78. A stability analysis was carried out to check the safety against overturning, sliding and to calculate stresses at base. In the stability analysis seismic force was taken in to account, and since no earthquake code or regulations for the seismic design of dams is available in Sri Lanka, Indian Standards were used.

[9] The Rantambe flood discharge data was obtained from the "Detailed Design Report – Rantambe Dam- April 2010" prepared under the Dam Safety and Water Resources Planning Project. According to the summary of flood analysis, the outflow flood peak for a 1000 year flood and Probable Maximum Flood are 5,552 m^3/s and 8,500 m^3/s, respectively.

79. The average river bed level at the near upstream of existing ogee section is taken as 111.0 masl. Therefore the height of the weir above the river bed is 6.5 m. From the geotechnical investigations it was found that the sound rock level at the upstream of ogee axis lies at 108 masl. Therefore the bottom level of the new concrete section was taken as 108.0 masl. Hence the new PKW section was analyzed for a 10 m height.

2. Improvements to Right Bank Head Sluice and Canal

80. The flow velocities at downstream of RB sluice would be approximately 11 m^3/s and 12.5 m^3/s respectively at the FSL and with 1 m afflux. Therefore a USBR Type 3 stilling basin is proposed immediately downstream of the RB sluice.

81. In addition, any breakdown or operating error at the RB sluice/intake can endanger the safety of the canal and the aqueduct at Badulu Oya drainage crossing. Therefore, a canal spill is proposed within first km of the canal to send excess water back to the river.

3. Improvements to Left Bank Head Sluice

82. **LB Sluice Piers.** The existing piers of the LB canal sluice gates are not provided with reinforcements for thermal and shrinkage crack control. As the piers are considerably wide, it is required to provide reinforcements to control thermal cracks. Therefore the new section as well as the existing section will be provided with reinforcements. Hence the existing section will be widened by 0.25 m on each side to place new reinforcements. The new sections were designed as a braced plain short wall.

83. Upstream and downstream footings were designed as a combined footing because the distance between piers is comparatively small, and independent footings cannot be provided for individual piers. The length of the footing is 13.04 m between the two edges of the right and left bank abutments of the sluice. Loads of abutments were not taken for the footing design. The designed bed level at the front of the sluice is 111.5 masl. Based on the geotechnical investigations, the foundation level is taken as 110.5 masl.

84. A stability analysis with new loads due to hydrostatic pressure and additional weight due to the increasing height of the pier was carried out to decide on improvements to be done to the existing piers. Different loading conditions, as above, will be considered during computations.

85. **Sluice Abutments.** The existing left bank abutment will be raised from 118.3 masl to 121.5 masl, its length is extended in upstream by 6.29 m to accommodate spacing for stop logs and trash racks and again extended by 6.33 m in downstream. Both new sections were designed as reinforced concrete walls. The increase in height of the existing section is 3.35 m and this section is designed as a mass concrete retaining wall. The height of the upstream new section is 10 m.

86. The new section, its wing wall, a new wall to be constructed perpendicular to the existing abutment was considered as one frame and the design was done accordingly. A Type 3 stilling basin is proposed to dissipate energy downstream of the sluice.

4. Mini-hydropower Generation

87. Considering the available head after raising the anicut and availability of almost continuous flow, there could be a possibility of generating hydropower. However, this aspect was not studied in detail under the detail designs.

B. Rehabilitation of Left Bank Main Canal

1. Design Discharge in Main Canal

88. The total irrigated area according to the updated issue tree is 7,472 ha. The design discharge of the LBMC was computed as follows:

- Required discharge for each distributary canal was computed based on a duty
- The duty in distributary canal is taken as 557.4 ha/m^3/s. This value was computed for Yala season considering the crop water requirements, farm losses (125 mm/month), and loss in the distribution system (20%).
- Considering a 35% main canal conveyance loss the total required discharge at head sluice was computed by adding the discharge required from the bottom end to top end.

89. According to the above computations the design discharge of MLBC at the head is taken as 21.8 m^3/s. The discharge computations are given in **Annex 8.**

90. For design and operational purposes the total canal length is divided in to eight reaches and the design discharges at each reach of the canal is shown **Table 6**.

Table 6: MLBC Design Discharges

Stage	Reach	Extent - ha		Distributory canals			**Design Discharge**
		Reach	Cumu.	Category	Disch. Range	No.	
(1)	(2)	(3)	(4)	(6)	(7)	(8)	(13)
Stage 1	R1	787.4	7472.5	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	17 8 - **25**	**21.8**
	R2	678.3	6685.1	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	19 16 - **35**	**19.5**
	R3	550.4	6006.8	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	4 9 - **13**	**17.5**
Stage 2	R4	759.1	5456.4	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	3 11 - **14**	**15.9**
	R5	1517.3	4697.2	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	9 13 1 **23**	**13.7**
Stage 3	R6	601.3	3179.9	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	4 3 1 **8**	**9.3**
	R7	1282.9	2578.6	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	11 7 - **18**	**7.5**
Stage 4	R8	1295.7	1295.7	Field canal Distributory Branch	0 - 0.03 0.03 - 0.71 > 0.71	1 8 1 **10**	**3.8**

Source: MCB, 2014

2. Canal Design Parameters

91. The design parameters for canal sections were computed using Manning's formula, with the Manning's "n" values between 0.026 to 0.028. For each reach an average bed width is taken (see **Table 7**). It was observed that within each reach there are some sections where the bed slopes are steep. Therefore the canal reaches were designed considering these sections separately.

3. Control Water Surface

92. One of the main concerns in the canal design is to maintain constant water levels in different reaches throughout the canal. Currently regulators are available in the canal at appropriate locations but some of these are not currently functioning. The control water surface can only be properly maintained in the canal by operating the cross canal regulators according the requirement.

93. It is planned to introduce new cross regulators at some locations. A Duckbill type long crested weir is proposed at a location in the tail end as agreed at a Technical Review Committee meeting. Advantage of using a duckbill weir as a cross canal regulator is to minimize the water level fluctuation for varying in canal discharges, without manually operating a gate. During a flood situation the spill gates of the minor tanks/streams are to be operated such that the afflux over the duckbill weir will be at the designed afflux.

94. As there are five level crossings with cross regulators immediately after the level crossings, the control water surface could be easily maintained by fixing the crest level appropriately if long crested weirs are used at these locations.

95. The control water surface of the canal was computed from the end regulator upwards considering the full supply depth of each reach, losses at cross regulators. The head availability at each turnout was checked[10] with the control water surface.

Table 7: Canal Design Parameters

Stage	Reach	Extent	Reach Section		Length	Bed Width	Design	Sub Reach Section				Bed	Hydraulic	FSD
		ha	From	To	km	m	Discharge	Name	From	To	End location	Slope	Gradient	m
Stage 1	R1	787.4	0.000	13.315	13.315	15	**21.8**	R1-1	0.000	3.568	Syphon 1	0.00035	0.00068	1.56
								R1-2	3.591	4.844	Syphon 2	0.00045	0.0011	1.42
								R1-3	4.859	6.800	Bridge	0.0012	0.0012	1.09
								R1-4	6.800	9.950	Regulator	0.0008	0.0007	1.23
								R1-5	9.950	11.075	Syphon 3	0.00033	0.0006	1.59
								R1-6	11.088	13.315	Regulator	0.0006	0.00035	1.57
	R2	678.3	13.315	22.550	9.235	14	**19.5**	R2-1	13.315	14.852	Trough 1	0.00028	0.00024	1.61
								R2-2	14852.000	17.517	Trough 2	0.0003	0.00027	1.53
								R2-3	17.517	19.439	Trough 4	0.0003	0.00031	1.53
								R2-4	19.439	22.550	Regulator	0.0004	0.00032	1.42
	R3	550.4	22.550	30.140	7.590	13	**17.5**	-	-		Hasalaka MST	0.00024	0.00022	1.58
Stage 2	R4	759.1	31.848	38.834	6.986	11.5	**15.9**	-	-		-	0.00033	0.00026	1.52
	R5	1517.3	38.834	49.820	10.986	11	**13.7**	R5-1	38.900	39.800	Regulator	0.00034	0.00034	1.35
								R5-2	39.800	42.200	Regulator	0.00014	0.00018	1.75
								R5-3	42.200	48.700	Regulator	0.00027	0.00027	1.38
								R5-4	48.700	49.800	Aquaduct	0.00031	0.00031	1.35
Stage 3	R6	601.3	49.984	53.200	3.216	8	**9.3**	-	-		-	0.00035	0.00035	1.25
	R7	1282.9	53.200	63.650	10.450	6	**7.5**	-	-		-	0.00028	0.00028	1.33
Stage 4	R8	1295.7	63.650	73.580	9.930	3	**3.8**	R8-1	63.650	66.700	Gamburu Oya	0.0006	0.00027	1.15
								R8-2	67.600	68.552	Regulator	0.0009	0.0004	1.05
								R8-3	69.638	73.580	End regulator	0.00019	0.00019	1.22

Source: MCB, 2014

[10] Computation details are given in Final Report Volume 2 – Part 2, Designs and Specimen Calculations.

VI. PROJECT COSTS AND BENEFITS

A. Costs

96. The total engineer's estimate for the MLBCR amounts to about Rs. 2,500 million. This estimate includes the cost of raising Minipe Anicut including improvements to RB canal and rehabilitation of MLBC.

97. The estimate of the project is divided into 6 packages as shown in **Table 8**. The purpose of packaging the contract was to get the construction work done in the shortest possible time within the short close period between two cultivation seasons. In addition, the fact that different components of the BOQ require different expertise such as civil, mechanical and electrical engineering was taken into consideration.

Table 8: Construction Packages – Engineer's Base Cost Estimate

No	Package Description	Amount Rs M
1	Rehabilitation of Minipe Main Canal – Stage 01	358
2	Rehabilitation of Minipe Main Canal – Stage 02	177
3	Rehabilitation of Minipe Main Canal – Stage 03	702
4	Rehabilitation of Minipe Main Canal – Stage 04	328
5	Electro-mechanical Components of Radial Gates and Cross Regulators	149
6	Improvements to Existing Minipe Weir	743
	Total	**2,457**

B. Benefits

98. Overall benefits of the proposed project can be summarized as follows.

- Reduction in current annual water use from about 340 MCM to about 300 MCM
- Increase in power generation during peak demand period by running turbines with 90 m^3/s output as there is sufficient storage at Minipe pool after raising the anicut
- Reduction in maintenance cost
- Reliable water supply to paddy fields
- Cropping intensity could be increased to 2.0 from current 1.9
- Yield of paddy could be increased to 6.0 mt/ha from the current 5.2 mt/ha
- Environmental enhancement due to improved watershed management

ANNEX 1: BASE DATA

1. This annex presents a summary of the base data for the design of proposed works.

A. Anicut Heightening

2. The investigations and surveys related to design of the anicut are outlined below.

1. Geotechnical Investigations

3. Geotechnical investigations were carried out during the feasibility study to verify the foundation conditions for the Anicut section. Rotary core drilling was carried out in eight locations along the Anicut axis in upstream and downstream. The in situ testing program was limited to testing of permeability of the foundation rock mass by Water Pressure Test (Lugeon test).

4. The geotechnical investigations recommended:

- To carry out local consolidation grouting of the foundation at the identified locations along the axis. After excavating the foundation further testing should be carried out to determine the sections of the foundations to be grouted and depth of grouting
- To carry out contact grouting between concrete structure and bed rock covering the entire base of the structure.
- In general consolidation grouting shall be done before placing the foundation concrete and contact grouting after placing the foundation concrete.

5. The detailed report on the geo-technical investigations is presented in Volume 2-Part 1.

B. Agricultural Productivity and Land Use Survey Study

6. The outputs of the agricultural productivity and land use survey included a low intensity soil map and land use recommendations for future development. Additionally, the current land use is incorporated in the low intensity soil map. These have been prepared at a scale of 1:20,000. Soil characteristics such as internal and external drainage, slopes, texture of soil, depth, water table etc. were assessed under the study.

7. Based on this information, classification of lands in irrigation command area and lands above the irrigation command was done.

Table 1: Recommended Crops

Land Category	Crop Recommendation	Percentage of Area			
		Stage 1	Stage 2	Stage 3	Stage 4
Well drained, deep RBE	Upland crops in both seasons with supplementary irrigation in Yala season.	6.0	1.1	0	0
Imperfectly drained deep RBE and Alluvia	Wetland rice in Maha season. Upland crops in Yala season with supplementary irrigation.	31.2	22.6	6.6	0.8
Poorly drained LHG and Alluvia	Wetland rice in both seasons.	62.8	76.2	93.4	99.2

8. **Increasing Paddy Productivity.** Currently annual paddy yields are approximately 5 metric tons per hectare (mt/ha) which is higher than the national average of 4.5 mt/ha for irrigated paddy. The field investigations and the results of the field demonstrations conducted by the agriculture extension officers indicate that there is potential to increase average yields to 6.0-6.5 mt/ha within few seasons by implementing a properly formulated productivity enhancement field program.

9. Based on the studies carried out during the study, the following recommendations are proposed to increase the productivity of paddy:

- Improve the non-certified seed paddy production within the scheme as the total requirement of seed paddy cannot be met with certified seed from formal sector
- Implement “Yaya demonstration programs” comprising package of inputs and agronomic practices
- Promote seedling broadcasting technique for paddy crop establishment
- Proper weed management and integrated pest management

C. Water Quality and Sedimentation Study

10. During the feasibility study a water quality study and a sedimentation study was carried out for Minipe pool and LBMC. The Engineering Design Centre of the University of Peradeniya was assigned to conduct the study. The consultants collected the data pertaining to 14 parameters in a period of eight months.

11. The study objectives were:

- To make an assessment of silt load in the irrigation water released from the Anicut and in the key locations of canal.
- To study the quality of water in the Minipe LB canal to establish whether it meets irrigation, drinking and bathing quality requirements, and the link with water weeds.

12. The selected locations along the Minipe LB canal included; upstream of Minipe Anicut, downstream of the Mananna-Oya confluence, downstream of the Hasalaka tank, downstream of the Heenganga confluence, downstream of Hettipola town and downstream of KokaWewa.

13. The study was conducted through the period of May to December 2012, covering an entire irrigation cycle. During the study water quality measurements for Color, Turbidity, pH, Temperature, Electrical Conductivity, Hardness, Nitrate, Phosphate, Fluoride, Manganese, Aluminum, BOD_5, Suspended Solids and Total and Fecal Coliform level were made.

14. For the sedimentation analysis, the suspended solid samples were obtained, and the silt load at the monitoring locations of Minipe LB canal was assessed and predicted. The suspended sediment concentrations were measured at the same sampling locations along the LB canal which were used for the water quality analysis. Two pumped samples were taken at each station, one at the surface and the other close to the channel bed. The discharges at these stations were also recorded. The sediments collected during sampling were mostly silt/clay material and sand content was found to be negligible.

15. Conclusions and recommendations from the study are:

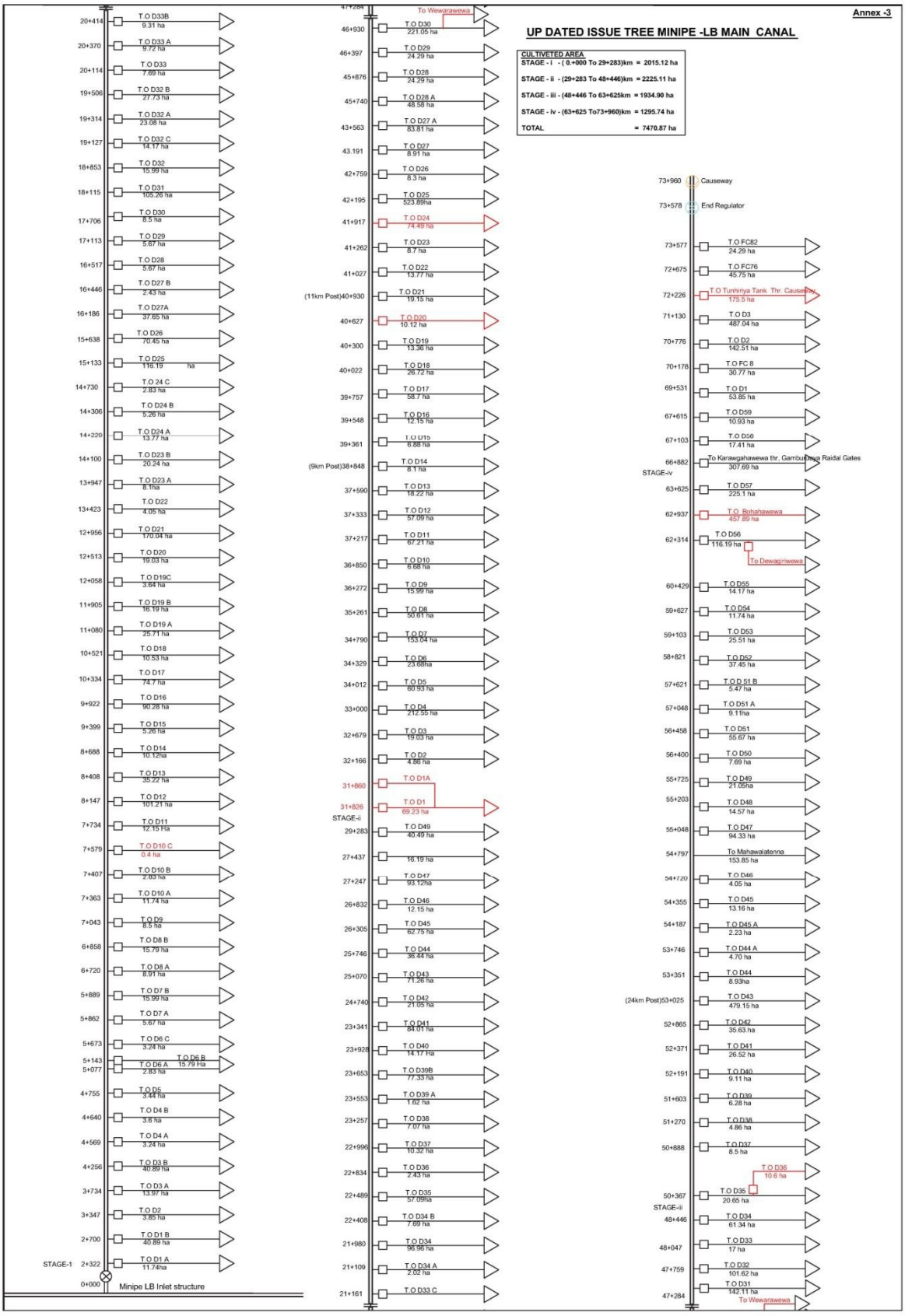
- The results obtained from the studies show that Color, Nitrate, Phosphate, Aluminum and Coliform counts exceed the safe standards for use as source water for drinking purposes, without treatment. Water is generally suitable for bathing except at locations with high Coliform counts, and generally suitable for irrigation. Based on the findings of the studies and the physical and financial constraints, some interventions are proposed to minimize the siltation in the canal and pollution of canal water, and they are incorporated to the feasibility designs:
- The nutrient contents show an increase during paddy cultivation periods. Available nutrient levels in canal water are more than sufficient for encouraging aquatic growth. Also the higher than natural Aluminum content in many of samples indicate possible contaminations from pesticides specially the excessive use of rodenticide, insecticide, and fumigant in the vicinity. Controlling the above contaminant levels in water sources require controlling the direct agriculture runoff entering the streams. Preventing direct draining of agricultural lands and construction of impounding water retaining structures can reduce these pollutants reaching the streams.
- There are several small streams joining the MLBC. Rehabilitation designs should provide silt traps at or before the stream entry points to the MLBC.
- The Sedimentation Study recommended a stable canal section needs to be established by placing gabions along the left bank of the channel at locations where the canal cross section is wide. This was to reduce the problem of canal siltation and improve the hydraulic performance of the Canal. In fact, this option was considered even at the inception phase of the Feasibility Study. However,

due to the very high cost of such an intervention, the protection was limited to 9.2 km, where it was found to be essential, and the canal bottom will be concreted.

- In the case of larger streams such as Mannana Oya, it is not possible to provide such silt traps due to the large water spread area. Under the Maintenance Plan, it is recommended to flush the sediment through the radial gated spills, at least once during a cultivation season.
- Urban wastage is flowing into the canal in the left bank stretch near Hettipola. A parallel lined drain is proposed to be constructed to prevent the urban waste inflow to the MLBC and an arrangement would be made to bypass the MLBC and drain out the waste water to a drainage canal.
- The findings of the Sedimentation and Water Quality study indicates that the main cause of sediment and pollutant inflow to the canal is the human activities related to agriculture and urbanization taking place in the immediate upper water shed of canal. Therefore, improving land use practices of the upper catchment, including proper fertilizer and agro chemicals use, plays a major role in the reduction of sediment and pollutant inflow to the canal. While the conservation of the lands from erosion benefits the farmers by conserving topsoil and reduction of fertilizer requirement etc., the reduction of pollution in the canal has benefits for the community who use the canal water for domestic purposes. As such, it is essential that community participation is solicited for any catchment conservation program from the planning and design stage onwards. Accordingly it is proposed to implement a comprehensive integrated catchment management program in the immediate upper watershed of Minipe canal with community and other stake holder participation for sustainable management of the irrigation system after the modernization of the MLBC.
- High levels of both total and fecal coliform indicate mixing of human waste and animal droppings with water. High fecal contamination is directly contributed by human waste. Often overflowing septic tanks, leaking cesspits and soakage pits are the common causes of fecal contamination. Therefore a proper awareness campaign and access to information on appropriate sanitation practices and sanitary waste disposal methods need urgent attention.
- It is proposed to construct an additional silt excluder on the Minipe Anicut. A coordinated operation of the two existing silt excluders and the proposed central silt excluder corresponding to Rantambe sediment flushing is recommended to minimize the additional silt deposition. In addition, periodic manual or mechanical sediment removal from the Minipe Pool is recommended to remove the sediment deposition, especially at key locations related to the structures.

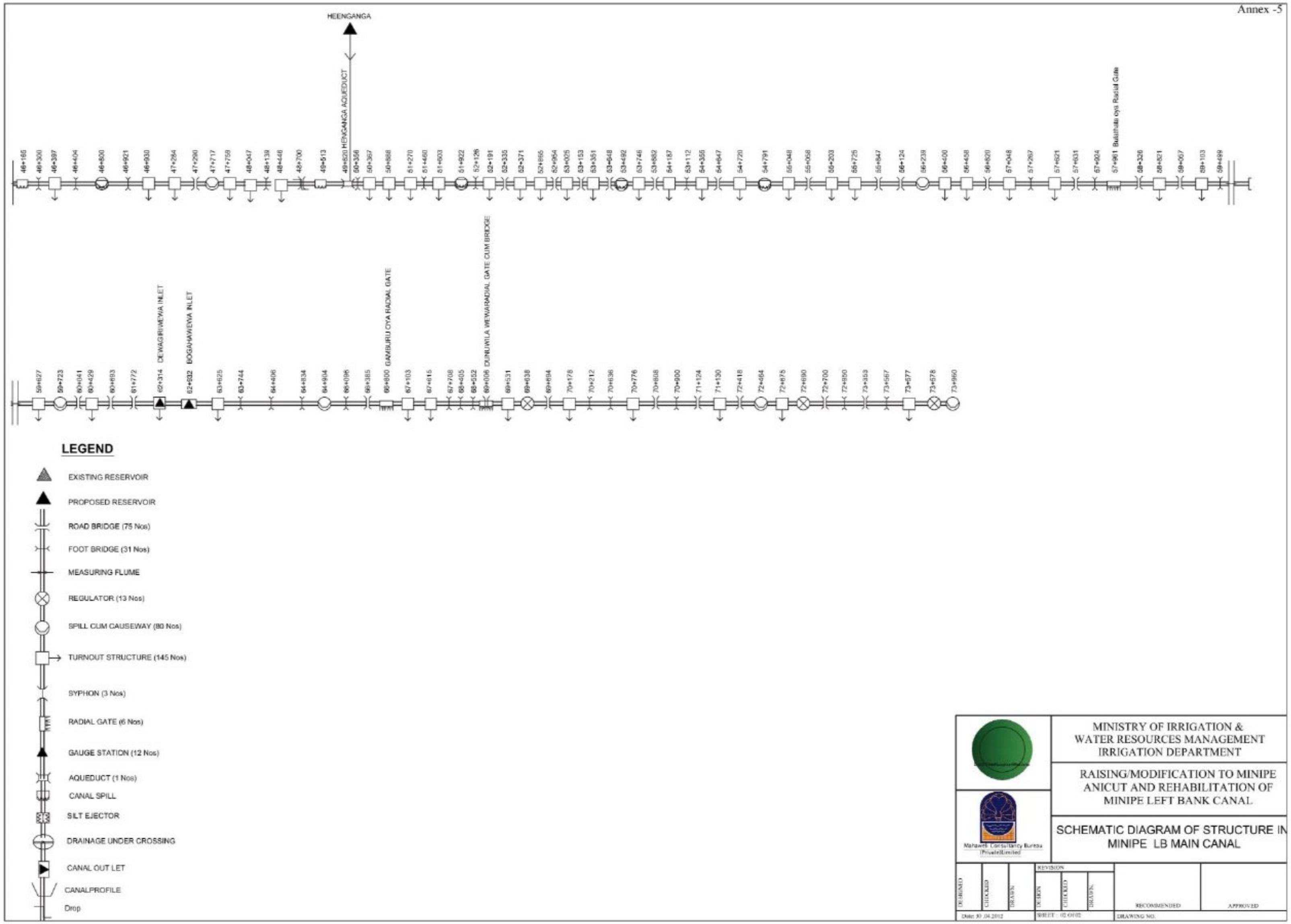
ANNEX 2: MLBC ISSUE TREE

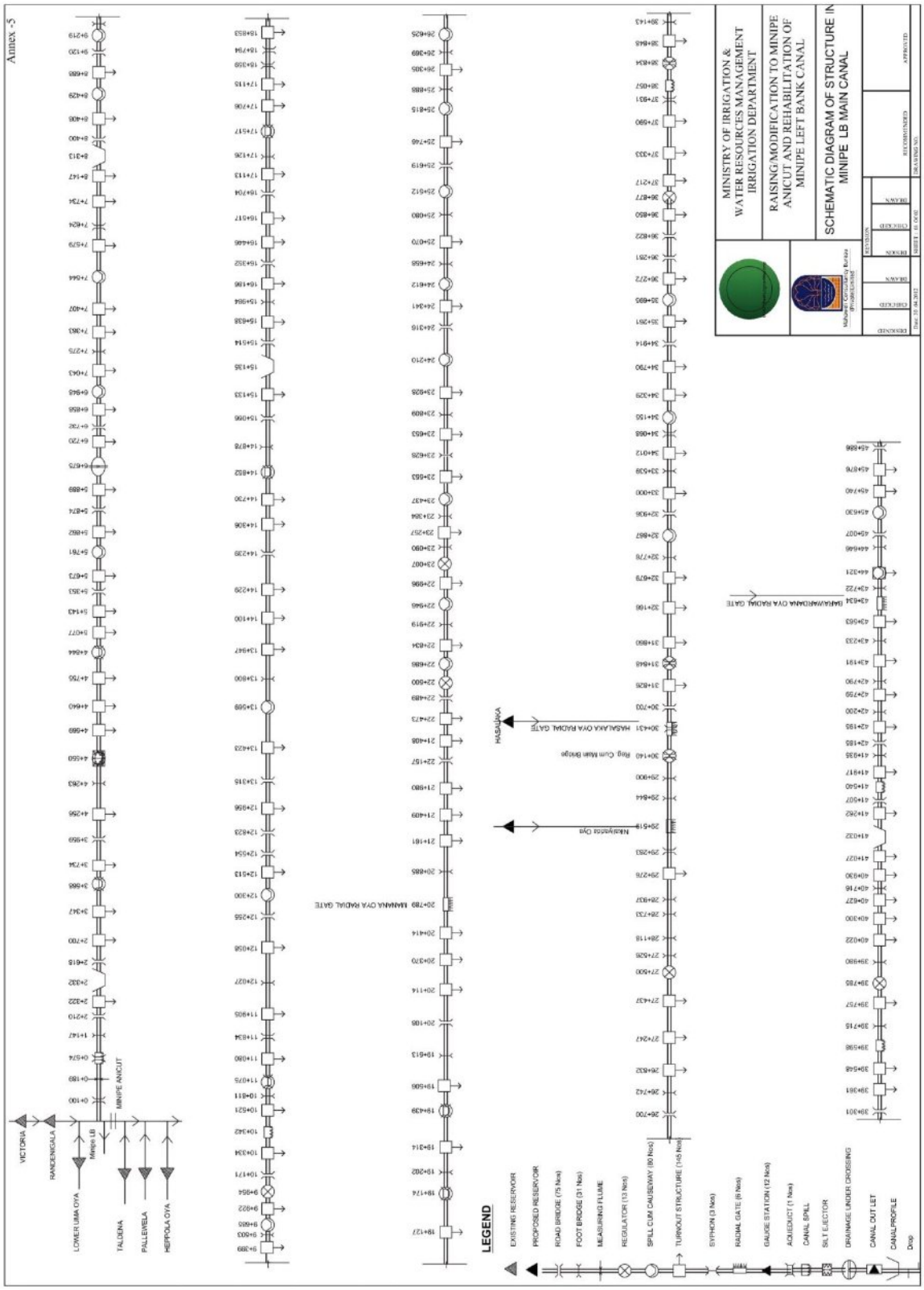
1. An updated ‘issue tree’ for water allocations within the Minipe Irrigation System is shown on the following page.


Annex -3
UP DATED ISSUE TREE MINIPE -LB MAIN CANAL
CULTIVETED AREA
STAGE - i - (0.+000 To 29+283)km = 2015.12 ha
STAGE - ii - (29+283 To 48+446)km = 2225.11 ha
STAGE - iii - (48+446 To 63+625km = 1934.90 ha
STAGE - iv - (63+625 To73+960)km = 1295.74 ha
TOTAL = 7470.87 ha
Minipe LB Inlet structure
To Wewarawewa
To Karawgahawewa thr. Gambuduwa Raidal Gates
To Dewagiriwewa
To Mahawalatenna
To Wewarawewa
STAGE-i
STAGE-ii
STAGE-iii
STAGE-iv
Causeway
End Regulator

ANNEX 3: MLBC STRUCTURES

1. The figure on the following page shows the main structures within the Minipe Irrigation System.


Annex -5
HEENGANGA
49+820 HENGANGA AQUEDUCT
57+961 Batuthala oya Radial Gate
62+314 DEWAGIRIWEWA INLET
62+832 BOGAHAWEWA INLET
66+800 GAMBURU OYA RADIAL GATE
69+006 DUNUWILA WEWARADIAL GATE CUM BRIDGE
LEGEND
EXISTING RESERVOIR
PROPOSED RESERVOIR
ROAD BRIDGE (75 Nos)
FOOT BRIDGE (31 Nos)
MEASURING FLUME
REGULATOR (13 Nos)
SPILL CUM CAUSEWAY (80 Nos)
TURNOUT STRUCTURE (145 Nos)
SYPHON (3 Nos)
RADIAL GATE (6 Nos)
GAUGE STATION (12 Nos)
AQUEDUCT (1 Nos)
CANAL SPILL
SILT EJECTOR
DRAINAGE UNDER CROSSING
CANAL OUT LET
CANALPROFILE
Drop
MINISTRY OF IRRIGATION &
WATER RESOURCES MANAGEMENT
IRRIGATION DEPARTMENT
RAISING/MODIFICATION TO MINIPE
ANICUT AND REHABILITATION OF
MINIPE LEFT BANK CANAL
SCHEMATIC DIAGRAM OF STRUCTURE IN
MINIPE LB MAIN CANAL
RECOMMENDED
APPROVED
DRAWING NO.


Annex -5
MINISTRY OF IRRIGATION & WATER RESOURCES MANAGEMENT
IRRIGATION DEPARTMENT
RAISING/MODIFICATION TO MINIPE ANICUT AND REHABILITATION OF MINIPE LEFT BANK CANAL
SCHEMATIC DIAGRAM OF STRUCTURE IN MINIPE LB MAIN CANAL
LEGEND
EXISTING RESERVOIR
PROPOSED RESERVOIR
ROAD BRIDGE (75 Nos)
FOOT BRIDGE (31 Nos)
MEASURING FLUME
REGULATION (13 Nos)
SPILL CUM CAUSEWAY (80 Nos)
TURNOUT STRUCTURE (145 Nos)
SYPHON (3 Nos)
RADIAL GATE (6 Nos)
GAUGE STATION (12 Nos)
AQUEDUCT (1 Nos)
CANAL SPILL
SILT EJECTOR
DRAINAGE UNDER CROSSING
CANAL OUT LET
CANAL PROFILE
Dept
VICTORIA
RANDENIGALA
LOWER UMA OYA
Minipe LB
MINIPE ANICUT
TALDENA
PALLEWELA
HERPOLA OYA
MAHAWARADA OYA RADIAL GATE
HASALAKA
HASALAKA OYA RADIAL GATE
Rog. Cum Main Bridge
Nilwarada Oya
MAHAWARADA OYA RADIAL GATE

ANNEX 4: IRRIGATION REQUIREMENTS – MAHA SEASON

1. The table below lists the calculated irrigation requirements for the Maha season.

Extent Stage 1&2	10603	Ac
Extent stage 3&4	7854	Ac
Total Extent	18457	Ac

Growth Stages, periods and CFfor Lowland Paddy 105 days

Stage	Kc	Period (days)
Initial Stage	1.00	20
Development Stage	1.15	30
Mid Stage	1.20	30
Late Stage	0.90	25

Monthly Eto & Effec RF - Inches

Month	ETo	Eff RF
Nov	4.3	4.7
Dec	4.5	6.7
Jan	4.7	6.0
Feb	5	1.7
Mar	6.2	1.0

Staggers: **Stagger 1:** 1st November to 15th March, Stage 3 & 4 — **Stagger 2:** 15th November to 30th March, Stage 1 & 2

Land preparation period: 15 days

Farm loss per month in Maha seson: 5 in/month **OR** Application efficiency for farm: 55 %

Losses in distribution system: 25 %

Following Computations based on farm losses

Losses in main canal = 4.00 m3/s = 141.2 cusec = 282.4 Acft/day (From head sluice to end)

		November				December				January				February				March		
		wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk2	wk3
Land Preparation requirement																				
Land soaking (4 inches)	Acft	2618		3534																
Land tilage (3 inches)	Acft		1964		2447															
Crop water requirement	ft																			
Ref Evapotranspiration - Eto	in			1.08	1.08	1.13	1.13	1.13	1.13	1.18	1.18	1.18	1.18	1.25	1.25	1.25	1.25	1.55	1.55	1.55
Stagger 1																				
Crop factors - Kc				1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90		
Crop water requirement	Acft			703.6	703.6	736.3	846.8	846.8	846.8	884.4	922.8	922.8	922.8	981.8	736.3	736.3	736.3	913.0		
Stagger 2																				
Crop factors - Kc						1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90
Crop water requirement	Acft					994	994	994	1143	1194	1194	1194	1246	1325	1325	1325	994	1233	1233	616
Farm Losses																				
Weekly losses	Acft	818	818	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1104	1104
Field Water Requirement (= LP/ CWR + Farm Losses)																				
Field Water Requirement	Acft	3436	2782	6161	5073	3653	3763	3763	3912	4001	4039	4039	4091	4230	3984	3984	3653	4068	2337	1721
Effective Rainfall at 75% probability	Acft	767.4	767.4	1803	1803	2576	2576	2576	2576	2319	2319	2319	2319	644	644	644	644	386	222	222
Field Irrigation Req = (FWR-ER)	Acft	2669	2014	4357	3270	1077	1187	1187	1336	1682	1721	1721	1773	3586	3340	3340	3009	3682	2115	1499
FIR inclu.losses in distribution sys.	Acft	3558	2686	5809	4360	1436	1583	1583	1782	2243	2294	2294	2364	4781	4454	4454	4012	4909	2820	1998
Loss in main canal for 7 days	Acft	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977
Total releases from sluice	Acft	5535	4662	7786	6336	3412	3560	3560	3758	4220	4271	4271	4340	6758	6430	6430	5989	6886	4797	3975
Total requirement at head sluice	m3/s	11.2	9.4	15.8	12.8	6.9	7.2	7.2	7.6	8.5	8.6	8.6	8.8	13.7	13.0	13.0	12.1	13.9	9.7	8.0

Avg **10.3** m3/s

Seasonal duty = 5.2542 ft Total qty for whole season = 96978 Acft

= 119.7 MCM

Irrigation Requirement for Stages 3 & 4 - Maha Season

Extent 7854 Ac

Losses in M/C 0.81 m3/s = 28.59 cusec = 57.19 Acft /day
(from Heenganga to end)

		November(11)				December(12)				January(1)				February(2)				March(3)		
		wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk2	wk3
Land Preparation requirement	ft																			
Land soaking (4 inches)		0.33																		
Land tilage (3 inches)			0.25																	
Crop water requirement	ft																			
Ref Evapotranspiration - ETo -in				1.08	1.08	1.13	1.13	1.13	1.13	1.18	1.18	1.18	1.18	1.25	1.25	1.25	1.25	1.55		
Crop factors - Kc				1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90		
Weekly crop water requirement				0.0896	0.0896	0.0938	0.1078	0.1078	0.1078	0.1126	0.1175	0.1175	0.1175	0.125	0.0938	0.0938	0.0938	0.1163		
Farm Losses - Ft																				
Weekly losses		0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.104	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042		
Field Water Requirement																				
(LP + CWR + Farm Losses)																				
Field Water Requirement	ft	0.44	0.35	0.19	0.19	0.20	0.21	0.21	0.21	0.22	0.22	0.22	0.22	0.23	0.20	0.20	0.20	0.22		
Effective Rainfall at 75% probability		0.098	0.098	0.098	0.098	0.140	0.140	0.140	0.140	0.126	0.126	0.126	0.126	0.035	0.035	0.035	0.035	0.021		
Field Irrigation Req = (FWR-ER)	ft	0.34	0.26	0.10	0.10	0.06	0.07	0.07	0.07	0.09	0.10	0.10	0.10	0.19	0.16	0.16	0.16	0.20		
FIR incl.losses in distribution system	ft	0.45	0.34	0.13	0.13	0.08	0.10	0.10	0.10	0.12	0.13	0.13	0.13	0.26	0.22	0.22	0.22	0.27		
FIR for total extent	Acft	3558	2686	1006	1006	611	758	758	758	954	1006	1006	1006	2034	1707	1707	1707	2089		
Losses in M/C from Heenganga	Acft	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400		
Irr. Req. at start of stage 3	Acft	3959	3086	1406	1406	1011	1158	1158	1158	1355	1406	1406	1406	2435	2107	2107	2107	2489		
Total requirement at start of stage 3	m3/s	**8.0**	**6.2**	**2.8**	**2.8**	**2.0**	**2.3**	**2.3**	**2.3**	**2.7**	**2.8**	**2.8**	**2.8**	**4.9**	**4.3**	**4.3**	**4.3**	**5.0**		

Seasonal Duty = **4.0** ft

Irrigation Requirement for Stages 1 & 2 - Maha Season

Extent 10603 Ac

Losses in M/C 3.19 m3/s = 112.6 cusec = 225.2 Acft /day
(from main sluice to Heenganga)

		November(11)				December(12)				January(1)				February(2)				March(3)		
		wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk2	wk3
Land Preparation requirement	ft																			
Land soaking (4 inches)				0.33																

Land tilage (3 inches)				0.25															
Crop water requirement	ft																		
Ref Evapotranspiration - ETo -in					1.13	1.13	1.13	1.13	1.18	1.18	1.18	1.18	1.25	1.25	1.25	1.25	1.55	1.55	1.55
Crop factors - Kc					1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90
Weekly crop water require.	ft				0.0938	0.0938	0.0938	0.1078	0.1126	0.1126	0.1126	0.1175	0.125	0.125	0.125	0.0938	0.1163	0.1163	0.1163
Farm Losses - Ft																			
Weekly losses			0.1042	0.1042	0.1042	0.1042	0.1042	0.104	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042
Field Water Requirement																			
(LP + CWR + Farm Losses)																			
Field Water Requirement	ft		0.44	0.35	0.20	0.20	0.20	0.21	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.20	0.22	0.22	0.22
Effective Rainfall at 75% probability			0.10	0.10	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.03	0.03	0.03	0.03	0.02	0.02	0.02
Field Irrigation Req = (FWR-ER)	ft		0.34	0.26	0.06	0.06	0.06	0.07	0.09	0.09	0.09	0.10	0.19	0.19	0.19	0.16	0.20	0.20	0.20
FIR inclu.losses in distribution system	ft		0.45	0.34	0.08	0.08	0.08	0.10	0.12	0.12	0.12	0.13	0.26	0.26	0.26	0.22	0.27	0.27	0.27
FIR for total extent	Acft		4804	3626	825	825	825	1023	1289	1289	1289	1358	2746	2746	2746	2305	2820	2820	2820
Losses in M/C from sluice to Heeng.	Acft		1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576
Irr. Req. at start of stage 3	Acft		6380	5202	2401	2401	2401	2600	2865	2865	2865	2934	4323	4323	4323	3881	4397	4397	4397
Total requirement at start of stage 3	m3/s		**12.9**	**10.5**	**4.9**	**4.9**	**4.9**	**5.3**	**5.8**	**5.8**	**5.8**	**5.9**	**8.7**	**8.7**	**8.7**	**7.9**	**8.9**	**8.9**	**8.9**

Seasonal Duty = **5.1** ft

Effective Rainfall Reference: Technical Guide Lines - 5.2.10.5

Effective Rainfall Pe = 0.67 * (R - 1) Where R = 75% probability monthly rainfall in inches

For lowland crops, if R = or less than 1, then Pe = 0
Maximum value of Pe = 9 inches

Minipe LB canal lies in the Agro Ecological zone of IL2

Month	75% pro. R/f - Inch	Pe(equa.	Pe - In
Nov	8	4.69	4.7
Dec	11	6.7	6.7
Jan	10	6.03	6.0
Feb	3.5	1.675	1.7
Mar	2.5	1.005	1.0
Apr	3.5	1.675	1.7

ANNEX 5: IRRIGATION REQUIREMENTS – YALA SEASON

1. The tables list the calculated irrigation requirements for the Yala season.

Extent Stage 1&2	10603	Ac
Extent stage 3&4	7854	Ac
Total Extent	18457	Ac

Stage	Kc	Period (days)
Initial Stage	1.00	20
Development Stage	1.15	30
Mid Stage	1.20	30
Late Stage	0.90	25

Monthly Eto & Effec RF - Inches

Month	ET0	Eff RF
Apr	5.9	1.67
May	6.4	0
Jun	6.9	0
Jul	7.5	0
Aug	7.6	0
Sep	7.5	0.67

Note: Monthly rainfall is taken for Agro Ecological region lL2

Staggers: Stagger 1: 15th April to 31st July, Stage 3 & 4 Stagger 2: 1st May to 15th August, Stage 1 & 2

Land preparation period 15 days

Farm loss per month in Yala 5 in/month

Losses in distribution system 20 %

Losses in main canal = 4.00 m3/s = 141.2 cusec = 282 Acft/day (for the reach from head sluice to end)

		April		May				June				July				August				Sep
		wk 3	wk 4	wk1	wk2	wk3	wk4	wk1	wk2	wk3	wk4	wk1	wk2	wk3	wk4	wk1	wk2	wk3	wk4	wk1
Land Preparation requirement																				
Land soaking (4 inches)	Acft	2618		3534																
Land tilage (3 inches)	Acft		1964		2446.8															
Crop water requirement	ft																			
Ref Evapotranspiration - Eto	in	1.48	1.48	1.60	1.60	1.60	1.60	1.73	1.73	1.73	1.73	1.88	1.88	1.88	1.88	1.90	1.90	1.90	1.90	1.88
Stagger 1 - Stages 3 &4																				
Crop factors - Kc				1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90		
Crop water requirement	Acft			1047	1047	1047	1204	1298	1298	1298	1355	1473	1473	1473	1104	1119	1119	560		
Stagger 2 - Stages 1 &2																				
Crop factors - Kc						1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90
Crop water requirement	Acft					1414	1414	1414	1626	1753	1753	1753	1829	1988	1988	1988	1491	1511	1511	746
Farm Losses																				
Weekly losses	Acft	818	818	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1104	1104
Field Water Requirement																				
(LP + CWR + Farm Losses)																				
Field Water Requirement	Acft	3436	2782	6504	5417	4384	4541	4635	4847	4974	5030	5148	5224	5383	5015	5030	4533	3993	2615	1850
Eff. Rainfall at 75% probability	Acft	642	642	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148
Field Irrigation Req = (FWR-ER)	Acft	2794	2139	6504	5417	4384	4541	4635	4847	4974	5030	5148	5224	5383	5015	5030	4533	3993	2615	1702
FIR inclu.losses in distri. System	Acft	3492	2674	8130	6771	5479	5676	5793	6058	6217	6288	6435	6530	6729	6269	6287	5666	4991	3269	2128
Loss in main canal for 7 days	Acft	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977	1977
Total releases from sluice	Acft	5469	4651	10107	8748	7456	7653	7770	8035	8194	8265	8412	8507	8706	8246	8264	7643	6968	5246	4104
Total requirement at head sluice	m3/s	11.1	9.4	20.5	17.7	15.1	15.5	15.7	16.3	16.6	16.7	17.0	17.2	17.6	16.7	16.7	15.5	14.1	10.6	8.3

15.2
Avg Q

Seasonal Duty = **7.7** ft

Total quantity for whole season= 142444 Acft

= 176 MCM

Field canal duty

6729	0.365	0.026	38.08	say	39
Acft	Ft	cfs/ac	Ac/cfs		

Seasonal Duty - Stage 3 &4

Yala

Losses in M/C
(from Heenganga to end) 0.81 m3/s = 28.59 cusec = 57.2 Acft /day Extent 7854 Ac

		November(11)			December(12)				January(1)				February(2)				March(3)			
requirement		wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk2
Land soaking (4 inches)	ft																		
Land tilage (3 inches)		0.33																	
Crop water requirement			0.25																
Ref Evapotranspiration - ETo -in	ft																		
Crop factors - Kc				1.48	1.48	1.60	1.60	1.60	1.60	1.73	1.73	1.73	1.73	1.88	1.88	1.88	1.88	1.90	
Weekly crop water requirement				1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90	0.90	
Farm Losses - Ft				0.1229	0.1229	0.13	0.153	0.15	0.1533	0.1653	0.1725	0.173	0.1725	0.1875	0.1406	0.1406	0.1406	0.1425	
Weekly losses																			
Field Water Requirement		0.104	0.104	0.1042	0.1042	0.1	0.104	0.1	0.104	0.1042	0.1042	0.104	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	
(LP + CWR + Farm Losses)																			
Field Water Requirement																			
Effective Rainfall at 75% probabil	ft	0.44	0.35	0.23	0.23	0.24	0.26	0.26	0.26	0.27	0.28	0.28	0.28	0.29	0.24	0.24	0.24	0.25	
Field Irrigation Req = (FWR-ER)		0.035	0.035	0.035	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
FIR incl.losses in distribution syst	ft	0.40	0.32	0.19	0.19	0.24	0.26	0.26	0.26	0.27	0.28	0.28	0.28	0.29	0.24	0.24	0.24	0.25	
FIR for total extent	ft	0.50	0.40	0.24	0.24	0.30	0.32	0.32	0.32	0.34	0.35	0.35	0.35	0.36	0.31	0.31	0.31	0.31	
Losses in M/C from Heenganga	Acft	3953.6	3135.5	1887.8	1887.8	####	#####	####	2528.0	2645.6	2716.2	#####	2716.2	2863.4	2403.2	2403.2	2403.2	2421.7	
Irr. Req. at start of stage 3	Acft	400.30	400.30	400.30	400.30	####	#####	####	400.30	400.30	400.30	#####	400.30	400.30	400.30	400.30	400.30	400.30	
	Acft	4353.9	3535.8	2288.1	2288.1	####	#####	####	2928.3	3045.9	3116.5	#####	3116.5	3263.7	2803.5	2803.5	2803.5	2822.0	
Total requirement at start of stage 3	m3/s	8.8	7.2	4.6	4.6	5.5	5.9	5.9	5.9	6.2	6.3	6.3	6.3	6.6	5.7	5.7	5.7	5.7	

Seasonal Duty

= **6.5** ft

Irrigation Requirement for Stages 1 & 2 - Yala Season

Extent 10603 Ac

Losses in M/C
(from main sluice to Heenganga) 3.19 m3/s = 112.6 cusec = 225 Acft /day

		November(11)			December(12)				January(1)				February(2)				March(3)			
		wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk2

requirement	ft																		
Land soaking (4 inches)				0.33															
Land tilage (3 inches)					0.25														
Crop water requirement	ft																		
Ref Evapotranspiration - ETo -in						1.60	1.60	1.60	1.60	1.73	1.73	1.73	1.73	1.88	1.88	1.88	1.88	1.90	1.90
Crop factors - Kc						1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.20	1.20	1.20	1.20	0.90	0.90	0.90
Weekly crop water require.	ft					0.13	0.133	0.13	0.1533	0.1653	0.1653	0.165	0.1725	0.1875	0.1875	0.1875	0.1406	0.1425	0.1425
Farm Losses - Ft																			
Weekly losses				0.1042	0.1042	0.1	0.104	0.1	0.104	0.1042	0.1042	0.104	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042
Field Water Requirement																			
(LP + CWR + Farm Losses)																			
Field Water Requirement	ft			0.44	0.35	0.24	0.24	0.24	0.26	0.27	0.27	0.27	0.28	0.29	0.29	0.29	0.24	0.25	0.25
Effective Rainfall at 75% probability				0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Field Irrigation Req = (FWR-	ft			0.40	0.32	0.24	0.24	0.24	0.26	0.27	0.27	0.27	0.28	0.29	0.29	0.29	0.24	0.25	0.25
FIR inclu.losses in distribution sys	ft			0.50	0.40	0.30	0.30	0.30	0.32	0.34	0.34	0.34	0.35	0.36	0.36	0.36	0.31	0.31	0.31
FIR for total extent	Acft			5337	4233	3148	3148	3148	3413	3572	3572	3572	3667	3866	3866	3866	3244	3269	3269
Losses in M/C from sluice to Hee	Acft			1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576	1576
Irr. Req. at start of stage 3	Acft			6914	5809	4724	4724	4724	4989	5148	5148	5148	5243	5442	5442	5442	4821	4846	4846
Total requirement at start of stage	m3/s			**14.0**	**11.8**	**9.6**	**9.6**	**9.6**	**10.1**	**10.4**	**10.4**	**10.4**	**10.6**	**11.0**	**11.0**	**11.0**	**9.8**	**9.8**	**9.8**

Seasonal Duty

Effective Rainfall Reference: Technical Guide Lines - 5.2.10.5

Effective Rainfall Pe = 0.67 * (R - 1) Where R = 75% probability monthly rainfall in inches

For lowland crops, if R = or less than 1, then Pe = 0
Maximum value of Pe = 9 inches

Minipe LB canal lies in the Agro Ecological zone of IL2

Month	75% pro. R/f	Pe(equa.	Pe - In
April	3.5	1.675	1.67
May	1	0	0
June	0	-0.67	0
July	0.5	-0.335	0
Aug	0.5	-0.335	0
Sep	2	0.67	0.67

ANNEX 6: MBLC IMPROVEMENTS

1. The tables below list the planned improvements to MBLC structures.

No	Loca.	Type	Existing Crest Level	Sill Level	FSL	Length	Bays without gates	Silt Ejector Gates	Proposal
1	0.574	Canal spill cum bridge	112.82	111.520	112.89			2/ 1.5m	No structural changes
2	4.55	Canal spill cum causeway	109.894 / 110.294	108.674	109.547	12.2	6	1 / 1 x 2	Raising not required, Crest level of all openings should be 109.6
3	5.761	Canal spill cum causeway	108.728	107.883	107.922	9	4	1 / 1.5 x 1.0	No structural changes
4	6.948	Canal spill cum causeway	107.143		106.571	9.2	5	-	Provide 1 silt ejecting gate, no raising
5	7.544	Canal spill cum causeway	107.245		106.154	7.1	4 / 2.7 (w)	-	Provide 1 silt ejecting gate, No raising
6	8.429	Canal spill cum causeway	105.824	104.574	105.535	8	3 / 1.3 (w)	1 /(1.3 x 1.9)	No structural changes
7	9.219	Canal spill cum causeway	105.161	103.881	104.982	15.4	6	3/ 1.2 x 2.4	No structural changes
8	9.685	Canal spill cum causeway	104.781		104.656	7.8	4/1.7 (w)	-	Provide 1 silt ejecting gate, No raising
9	10.342	Canal spill cum causeway	104.176	102.500	103.846	9.4	4	1/1.4 x 1.9	No structural changes
10	12.3	Canal spill cum causeway	102.323	100.768	102.665	14.35	7/ 1.5	-	Provide 2 silt ejecting gates, raising required, new crest level: 102.7
	13.315	**END OF REACH 1**							
11	13.569	Canal spill cum causeway	101.786	100.021	101.944	15.1	6	-	Provide silt ejecting gate, crest level: 101.95
12	20.789	Radial gated spill - Mannana Oya	97.521		99.772			3/4.6 x 2.45	No raising required
13	22.686	Canal spill	99.565		98.878	4.6	2	1/ 600 dia	No structural changes
	22.55	**END OF REACH 2**							
14	22.946	Canal spill	99.34	97.983	98.821	7.5	spill	1/(1.74x1.55)	
15	23.437	Canal spill	99	97.310	98.713	7.5	spill	-	Sile ejecting gate to be provided
16	24.21	Canal spill	98.82 / 99.02	97.390	98.543	8.7	3		Silt ejecting gate to be provided,No raising required
17	24.612	Canal spill cum causeway	98.655 / 98.8	96.355	98.454	31	12/1.5 x .6	1 / 600mm dia	Provide 2 silt ejecting gates, No raising required
18	25.512	Canal spill cum causeway	99.35 / 99.56	97.328	98.190	16	1		Provide silt ejecting gates, No raising required
19	25.815	Canal spill cum causeway	99.235/ 99.415	97.125	98.190	50	spill	2/ 750 dia	Provide 1 silt ejecting gate, No raising required
20	26.625	Canal spill cum causeway	98.281	96.305	98.011	12.7	spill	2 / 750 dia	Provide silt ejecting gate, No raising required
21	29.519	Radial gated spill - Nikaliyadda Oya	94.08		97.375			3/6.1x3.05	Crest level to be raised by 0.5m, new crest level: 94.58
	30.14	**END OF REACH 3**							
22	30.431	Hasalaka Oya r.gated spill	93.704		97.054			4/5.7x3.05h	Crest level to be raised by 0.5m, New crest level: 94.204
23	32.867	Canal spill cum causeway	-	94.416	96.250	15		1.5 x 1.5	
24	34.155	Canal spill cum causeway	-		95.916	15.3		1.5 x1.5	
25	35.7	Berabun Oya tank spill		92.522	95.600				New semi-circular overflow spill to be constructed to join the existing pipe
26	38.057	Ulpathagama tank natural spill	94.615	-	95.000	60	-	-	Existing spill to be raised by 0.385m upto 95.00

No	Loca.	Type	Existing Crest Level	Sill Level	FSL	Length	Bays without gates	Silt Ejector Gates	Proposal
	38.834	END OF REACH 4							
27	39.598	Canal spill - gated		92.893	94.263		-	1/(1.0 x 1.45)	
28	41.54	Spill cum causeway	93.945	92.165	93.937	30.2	-	3/ 900 dia	
29	43.634	Radial gated spill - Barawardana Oya	89.945		93.163			3 / 6.1 x 3.05	Crest to be raised by 0.3m
30	44.321	Canal spill cum causeway	93.014	91.072	92.977	31	-	2 / 900 dia	
31	45.63	Canal spill cum causeway	91.33	90.700	92.759		-	3 / 900 dia	
32	46.165	Vented causeway	92.61	90.628	92.614	15	-	2 / 900 dia	No structural changes
33	46.8	Vented causeway	93.948	90.465	92.443	15	-	2 / 900 dia	No structural changes
34	47.717	Vented causeway	92.563	90.286	92.195	31	-	2 / 900 dia	No structural changes
35	49.513	Canal spill cum silt ejector	91.887	89.801			-	2/	
	49.82	END OF REACH 5							
36	51.922	Vented causeway	91.876	90.503	90.017	30.5	-	3 / 900 dia	
	53.2	END OF REACH 6							
37	53.492	Vented causeway	90.263	88.511	89.794	22.5	-	2 / 600 dia	No structural changes
38	54.791	Vented causeway - Mahawatenna	90.09	88.353	89.431	22	-	2 / 600 dia	No structural changes
39	56.239	Vented causeway	90.2	88.679	89.025	35	-	2 / 900 dia	No structural changes
40	57.961	Bulatha Atha Oya r g. spill	85.442		88.543	19.7		3 / 6.1 x 3.05	Crest to be raised by 0.3m
41	59.723	Vented cauaseway - Namini Oya	88.38	86.007	88.050	6.3		2 / 900 dia	No structural changes
	63.65	END OF REACH 7							
42	64.904	Vented causeway	87.03	85.667	86.311	32		2 / 900	No structural changes
43	66.806	Gamburu Oya r.g. spill	83.39		85.800			3 / 6.1 x 3.05	Crest to be raised by 0.5m
44	69.006	Dunuwila wewa r.g spill	82.24		85.780			2 / 6.1 x 3.05	Crest to be raised by 0.6m
45	72.464	Vented causeway	84.665	83.446	84.953	44		2 / 600 dia	Crest level of causeway to be raised
46	73.96	Vented causeway	84.437	83.152	83.475	30		1 / 900 dia	No structural changes

ANNEX 7: MBLC CROSS REGULATORS

1. The table below lists details of the MBLC cross regulators.

Location	No	Purpose	Proposal	
9.954	CR1	To keep the required head for Turnouts	Demolish the existing regulator and reconstruct a gated regulator	Reconstruct
13.315	CR2	End of Reach 1 and close to D21, the largest canal in Stage 1	Incorporate a gated regulator to the existing bridge at 13.315	New
End of Reach 1				
22.5	CR3	End of Reach 2, To head up D35	Existing regulator to be reconstructed, gated cum weir	Reconstruct
End of Reach 2				
23.007		Not required	Existing regulator to be demolished	Demolish
27.526		Not required	Existing regulator to be demolished	Demolish
30.14	CR4	End of Reach 3	Improvements to be done to gated regulator	Improvements
End of Reach 3				
13.315		**END OF STAGE 1**		
31.848	CR5	End of Hasalaka wewa, start of Reach 4	Repairs to gated regulator	Repairs
36.877	CR6	1.277 km downstream of Berabun Oya	Existing regulator, gated cum weir	Repairs
38.834	CR7	End of Reach 4, After Uplathagama tank	Existing gated regulator	Repairs
End of Reach 4				
39.785	CR8	D/S of D17, Required to head up D 17 as the head is not sufficient at CSWL	Existing gated cum weir regulator	Repairs
42.2	CR9	To head up at D25, branch canal	New regulator to be incorporated with the existing bridge at 42.2km	New
48.7	CR10	To head up at D34, Branch canal, End of Reach 5	New regulator to be incorporated with the bridge at 48.7 km	New
End of Reach 5				
49.82		**END OF STAGE 2**		
53.2	CR11	End of Reach 6	New regulator to be constructed	New
		To head up D 43		
End of Reach 6				
63.65	CR12	End of Reach 7	New regulator to be constructed	New
		To head up D 57		
End of Reach 7				
63.65		**END OF STAGE 3**		
69.638	CR13		Existing gated cum weir regulator, Improvements to be done	Improvements
72.69			Existing regulator	Demolish
73.58	CR14	End of Reach 8, End Regulator	Existing gated regulator, Improvements to be done	Improvements
End of Reach 8				

ANNEX 8: MBLC DESIGN DISCHARGES

1. The tables below list the discharges for the MBLC.

Design Discharges

Duty in distributory canals 557.4 ha/cumec = Ac/cusec 39
Durty in branch canal 357.3 ha/cumec = Ac/cusec 25
Conveyance losses in main canal: 35 %

No	Chainage	Name	Extent - ha		Cum. Total		Discharge in D canals - cumec				Q for dist.	M/C Dis. Incl.	M/C Design
			Spec.	Actual	Extent - ha		Calcula.	Desig.	Cumu.	cumu.	canals m3/s	losses - m3/s	Discharge
	0.574	Canal spill with bridge											
1	2.332	D 1 A		11.74	11.7		0.02	0.02	0.02	14.2	1.41	21.8	21.8
2	2.700	D 1 B		40.89	52.6		0.07	0.07	0.09	14.2		21.8	
3	3.347	D 2		3.85	56.5		0.01	0.01	0.10	14.1		21.7	
	3.568	Syphon cum causeway											
4	3.734	D 3 A		13.97	70.5		0.03	0.03	0.13	14.1		21.7	
5	4.256	D 3 B		40.89	111.3		0.07	0.07	0.20	14.1		21.6	
	4.550	Canal spill cum silt ejector and causeway											
6	4.566	D 4 A		3.24	114.6		0.01	0.01	0.21	14.0		21.5	
7	4.569	D 4 B		3.6	118.2		0.01	0.01	0.21	14.0		21.5	
8	4.755	D 5		3.44	121.6		0.01	0.01	0.22	14.0		21.5	
	4.844	Syphon cum causeway											
9	5.077	D 6 A		2.83	124.5		0.01	0.01	0.22	14.0		21.5	
10	5.143	D 6 B		15.79	140.2		0.03	0.03	0.25	14.0		21.5	
11	5.673	D 6 C		3.24	143.5		0.01	0.01	0.26	13.9		21.5	
	5.761	Canal spill, silt ejector											
12	5.862	D 7 A		5.67	149.2		0.01	0.01	0.27	13.9		21.4	
13	5.889	D 7 B		15.99	165.1		0.03	0.03	0.30	13.9		21.4	
	6.108	Drainage undercrossing											
14	6.720	D 8 A		8.91	174.1		0.02	0.02	0.31	13.9		21.4	
15	6.858	D 8 B		15.79	189.8		0.03	0.03	0.34	13.9		21.4	
	7.050	Canal spill cum cause way											
16	7.043	D 9		8.5	198.3		0.02	0.02	0.36	13.9		21.3	
17	7.363	D 10 A		11.74	210.1		0.02	0.02	0.38	13.8		21.3	
18	7.407	D 10 B		2.83	212.9		0.01	0.01	0.38	13.8		21.3	
	7.544	Canal spill cum causeway											
19	7.579	D 10 C		0.4	213.3		0.00	0.00	0.38	13.8		21.3	
20	7.734	D 11		12.15	225.5		0.02	0.02	0.40	13.8		21.3	
21	8.147	D 12		101.21	326.7		0.18	0.18	0.59	13.8		21.2	
22	8.408	D 13		35.22	361.9		0.06	0.06	0.65	13.6		20.9	
	8.429	Canal spill cum causeway											
23	8.688	D 14		10.12	372.0		0.02	0.02	0.67	13.5		20.8	
	9.219	Canal spill cum causeway											
24	9.400	D 15		5.26	377.3		0.01	0.01	0.68	13.5		20.8	
	9.658	Canal spill cum causeway											
25	9.922	D 16		90.28	467.6		0.16	0.16	0.84	13.5		20.8	
	9.954	Regulator - Fully Damaged - To be reconstructed											
26	10.334	D 17		74.7	542.3		0.13	0.13	0.97	13.4		20.6	
	10.342	Canal spill											
27	10.521	D 18		10.53	552.8		0.02	0.02	0.99	13.2		20.3	
28	10.075	D 19 A		25.71	578.5		0.05	0.05	1.04	13.2		20.3	
	11.080	Syphon cum causeway											
29	11.905	D 19 B		16.19	594.7		0.03	0.03	1.07	13.2		20.2	
30	12.450	D 19 C		3.64	598.3		0.01	0.01	1.07	13.1		20.2	
	12.300	Canal spill cum causeway											
31	12.513	D 20		19.03	617.4		0.03	0.03	1.11	13.1		18.7	
32	12.956	D 21		170.04	787.4		0.31	0.31	1.41	13.1		20.1	
	13.315	New regulator to be constructed				Incorporate with Bridge						END OF REACH 1	
33	13.423	D 22		4.05	791.4		0.01	0.01	1.42	12.8	1.2	19.7	19.7
	13.569	Canal Spill											
34	13.947	D 23 A		8.1	799.5		0.01	0.01	1.43	12.8		19.7	
35	14.085	D 23 B		20.24	819.8		0.04	0.04	1.47	12.8		19.6	

No	Chainage	Name	Extent - ha		Cum. Total		Discharge in D canals - cumec				Q for dist.	M/C Dis. Incl.	M/C Design
			Spec.	Actual	Extent - ha		Calcula.	Desig.	Cumu.	cumu.	canals m3/s	losses - m3/s	Discharge
	14.600	Canal spill cum causeway											
36	14.229	D 24 A		13.77	833.6		0.02	0.02	1.50	12.7		19.6	
37	14.306	D 24 B		5.26	838.8		0.01	0.01	1.50	12.7		19.5	
38	14.730	D 24 C		2.83	841.6		0.01	0.01	1.51	12.7		19.5	
	14.825	Trough cum causeway											
39	15.133	D 25		116.19	957.8		0.21	0.21	1.72	12.7		19.5	
40	15.638	D 26		70.45	1028.3		0.13	0.13	1.84	12.5		19.2	
41	16.186	D 27		37.65	1065.9		0.07	0.07	1.91	12.4		19.0	
42	16.446	D 27 B		2.43	1068.4		0.00	0.00	1.92	12.3		18.9	
43	16.517	D 28		5.67	1074.0		0.01	0.01	1.93	12.3		18.9	
44	17.113	D 29		5.67	1079.7		0.01	0.01	1.94	12.3		18.9	
	17.517	Trough cum causeway											
45	17.706	D 30		8.5	1088.2		0.02	0.02	1.95	12.3		18.9	
46	18.117	D 31		105.26	1193.5		0.19	0.19	2.14	12.2		18.8	
47	18.853	D 32		15.99	1209.5		0.03	0.03	2.17	12.1		18.5	
48	19.127	D 32 C		14.17	1223.6		0.03	0.03	2.20	12.0		18.5	
	19.174	Trough cum causeway											
49	19.314	D 32 A		23.08	1246.7		0.04	0.04	2.24	12.0		18.5	
	19.439	Trough cum causeway											
50	19.506	D 32 B		27.73	1274.4		0.05	0.05	2.29	12.0		18.4	
51	20.114	D 33		7.69	1282.1		0.01	0.01	2.30	11.9		18.3	
52	20.370	D 33 A		9.72	1291.8		0.02	0.02	2.32	11.9		18.3	
53	20.414	D 33 B		9.31	1301.2		0.02	0.02	2.33	11.9		18.3	
	20.778	Radial gated canal spill across Mannanna Oya											
54	21.161	D 33 C		0.81	1302.0		0.00	0.00	2.34	11.9		18.2	
55	21.409	D 34 A		2.02	1304.0		0.00	0.00	2.34	11.9		18.2	
56	21.980	D 34		96.96	1400.9		0.17	0.17	2.51	11.9		18.2	
57	22.408	D 34 B		7.69	1408.6		0.01	0.01	2.53	11.7		18.0	
58	22.489	D 35		57.09	1465.7		0.10	0.10	2.63	11.7		18.0	
	22.550	Regulator - not functioning, To be reconstructed										END OF REACH 2	
	23.310	Canal spill cum causeway											
59	22.834	D 36 B		2.43	1468.2		0.00	0.00	2.63	11.6	1.0	17.8	17.8
	22.946	Canal spill cum causeway											
60	22.996	D 37		10.32	1478.5		0.02	0.02	2.65	11.6		17.8	
	23.007	Regulator - not functioning - To be demolished											
61	23.257	D 38		7.07	1485.5		0.01	0.01	2.67	11.5		17.8	
	23.437	Canal spill cum causeway											
62	23.553	D39 A		1.62	1487.2		0.00	0.00	2.67	11.5		17.7	
63	23.653	D39		77.33	1564.5		0.14	0.14	2.81	11.5		17.7	
64	23.928	D 40		14.17	1578.7		0.03	0.03	2.83	11.4		17.5	
	24.210	Canal spill cum causeway											
65	24.341	D 41		84.01	1662.7		0.15	0.15	2.98	11.4		17.5	
	24.612	Canal spill cum causeway											
66	24.740	D 42		21.05	1683.7		0.04	0.04	3.02	11.2		17.3	
67	25.070	D 43		71.26	1755.0		0.13	0.13	3.15	11.2		17.2	
	25.512	Canal spill cum causeway											
68	25.746	D 44		36.44	1791.4		0.07	0.07	3.21	11.0		17.0	
	25.815	Canal spill cum causeway											
69	26.305	D 45		62.75	1854.2		0.11	0.11	3.33	11.0		16.9	
	26.625	Canal spill cum causeway											
70	26.832	D 46		12.15	1866.3		0.02	0.02	3.35	10.9		16.7	
71	27.247	D 47		93.12	1959.4		0.17	0.17	3.52	10.8		16.7	
72	27.437	D 48		16.19	1975.6		0.03	0.03	3.54	10.7		16.4	
	28.060	Regulator TO BE DEMOLISHED											
73	29.276	D 49		40.49	2016.1		0.07	0.07	3.62	10.7		16.4	
	29.519	Spill with radial gated structure across Nikaliyadda Oya cum bridge											
	30.140	Regulator cum main bridge across Mahiyangana Kandy road										END OF REACH 3	
	30.233	Start of Hasalaka wewa											
	30.431	Spill with radial gated structure across Hasalaka Oya cum bridge											

No	Chainage	Name	Extent - ha		Cum. Total		Discharge in D canals - cumec				Q for dist.	M/C Dis. Incl.	M/C Design
			Spec.	Actual	Extent - ha		Calcula.	Desig.	Cumu.	cumu.	canals m3/s	losses - m3/s	Discharge
	31.800	End of Hasalaka wewa											
74	31.823	D 1		69.23	2085.4		0.12	0.12	3.74	10.6	1.4	16.3	16.3
	31.848	Regulator cum bridge											
75	31.860	D1 A					0.00	0.00	3.74	10.5		16.1	
76	32.166	D 2		4.86	2090.2		0.01	0.01	3.75	10.5		16.1	
77	32.679	D 3		19.03	2109.2		0.03	0.03	3.78	10.4		16.1	
	32.867	Canal spill cum causeway with silt ejector											
78	33.300	D 4		212.55	2321.8		0.38	0.38	4.17	10.4		16.0	
79	34.012	D 5		60.93	2382.7		0.11	0.11	4.27	10.0		15.4	
	34.155	Canal spill cum causeway with silt ejector											
80	34.329	D 6		23.68	2406.4		0.04	0.04	4.32	9.9		15.3	
81	34.799	D 7		153.04	2559.4		0.27	0.27	4.59	9.9		15.2	
82	35.261	D 8		50.61	2610.1		0.09	0.09	4.68	9.6		14.8	
	35.300	Start of Berabun Oya											
	35.700	Berabun Oya spill											
	35.800	End of Berabun Oya											
83	36.272	D 9		15.99	2626.0		0.03	0.03	4.71	9.5		14.6	
84	36.850	D 10		6.68	2632.7		0.01	0.01	4.72	9.5		14.6	
	36.877	Regulator R5											
85	37.217	D 11		67.21	2699.9		0.12	0.12	4.84	9.5		14.6	
86	37.333	D 12		57.09	2757.0		0.10	0.10	4.95	9.4		14.4	
87	37.590	D 13		18.22	2775.2		0.03	0.03	4.98	9.3		14.2	
	37.956	Start of Ulpathagama tank											
	38.057	Ulpathgama tank , spill											
	38.800	End of Ulpathagama tank											
	38.834	Regulator cum bridge										END OF REACH 4	
88	38.848	D 14		8.1	2783.3		0.01	0.01	4.99	9.2	3.2	14.2	14.2
89	39.361	D 15		6.88	2790.2		0.01	0.01	5.01	9.2		14.2	
90	39.548	D 16		12.15	2802.4		0.02	0.02	5.03	9.2		14.1	
	39.698	Canal spill											
91	39.757	D 17		58.7	2861.1		0.11	0.11	5.13	9.2		14.1	
	39.785	Regulator											
92	40.022	D 18		26.72	2887.8		0.05	0.05	5.18	9.1		13.9	
93	40.300	D 19		13.36	2901.2		0.02	0.02	5.21	9.0		13.9	
94	40.278	D 20		10.12	2911.3		0.02	0.02	5.22	9.0		13.8	
95	40.930	D 21		19.15	2930.4		0.03	0.03	5.26	9.0		13.8	
96	41.027	D 22		13.77	2944.2		0.02	0.02	5.28	8.9		13.8	
97	41.262	D 23		8.7	2952.9		0.02	0.02	5.30	8.9		13.7	
	41.540	Canal spill cum causeway											
98	41.917	D 24		74.49	3027.4		0.13	0.13	5.43	8.9		13.7	
99	42.195	D 25		523.89	3551.3		1.47	1.47	6.90	8.8	Branch c.	13.5	
	42.200	New Regulator R7											
100	42.759	D 26		8.3	3559.6		0.01	0.01	6.91	7.3		11.2	
101	43.191	D 27		8.91	3568.5		0.02	0.02	6.93	7.3		11.2	
102	43.563	D 27 A		83.81	3652.3		0.15	0.15	7.08	7.3		11.2	
	43.581	Start of Balawardana Oya											
	43.634	Radial gated canal spill across Barawardana Oya											
	43.777	End of Balawardana Oya											
	44.321	Canal spill cum causeway with silt ejector											
	45.117	Start of OkiriKotuwa tank											
	45.584	End of Okirikotuwa tank											
	45.630	Canal spill cum causeway - natural with silt ejector											
103	45.740	D 28 A		48.58	3700.9		0.09	0.09	7.17	7.1		11.0	
104	45.876	D 28		24.29	3725.2		0.04	0.04	7.21	7.0		10.8	
	46.165	Canal spill cum causeway											
105	46.397	D 29		24.29	3749.5		0.04	0.04	7.25	7.0		10.7	
	46.800	Canal spill cum causeway											
106	46.930	D 30		221.05	3970.5		0.40	0.40	7.65	6.9		10.7	
107	47.280	D 31		142.11	4112.6		0.25	0.25	7.90	6.5		10.1	

No	Chainage	Name	Extent - ha		Cum. Total		Discharge in D canals - cumec				Q for dist.	M/C Dis. Incl.	M/C Design
			Spec.	Actual	Extent - ha		Calcula.	Desig.	Cumu.	cumu.	canals m3/s	losses - m3/s	Discharge
	47.717	Canal spill cum causeway											
108	47.759	D 32		101.62	4214.2		0.18	0.18	8.09	6.3		9.7	
109	48.047	D 33		17	4231.2		0.03	0.03	8.12	6.1		9.4	
110	48.446	D 34		61.34	4292.6		0.11	0.11	8.23	6.1		9.4	
	48.739	New Regulator - Existing bridge to be incorporated with gated regulator to control the water surface											
	48.446	Canal spill 2 bay											
	49.820	Start of Heenganga aquaduct											
	49.984	Heenganga Aquaduct										END OF REACH 5	
111	50.367	D 35		20.65	4313.2		0.04	0.04	8.26	6.0	1.5	9.2	9.2
		D36		10.6	4323.8								
112	50.888	D 37		8.5	4332.3		0.02	0.02	8.28	5.9		9.1	
113	51.270	D 38		4.86	4337.2		0.01	0.01	8.29	5.9		9.1	
114	51.605	D 39		6.28	4343.5		0.01	0.01	8.30	5.9		9.1	
		Canal spill cum causeway											
115	52.191	D 40		9.11	4352.6		0.02	0.02	8.32	5.9		9.1	
116	52.237	D 41		26.52	4379.1		0.05	0.05	8.36	5.9		9.0	
117	52.865	D 42		35.63	4414.7		0.06	0.06	8.43	5.8		9.0	
118	53.025	D 43		479.15	4893.9		1.34	1.34	9.77	5.8	Branch C.	8.9	
	53.200	New Regulator		R9								END OF REACH 6	
119	53.351	D 44		8.93	4902.8		0.02	0.02	9.79	4.4	2.0	6.8	6.8
	53.492	Canal spill cum causeway											
120	53.746	D 44 A		4.7	4907.5		0.01	0.01	9.79	4.4		6.8	
121	54.184	D 45 A		2.23	4909.7		0.00	0.00	9.80	4.4		6.8	
122	54.353	D 45		13.16	4922.9		0.02	0.02	9.82	4.4		6.8	
123	54.720	D 46		4.05	4926.9		0.01	0.01	9.83	4.4		6.7	
	54.791	Canal spill - flow to Mahawatenna tank											
				153.85	5080.8								
124	55.048	D 47		94.33	5175.1		0.17	0.17	10.00	4.4		6.7	
125	55.203	D 48		14.57	5189.7		0.03	0.03	10.02	4.2		6.5	
126	55.725	D 49		21.05	5210.7		0.04	0.04	10.06	4.2		6.4	
	56.239	Canal spill cum causeway											
127	56.400	D 50		7.69	5218.4		0.01	0.01	10.08	4.1		6.4	
128	56.458	D 51		55.67	5274.1		0.10	0.10	10.18	4.1		6.3	
129	57.048	D 51 A		9.11	5283.2		0.02	0.02	10.19	4.0		6.2	
130	57.621	D 51 B		5.47	5288.7		0.01	0.01	10.20	4.0		6.2	
	57.961	Radial gated structure across Bulath atha Oya - Hettipola											
131	58.821	D 52		37.45	5326.1		0.07	0.07	10.27	4.0		6.1	
132	59.103	D 53		25.51	5351.6		0.05	0.05	10.31	3.9		6.0	
133	59.627	D 54		11.74	5363.4		0.02	0.02	10.34	3.9		6.0	
	59.723	Causeway - Namini Oya											
134	60.429	D 55		14.17	5377.6		0.03	0.03	10.36	3.9		5.9	
135	62.314	D 56		116.19	5493.7		0.21	0.21	10.57	3.8		5.9	
	62.932	Outlet		457.89	5951.6		0.82	0.82	11.39	3.6		5.6	
136	63.625	D 57		225.1	6176.7		0.40	0.40	11.79	2.8		4.3	
	63.650	New regulator - Duckbill Weir										END OF REACH 7	
												END OR STAGE III	
	64.904	Canal spill cum causeway											
	66.749	Start of Gamburu Oya											
	66.806	Radial gated spill across Gamburu Oya											
	66.806	Gambu.outlet		307.69	6484.4		0.14	0.14	11.93	2.4	2.4	3.7	3.7
137	67.103	D 58		17.41	6501.8		0.03	0.03	11.97	2.3		3.5	
138	67.761	D 59		10.93	6512.8		0.02	0.02	11.99	2.2		3.4	
	69.006	Radial gated spill across Dunuwila Oya cum bridge						0.00					
139	69.531	D 1		53.85	6566.6		0.10	0.10	12.08	2.2		3.4	

No	Chainage	Name	Extent - ha		Cum. Total		Discharge in D canals - cumec				Q for dist.	M/C Dis. Incl.	M/C Design
			Spec.	Actual	Extent - ha		Calcula.	Desig.	Cumu.	cumu.	canals m3/s	losses - m3/s	Discharge
	69.638	Regulator						0.00					
140	70.178	FC 8		30.77	6597.4		0.06	0.06	12.14	2.1		3.3	
141	70.720	D 2		142.51	6739.9		0.26	0.26	12.39	2.1		3.2	
142	71.433	D 3		487.04	7226.9		1.36	1.36	13.76	1.8		2.8	
	72.464	D4- Thun.		175.5	7402.4		0.31	0.31	14.07	0.4		0.7	
	72.464	Canal spill cum causeway						0.00					
143	72.675	FC 76		45.75	7448.2		0.08	0.08	14.15	0.1		0.2	
	72.690	Regulator											
144	73.57	FC 82		24.29	7472.5		0.04	0.04	14.20	0.04		0.1	
	73.58	Regulator						0.00					
	73.96	Silt Ejector						0.00				END OF REACH 8	
								0.00					
					7472.0								

TECHNICAL DESIGN REVIEW AND ASSESSMENT
GEOTECHNICAL DESIGN ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 6

GEOTECHNICAL DESIGN ASSESSMENT

OF TUNNELS OF THE UPPER ELAHERA CANAL AND KALU GANGA – MORAGAHAKANDA TRANSFER CANAL

AND TUNNEL AND DAMS OF THE NORTH WESTERN PROVINCE CANAL PROJECT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
CP	–	Concept Paper
DOI	–	Department of Irrigation
EIA	–	Environment impact assessment
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MRB	–	Mahaweli River Basin
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
NCPCP	–	North Central Province Canal Program
NWPC	–	North Western Province Canal
PDA	–	project design advance
PMDC	–	program management and design consultant
PPTA	–	project preparatory technical assistance
SIWRM	–	strengthening integrated water resources management
SLPI	–	Sri Lanka Prosperity Index
UEC	–	Upper Elahera Canal
WTP	–	willingness to pay

WEIGHTS AND MEASURES

ACE	–	annual per capita endowment
ha	–	hectares
km	–	kilometer
MCM	–	million cubic meters
mm	–	millimeter
m^3	–	cubic meter
MW	–	megawatt

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FIGURES

to be added

I. OVERVIEW

A. Introduction

1. The Ministry of Irrigation and Water Resources Management (MIWRM) has launched an ambitious project to convey water from the south-central part of the country to the dry regions in the north. This Water Resources Development Investment Program (WRDIP) has been under study for several decades. Now the Asian Development Bank's (ADB's) multitranche financing facility (MFF) allows the realization of the project.

2. The WRDIP entails the construction of canals, aqueducts, dams and tunnels to convey water in a gravity system over a combined distance of some 154 km from the Mahaweli River Basin (Central Province) to the North Central Province (NCP) and North Western Province (NWP). The major infrastructure to be constructed in the investment program includes (among other projects that are not covered by this report): (i) the Upper Elahera Canal (UEC) and Kalu Ganga Transfer Canal (KMTC); (ii) the North Western Province Canal (NWPC); and (iii) the Mahakithula and Mahakirula Dams. The WRDIP constitutes the first phase of the proposed North Central Province Canal Program (NCPCP), with a subsequent phase following that will utilize these WRDIP conveyance works for providing irrigation and drinking water in the service areas of Mahaweli Development Program (MDP).

3. The PPTA Tunneling Specialist visited mainly the alignment of some tunnel portions and in particular all the sites of the temporary inlet and outlet portals during the first two weeks of June 2014. Details of the walkover, the itinerary and the participants are compiled in **Annex 1**. Critical areas for the construction of tunnels, such as very low cover at creeks, the location of tanks very close to the alignment, and the potential hazards of karstified marble have been inspected in the field. Some of core boxes from previous and actual drilling campaigns have been checked physically on the geological and tectonic conditions as well as the thickness of the overburden. In addition morphological features, like deeply cut streams or shear zones have been targeted at various chainages along the alignment.

4. Based on the observations and findings from the walkover of the tunnel traces, the drilling investigations were modified and it was proposed to change some alignments for economic and/or technical reasons. The modifications of the boreholes happened with Tunnel 3 of the UEC. The change of alignment occurred at Tunnel 4 of the UEC and at the Tunnel of the NWPC. Consequently the sites were selected for new boreholes. Later, in during the course of detailed design, Tunnel 4 of the UEC was replaced by a canal section and a shorter alignment was recommended for Tunnel 3 of the UEC.

5. Since the MIWRM has already launched a similar project comprising tunnels with mechanized as well as conventional drive, canals and dams under comparable geological conditions in Uma Oya Province, a site visit was carried out in order to study mainly the installation and performance of two tunnel boring machines (TBMs) in Sri Lanka. Although the diameters of the mechanized tunnels are smaller than in the WRDIP the organization of the site and the technology of tunneling will be very similar. Further details of the itinerary and the participants are compiled in **Annex 2**.

B. Documents

6. The following documents have been used for the site visit as well as for this report:

(i) Geological map with the alignment of the tunnels of the KMTC, UEC and NWPC at a scale of 1:100,000

(ii) Geological sections along each tunnel route based on the geological map 1:100,000

(iii) Topographic map with a layout of canals and tunnels with the locations of old and new boreholes

(iv) Location map, cross sections of the dams and geological sections along the dam axis of all dams in the NWPC Project

C. Alignment of the Tunnel Routes

1. Upper Elahera Canal (UEC)

7. **Tunnel 1.** This tunnel (**Figure 1**) is located in the forest of a Nature Reserve and it is the shortest of all the tunnels in the investment program. The intersection of the ground surface with the top of the canal will be at chainages 17+730 and at 17+940. Due to the short length the tunnel has to be excavated conventionally by drilling and blasting. Heading works can start when a rock cover of at least one tunnel diameter has been reached. This will most probably be the case at chainages 17+820 and 17+890, where the temporary portals will be located. The portion between the portals and the intersection with the ground surface should be constructed as cut-and-cover. The maximum height of the burden above the roof of the tunnel will be 20.9 m as displayed in **Figure 10**.

8. **Tunnel 2.** This tunnel (**Figure 1**) is also situated in a forest of the same Nature Reserve as Tunnel 1. The intersection of the ground surface with the canal will be at chainages 22+200 and 23+100. The temporary portals can be arranged at chainages 22+270 and 22+960 for conventional heading works. In general this tunnel has a low rock cover between 7 and 20 m. The minimum cover will be encountered in the northern part, where three gullies with an estimated depth of 4 to 7 m cross the alignment (**Figure 10**). The total thickness of the burden measures 7 to 10 m at these intersections (chainage 22+780 to 22+840). The portion between the portals and the intersection with the ground surface should be constructed as cut-and-cover.

9. **Tunnel 3.** This tunnel (**Figure 2**) will be the longest of all in the investment program. The previous alignment (Route 1) has been revised after some discrepancies of the topographic survey had been detected shortly before the site visit. The tunnel was shifted approximately 1.1 km westwards in the south (Route 2). At chainage 27+200 the alignment of Route 2 turns from a northerly into north western direction. Another bend starts at chainage 28+800, which brings the tunnel back into north-northwest azimuth. From chainage 29+200 onwards the trace aims in a straight line towards chainage 54+000, where it returns to the previous alignment. The intersection of the ground surface with the canal will be at chainages 27+120 and 55+720. The respective temporary portals can be constructed at chainages 27+500 and 53+540, which

results in a total length of 26.04 km of tunneling works. Great parts of the alignment are located in the Nature Reserve, which is mainly covered by scrub land and to a lesser degree by forest approximately up to chainage 42+500. Small portions of grassland occur in flat areas. North of chainage 42+500 agricultural use of the land was observed in the vicinity of settlements. From the inlet portal onwards the morphology rises gently with increasing stationing. At chainage 27+760 approximately the tunnel traverses the first mountain ridge with rising rock covers. At chainage 27+830 the cover exceeds 100 m and the maximum of around 200 m lies between chainages 27+980 and 28+060. A second maximum with some 190 m of rock cover will be encountered from chainage 28+180 to 28+210. The morphology decreases with increasing distance from the portal. At chainage 28+620 the rock cover is reduced to 100 m and the tunnel traverses a wide valley with a rock cover of about 90 m. Another mountain ridge will be crossed with rock covers >100m between the chainages 28+940 and 29+520. The highest cover in this section reaches 155 to 160 m from chainage 29+140 to 29+220. The morphology declines further north. A rock cover of 50 m is reached at chainage 29+950 approximately. Between chainages 30+080 and 30+300 the tunnel traverses a wide valley with two streams and a low cover of 24 m only. After that the morphology becomes hilly towards north up to chainage 31+260 with an average cover of some 40 m and highest elevations between 70 and 80 m. Until chainage 31+340 the tunnel has a very low cover of 15-18 m which increases to 25 m further downstream (chainage 31+680). The cover increases gradually up to nearly 60 m (chainage 31+980) followed by another decrease towards the next valley characterized by a shallow cover of 9 to 16 m from chainages 32+430 to 32+885. Up to chainage 33+180 the cover reaches 30 m with a subsequent portion of insufficient burden between chainages 33+230 and 33+360. The cover increases again up to 50 m and even 90 m from chainage 33+790 to 35+480 and then decreases gradually to 40 m and finally to 30 m at chainage 46+040. Another critical low cover ranges from chainage 46+600 to 46+880 with a burden of 16 to 19 m only. Up to chainage 47+275 the cover surpasses slightly the 20 m mark, but it falls again below that up to chainage 47+400. The tunnel section till chainage 49+940 displays a completely similar situation interrupted by two sections of insufficient cover between chainages 48+530 and 48+630 as well as between 49+310 and 49+550. The next tunnel portion varies with the cover between 20 and 47 m up to chainage 52+300. The low burden of 18 to 20 m only, will continue to the temporary portal at chainage 53+540. Due to the insufficient cover of 14 to 18 m thereafter the tunnel should be constructed as cut-and-cover in an open pit till the final portal will be reached at chainage 55+400. More details are presented in the longitudinal section of **Figure 11**.

10. In an effort to reduce the construction cost of this long tunnel, an alternative trace (**Figure 3**) was elaborated for the intake by extending the canal portion from the turning point of Route 2 towards northeast, traversing Elahera Giritale Sanctuary, then crossing the creek Ruppe Ela west of the rice paddies. Thereafter the canal heads north towards Mt. Migas, where the inlet portal can be constructed at its foothills. The tunnel will be headed for some 300 m in a northerly direction and the alignment turns then towards northwest for about 3.2 km. At its end the trace returns in a wide curve to the northern direction and enters the old alignment approximately at chainage 34+000. The alternative Route 3 was neither been inspected in the field nor were any geotechnical investigations launched due to time constraints. Route 2 is the final alignment.

11. **Tunnel 4.** Tunnel 4 was previously supposed to run at a certain distance more or less parallel to Hurulu Wewa, i.e. parallel to the contour lines of a low, forested hill with a very shallow burden of 5 to 12 m from chainage 60+840 to 62+200. Due to the insufficient rock cover, heading works could only be envisaged between the chainages 61+700 and 62+060 under considerable geological and technical risks. In addition a high groundwater table can be expected from Hurulu Wewa as experienced from three wells at the foot of the small hill. The water level was encountered 0.3 m below surface. Finally a strong ecological impact on the forest would be the consequence of long tunnel portions constructed as cut-and-cover in open pits at either side of the temporary portals.

12. The high technical risks and the ecological impact on the environment favored the selection of an alternative tunnel route. Although longer, but traversing hard rock, the heading works would finally have proven to be more economic and more environmental friendly. The new alignment would turn at chainage 61+700 from north-northwest to northwest and traverses a hillock normal to its contour lines. At chainage 62+500 the tunnel returns to its previous azimuth. The new alignment has been shifted some 300 m further upstream as an alternative. The temporary portals would be constructed at chainage 61+870 for the inlet and at chainage 62+450 for the outlet.

13. In a final discussion with regard to cost reduction it was concluded to cancel the new alignment and to replace the Tunnel 4 by an open canal. At chainage 61+700 the open canal will continue further north and follow along near the shore of Hurulu Wewa in a close distance. Consequently, all envisaged geotechnical investigations were cancelled in time.

2. Kalu Ganga – Moragahakanda Transfer Canal (KMTC)

14. **Tunnel 1A.** Tunnel 1A starts downstream of Kalu Ganga Reservoir (**Figure 4**) in the forest of a National Reserve. The inlet portal can be constructed at chainage 0+920 and the temporary portal will be at chainage 1+020. This means that between the inlet and temporary portal the tunnel will comprise a cut-and-cover section. Heading works will face a low rock cover of 17 to 29 m till chainage 1+280 for the tunnel. After that it traverses a gentle ridge and the burden increases up to some 70 m between chainages 1+510 and 1+670. Further downstream the cover decreases gradually down to 18 m at chainage 2+560. Towards the outlet portal the morphology rises again to a maximum cover of 45 m at chainage 2+780. After traversing some deeply incised valleys the temporary portal can be constructed on a steeply inclined slope at chainage 2+815 and the final portal will be at chainage 2+840 (**Figure 12**).

15. **Tunnel 1B.** This tunnel is situated also in the forest of the same National Reserve (**Figure 4**). The slope at the inlet is rather flat and therefore the temporary tunnel portal can be opened at chainage 3+210 (**Figure 12**). The morphology is continuously rising with the chainage progressing and a first maximum of more than 200 m of burden ranges from chainages 3+870 to 4+050. At chainage 4+300 the tunnel traverses a valley with a cover of 120 m and after that it increases to more than 250 m between chainages 4+690 and 5+480. The highest burden with more than 370 m will be reached from chainage 6+160 to 6+180. Further on the cover over the roof of the tunnel decreases gradually to 114 m at chainage 7+540. A last peak with a burden of 185 m will be traversed between chainage 8+180 and 8+200. Hereafter the cover decreases continuously down to 18 m, where the temporary portal can be established. The respective chainage reads 9+120.

16. Discussions were held to allow TBM heading for both tunnels with one machine for economic reasons. The only obstacle for this target was a sigmoidal alignment traversing a creek between both structures with too low radii for a mechanized tunneling. Attempts to redesign the alignment of an aqueduct in the creek lead either to disadvantages for the tunnels or to complicated solutions in the valley. Consequently the idea using a TBM continuously was abandoned for both tunnels. The short tunnel 1A must be excavated by the conventional drill and blast method.

3. North West Province Canal (NWPC)

17. The previous alignment of the NWPC tunnel situated in a forest of a Natural Reserve has also been revised after the site visit for geologic and economic reasons (**Figure 5**). The new inlet portal however, calls again for an adjustment of the canal route to avoid a long section as cut-and-cover. The new temporary portal should be shifted further upstream and closer to the steep slope to protect more effectively the environment.

18. The previously revised temporary portal can be constructed at chainage 22+410 (**Figure 13**). From there the morphology rises gently to chainage 22+670, where the cover reaches 35 m above the crown. The burden decreases to 23 m at chainage 22+775 and increases again to a first maximum of 65 m between the chainages 23+020 and 23+050. The next depression is located at chainage 23+200 with 30 m of total cover. The second maximum with another 65 m of burden is situated at chainage 23+285. The morphology decreases gradually to chainage 23+420, where the temporary outlet portal can be placed with 10 m cover above the crown.

19. **Dams.** Three dams form part of the NWPC Project (**Figure 5**). From the permanent outlet portal at chainage 23+470 a short canal conveys the water to the first proposed **Mahakitula Reservoir**. The earth dam with a clay core and an ungated spillway on the left bank will have a height of 25.8m and a crest length of 1,295m. The upstream part of the reservoir will be closed by an 11.2m high and 572.45m long saddle dam filled with earth and constructed with a clay core as well. Both dams entail a gated sluice on the right bank to convey the water to existing reservoirs. A new 1.49km long canal has to be constructed from the stilling basin of the main dam to a creek which conveys the water to Pothuwila Wewa. From the saddle dam a 3.66km long feeder canal will be constructed towards **Mahakirula Reservoir** while passing along the tailwaters of the existing Mahadambe Wewa.

20. The Mahakirula earthfill dam has the same design features like the other two dams; an ungated spillway on the left and a gated sluice on the right bank. The height will be 24m and the crest length measures 333.38m. It will be constructed immediately upstream of an existing bund. The sluice will feed into the proposed Upper Mi Oya Canal which conveys the water farther north.

D. Geological Conditions along the Tunnel Routes

1. General

21. **Geological Map.** All tunnel routes and the foundations of the three dams are covered by the Geological Map of Sri Lanka in a scale of 1:100,000. The structures are situated in the Precambrian Highland Complex, which is composed of paragneiss. The Highland complex is formed by the Khondalite Group of metamorphosed sediments and charnokites. It occupies a broad belt running across the center of the island from south west to north east. It thus occupies the whole central Hill Country of Sri Lanka. The dominant rock types within the project area are biotite hornblende gneiss, granitic gneiss, crystalline limestone, quartzo-felspathic rocks, charnockitic gneiss and quartzite. For the purpose of tunneling the map can provide a general overview of the sequence of strata, i.e. a series of different gneiss varieties without presenting any particular details, such as thin intercalations of different rock types, occurrence of dykes, faults or similar. During the site visit it was observed that e.g. intersections of quartzites and/or quartz dykes were widely spread at all tunnel alignments without being marked on the geological map. Consequently, the MCB has actually mapped the ground surface in a corridor of 200 m on either side of the alignment for Tunnel no 3 of UEC and the tunnel of NWPC. The respective activities for the other structures are still pending.

22. **Geological Section**. On the basis of the 1:100,000 Geological Map of Sri Lanka longitudinal sections have been established for each of the tunnels by the MCB. As mentioned above these geological sections provide only general information of different rock types on a large scale. As soon as results from core drilling, surface mapping, tectonic evaluation of aerial photos and also geo-electrical exploration became available these sections had been revised accordingly with proper strike and dip, occurrence of fault and/shear zones as well as groundwater levels, thickness of overburden and the influence of weathering. A first section has already been established for the tunnel of NWPC and Tunnel 3 of UEC is under preparation since one borehole and small portions of the geoelectrical sounding are still pending.

23. It is anticipated that then the geological hazards of e.g. karstification or insufficient rock cover etc. can better be judged and restricted to some sections within the tunnels traversing calcareous gneiss, marble and/or deep-seated weathering after all reports dealing with the geotechnical investigations have been submitted to MCB.

2. Geological Conditions along the UEC

a. Rock Types

24. **Tunnel 1** traverses on its entire length on a west-east route a quartzite of the Precambrian Highland Complex (**Figure 6**). This rock type may contain up to 5% of sillimanite, some biotite and little kaolinised feldspar. The content of quartz is assumed to be around 90% or even more. Two boreholes have been drilled at the portal of this tunnel with depths between 19.2 and 24.4 m; the thickness of the overburden ranges from 2.45 to 14.05 m. The latter case calls for a deep cut at the temporary portal since a rock cover of at least 7 m above the roof of the tunnel is required for safety reasons. The geo-electrical exploration has disclosed a shallow depth of overburden and/or weathering zone with a range of 2 to 4 m, only.

25. **Tunnel 2** runs from south-east to north-west and intersects three layers: (i) quartzite at the inlet, (ii) Khondolite, and (iii) marble. The quartzite is the same as described above. The Khondolite represents a sillimanite – garnet paragneiss with plagioclase, quartz and biotite (**Figure 6**). The petrographic description of the marble has also been given before.

26. **Tunnel 3** measures some 26 km and will be the longest tunnel in this project. Apart from the portion of the inlet, where the alignment runs more or less southeast-northwest for a short distance the tunnel turns into northerly direction over the rest of the trace. On its way it passes through several different rock types, such as:

- Khondolite representing 16.4% of the tunnel portion
- Charnokite representing 10.4% of the tunnel portion
- Quartz schist representing 1.7% of the tunnel portion
- Quartzite representing 6.9% of the tunnel portion
- Marble and/or calc-gneiss representing 41.3% of the tunnel portion
- Migmatitic gneiss representing 14. 5% of the tunnel portion
- Quartzo feldspathic gneiss representing 8.8% of the tunnel portion

27. The quartz schist can be associated with impure quartzites. The mineralogical composition displays besides quartz, sillimanite, ± magnetite and ± garnet. In places the quartz schist can be interlayered by quartz rich, biotite bearing quartzofeldspathic gneiss. The migmatitic gneiss is composed of tectonically interlayered garnet – sillimanite – biotite paragneiss and biotite - hornblende orthogneiss. The layers are variably migmatised with abundant potash melts in the paragneiss. The quartzo feldspathic gneiss comprises besides the main minerals quartz and feldspar a considerable amount of pink garnet.

b. Tectonics

28. At **Tunnel 1** the geological map reveals that the quartzite strikes nearly north-south and dips flatly towards west. The tunnel runs more or less normal to the strike which favors the heading from west towards east. The bearing of the joint system has not yet been mapped due to lack of outcrops at the surface. The geological map does not show any prominent faults in the close vicinity of the tunnel.

29. **Tunnel 2** traverses the sequence of strata at an angle of about 45 degrees and the dip direction is west-north west. No details have been communicated about the strike and dip of the joint system. The geological map displays a prominent fault trending with a very small angle on the north east of the tunnel. It seems very likely that the fault intersects the alignment upstream or downstream of the temporary tunnel portal.

30. **Tunnel 3** traverses on its first km the sequence of strata diagonally. Beyond chainage 29+000 and after the bend the alignment intersects all layers at an oblique angle of around 40 degrees; from chainage 34+000 onwards the angle of intersection decreases to 10 degrees which leads to a very long passage of 11.5 km through marble and/or calcareous gneiss. The rest of the tunnel runs at an angle of 25 degrees through the sequence of strata. The layers dip gently towards west and northwest. Some weak zones have been detected and they are compiled in the **Table 1**.

Table 1: Weak Zones and Rock Types in UEC Tunnel 3

Chainage		Type of weak zone	Distance/km
From	To		
27+660	27+700	Rock Contac zone	0.04
28+230	28+280	Rock Contac zone	0.05
28+660	28+710	Rock Contac zone	0.05
29+300	29+660	Rock Contac zone & Quartzite(Highly Fractured)	0.36
29+880	29+900	Rock Contac zone	0.02
30+660	30+700	Rock Contac zone	0.04
30+820	30+860	Rock Contac zone	0.04
31+260	32+200	Rock Contac zone ,Quartzite(Highly Fractured)& marble soluble rock type with water ,solution cavities	0.94
32+260	32+400	shear zone	0.14
32+360	33+060	Rock Contac zone& marble soluble rock type with water ,solution cavities	0.7
35+300	41+160	Rock Contac zone& marble soluble rock type with water ,solution cavities	5.86
41+680	45+420	Rock Contac zone& marble soluble rock type with water ,solution cavities	3.74
44+700	46+000	shear zone	1.12
49+300	49+340	Rock Contac zone	0.04
50+300	50+350	Rock Contac zone	0.05
51+140	51+440	Rock Contac zone & Quartzite(Highly Fractured)	0.3
54+660	54+880	Rock Contac zone & Quartzite(Highly Fractured)	0.22

Source: MCB, 2014

31. No details are known yet about the joint system in Tunnel 3. Morphological features, like the trend of fault controlled valleys indicate a set of directions for the strike with the number of occurrence, such as:

Chainage 28+000 to 34+500	NE – SW (6)
	NW – SE (4)
	E – W (3)

	NNE – SSW (2)
	NNW – SSE (1)
Chainage 37+000 to 54+000	NE – SW (10)
	NW – SE (4)
	E – W (4)
	N – S (2)
	ENE – WSW (2)
	WNW – ESE (1)
	NNE – SSW (1)

32. In the first part of Tunnel 3 the majority of the faults follow the bedding joints. The east-west direction intersects the tunnel nearly normal to the alignment and all other trends cross at oblique angles the tunnel route. The dip is not known either; it is assumed however, that it will be rather steep.

33. The geological map displays prominent faults striking north west – south east at chainages 32+000, 41+500 and 41+800. Another fault trending northeast – southwest intersects the tunnel at chainage 45+700 (approximately). The morphology however, indicates that many valleys are fault controlled.

c. Groundwater

34. The groundwater readings from the drilling operations have been incorporated into the geological sections. However, they represent the status of the period of drilling. Due to lack of time and personnel any long-term observation was not envisaged for an extended period.

35. **Tunnels nos. 1** and **2** of the UEC either lack information regarding groundwater or it was not encountered during the drilling process. It is assumed however, that inflow of water might be expected while tunneling in the course of or shortly after the rainy season in more or less small quantities due to a limited catchment area.

36. Along **Tunnel 3**, which is under investigation, all relevant data will be collected for the future heading works. At the inlet portal the groundwater was encountered 8.1 m and 11.15 m below ground. The latter level will be above the crown. From chainage 27+700 to 29+900 the rock cover increases considerably. In case water laden joints and/or faults will be intersected by the tunnel the inflow will be under high to very high load. However, these cases will be very rare since joints and/or faults become watertight with increasing depth.

37. Tunnel sections with low or very low rock cover may experience ingress of water only in or shortly after the rainy season in gneissic environment. In shear zones and calcareous geology, i.e. in marble or calc-gneiss, inflow of water will be difficult to predict since the extent of shear zones or karstification cannot be investigated in sufficient detail for economic reasons and time constraints with the project. In some cases karstic channels might be filled with water only during or after the rainy season.

38. At the beginning of the site visit the influence of karstification was detected only on the ground surface. The drilling works progressing e.g. revealed signs of karst through open caves in the boreholes with complete loss of flush water in the northern part of the alignment. The same phenomena were also reported from the actual tunneling works in Uma Oya Province, where two TBMs had to cross open caves causing some delay with the progress and calling for extra measures, like e.g. filling the caves with grout or even with concrete. Inflow of water hampered also the advance rates. The pilot hole of the raise boring machine drilling in the gate shaft got stuck due to a complete loss of drilling fluid in a cavity.

39. The marble and calcareous gneiss will pose quite similar problems for Tunnel 3 in general. In addition however, the tunnel route traverses thalwegs of streams and river courses with very low or even insufficient rock cover at the approximate chainage 32+500. In the vicinity of chainage 31+310 the tunnel crosses the river running in quartzite which is in close contact to a marble. Due to that fact the marble might be infiltrated by the river posing a hazard of high inflow of water into the tunnel through karst channels.

40. Other hydrogeological hazards may have an influence on the heading works in marble by the existence of tanks close by or even above the tunnel route at the following chainages:

33+300 – 33+400	tank some 100 m west of the tunnel, cover 14 m
35+700 – 35+800	tank 45 m above the tunnel
36+200 – 36+300	tank immediately west of the tunnel, cover 41 m
37+600 – 38+000	tank 50 to 150 m east of the tunnel, cover 36 m
44+200	tank some 250 m east of the tunnel, cover 35 m

41. Although the distance and/or cover seem to be sufficient, these features have to be investigated in detail prior to the heading works to exclude a flooding of the tunnel by potential waterways between a tank, river or stream and the tunnel. Between chainages 44+800 and 46+200 the tunnel intersects a very long shear zone which might be laden with groundwater. The hazard will be imminent in the marble and/or calc-gneiss in particular. The alignment runs into gneissic rock in the shear zone. Further north the rock cover decreases down to 12 m in places. This thin cover raises not only stability problems for the tunnel, but it increases the risk of inflow of perennial water in the rainy season or shortly afterwards. The groundwater can be expected between 4 and 9 m in the most northern part of the tunnel, i.e. within the tunnel section.

42. **Tunnel 1A** of the KMTC has records from the inlet portal with 7.5 m below ground, where the water was encountered in the bedrock. At the outlet portal groundwater was found in two boreholes at 8.0 m still in the highly weathered bedrock and at 10.8 m in the second hole.

43. **Tunnel 1B** of KMTC had no groundwater down to the final depth of 25 m in drill hole DT 03. No corresponding data have been made available for the outlet portal.

3. Geological Conditions along KMTC

a. Rock Types

44. The geological mapping along both tunnels is either incomplete or has not even started in the period of report writing. No definite date of handing in the new maps has been communicated by MCB. Consequently a comment on an update of the geological conditions remains pending for the near future.

45. **Tunnel 1A** runs from south east to the northwest and intersects obliquely charnokitic gneiss, calcareous gneiss and quartzo feldspathic gneiss from upstream towards downstream. The petrographic description of these rock types has already presented above. The respective quantities are compiled as follows:

- Charnokite representing 88.6% of the tunnel portion
- Quartzite representing 5.6% of the tunnel portion
- Quartzo feldspathic gneiss representing 1.1% of the tunnel portion
- Calcareous gneiss representing 4.7% of the tunnel portion

46. **Tunnel 1B** trends in the same direction like Tunnel 1A and the rock types are restricted to charnokite and quartzite. Due to the anticlinal feature in this ridge the quartzite appears three times totaling 19% and the charnokite four times with 81%.

b. Tectonics

47. The alignment of **Tunnel 1A** intersects quite uniformly the strike of the sequence of strata at an angle of 53° according to the general geological map. The foliation trends north - south and the dip ranges from 30° in the south to 55° in the north.

48. The alignment lies between two major faults running more or less parallel in 700 m to 1,300 m distance. It is assumed that these tectonic elements will not have any influence on the rock conditions in the tunnel.

49. Master joints and other prominent tectonic elements were depicted from the aerial photos as follows:

- 3 elements cross the tunnel NE-SW, normal to the alignment
- 3 elements cross the tunnel NW-SE, diagonal to the alignment
- 1 element crosses the tunnel W-E, diagonal to the alignment
- 1 element crosses the tunnel N-S, diagonal to the alignment
- 1 element crosses the tunnel W-E, diagonal to the alignment
- 1 element crosses the tunnel SSW-NNE, diagonal to the alignment

The numbers given above are only indicative for the distributions of the directions of discontinuity planes encountered in the tunnel. In reality far more joints, faults, shear zones or similar tectonic elements will occur in the tunnel.

50. **Tunnel 1B** is located on the western limb of an anticline which is intersected by two transverse faults between chainages 6+950 and 7+100. The most northern of them (CH. 7+100) seems to be a transform fault. The respective effects of the faults in some 180 m depth cannot be assessed at the moment. From chainage 7+100 the alignment follows the strike of the strata dipping towards east south east.

51. Some 250 m north of the outlet portal the geological map displays another major fault trending west south west – east north east. Borehole PBH-02 at the outlet portal has traversed highly weathered charnokite between 17.5 m and 21.35 m (bottom of the hole) and moderately weathered charnokite above. The degree of weathering in this borehole may indicate an influence from this fault or an element running parallel to it further south.

52. Master joints and other prominent tectonic elements were depicted from the aerial photos as follows:

- 8 elements run parallel to the tunnel in NW-SE direction
- 6 elements cross the tunnel NE-SW, normal to the alignment
- 5 elements cross the tunnel WNW-ESE, diagonal to the alignment
- 4 elements cross the tunnel NNW-SSE, diagonal to the alignment

The numbers given above are only indicative for the distributions of the directions of discontinuity planes encountered in the tunnel. In reality far more joints, faults, shear zones or similar tectonic elements will occur in the tunnel.

c. Groundwater

53. **Tunnel 1A** of the KMTC has groundwater records from borehole DT 1 at the inlet portal with 7.6 m below ground, where it was encountered in the bedrock. At the outlet portal groundwater was found in two boreholes i.e. at 8.0 m (DT 4) and at 10.5 m (DT 2); both levels are in the highly weathered bedrock.

54. **Tunnel 1B** of KMTC had no groundwater down to the final depth of 25 m in drill hole DT 03. No corresponding data have been made available for the outlet portal, but the water level is estimated to be in the range of the elevation of the river.

E. Previous Geotechnical Investigations

1. Core Drillings

55. Before the site visit the following tunnels had already been explored by core drillings:

• Tunnel 1A	(KMTC)	3 boreholes
• Tunnel 1B	(KMTC)	2 boreholes
• Tunnel 1	(UEC)	3 boreholes
• Tunnel 2	(UEC)	3 boreholes

56. The locations of the boreholes are all located in the portal areas of the KMTC. At the UEC the drillings are distributed over the length of the tunnel due to the flat morphology. At

Tunnels 3 and 4 of the UEC as well as at the tunnel of the NWPC the exploration started in May-June 2014.

57. The soil along the canal alignment of the UEC has been investigated by nine auger holes with depths between 1.75 and 5.0 m.

2. Geo-electrical Exploration

58. The geophysical exploration was performed for the UEC from April to September 2012. Altogether, 14 profiles have been investigated with lengths of 54 and 108 m in a Schlumberger array between chainages 0+000 and 56+000. The maximum penetration depth was limited to 20 m under these conditions.

59. A short profile, 11.6 m deep, exists for the inlet area of Tunnel 1 displaying sound rock at very close to the surface. Five similar soundings are available from the flat areas of Tunnel 3 depicting the variations of weathering with some rock types. At chainages 37+500 and 42+000 solid marble can be expected at depths from 2.5 to 5.0 m below ground. Simultaneously the latter section displays also deep seated weathering to more than 20 m depth. At chainages 44+000 and 50+000 only fragments of marble and charnokite with a higher degree of weathering have been explored down to a depth of more than 11 m. The quartzo feldspathic gneiss appears highly weathered only in fragments in similar depths at chainage 53+000.

F. Actual Geotechnical Investigations

1. Core Drillings

60. After the site visit of the UEC Tunnel 3 the drilling program, which had been considerably extended upon request by the MCB's Consultant Dr. H. Wagner, was checked on its efficiency. Out of 46 drilling locations 6 were cancelled and 1 was newly added to the investigation program. Five boreholes had already been completed and three drillings were in progress at the time of the visit.

61. The drilling program was revised to gain more information regarding karstified rock at petrographic or tectonic contacts in shear zones as well as to enlighten the geologic conditions at tanks situated on or close by the tunnel alignment. The main changes are summarized below with the respective borehole numbers:

DT 4R	to be shifted onto the alignment
DT 5	60 degrees inclined towards upstream
DT 6	shifted to chainage31+500, 60 degrees inclined towards upstream
DT 6R	at chainage 31+710 on alignment, depth twice the tunnel diameter below the invert
DT 7L	shifted to chainage 32+380, 60 degrees inclined towards upstream, 10 m below the invert of the tunnel
DT 7R	shifted to chainage 32+600
DT 7	60 degrees inclined towards upstream
DT 8	shifted to chainage 32+800

DT 9	shifted to chainage 33+040, 60 degrees inclined towards upstream
DT 10L	to be shifted close to tank, depth twice the tunnel diameter into the khondolite
DT 10R	shifted to chainage 33+750
DT 11L	at chainage 35+710, 10 m west of trace, 50 degrees inclined towards downstream, 30-60m long
DT 11R	at chainage 36+220, 10 m east of trace, 50 degrees inclined towards downstream, 30-60m long
DT 11	shifted to chainage 37+950, 50 degrees inclined towards east, 30 m long
DT 14	shifted to chainage 41+160, 60 degrees inclined towards upstream
DT 15	shifted to chainage 41+720, 60 degrees inclined towards upstream
(DT 18)DT 18L	shifted to chainage 44+840, 19 m west of trace
DT 19	shifted to chainage 45+350, 60 degrees inclined towards upstream
DT 20	shifted to chainage 45+640, 50 degrees inclined normal to strike of strata, 35 m long
DT 21	shifted to chainage46+000, 50 degrees inclined normal to strike of strata, 35 m long

62. The duration of the drilling activities was initially assumed to be about 8 to 10 weeks with four rigs, i.e. the campaign could be finished at mid or end of August. As matter of fact the drilling works continued up to mid-November due to technical reasons and lack of flush water in the dry season.

63. The tunnel of the NWPC runs on a new trace and both portals as well as a small valley at chainage 22+765 call for core drillings.

2. Geo-electrical Exploration

64. In view of the extensive occurrence of potentially karstified marble or calcareous gneiss the number of geo-electrical soundings have been increased along the morphologically flat areas of the Tunnel 3; the arrays have to be modified to obtain a penetration depth of 40 m in general.

65. It is recommended to cover those parts of Tunnel 3 completely where the burden is either insufficient or the marble reaches a thickness of 40 m or more. The aim will be to collect as much information about deep seated tropical weathering and signs of karstification as possible.

66. The intake as well as outlet of the tunnels with NWPC should be sounded in a similar way in order to detect the influence of the tropical weathering with regard to the stability of the structure during heading works.

3. Geological Mapping

67. The lack of detailed tectonic data for the various rock types encountered in the tunnels calls for a surface mapping in a strip of 200 m on both sides of the alignment. As mentioned before the actual knowledge of the sequence of strata with its strike and dip, the occurrence of faults and/or shear zones is only based on the geological map with a scale of 1:100,000. In

reality however, the geologic conditions are more complex by folding, by intrusion of dykes, pegmatites and/or aplites, by faulting and shearing. The joint pattern which regulates the occurrence and size of wedges at slopes or in tunnels will be logged in the field and/or evaluated from aerial photos.

68. The new geological maps will provide more detailed information which can be used for the stability of crown, face and walls for the tunnel. Details of the petrographic sequence and its composition have an influence on the wear of drilling or cutting tools. Particular laboratory tests are recommended which will be performed in Sri Lanka and abroad.

69. All results will be evaluated with regard to the material properties for open cuts, the temporary portals, and the tunneling works for conventional as well as mechanized heading.

4. Tectonic Evaluation of Aerial Photos

70. The lush vegetation and/or the intense weathering might hamper or even prevent detailed tectonic logging of master joints, faults and shear zones in the field. For this reason it was proposed to use aerial photos to evaluate the tectonic inventory along the tunnel alignments.

71. The Ministry of Land was visited with MCB on the 30th of May 2014. The archive disposes of a set of black and white aerial photos in very good quality covering the corridor of Tunnel 3 of UEC on its entire length. The photos of mountainous areas display all master joints and faults even in forests. The soft copies have been submitted to MCB in July for all tunnels including KTMC.

5. Laboratory Testing

72. For the performance of laboratory tests representative samples have to be selected from the core boxes in sufficient quantity. The tests for unconfined compressive strength as well as for tensile strength (Brazilian Test) call for a length of the core which should be more than twice the diameter of the core after both ends of the core have been cut normal to the direction of drilling.

73. For other tests sufficient material has to be taken and sent to the laboratory. The Technische Universität München (Germany) was selected to test (Cerchar test) all quartz bearing strata which are known for their elevated abrasivity (See **Annex 3**).

74. The following number of samples should be taken for particular tests:

Unconfined Compressive Strength	each rock type	7-10 cores
Brazilian Test	each rock type	3-5 cores
Potential Reactivity Test	rock rich quartz	2 samples
Petrographic Analyses	each rock type	2 samples
Rock Shear Test	each rock type	3 samples
Cerchar Test	quartzite, quartzitic schist	2 samples
Chemical Analyses	marble, etc.	10-15 samples
Chemical Analyses	water	4 samples

a. Index Property Test

75. The index property tests consist of the determination of porosity, unit weight, absorption and specific gravity of rock core samples. The test procedures shall be in accordance with the methods described in ISRM (International Society for Rock Mechanics), CLT No. 2 or equivalent.

b. Unconfined Compression Test

76. Unconfined compression tests shall be carried out to determine the compressive strength of both dry and saturated samples and, also, to determine the Young's modulus and the Poisson's ratio. All deformation measurements shall be carried out by means of electrical strain gauges. The testing procedure shall be in accordance with the ISRM Suggested Methods (latest edition) and the relevant ASTM Standards (e.g. ASTM 2938, ASTM D3148).

77. For each specimen, the wet and dry unit weights and the absorption index shall be determined. The test procedure must conform to the standard ASTM 2938-71a and the instructions of the Engineer. The report on the test results shall include a schematic sketch of the failure planes and cracks, together with photographic documentation, the Young's modulus, and Poisson's ratios calculated by both the tangent and secant methods. The tested specimen must be preserved and handed to the Engineer after completion of all tests.

c. Potential Reactivity Test

78. The potential alkali-aggregate reactivity of quartz bearing gneiss, quartzitic schist and quartzite shall be tested by the Accelerated Method (ASTM C-9, P214) and the Mortar-Bar Method (ASTM C227 – 97a).

d. Petrographic and X-Ray Analyses

79. The purpose of the petrographic analysis is to describe, classify and determine the amounts of mineral constituents of rocks. The analysis shall be performed in accordance to ASTM C295-90 (1994). The results of the petrographic analysis shall be compared with the chemical analysis as described below.

80. The presence and quantity of any deleterious minerals shall be determined thoroughly using the X-ray defractometry and other recognized methods.

e. Rock Shear Test

81. The rock shear tests shall be performed on samples of weak rock types, along faults and/or foliation planes taken from the core drillings using e.g. standard rock laboratory direct shear testing equipment; or portable rock shear apparatus such as Hoek type (ELE Laboratory, U.K.).

82. After saturation, the samples shall be sheared either through the weak rock or along the interface between the weak and hard rock.

83. The rock shear tests shall determine the peak and residual shear strength of the weak material. The test results shall include:

- Porosity, unit weight, natural moisture content and water absorption
- Water content before and after testing
- Graph of shear strength versus shear displacement for the peak and residual shear strength
- Mohr-Coulomb diagrams for the peak and residual shear strength
- Photographs of the sheared surfaces of the samples after shear tests

f. Brazilian Test

84. Brazilian indirect tensile tests on rock core shall be carried out for each type of rock in accordance with the specification given in the ISRM suggested Methods (latest edition) and ASTM D 3967.

g. Cerchar Test

85. The Cerchar abrasivity index is the most common indicator for the standing time of drilling tools. Hence cores from each type of quartz bearing rock have to be tested on the abrasivity according to the publication in the Journal Rock Mechanics, 15, p. 1-7, (1982), for the selection of the cutting tools. The results are presented in **Annex 3**.

h. Chemical Analysis

86. The chemical analyses of rocks shall be performed in accordance with recognized methods. These analyses shall determine the carbonate content in calcareous gneiss and marble as well as the existence and quantity of any harmful minerals which are expansive, aggressive to concrete and/or tend to disintegrate when exposed to air or water.

i. Analyses of Water

87. Samples of water should be taken from those rivers which will fill the future reservoirs to be analyzed on its aggressivity towards concrete according to the German Standard DIN 4030.

II. KEY FINDINGS, OBSERVATIONS AND RECOMMENDATIONS

A. Alignment of Tunnels

1. KMTC

a. Tunnel 1A

88. Parts of the tunnel have a low cover of 17 to 20 m, which will cause a reduction of the advance rate and an increase of support measures. The remaining rock cover above the crown will not be able to carry the static load of the overburden. The morphology permitting the alignment should be shifted to areas with higher cover between the chainages 1+180 and 1+240, as well as from 2+380 to 2+640.

b. Tunnel 1B

89. Although the inlet portal is located at a gently dipping slope any shifting to a steeper morphology would cause an extension of the tunnel and automatically an increase in cost. Hence the alignment should not be changed.

2. UEC

a. Tunnels 1 and 2

90. There are no alternatives for these tunnels to improve the thickness of the rock cover due to their short lengths and the lack of detailed topographic maps. Tunnel 2 will be driven under generally shallow cover of 16 to 24 m. Three streams however, are crossing the alignment and consequently reduce the burden further down to 7 m, only.

b. Tunnel 3

91. The alignment of Tunnel 3 has already been revised to improve the foundation conditions of the inlet portal and to avoid any daylighting of the tunnel in some valleys. The topographic and geologic maps should be consulted to select a route with sufficient rock cover, with a reduced portion of marble and shorter tunnel lengths.

c. Tunnel 4

92. The alignment of this tunnel has already been checked and shifted because of very low burden of 8 to 12 m and a high groundwater level from the Huruluwewa Reservoir. A tunnel of this size would have been very costly with regard to the very high geological risk.

3. NWPC

93. Despite the fact that the diameter of the tunnel measures 4.5 m only, the burden ranged from 9 to 27 m, which increases the hazards of tunneling works. Consequently the inlet portal was shifted slightly upstream and the tunnel turned to an east-west direction. This arrangement calls for a longer, but safer tunnel with a cover of 15 to 65 m above the crown. The length of the canal can be reduced for 350 m by this change of alignment.

B. Geological Hazards

94. In the course of the site visit the following geological hazards have been detected:

- High portion of marble and/or calcareous gneiss with risk of karstification
- Inflow of water and groundwater into the tunnel
- Thick shear or fault zones
- Intersections of quartz dykes in the gneiss
- Low rock cover
- Deep seated tropical weathering

1. Karstification

95. Tunnel 1A of KTMC and Tunnel 3 of UEC are affected by the risk of karstification. At both portals of the former tunnel calcareous gneiss was drilled in two boreholes. The rock cores did not reveal signs of karstification and the respective logs present neither hints nor any observation. On the surface however, indications of solution of lime become evident in close vicinity of the tunnel.

96. At Tunnel 3 of UEC drilling works are underway. Some of the boreholes in marble area have already encountered cavities and loss of flush water. It is expected that more information will become available in near future.

97. Some of the boreholes shall clarify the genesis of some tanks along the alignment, since certain features, e.g. observed at the tank west of chainage 33+400, may resemble a doline, i.e.bowl-shaped depression in limestone. In addition, geo-electrical sounding will add valuable information on potential interconnections between tanks and the tunnel in near future.

98. Any interconnections bear the high risk that all water flows from the tank into the tunnel with the consequences of emptying the tank, flooding TBM and tunnel as well as ample sealing works thereafter.

2. Inflows of Water and Groundwater into the Tunnels

99. Potential inflows of water are not only bound to the tanks but also to streams crossed by the tunnel in shallow depth, which is the case at the following chainages of Tunnels 2 and 3 (UEC) with a total cover <30 m:

• 22+710	Khondolite	12 m cover	perennial
• 22+775	Khondolite	7 m cover	perennial
• 22+810	Khondolite	7 m cover	perennial
• 30+130	Khondolite	24 m cover	perennial
• 30+300	Khondolite	28 m cover	perennial
• 31+310	Quartzite	14 m cover	
• 32+500	Marble	9 m cover	
• 33+560	Khondolite	14 m cover	perennial
• 46+570	Migmatitic Gneiss	19 m cover	perennial

- 46+620 Migmatitic Gneiss 19 m cover perennial
- 47+470 Migmatitic Gneiss 19 m cover perennial
- 47+900 Migmatitic Gneiss 17 m cover perennial
- 48+080 Migmatitic Gneiss 22 m cover perennial
- 49+520 Migmatitic Gneiss 13 m cover perennial

100. Since the streams are most probably fault controlled, ingress of water can be expected in the tunnel(s) crossing the fault in case of continuous flow and low cover. Perennial streams however, may contribute to the infiltration in the rainy season, only. The respective quantities depend on the length of the intersection, the permeability of the rock and/or the fault zone as well as the season of the year.

101. Most of the boreholes of all tunnels reveal groundwater in depths between 2.8 and 11.2 m, i.e. generally above the crown. The portions at shallow depth with high permeability in the bedrock may have to face continuous inflow depending on the size of the catchment area. The yield will reach maximum in the rainy season. With increasing depth of the tunnel section the joints will be more and more closed and the yield decreases gradually. Exceptions from this rule might be encountered with pervious faults or shear zones and in karstified marble (KMTC Tunnel 1A, UEC Tunnel 3). The respective yields can only be estimated with regard to the prevailing precipitation.

3. Thick Shear or Fault Zones

102. Up to now neither detailed results of geological mapping nor tectonic logging of shear or fault zones are available to assess their impact for any of the tunnels as well as the respective support measures. The geological map with a scale of 1:100,000 however, reveals thick shear zones intersected by Tunnel 3 of UEC between the following chainages:

- 32+320 – 32+460 Charnokite and marble
- 44+860 – 46+180 Marble and migmatitic gneiss

103. The shear zones represent roughly 5-6% of the tunnel length. Few boreholes have been located at these tectonic elements to explore their true thickness, composition, strength and permeability. Based on these findings the proper support has to be designed for either conventionally and mechanically driven tunnels.

4. Intersections of Quartz Dykes in the Gneiss

104. The existing geological map does not disclose any details of presence and thickness of quartz dykes intersecting the gneiss. On the occasion of the walk-over of the alignment many pebbles, cobbles and boulders of white quartz were found on the surface over distances of 5 m and more. Due to its hardness and any lack of cleavage quartz is a highly abrasive mineral for the cutter tools. Consequently the progress of tunneling, either conventional or mechanical, will be reduced immediately by the high wear and the exchange of the drilling bits (Jumbo Driller) or the discs (TBM) with the occurrence of thick dykes. It is assumed that the thickness may even exceed 20 m in places.

105. The risk of reduced excavation rates has to be assessed for the progress of the heading works by means of mapping thickness as well as strike and dip of all dykes.

5. Low Rock Cover

106. At many locations the tunnels have shallow to insufficient rock cover. There should be at least one tunnel diameter of rock between the crown and the overburden to develop an arch effect after excavation which carries at least most of the load above the roof. If the rock cover is reduced, highly weathered and/or strongly jointed/faulted the tunnel has to be supported for stability reasons.

107. The weaker the arch effect the more intense the support system has to be selected. That means reinforced shotcrete and a grid of rock bolts alone might be too weak because the thickness and/or jointing of the rock cover does not allow the installation of sufficiently long rock bolts as required by the stability calculations and consequently steel arches are needed instead or in addition. The stability calculations of the rock mechanical conditions have not only to indicate the quality and thickness of the steel but also the spacing of the arches between each other.

108. The support measures increase the overall cost of tunneling and cut down the progress rates automatically. The lack of any arching effect reduces the length per round with the conventional heading works strongly, but it affects nevertheless the advance rate of a normal TBM as well, due to the increased support. Double shield or earth pressure balanced TBMs have less delay grace to their segmental lining which of course, has to be reinforced accordingly.

109. The tunnel sections with low rock cover are listed below for the KMTC and UEC:

• 1+020 – 1+280	Charnokite	14 – 30m cover	Tunnel 1A
• 2+340 – 2+670	Charn./Qzt.	18 – 30m cover	Tunnel 1A
• 3+180 – 3+220	Charnokite	18 – 27m cover	Tunnel 1B
• 9+080 – 9+120	Charn./Qzt.	18 – 30m cover	Tunnel 1B
• 17+820 – 17+890	Quartzite	14-21 m cover	Tunnel 1
• 22+270 – 22+960	Quartz./Khon.	7-20 m cover	Tunnel 2
• 30+120 – 30+260	Khondalite	24 m cover	Tunnel 3
• 31+260 – 31+340	Khon./Quartz.	15-18 m cover	Tunnel 3
• 31+340 – 31+680	Quartz./Marb.	25 m cover	Tunnel 3
• 32+320 – 32+920	Charn./Marb.	9-24 m cover	Tunnel 3
• 33+180 – 33+700	Khondalite	14-22 m cover	Tunnel 3
• 46+280 – 50+100	Migm.-/Gran.	12-24 m cover	Tunnel 3
• 50+360 – 50+500	Qz.-Fs. Gneiss	23-24 m cover	Tunnel 3
• 50+700 – 51+300	Q.-F. G/Qzt.	18-24 m cover	Tunnel 3
• 52+040 – 53+540	Qz.-Fs. Gneiss	18-24 m cover	Tunnel 3
• 61+870 - 61+890	Qz.-Fs. Gneiss	16-23 m cover	Tunnel 4
• 62+400 – 62+450	Qz.-Fs. Gneiss	18-24 m cover	Tunnel 4

110. The portion of low to very low rock cover reaches the following percentages:

- KTMC Tunnel 1A 33%
- KTMC Tunnel 1B 1%
- UEC Tunnel 1 100%
- UEC Tunnel 2 100%
- UEC Tunnel 3 31%
- UEC Tunnel 4 12 %

111. Tunnel 1B has the least portion of low rock cover from all other tunnels due to an alignment intersecting a mountain range with elevations up to more than 700 m.

112. The new alignment of the tunnel for NWPC will have rock covers between the chainages as follows (nearly 18% for this tunnel):

- 22+460 – 22+620 15-20 m cover
- 23+395 – 23+400 15-20 m cover

6. Deep-seated Tropical Weathering

113. This hazard has the same consequences for the tunnel and its support as described with the shallow cover. However, the deep seated tropical weathering is not easy to be detected in the actual exploration phase in which boreholes reach maximum depths of 50 m and the geo-electrical method only 40 m. To date the drillings revealed high influence of weathering reaching 14.05 m (UEC Tunnel 1), 15.7 m (UEC Tunnel 3) and even 21.35 m (KMTC Tunnel 1B) in presumably a fault.

114. The phenomenon of deep reaching disintegration of the rock mass does not follow any rules and renders any prediction difficult. The only higher probability of occurrence is bound to fault and shear zones, which can be mapped and logged on the ground. However, there is no guaranty that all features become visible due to thick soil cover.

115. For safety reasons it is recommended to have advance drillings from the tunnel face to detect soft rock or zones 10 to 30 m ahead before reaching them.

C. Infrastructure for Tunneling Works

116. Each construction site needs infrastructural measures to facilitate the execution of the works. Access has to be provided for machines and heavy equipment. Roads have to be widened, bridges to be improved and transmission lines inspected for their height. Land must be acquired or rent for site installations, for either temporary storage or final dump facilities of unusable tunnel muck, for waste disposal, for retention basins and/or water treatment plants.

117. In general the Employer provides all facilities for supply of electric energy to the contractor, i.e. transmission lines and substations. The local infrastructure permitting, raw water will be delivered for use on the site. Sewage has to be collected and treated effectively in the close vicinity. Land will be given temporarily for the installation of a main camp with offices,

canteen, laboratory, clinic, firefighting, crushing and batching plants, workshops, deposits of construction materials, factory for segmental lining, a power station as stand-by measure and residential as well as recreational areas with shopping facilities.

118. At each portal respective site installations are needed which comprise offices, workshops, storage and disposal areas, retaining basins for water from the tunnel and the respective treatment facilities. It is recommended for environmental reasons to keep the site installations limited to the temporary portal only, in the forests of the Natural Reserve and establish a railway line on the canal route to the nearest grassland, where all necessary facilities can be erected. This will preferably be the case for the start-up section of the TBM. Alternatively for conventional tunneling the site installation could also be placed along the canal alignment to keep the impact on the forest as small as possible.

D. Conventional Tunneling

1. Geotechnical Assessment of the Conditions along the Alignment

119. The assessment of the geotechnical conditions forms the essential basis of either tunneling works independent from conventional or mechanized heading. The alignment should be selected preferably in a geological environment allowing stable rock conditions with sufficient strength over most part of the tunnel, a minimum of faults and shear zones intersecting, little or no inflow of groundwater hampering the progress.

120. In most cases not all of these goals can be achieved due to political, economic or ecologic constraints. Hence tunneling works have to be adapted to the prevailing geological conditions. In order to find the most economical solution for tunnel construction all important parameters from the geotechnical point of view must be collected and/or evaluated, such as:

- Sequence of strata with the respective thickness
- Petrographic composition of each rock type
- Influence of weathering
- Tectonic condition with strike and dip
- Occurrence of folds, faults and/or shear zones with their respective thickness and kind of filling material
- Degree of jointing
- Strength of each rock type
- Abrasivity of each rock type
- Shear parameters of each rock type and the various joint or fault fillings (e.g. breccia, mylonite, etc.)
- Permeability of the rock mass
- Inflow and chemical composition of groundwater

121. The above listed parameters will be obtained by geological mapping, geophysical logging, core drilling with in-situ tests, rock sampling from cores or from the field and laboratory testing. Some of the parameters will be used for the classification of the rock mass which has been introduced to provide homogeneous standards for tunnel excavation.

2. Rock Mass Rating and Rock Classes (RC)

122. Bieniawski (1976) has published the details of a rock mass classification called the Geomechanics Classification or the Rock Mass Rating (RMR) system. Over the years, this system has been successively refined as more case records have been examined. In 1989 some changes improved the classification which is used worldwide as simple tool for rock excavations of underground structures, rock slopes and foundations on rock.

123. The following five parameters are used to classify a rock mass using the RMR system:

- Strength of rock material.
- Rock Quality Designation (RQD)
- Spacing of discontinuities
- Condition of discontinuities
- Groundwater conditions

124. These parameters will be taken from core drillings, in-situ, and laboratory testing as well as observations in the field. They will be rated individually as summarized in **Table 2** providing a number which indicates the quality of the rock mass. The big advantage of this number renders stability calculations easy and reproducible.

125. Since the spacing and the roughness of joints and/or faults have a strong influence on the stability of an underground structure, the strike and dip of the discontinuity planes calls for an adjustment of line JA3 (cf. **Table 2**) as shown in **Table 3**. The adjusted rating is then used for the classification of rock mass parameters as presented in **Table 4** independent from any particular structure. Five rock classes (RC) are marked in **Table 5** as follows:

- Rock Class 1 Very good rock mass 100-81 Rating
- Rock Class 2 Good rock mass 80-61 Rating
- Rock Class 3 Fair rock mass 60-41 Rating
- Rock Class 4 Poor rock mass 40-21 Rating
- Rock Class 5 Very poor rock mass <21 Rating

126. Corrections must also be made for the surface of the discontinuity planes in line JA4 as listed in **Table 6** for tunneling works.

127. In general either rock class is related to an excavation class, which defines the length of round in the conventional tunneling and the advance rate for the TBM. On basis of the five rock classes, the related stand-up time for underground structures (cf. **Table 5**) and the effect of the orientation of the discontinuity planes on the tunneling the excavation classes have to be developed individually for the heading works for the tunnel. Special cases like shallow cover, karst, extended fault or shear zones, etc. call for special treatment and hence extra excavation classes.

Table 2: Rock Mass Rating System (Bieniawsky, 1989)

A. Classification Parameters and their Ratings							
Parameter	**Range of Values**						
A1. Strength of Intact Rock Material							
Point-Load Strength Index	> 10 MPa	4 - 10 MPa	2 - 4 MPa	1 - 2 MPa	For this low range - uniaxial compressive test is preferred		
Uniaxial Compressive Strength	> 250 MPa	100 - 250 MPa	50 - 100 MPa	25 - 50 MPa	5 - 25 MPa	1 - 5 MPa	< 1 MPa
Rating J_{A1}	15	12	7	4	2	1	0
A2. Drill Core Quality - RQD	90% - 100%	75% - 90%	50% - 75%	25% - 50%	< 25%		
Rating J_{A2}	20	17	13	8	3		
A3. Spacing of Discontinuities	> 2 m	0.6 - 2m	200 - 600 mm	60 - 200mm	< 60 mm		
Rating J_{A3}	20	15	10	8	5		
A4. Condition of Discontinuities	Very rough surfaces Not continuous No separation Fresh wall rock	Slightly rough surfaces Separation < 1 mm Slightly weathered walls	Slightly rough surfaces Separation < 1 mm Highly weathered walls	Slickensided surfaces or Gouge < 5 mm thick or Separation 1 - 5 mm Continuous	Soft gouge > 5 mm thick or Separation > 5 mm Continuous		
Rating J_{A4}	30	25	20	10	0		
A5. Groundwater							
Inflow per 10 m tunnel length (L/min)	None	< 10	10 - 25	25 - 125	> 125		
Joint water pressure/ Major principal σ	0	< 0.1	0.1 - 0.2	0.2 - 0.5	> 0.5		
General Conditions	Completely dry	Damp	Wet	Dripping	Flowing		
Rating J_{A5}	15	10	7	4	0		

Table 3: Adjustment of Joints due to their Orientation

B. Rating Adjustment for Discontinuity Orientations						
Strike and Dip Orientations		**Very Favorable**	**Favorable**	**Fair**	**Unfavorable**	**Very Unfavorable**
Rating J_B	Tunnels and Mines	0	- 2	- 5	- 10	- 12
	Foundations	0	- 2	- 7	- 15	- 25
	Slopes	0	- 5	- 25	- 50	- 60

Table 4: Rock Classification on basis of Rock Mass Rating

C. Rock Mass Classes Determined from Total Ratings					
Rating	100 - 81	80 - 61	60 - 41	40 - 21	< 21
Rock Class No.	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock

Table 5: Stand-up Time for Tunnels on basis of Rock Classes

D. Meaning of Rock Classes					
Rock Class No.	I	II	III	IV	V
Average Stand-up time	20 yr. for 15 m span	1 yr. for 10 m span	1 wk. for 5 m span	10 h for 2.5 m span	30 min for 1 m span
Cohesion of rock mass (kPa)	> 400	300 - 400	200 - 300	100 - 200	< 100
Friction angle of rock mass (deg.)	> 45	35 - 45	25 - 35	15 - 25	< 15

Table 6: Adjustments for the Rating of Discontinuities in J_{A4}

E. Guidelines for Classification of Discontinuity Conditions*					
Discontinuity Length (persistence)	< 1 m	1 - 3 m	3 - 10 m	10 - 20 m	> 20 m
Rating	6	4	2	1	0
Separation (aperture)	None	< 0.1 mm	0.1 - 1.0 mm	1 - 5 mm	> 5 mm
Rating	6	5	4	1	0
Roughness	Very rough	Rough	Slightly rough	Smooth	Slickensided
Rating	6	5	3	1	0
Infilling (gouge)	None	Hard Filling < 5 mm	Hard Filling > 5 mm	Soft Filling < 5 mm	Soft Filling > 5 mm
Rating	6	4	2	2	0
Weathering	Unweathered	Slightly weathered	Moderately weathered	Highly weathered	Decomposed
Rating	6	5	3	1	0

*Some conditions are mutually exclusive. For example if infilling is present, the roughness of the surface will be overshadowed by the influence of the gouge. In such cases use A.4 directly.

Table 7: Results of Tunnel Drive on Basis of Joint Orientation

F. Effect of Discontinuity Strike and Dip Orientation in Tunneling**			
Strike perpendicular to tunnel axis		Strike parallel to tunnel axis	
Drive with dip - Dip 45 - 90°	Drive with dip - Dip 20 - 45°	Dip 45 - 90°	Dip 20 - 45°
Very favorable	Favorable	Very unfavorable	Fair
Drive against dip - Dip 45 - 90°	Drive against dip - Dip 20 - 45°	Dip 0 - 20° - Irrespective of strike	
Fair	Unfavorable	Fair	

** Modified after Wickham et al (1972)

3. Excavation Classes (EC) for Conventional Heading

128. The excavation classes compiled below have been established on the basis of the RMR and the experience of heading works for tunnels with big diameters under similar conditions in other countries. In the actual case, the ECs are applicable for the tunnels of KTMC and UEC projects. Originally the conventional tunnels were designed with a circular cross section. This shape however, poses problems with the drill-and-blast technique as well as with the maneuverability of the machines on the rounded invert. Normally the contractors will backfill the invert after bench heading with tunnel muck. Later it will be replaced by lean concrete covered with a concrete slab or a U-shaped concreted canal. Alternatively, a third heading could be performed in the rounded invert. This procedure however, will extend the excavation period. For practical as well as economic reasons it is recommended to design all conventional tunnels with a horseshoe profile. The size of the tunnels calls for a division into crown heading and bench blasting approximately in mid-height for the conventional tunnel excavation. Crown heading will advance and with a minimum distance of 300 m to 500 m bench blasting will follow. Each face of the bench comprises a ramp to provide continuous access to the crown.

129. The excavation classes are based on the rock classes. A favorable rock class permits also high advance rate. However, the big diameter calls for two sets of ECs with the crown heading first, followed by bench tunneling second:

- Excavation Class 1 — 2.5-3.0 m in the crown
- Excavation Class 2 — 2.0-2.5 m in the crown
- Excavation Class 3 — 1.5-2.0 m in the crown
- Excavation Class 4 — 1.0-1.5 m in the crown
- Excavation Class 5 — 1.0-1.5 m in the crown
- Excavation Class 5.1 — 0.75-1.0 m in the crown
- Excavation Class 5.2 — 0.75-1.0 m in the crown*
- Excavation Class 5.3 — 0.75-1.0 m in the crown**

*With supporting rock wedge at the front of the crown
**Part-face heading in preferably three sections at the crown

130. Based on the general stability conditions and the stress relief in the crown, bench excavation normally permits higher advance rates which are expressed in separate ECs as follows:

- Excavation Class 6 — 5.0-6.0 m at the bench
- Excavation Class 7 — 4.0-5.0 m at the bench
- Excavation Class 8 — 3.0-4.0 m at the bench
- Excavation Class 9 — 2.0-3.0 m at the bench
- Excavation Class 10 — 2.0-3.0 m at the bench
- Excavation Class 10.1 — 1.5-2.0 m at the bench
- Excavation Class 10.2 — 1.5-2.0 m at the bench
- Excavation Class 10.3 — 1.5-2.0 m at the bench

131. The tunnel with NWPC project will have an internal diameter of 4.5 m, which is still a size for regular tunnel equipment. Hence, the geological conditions permitting full face tunneling will be possible. For reasons of easy performance it is recommended to excavate the tunnel in a horseshoe profile as already mentioned above. The respective excavation classes will be as follows:

- Excavation Class 1 2.5-3.0 m
- Excavation Class 2 2.0-2.5 m
- Excavation Class 3 1.5-2.0 m
- Excavation Class 4 1.0-1.5 m
- Excavation Class 5 1.0-1.5 m
- Excavation Class 5.1 0.75-1.0 m
- Excavation Class 5.2 0.75-1.0 m *
- Excavation Class 5.3 0.75-1.0 m **

*With supporting rock wedge at the face
**Part-face heading in preferably three sections

4. Support Classes (SC)

132. The support is also classified according to the quality of the rock. The details are based on practical experience with tunnel construction of this size under similar conditions using reinforced shotcrete, rock bolts and steel arches with varying dimensions and spacing. In **Table 8** all details are compiled for the tunnels with the big diameter foreseen for the tunnels at KTMC and UEC projects.

Table 8: Support Classes and Necessary Support in the Crown

Support Class	Shotcrete	Wire Mesh	Rock Bolt/ Area	Steel Arch	Remarks
SC 1	--	--	Spot bolting, crown, L=3m	--	
SC 2	5 cm, crown	--	1/9m^2, L=3m	--	
SC 3	10 cm	1 layer	1/6m^2, L=4m	--	
SC 4	15 cm	2 layers	1/4m^2, L=5m	--	
SC 5.0	20 cm	2 layers	1/2m^2, L=5m	1.0-1.5m spacing	Fore poling in soil or soft rock
SC 5.1	20 cm	2 layers	1/1m^2, L=5m	0.8-1.0m spacing	Fore poling in soil or soft rock
SC 5.2	25 cm	3 layers	1/1m^2, L=6m	0.8-1.0m spacing	Supporting rock wedge
SC 5.3	30 cm	3 layers	1/1m^2, L=6m	0.8-1.0m spacing	Part face heading

133. The support classes 1 to 4 are normally applied in very good to bad rock conditions. The latter can be expected in fault or shear zones. SC 5 and its subclasses are designed to cope with the normally very poor rock conditions at the temporary portals, where the weathering and disintegration of the rock mass calls for a high degree of support to stabilize the tunnel. However, fault or shear zones and deep seated tropical weathering might also be responsible for very bad rock conditions as well as the application of strong to very strong support.

134. The available means are reinforced shotcrete with a concrete strength of at least 25 MPa sprayed in varying thicknesses, in which the reinforcement may either comprise wire mesh according to ASTM A185 or the equivalent amount of steel fibers; rock bolts, 25 mm in diameter, with different lengths and a nominal load of 100 kN including plates with nuts as well as steel arches with intermediate to high load in the shape of the tunnel section, i.e. horseshoe profile.

135. In some sections of the alignment the burden of the tunnel is very low or, at other locations, the influence of the tropical weathering reaches into, or even below the tunnel trace. These conditions will slow down the advance rate because of drastically reduced stability which demands the installation of immediate strong support in order to avoid any collapse from crown, side walls or even from the face. Under these conditions SC5 has to be applied as well and instead of blasting the excavation has to be performed mechanically by an excavator. In presence of groundwater the necessity of fore poling may arise to prevent erosion from face, crown and/or walls and to facilitate shotcreting. Small steel sheets of at least 2.5 m length have to be driven from the last steel arch approximately 2 m ahead to stabilize crown and walls for the next round. Spiling will be an alternative for dry conditions of soil or soft rock by using grouted rock bolts of 3 or 4m length; the free end of which rests also on the last steel arch.

136. Bench heading needs similar support classes although the advance rates differ from the crown. The stability conditions below the crown permit higher progress and the support can also be reduced. The respective compilation is listed in **Table 9**.

Table 9: Support Classes with Necessary Support for the Bench

Support Class	Shotcrete	Wire Mesh	Rock Bolt/ Area	Steel Arch	Remarks
SC 6	--	--	Spot bolting, L=3m	--	
SC 7	--	--	1/9m^2, L=3m	--	
SC 8	5 cm	--	1/6m^2, L=4m	--	
SC 9	10 cm	1 layer	1/4m^2, L=5m	--	
SC 10.0	15 cm	2 layers	1/2m^2, L=5m	1 per 2.0-3.0 m	Fore poling in soil or soft rock
SC 10.1	20 cm	2 layers	1/2m^2, L=5m	1 per 1.6-2.0 m	Fore poling in soil or soft rock
SC 10.2	20 cm	2 layers	1/1.5m^2, L=5m	1 per 1.6-2.0 m	Fore poling in soil or soft rock
SC 10.3	25 cm	3 layers	1/1m^2, L=6m	1 per 0.8-1.0 m	Fore poling in soil or soft rock

137. A comparison of **Tables 8** and **9** reveals that only every second steel arch from the crown finds a continuation at the bench due to the achieved load distribution around the tunnel by the support of the crown. The intensity of rock bolting can also be reduced for some of the SCs.

138. For the smaller sized tunnel at NWPC the support has to be adapted accordingly. In particular the length of the rock bolts has to be reduced and the steel arches have to be shaped on the basis of the tunnel design. The support classes for NWPC tunnel are compiled in **Table 10**.

Table 10: Support Classes and necessary Support

Support Class	Shotcrete	Wire Mesh	Rock Bolt/ Area	Steel Arch	Remarks
SC 1	--	--	Spot bolting, crown, L=2m	--	
SC 2	5 cm, crown	--	1/9m^2, L=2m	--	
SC 3	10 cm	1 layer	1/6m^2, L=3m	--	
SC 4	15 cm	2 layers	1/4m^2, L=3m	--	
SC 5.0	20 cm	2 layers	1/2m^2, L=3.5m	1.0-1.5 m spacing	Fore poling in soil or soft rock
SC 5.1	20 cm	2 layers	1/1m^2, L=3.5m	0.8-1.0 m spacing	Fore poling in soil or soft rock
SC 5.2	25 cm	3 layers	1/1m^2, L=3.5m	0.8-1.0 m spacing	Supporting rock wedge
SC 5.3	30 cm	3 layers	1/1m^2, L=3.5m	0.8-1.0m spacing	Part face heading

5. Heading Works

139. Four out of six tunnels have proven that they are uneconomic for mechanized heading simply because they are too short for this method. The profile of excavation has to be adapted to drilling and blasting technique, i.e. the invert must be horizontal, because it is simple to make and it allows easier maneuvering of machines and equipment as previously discussed. The respective dimensions for the profile have not yet been established. The diameters presented in **Table 11** originate from the circular shape.

Table 11: Details of Conventional Tunnels

Tunnel	Location	Length between Permanent Portals	Length between Temporary Portals	Internal Diameter	Cross Section	Remarks
1A	KMTC	1,950 m	1,710 m	7.0 m	Circle	Diam. not yet fixed
1	UEC	210 m	70 m	7.0 m	Circle	Shallow cover
2	UEC	900 m	690 m	7.0 m	Circle	Shallow cover
4	UEC	790 m	580 m	7.0 m	Circle	New alignment
	NWPC	1,195 m	1,010 m	4.5 m	Circle	New alignment

140. Only one tunnel out of five (cf. **Table 11**), i.e. the tunnel of NWPC, can be excavated with full size since its diameter is still in the working range of the machines like drilling jumbo, excavator, hydraulic lifter and automated shotcreting machine. The tunnels with bigger diameters need to have a division between crown and bench heading. The tunnel will always start in the crown and the bench follows in 300 to 500 m distance. However, this arrangement makes only sense in tunnels longer than 1,000 m, where it does not disturb the sequence of the work.

141. Conventional tunneling has a slow progress in comparison with the mechanized heading works. However, the drill-and-blast method is more flexible to cope with unexpected geological conditions and with the possibility of tunneling from both portals to reduce the construction time. It is recommended that the tunnels with lengths over 500 m should have two fronts, since counter-heading will be necessary for the break-through within the tunnel under defined conditions.

142. Only smooth blasting will be allowed for the excavation. This means that electric delay detonators must be used. The blast holes at the periphery of the tunnel have to be drilled and charged with regard to the pre-splitting technique, i.e. spacing of blast holes 40-50 cm and charging exclusively with detonating chord to avoid any excessive oversize beyond the tolerable excavation line. The interrelation between tunnel drive and the strike of the strata will lead generally to a certain oversize in the crown along foliation planes bordered by steeply dipping joint planes.

6. Portals

143. The portals of either tunnel consist of two structures, i.e. a permanent portal with a cut and cover section, which joins the canal and the temporary tunnel portal, where heading work starts. The open air section will be excavated more or less normal to the contour lines from the soil by excavator and from the metamorphic rock by ripping in the highly weathered portion or by conventional drill and blast technique in the moderately weathered to fresh rock. The length of this part depends on the inclination of the slope and a minimum rock cover of at least one diameter above the crown as position for the temporary tunnel portal.

144. If the open cut is to remain stable permanently the slopes have to be inclined in accordance with their geotechnical parameters. Since this method may require extensive or flatly inclined excavation, it is recommended to cut the slopes as steep as possible with the provision of primary support for the duration of the heading works. The support comprises reinforced shotcrete and rock bolts according to the stability calculations. Use of pre–splitting method would minimize overbreak and excessive loosening of the rock. The foliation strikes oblique to normal to the direction of heading. The tunnel drive should be in the direction of the dip to safeguard a stable face.

145. Regularly spaced weep holes will prevent any water load on the shotcrete. The crown of the tunnel will be protected by a set of horizontal rock bolts, 3 m long, with a spacing of 1.0 to 1.5 m and a distance of 1m to the excavation line. Two sets of steel arches with wire mesh and shotcrete erected at the face of the slope shall safeguard the first blast of the tunnel and shall protect the miners from stones falling down the slope. Later this structure will be incorporated into the cut and cover section. It is estimated that more steel arches will be required for the first 5 to 15 m in the tunnel. A hillside stitch has to be arranged in the overburden to catch the surface run–off and convey it away from the construction pit. The open cut has to be backfilled with free draining material.

146. The overburden and the residual soil have to be excavated as steep as possible to prevent erosion and to minimize the use of land. After every 4 m of excavation a 3 m wide berm must be arranged for safety reasons. The last berm will be on the rock surface.

7. Dewatering

147. The level of the groundwater has been observed in many boreholes. However, few of them remained dry down to their bottom, i.e. 25 m in places. The groundwater is confined to open joints and fault zones with sufficient permeability. Based on the experience with the drillings the water levels have been encountered between 2.78 and 11.15 m below ground.

148. The aquifers have to be tapped during conventional heading by means of plastic hoses fixed to short drill holes or half pipes bolted to the rock prior to shotcreting. In case of uphill heading the water will flow freely to the tunnel portal, where it should be collected in big basins for further treatment. The suspended matters have to settle and the water must be checked on its alkalinity. Only clean and chemically neutralized water can be conveyed to the streams. In case of downhill heading the water has to be collected in sump pits in order to be pumped to the surface, where it has to be collected and treated in settlement ponds, as well.

149. Major inflows of water have to be checked at regular intervals to provide information of this aquifer. Water samples should be taken as well to have them analyzed for their aggressivity towards concrete. In the presence of groundwater the shotcrete lining has to be protected from additional water load by the installation of 3 m long weep holes. It is estimated that for a regular pattern 3 to 4 holes per section with a diameter of 56 mm will provide sufficient drainage. The spacing of the weepholes should range between 3 and 5 m.

150. Prior to heading works the potential inflow of groundwater has to be assessed on its yield by means of the average precipitation rates of the area and the transmissivity of the bedrock at various tunnel sections in a corridor of 100-200 m either side. Later each inflow must also be checked on its yield and the potential risks of leakage in regular intervals.

8. Cost for Conventional Tunneling

151. At this stage of the project the geotechnical investigations have not yet been completed and most of the evaluation is missing. Hence, costs can only be assumed on the basis of excavation works for tunnels of similar size and with similar geological conditions. A cost estimate must consider the infrastructural necessities for each tunnel and each site installation, i.e. mainly free access, power supply, water supply, collection and treatment of sewage as well as restrictions by the Natural Reserve or other limitations.

152. The cost of tunneling comprises mainly the following items:

- Site installation with all facilities
- Preparation of temporary and permanent dump areas
- Excavation in the open air with excavator, ripper or by blasting
- Ventilation with fan, booster fan and flexible air duct
- Excavation underground by smooth blasting separate for each excavation class
- Mucking of tunnel material under consideration of the distance from the face to the portal and of the bulk factor; including equipment maintenance, energy and labor cost

- Transport of tunnel muck from the temporary dump area (portal) under consideration of the distance to the permanent dump area(s)
- Tunnel support according to the classification for either class, separate for the variations of shotcrete, wire mesh, steel fibers, rock bolts, anchors, steel arches and sheet piles
- Installation and monitoring of convergence sections
- Tapping the inflow of groundwater with flexible hoses
- Covering wet rock wall with drainage foils
- Construct settlement ponds with treatment facilities of p_H and suspended fines
- Advance drilling with and without core recovery
- Acoustic sounding or refraction seismics in boreholes
- Grouting works from the tunnel to seal pervious rock and/or to improve the stability and strength of the rock mass including percussion drilling in all inclinations and directions, cement, plasticizer, bentonite, filler
- Grouting time of grout pump with continuous registration of pressure and take
- Concreting of a watertight canal with a vaulted concrete slab in the cut-and-cover section of the tunnel comprising lean concrete, shotcrete, reinforcement, formwork and concrete
- Backfilling the open cut with tunnel muck and compacting in layers and topped by fertile soil considering the haulage distances

E. Mechanized Tunneling by TBM

1. Geotechnical Assessment of the Conditions along the Alignment

153. Two long tunnels will be excavated by a Tunnel Boring Machine (TBM). The length measures 5.94 km between the temporary portals at Tunnel 1A of KMTC and 26.04 km at Tunnel 3 of the UEC.

154. Geotechnical investigations are still on the way for Tunnel3 of the UEC and they are expected to be completed end of September/beginning of October 2014. Some 60% of the core drillings, 65% of geological mapping and 46% of geo-electrical sounding support the revision and update of the geological section which is based on the geological map with 1:100,000 scale. Core samples have been taken for laboratory testing of the rock parameters which are required for the assessment of progress rates as well as the wear of the cutting tools, such as:

- Unconfined Compressive Strength
- Brazilian Test
- Rock Shear Test
- Petrographic Analyses
- Cerchar Test

155. The results will be also applicable for Tunnel 1B since the same rock types occur in the southern parts of the project as well.

156. The tunneling performance of TBMs is highly dependent on rock conditions, such as strength, porosity, in-situ stress of the rock mass, hardness/abrasiveness and jointing, e.g. type and continuity, frequency as well as orientation. The machine parameters, like thrust per cutter, cutter spacing and diameter, torque capacity and revolution per minute as well as backup equipment have to be derived from the rock mass factors. Finally, the machine performance is highly dependent on the design of its individual components.

157. The abrasiveness and in particular the content of quartz in the gneiss will govern the advance rate of the machine. The occurrence of quartz dykes with thicknesses of 0.5 to more than 20 m and 100% content of quartz will definitely reduce the progress. Next come the quartzite of which the quartz content may range between 90 and 100%. At Tunnel 3 of the UEC the presence of quartzite and quartzitic schist achieves some 8.6%. Tunnel 1B of the KMTC has to cross more than 18% of quartzite. In some of the boreholes the rock seemed to be silicified in the hydrothermal phase of the orogeny and all minerals have been transformed into quartz or chert. Quartzitic schist is assumed to have a quartz content of 60 to 90%. The petrographic investigations are still pending.

158. Other rock types like charnokite, khondolite, biotite-hornblende gneiss, granitic gneiss or hornblende-garnet gneiss will presumably have quartz contents between 20 to 50% which will also be proven by the investigations in the laboratory. Calcareous gneiss can be rated with low to very low contents of quartz. The marble is assumed with a very high content of calcite of most probably 80 to 100%. Presence of dolomite can also not be excluded and both minerals must be proven by chemical and mineralogical investigations.

159. On the one hand calcareous gneiss and the marble will favor high advance rates due to the excellent cleavage of the calcite. On the other hand however, this mineral bears the risk of karstification in the rock. All boreholes drilled so far have been checked for this phenomenon. Only a few caves of small size have been encountered with the drillings. Nevertheless, the hazard is still imminent and should not be neglected for tunneling since 41% of Tunnel3 run through marbles and/or calcareous gneiss with low to intermediate burden. At few locations the cover is even insufficient on short distances.

160. The insufficient or low burden occurs also in gneissic rock and it is rather likely that the TBM runs into completely to highly weathered rock or even into soil. This may happen for parts of the face or also for the entire face for a couple of meters. The TBM must cope with this soft rock or soil. Big slope cuts in the weathering zone reveal isolated rock boulders and few of the boreholes have drilled through boulders of hard rock which were embedded in the overburden or in the residual soil.

161. A quite similar phenomenon reveals the deep seated tropical weathering, which might be encountered with the same features at greater depth. Only one borehole at the outlet portal of Tunnel 1B drilled through highly weathered charnokite from 17.5 to 21.35 m (end of the hole). However, the geo-electrical sounding indicates the deep reaching weathering at several locations at the tunnel alignment.

162. Shear or fault zones will also have the same soft effect on the rock mass. Based on the geological map two major shear zones will be encountered with Tunnel 3. Core drillings and geo-electrical exploration will provide additional information of these tectonic elements.

163. The low burden, the deep seated tropical weathering and the presence of shear or fault zones may bear the risk of hard rock embedded in soil or soft rock. Consequently the TBM must technically be able to cope with these obstacles in the tunnel section.

164. At Tunnel 1B of the KMTC the geological hazards comprise a higher percentage of quartzite, the potential presence of fault or shear zones and inflow of groundwater at higher pressure. Low cover above the crown occurs only in the immediate vicinity of the temporary portals. In general the rock cover ranges between 100 and 370 m and the high burden may bear a certain risk of primary stress at tunnel level. On the other hand the joints will be closed by the stress and the risk of inflow of groundwater might be minimized. Deep seated tropical weathering could be associated with fault or shear zones and probably in tunnel portions with rock covers up to around 100 m.

2. Rock Mass Rating and Support Classes

165. The RMR (cf. **Table 5**) is also applicable for the mechanized tunneling. However, there are no particular excavation classes associated to it, because the advance of the TBM is mainly governed by the strength of the rock, the quartz content, and the joint system. The support classes will be based on the rock classes. In general the tunnels excavated with TBM will be supported by segmental lining. The respective support classes are compiled in Tab. 12 below. The details however, are based on experience with similar projects of this size. Stability calculations will become necessary for the proper design of the concrete segments with regard to the geological conditions in areas of low to very low rock cover or deep seated tropical weathering, shear and fault zones as well as in karstified environment.

Table 12: Support Classes for TBM with Segmental Lining

Support Class Segmental Lining	Grade of Concrete	Thickness	Reinforcement
SCS 1	--	--	--
SCS 2	C30	25 cm	50 kg
SCS 3	C30	30 cm	100 kg
SCS 4	C30	35 cm	150 kg
SCS 5	C 40	40 cm	200 kg

166. The design team has considered an alternative support in their cost estimate for a mechanized tunnel with reinforced shotcrete and rock bolts. However, shotcreting in combination with a TBM is not the best option. The spraying of shotcrete **always** creates a cement dust, even if a wet mix is used. The dust settles everywhere in the tunnel and on the machine. If the TBM and the affected backup trailer are not cleaned properly with a strong water jet immediately after the application cement incrustations will harm all machines.

167. A viable solution will be a division between the installations of steel arches, rock bolts and wire mesh close to the TBM and later, after the backup trailer has passed the area of the steel support, the shotcrete can be applied at the tunnel walls, i.e. out of the reach of the TBM and without hampering the progress. For this purpose the wire mesh must be installed with centralizers to prevent any direct contact of the steel with the rock surface.

168. **Table 13** presents the support on the basis of the conventional support of reinforced shotcrete, rock bolts and steel arches. Prior to tendering the tunneling works stability calculations have either to confirm or modify the proposed measures.

Table 13: Support Classes for TBM with Shotcrete and Rock Bolts

Support Class Conventional	Rock Bolt / Area	Wire Mesh / Area	Steel Arch / m	Shotcrete
SCC 1	Spot bolting	--	--	--
SCC 2	1/9m^2, l = 3m	1 / Crown	--	5 cm
SCC 3	1/6m^2, l = 4m	1 / Crown, Walls	--	10 cm
SCC 4	1/4m^2, l = 5m	2 / Crown, Walls	1 / 1.5m	15 cm
SCC 5	1/2m^2, l = 5m	2 / Crown, Walls	1 / 1.0m	15 cm

F. Allocation of Risk and Selection of Contract Type for Underground Works

1. Risk Ownership and Risk Management

169. This section summarizes recommendations with respect to the allocation of the risk between the parties for underground works in the WRDIP, in particular for the tunneling contracts for the KMTC and UEC, and the selection of the appropriate type of FIDIC contract.[1] The contract conditions, including the details of any amendments to the standard FIDIC General Conditions made through the Particular Conditions, have a fundamental effect also on the structure and content of many of the technical parts of the tender documents. The finalization of many aspects of the project concept therefore requires the details of the contractual arrangements to have been confirmed.

Extensive experience with the implementation of major hydropower and tunneling projects, and especially the application of the various FIDIC standard types of contract, has shown that in order to be able to establish the optimum contractual relationship between the contractor and the employer, it is very important to: (i) Allocate the risk for the detailed design, and between the parties in the most advantageous (and practical) manner; (ii) ensure that construction risks are allocated in the most robust and cost-effective manner; and (iii) select the correct FIDIC contract form as the basis of the construction contract. These issues are intrinsically related, such that it is appropriate to discuss them simultaneously. A major element of this consideration is the degree to which risks are allocated to the Contractor in relation to unforeseen physical conditions. The appropriate type of contract for the underground works component of the WRDIP is most likely,

[1] The Multilateral Development Banks (MBDs) Harmonised Edition of the 1999 Red Book (FIDIC Conditions of Contract for Construction) is the form of contract in the ADB's SDBs for Large Works Conditions of Contract referred to in the previous section.

as for all the other construction works, is the FIDIC Pink Book[2] form used as part of the ADB's SBDs. This method of compensation and this allocation of design responsibility are fully compatible with the contract philosophy, which defines the structure and content of the Pink Book, into which an amendment could be made (through the Particular Conditions) governing the contractual details of the specific contractor's design obligations. This has also been the experience of and the solution applied on similar projects worldwide.

a. Implications of allocating the Risk for Detailed Design to the Contractor

170. Although both the FIDIC Red Book[3] and the FIDIC Yellow Book[4] forms of contract deal with the risk of unforeseen (physical) conditions on site in the same way, the allocation to the contractor of the responsibility for design of the works – which is the underlying philosophy on which the entire structure of the Yellow Book has been based – means that the contractor must carry the whole risk for any other changes in the required work resulting from the actual encountered conditions.

171. In order to be able to do this for tunneling works, the contractor would need to have sufficient certainty about the detailed situation (i) all along the route of each tunnel, and (ii) throughout the depth of each shaft. An economically budgeted geotechnical investigations program, such as that which would generally be approved for such works, cannot yield the density of information which would be required in order to provide the contractor with that level of certainty. For the many aspects of underground works the contractor will have tendered for the construction measures as presented in the tender documents. These measures will have been estimated from the basic design performed prior to tendering, at which time only the information from the initial geotechnical investigation program will have been available. The distribution of different types of rock support measures along the tunnels and shafts and throughout the caverns will have been developed to be, as far as possible, representative of what is *assumed* to be actual conditions.

172. If the contractor bears the responsibility for the subsequent detailed design, which means that the risk for that detailed design is allocated to him under the contract, then under the Yellow Book he will only be able to receive additional payment in the event that the conditions are actually encountered which were unforeseeable by an experienced contractor and which necessitate a change in the design to that which is shown in the basic design and represented in the contract document. If the conditions which are encountered could – contractually speaking – have been foreseen (i.e. they do not actually contradict information from the previous geotechnical investigation results etc.), the cost of any more conservative design which he chooses to apply is at his own risk. He may request the employer to agree with him on the necessity of the additional measures, and if the employer does agree and approve them he

[2] The Pink Book: FIDIC Harmonised Red Book (MLB Ed.) Conditions of Contract for Construction for Building and Engineering Works designed by the Employer (Ver. 3 2010)
[3] The Red Book: FIDIC Conditions of Contract for Construction for Building and Engineering Works designed by the Employer (1st Ed. 1999).
[4] The Yellow Book: FIDIC Conditions of Contract for Plant and Design-Build- for electrical and mechanical plant, and for building works, designed by the Contractor (1st Ed. 1999)

would be able to obtain commensurate additional payment. However, this would remain at the discretion of the employer – i.e. the contractor carries the risk that the employer may not agree, whereupon he would have to decide whether to risk adopting the originally assumed design (which may well be inadequate under the actual circumstances encountered) or whether to proceed with his proposed conservative design and carry the additional costs himself.

173. It is the existence of such unavoidable uncertainties at the tendering stage for most underground works that lead to the conclusion that the allocation to the contractor of the risk for the detailed design of those types of works is not reasonable. Nor, ultimately, is it likely to be as cost effective as if the employer retains the detailed design responsibility, since a serious contractor will have tried to build in a significant allowance for the risk and potential additional cost of all such "non-unforeseen" (but as yet not identified) changes in design.

b. EPC Contract (FIDIC Silver Book)

174. The FIDIC Silver Book[5] allocates the responsibility for the design of the works squarely to the contractor, and is generally interpreted to protect the employer from any errors in any antecedent front-end engineering design work performed by others (such as his separate design consultant). This would include any errors due to false assumptions about the nature of the subsurface conditions.

175. Sub-Clause 5.1 states: "Any data or information received by the Contractor, from the Employer or otherwise, shall not relieve the Contractor from his responsibility for the design and execution of the Works." This means that "... the Contractor will, generally, bear the risk of encountering what would otherwise be unforeseeable physical conditions in the [Red and Yellow] Books" (Baker et al, 2009). Even while defending the risk allocation embodied in the Silver Book, the former chairman of the FIDIC Contracts Committee admitted that: "The employer must ... realise that asking serious contractors to price such risks will increase the construction cost and result in some contracts not being commercially viable" (Wade 2000).

176. The apparent benefits of an EPC contract for the Employer may be summarized as follows:

- There is a low risk – on paper – of the agreed (budgeted) cost and time of execution being significantly extended.
- The contractor bears the risk of integrating the performance of all design and construction package contractors, and therefore minimizes the administration burdens on the employer.

177. However, the disadvantages that must be anticipated on projects with significant underground works are the following:

- The degree of participation by serious contractors in the tendering process may be insufficient due to their concerns about the appropriateness of this form of contract

[5] The Silver Book: FIDIC Conditions of Contract for Construction for EPC/Turnkey Projects (1st Ed. 1999).

for such works - only a limited proportion of contractors have the financial capacity to accept such risks.

- All serious tendering contractors will add a substantial risk premium to the tender price – this is very unlikely to be as low as any actual cost increases that might occur on a re-measured contract should the subsurface conditions turn out to be worse than expected, and of course there is always the possibility that re-measurement would not necessarily result in any significant increase at all (discussed in the following section).

- The employer is able to exercise substantially less control of the detailed design and construction process, and the contractor will inevitably aim for the minimum (arguably) compliant standard – a less serious (i.e. lower tender price) contractor may not even do that.

- In reality, the nature of the unforeseen subsurface conditions may make it physically impossible for the Contractor to maintain the agreed program, and may force it to apply every method to recover its additional costs through contractual disputes.

178. For these reasons the PPTA Consultant would generally advise strongly against the application of an EPC contract, based on the FIDIC Silver Book or otherwise, on a project comprising predominantly underground works – unless the value to the Employer of avoiding the risk of budget overrun is worth a substantially higher financial burden for execution.

2. Effect of Re-measurement on the Actual Allocation of the Detailed Design Risk

179. Even under the FIDIC Yellow Book it is possible to introduce re-measurement for some limited and strictly identified parts of the works (Sub-clause 14.1). However, in that case the conditions and procedure for effecting such measurement and payment need to be added into the Particular Conditions, since there is no provision whatsoever in the General Conditions for this. It must nevertheless be understood that the structure and contents of the Yellow Book Conditions of Contract have been established based on the premise that, at least generally speaking, the contractor will be completely responsible for the design and construction of the works under a lump sum form of payment.

180. If, on the contrary, the construction works are to be generally subject to re-measurement, then either:

(i) Under the terms of the contract the employer is obliged to pay for whatever works the contractor deems necessary, such that the risk for the detailed design has by definition been transferred back to the employer; or else

(ii) Under the terms of the contract the employer is not obliged to pay for any works that exceed the works assumed in the basic design and the contract, in which case he may choose to pay only for the works as previously estimated, such that the risk for the detailed design is carried by the contractor.

181. If the terms of the contract are as in (i) above, then the employer is at a severe disadvantage in that he must pay for a conservative design (which increases the price to the contractor) even where his own design experts are advising him that this is not necessary. If the terms of the contract are as in (ii) above, then the contractor is placed in the inappropriate position of having to rely on the discretion of the employer – without any protection under the contract – for payment of any more conservative or different design which he believes to be necessary (provided this is not related to conditions which were actually unforeseen, which is in any case often difficult to prove). The consequences of this have been mentioned in previous section.

3. Optimum Allocation of the Detailed Design Risk

182. The construction works in the WRDIP comprise different elements with various types of procedures for producing the final constructed design. However, the risk for detailed design should be allocated to the contractor primarily for the hydro-mechanical, mechanical and electrical works. Provided these works are small in volume compared with the civil works, they are normally contractor-designed works included within the main re-measurement contract. The technical specifications would, therefore, be formulated in order to provide the contractor with all the information he requires as well as to define the performance and other criteria which his designs for this equipment must satisfy.

183. The employer would then retain the responsibility for the detailed design of the remainder of the works. The responsibility for the detailed design activities involved in determining the rock support requirements in the tunnels and shafts should remain with the employer, for the reasons presented above.

184. It would be theoretically possible to allocate the responsibility for the design activities involved for reinforced concrete works for any other structures to the contractor; however, this would not bring the employer any realistic advantage. The standards and procedures defining the correct method of calculating the primary structural reinforcing steel required are straightforward and reliable – in the event of any future failure it would be a relatively easy matter to prove, through forensic examination, whether or not the design had been satisfactory. It is frequently adopted practice to establish technical specifications that require the contractor to follow clear procedures and standards and take responsibility for:

(i) Determining the secondary steel to be incorporated, and completing all the reinforcement detailing

(ii) Providing suitable quality reinforcement, placing it as designed/ detailed, and completing construction of the concrete structures to the necessary standard in every respect.

185. For the Employer to retain the risk of the detailed structural design itself would not, therefore, entail any practical loss in indemnity.

4. Geotechnical Baseline Report

186. Included in the technical specifications prepared by the MCB for each tunneling contract package of the KMTC and UEC, as well as the dam designs in the NWPCP, will be a Geotechnical Baseline Report (GBR). The GBR is to describe conditions expected to be encountered during tunneling. Geological mapping, borehole investigations, geo-physical explorations, laboratory testing of rock samples and other design work in progress will support the preparation of the GBRs. The GBRs require a complete longitudinal section of each tunnel with information on structural faults, groundwater, and the categorization of rock, excavation and support classes.

187. For conventional consultant (i.e. employer) designed works (FIDIC Pink Book), it is usually simply part of the pre-construction process – planned, agreed and supervised by the design consultant for the purposes of (i) the tender (detailed) design, and (ii) as information for the contractor later. The word "Baseline" is then not really appropriate, since it is usually the only program of geotechnical investigations performed. Sufficient budget has to be made available to achieve an adequate program, on the grounds that the better the information at the detailed design stage, the lower the risk of unexpected cost increases during construction.

188. The main purpose of the (not "Baseline") Geotechnical Report in a FIDIC Pink Book tender is to ensure that the contractor has a reasonable idea of what he will be meeting, so that he can provide the most appropriate equipment and resources. The actual payment, however, is based on the actual rock quality encountered, each quality designation having different excavation and rock support rates. The actual quality is agreed (or determined) on site by the Engineer. The contractor does not therefore carry the risk of unexpectedly poor conditions being encountered.

189. For contracts where the contractor carries the detailed design responsibility (e.g. EPC) it is indeed a "Baseline" report - the contractor will be expected to supplement it to the extent that he believes necessary. The GBR in this case will usually be much more "indicative". It may be possible nevertheless to work in some complicated arrangement of agreeing with the contractor on a reasonable investigation program for separate payment, following which he carries (as explained above) the full responsibility for the design and execution without any recourse to price adjustment for physical works extent. However, the contractor is not really able to rely on the completeness or even correctness of the information under the usual terms of an EPC contract, so it is not recommended to attempt to do add this complexity to a standard EPC arrangement.

190. Relatedly, a “tunnel classification matrix” will be prepared by the MCB for the technical specifications in the tunneling contracts relating the procedure for assessing the actual rock class encountered together with the system for deciding what rock support would then be needed. In a FIDIC Pink Book contract, the rock class is agreed on site and the specified respective rock support works paid as re-measured items. Payment for excavation and support is based on the rock class encountered. Under an EPC contract the contractor will have been expected to have made his own assessments and priced in enough for what he expects to encounter and the rock support he will then have to build in - i.e. full pricing risk on the contractor.

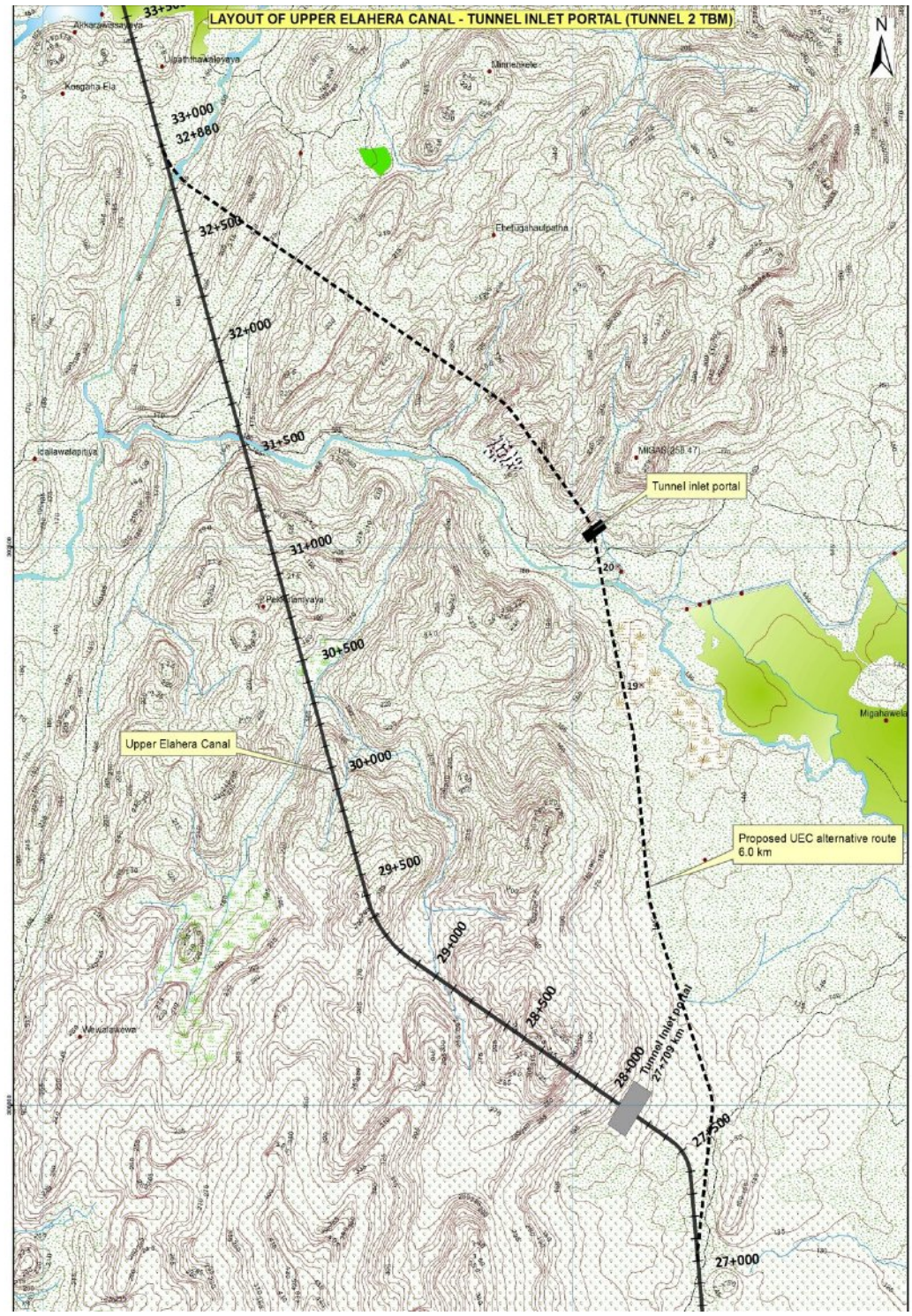
191. The level of risk allocation onto the contractor in a FIDIC Pink Book contract can be increased in certain very specific ways, for instance, by setting variability limits before he is allowed any compensation in money or time, or imposing a sharing of the burden etc. However, all this effectively does is provide some strictly limited degree of risk relief afforded to the contractor, for which it must be expected that he will have to build in some extra risk premium into his price (albeit not nearly as much as under the blanket risk allocation under the standard EPC terms).

192. The specific potential areas of risk relief (and associated price increase risk) should be discussed individually and comprehensively between the MIWRM and PMDSC during the detailed design phase of the tunneling to establish where their priorities lie.

FIGURES

Figure 1: Alignment of Canals and Three Tunnels of UEC

Figure 2: Alternative Alignment of Tunnel 3 of UEC (Route 3)



ANNEX 1
SITE VISIT – TUNNELS OF KMTC, UEC AND NWPC

A. Overview

1. The site was visited by the PPTA Tunneling Specialist in the first two weeks of June 2014 to inspect mainly the potential areas for the construction of tunnel portals and the physical check of core boxes from previous and actual drilling campaigns. Tunnel sections with a low cover of rock have been targeted at various chainages along the alignment. In addition morphological features, like deeply cut streams, or geological aspects, such as shear zones and the wide occurrence of calcareous gneiss and/or marble called also for an inspection in the field.

2. The following documents had been prepared for the site visit:

(i) Geological map with the alignment of the project at a scale of 1:100,000
(ii) Geological section along the tunnel route
(iii) Topographic map with a layout of the project and locations of old and new boreholes

3. The participants of the site visit of UEC are listed below:

- Mr. S.A.A. Dharmasiri — Project Director UEC, KMTC
- Mr. S.D. Goonatilleke — Design Engineer UEC, KMTC
- Mr. J. Joachimthasan — Consultant MCB
- Mr. M.P.K.G. Jayathilake — Geological Engineer, MCB
- Mr. Y.K.V. Costa — Engineer, MCB
- Dr. H. Wagner — Consulting Engineer to MCB
- Dr. D. Paul — Tunneling Specialist, ADB

The following engineers visited KMTC and NWPC:

- Mr. M.P.K.G. Jayathilake — Geological Engineer, MCB
- Mr. Y.K.V. Costa — Engineer, MCB
- Mr. S.M.N.M. Senevirathna — Geologist of Mahaweli Authority
- Dr. D. Paul — Tunneling Specialist, ADB

4. Since the MIWRM has already launched a similar project in Uma Oya Province with the excavation of several tunnels in comparable geological conditions, a site visit was proposed in order to study the installation and performance of two tunnel boring machines (TBMs) in Sri Lanka. The participants are listed below:

- Mr. J. Joachimthasan — Consultant MCB
- Mr. M.P.K.G. Jayathilake — Geological Engineer, MCB
- Dr. D. Paul — Tunneling Specialist, ADB

B. Itinerary

i. Tunnels of Upper Elahera Canal (UEC)

5. The site visit was performed according to the following schedule:

02.06.14 Colombo – Bakamuna; inspection of outlet and inlet portals of UEC Tunnel 1, walk along the alignment. Visit inlet and outlet portals of UEC Tunnel 2, walk along the alignment.

03.06.14 Visit of inlet portal of UEC Tunnel 3, inspection of three drilling sites. Inspection of a stream at chainage 31+300 and search for morphological/ geological indications of karstified marble.

04.06.14 Search for morphological/geological indications of karstified marble between chainages 36+000 and 36+300. Visit of driller's office, logging cores, obtain information about geo-electrical exploration

05.06.14 Inspection of outlet portal of Tunnel 4. Visit outlet portal UEC Tunnel 3 and the actual drilling activities. Return to Colombo.

ii. Tunnels of Kaluganga-Moragahakanda Transfer Canal and North West Province Canal (KMTC)

6. The site visit was performed according to the following schedule:

09.06.14 Colombo – Moragahakanda guest house. Visit of Guruwela Block Office and inspection of drilled core samples from a previous drilling campaign. Visit of inlet and outlet portals of KMTC Tunnel 1A. Inspection of inlet portal of KMTC Tunnel 1B.

10.06.14 Visit outlet portal of KMTC Tunnel 1B. Inspection of core boxes from previous drilling campaign at Mahaweli Authority Block Office.

11.06.14 Visit of both portals of the tunnel of NWPC; walk along the alignment. Inspection of the recently started borehole. Return to Colombo.

C. Photos

Figure 1-1: Tunnel 1A of KMTC, temporary portal at the outlet (chainage 2+815) with charnokite

Figure 1-2: Tunnel1 crossing a ridge composed of quartzite (background)

Figure 1-3: Tunnel 3 of UEC traversing Ruppe Ela with a cover of 15 m at chainage 31+310

Figure 1-4: Tank approx. 115m west of the tunnel3 of UEC at chainage 33+300

Figure 1-5: Tunnel 3 at the temporary outlet portal (chainage 53+540); view toward downstream along the cut-and-cover section

ANNEX 2
SITE VISIT – UMA OYA PROJECT

A. Overview

1. Since the MIWRM has already launched a similar project in Uma Oya Province with the excavation of several tunnels in comparable geological conditions, a site visit was proposed in order to study the installation and performance of two tunnel boring machines (TBMs) in Sri Lanka.

2. The Uma Oya Project is located in the southeast of Sri Lanka. It is currently under construction and offers the possibility to observe the heading works of two tunnels by TBM as well as conventional tunneling with the Drill and Blast Method (DBM) and the construction of dams.

3. Although the diameter of the mechanized tunnels measures less in comparison of KMTC and UEC tunnels, the sequence of rock, the technology and the performance of the system is similar to nearly identical with WRDIP further north.

B. Itinerary

23.06.14 Colombo – Wellawaya. Visit of factory for the production of segmental lining as well as headrace and tailrace tunnels excavated by TBMs.

24.06.14 Visit of valve chamber and raise boring equipment for the excavation of the surge shaft. Visit of the portal of the link tunnel and the foundation of Pohul Pola Dam. Return to Colombo.

C. Photos

Figure 2-1: Outlet portal of the headrace tunnel with precast elements of segmental lining

Figure 2-2: Conveyor belt with tunnel muck of the TBM , type double shield

Figure 2-3: Conventionally excavated access tunnel

Figure 2-4: Preparatory works for the foundation of a RCC dam

ANNEX 3
CERCHAR TEST RESULTS

Rock Properties Report

19 November 2014

TECHNISCHE
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Rock Properties Report

Results of the CERCHAR-Abrasivity-Tests

8 pages, 1 figure, 4 tables, 1 appendix

P. Ellecosta, M.Sc.
Dr. H. Käsling
Prof. Dr. K. Thuro

Munich (Germany), November 19th 2014

Table of contents

1 Preliminary remarks

On behalf of Dr. Paul and the Asian Development Bank in Manila, CERCHAR-Abrasivity-Tests were performed on 40 metamorphic rock samples for a TBM-project in Sri Lanka.

2 References

[1] ALBER, M., YARALI, O., DAHL, F., BRULAND, A., KÄSLING, H., MICHALAKOPOULOS, T.N., CARDU, M., HAGAN, P., AYDIN, H. & OZARSLAN, A. (2014): ISRM Suggested Method for Determining the Abrasivity of Rock by the CERCHAR Abrasivity Test.- Rock Mechanics and Rock Engineering, 47, 1, 261-266.

[2] CENTRE D´ETUDES DE CHARBONNAGES DE FRANCE (1986): The Cerchar Abrasiveness Index.- 8 S., 4 Taf., Verneuil.

[3] AFNOR (2000): Normalisation Française P94-430-1 (10/2000): Roches: Détermination du pouvoir abrasive d'une roche. Partie 1: Essai de rayure avec une pointe.

[4] WEST, G. (1989): Technical Note: Rock abrasiveness Testing for Tunneling.- Int. J. Rock Mech. Min. Sci. & Geomech. Abstr., 26, 2: 151-160.

[5] KÄSLING, H., THIELE, I. & THURO, K**.** (2007): Abrasivitätsuntersuchungen mit dem Cerchar-Test – eine Evaluierung der Versuchsbedingungen. – In: OTTO, F. (ed.): Veröffentlichungen von der 16. Tagung für Ingenieurgeologie, 7.-10. März 2007, Bochum. – 492 S., Bochum (Technische Fachhochschule Georg Agricola), 229-235.

3 Origin of the tested samples

The rock samples (drilling cores) from an exploration campaign of a TBM-project in Sri Lanka were selected and collected by the client (represented by Dr. Paul). They were sent in two packages to the Chair of Engineering Geology at the Technische Universität München in august & november 2014. Table 1 gives an overview of the 40 tested samples.

Table 1a: Overview of the tested rock samples, lithology and the conducted CAI-test (CERCHAR-Abrasivity-Test) (1/2).

Sample-No.	Borehole-Nr.	Depth [m]	Rock Type	CAI
ABD-SRL-1	DHT-P-05	11.02 - 11.15	Quartzite with few garnet	X
ABD-SRL-2	DT-11-L	57.30 – 57.60	Khondolite	X
ABD-SRL-3	DT-12	38.25 – 38.39	Calc gneiss	X
ABD-SRL-4	DT-29	19.85 – 19.94	Quartz feldspathic gneiss	X
ABD-SRL-5	DT-30	25.80 – 26.03	Garnet Hornblend Biotite gneiss (medium grain)	X
ABD-SRL-6	DT-30	27.50 – 27.60	Garnet Hornblend Biotite gneiss (fine grain)	X
ABD-SRL-7	DT-28	23.10 – 23.20	Hornblend Biotite gneiss	X
ABD-SRL-8	DT-28	25.25 – 25.35	Hornblend Biotite gneiss	X
ABD-SRL-9	DT-26	18.05 – 18.15	Hornblend Biotite gneiss	X
ABD-SRL-10	DT-26	23.30 – 23.40	Granitic gneiss	X
ABD-SRL-11	DT-26	18.48 – 18.58	Granitic gneiss	X
ABD-SRL-12	DT-27	24.71 – 24.82	Quartz feldspathic gneiss	X
ABD-SRL-13	DT-27	27.75 – 27.83	Granitic gneiss	X
ABD-SRL-14	DT-23	22.15 – 22.25	Quartz feldspathic gneiss	X
ABD-SRL-15	DT-23	30.70 – 30.75	Granitic gneiss	X
ABD-SRL-16	DT-22	16.80 – 16.90	Granitic gneiss	X
ABD-SRL-17	DT-03	24.10 – 24.25	Charnokitic gneiss	X
ABD-SRL-18	DT-02	22.80 – 23.02	Calc gneiss	X
ABD-SRL-19	DT-01	23.70 – 23.77	Charnokitic gneiss	X
ABD-SRL-20	PBH-02	16.52 – 16.60	Charnokitic gneiss	X
ABD-SRL-21	DT-01	20.25 – 20.36	Charnokitic gneiss	X
ABD-SRL-22	DT-02	28.20 – 28.28	Charnokitic gneiss	X
ABD-SRL-23	DT-03	41.40 – 41.50	Calc gneiss	X
ABD-SRL-24	DT-6-R	43.90 – 43.99	Calc gneiss	X
ABD-SRL-25	DT-5	27.37 – 27.47	Quartzite	X
ABD-SRL-26	DT-6	28.24 – 28.38	Quartzite	X
ABD-SRL-27	DT-6	39.95 – 40.05	Quartzite	X
ABD-SRL-28	DT-10-R	14.10 – 14.26	Khondolite (slightly weathered)	X
ABD-SRL-29	DT-10-R	29.65 – 29.78	Hornblend Biotite gneiss	X

Table 1b: Overview of the tested rock samples, lithology and the conducted CAI-test (CERCHAR-Abrasivity-Test) (2/2).

Sample-No.	Borehole-Nr.	Depth [m]	Rock Type	CAI
ABD-SRL-30	DT-10	22.50 – 22.65	Calc gneiss	X
ABD-SRL-31	DT-13	52.45 – 52.62	Khondolite	X
ABD-SRL-32	DT-11-L	47.05 – 47.22	Hornblend Biotite gneiss	X
ABD-SRL-33	DT-11-R	26.83 – 26.97	Khondolite	X
ABD-SRL-34	DT-25	7.32 – 7.46	Hornblend Biotite gneiss	X
ABD-SRL-35	DT-19	60.66 – 60.82	Khondolite	X
ABD-SRL-36	DT-07	25.14 – 25.30	Quartzite	X
ABD-SRL-37	DT-07-L	46.64 – 46.77	Garnet Hornblend Biotite gneiss	X
ABD-SRL-38	DT-04-R	31.85 – 31.96	Quartz feldspathic gneiss	X
ABD-SRL-39	DT-04	20.49 – 20.60	Quartz feldspathic gneiss	X
ABD-SRL-40	DT-07-L	28.04 – 28.18	Garnet Hornblend Biotite gneiss	X

4 Methodology

4.1 CERCHAR Abrasivity Test

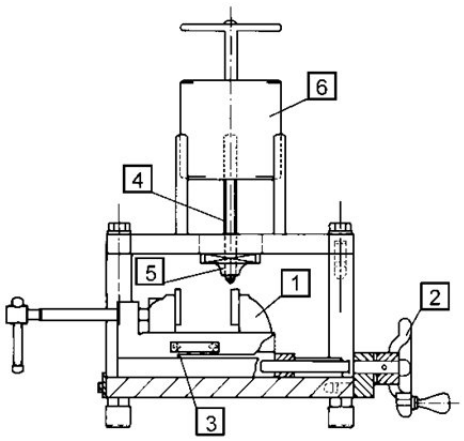
The CERCHAR Abrasivity Test was performed according to the ISRM suggested method for determining the abrasivity of rock by the CERCHAR Abrasivity Test (ALBER et al. 2014) [1] and implements all specifications given in the recommendations of Centre d´Etudes de Charbonnages de France (CERCHAR, 1986) [2] and AFNOR (2010) [3] whereby the **C**ERCHAR-**A**brasivity-**I**ndex (CAI) is determined.

4.1.1 Sample preparation

Rock samples with a rough surface, which is produced by fracturing the rock, are used for the CERCHAR Abrasivity Test according to ALBER et al. (2014) [1].

4.1.2 Testing equipment

The testing device (Fig. 1) is in accordance with the modified CERCHAR-device presented in WEST (1989) [4] and fits all specifications given in ALBER et al. (2014) [1].



① Device ② crank handle ③ precision slide
④ testing pin ⑤ pin guide ⑥ weight

Fig. 1: CERCHAR-device for the determination of the CERCHAR-Abrasivity-Index (according to WEST, 1989 [4], modified).

4.1.3 Testing procedure

During the CERCHAR Abrasivity Test a steel testing pin with defined geometry and quality (HRC 54-56) is scratched over 10 mm of a rough sample surface under a static load of 7 kg. For each sample 5 single tests with resharped testing pins are performed.

4.1.4 Test evaluation

The resulting wear of the steel pin is determined with an accuracy of 0.02 mm using a reflected-light binocular microscope with a measuring scale. According to KÄSLING et al. (2006) [5] and ALBER et al. (2014) [1] each steel needle is measured in 4 perpendicular directions and the results are averaged.

The CERCHAR-Abrasivity-Index (**CAI**) is calculated using equation 1 from the wear of the steel needle (d). An evaluation of the abrasivity of the rock is performed according to the classification table below (*table 2*).

Equation 1: Calculation of the CERCHAR-Abrasivity-Index (CAI).

$$CAI = d \times k$$

with:	CAI	CERCHAR-Abrasivity-Index	[-]
	d	Wear of the steel needle	[mm]
	k	value of scale (k = 10)	[1/mm]

Table 2: Abrasivity classification using the CERCHAR-Abrasivity-Test (according to CERCHAR (1986) [2]).

CAI	Classification
0.3-0.5	not very abrasive
0.5-1.0	slightly abrasive
1.0-2.0	medium abrasive
2.0-4.0	very abrasive
4.0-6.0	extremely abrasive

5 Results of the laboratory tests

The results of the laboratory tests are summarized and discussed in this chapter. Table 3 shows the results of all conducted CERCHAR Abrasivity Tests in detail. Table 4 gives an overview of the tested rock types, their mean CAI-value and the minima and maxima.

Table 3a: Results of the Cerchar-Abrasivity-Tests for the rock samples ABD-SRL-1 to -40 (1/2).

Sample-No.	Rock Type	CAI		Mean	Min.	Max.
ADB-SRL-03	Calc gneiss	1.2	medium abrasive	**1.6**	0.8	3.5
ADB-SRL-18		0.8	slightly abrasive			
ADB-SRL-23		3.5	very abrasive			
ADB-SRL-24		1.0	slightly to medium abrasive			
ADB-SRL-30		1.5	medium abrasive			
ADB-SRL-17	Charnokitic gneiss	3.4	very abrasive	**2.9**	2.5	3.4
ADB-SRL-19		2.5	very abrasive			
ADB-SRL-20		2.8	very abrasive			
ADB-SRL-21		3.3	very abrasive			
ADB-SRL-22		2.5	very abrasive			
ADB-SRL-37	Garnet Hornblend Biotite gneiss	4.2	extremely abrasive	**4.3**	4.2	4.4
ADB-SRL-40		4.3	extremely abrasive			
ADB-SRL-06		4.2	extremely abrasive			
ADB-SRL-05		4.4	extremely abrasive			
ADB-SRL-10	Granitic gneiss	4.9	extremely abrasive	**4.3**	3.7	4.9
ADB-SRL-11		3.9	very abrasive			
ADB-SRL-13		4.3	extremely abrasive			
ADB-SRL-15		4.6	extremely abrasive			
ADB-SRL-16		3.7	very abrasive			
ADB-SRL-07	Hornblend Biotite gneiss	4.0	very to extremely abrasive	**3.5**	2.1	4.7
ADB-SRL-08		3.7	very abrasive			
ADB-SRL-09		2.8	very abrasive			
ADB-SRL-29		3.7	very abrasive			
ADB-SRL-32		2.1	very abrasive			
ADB-SRL-34		4.7	extremely abrasive			
ADB-SRL-02	Khondolite (Garnet Sillimanite Graphite Gneiss)	2.3	very abrasive	**3.4**	2.3	4.3
ADB-SRL-31		3.8	very abrasive			
ADB-SRL-33		4.1	extremely abrasive			
ADB-SRL-35		4.3	extremely abrasive			
ADB-SRL-28		2.5	very abrasive			

Table 3b: Results of the Cerchar-Abrasivity-Tests for the rock samples ABD-SRL-1 to -40 (2/2).

Sample-No.	Rock Type	CAI		Mean	Min.	Max.
ADB-SRL-04	Quartz feldspathic gneiss	3.6	very abrasive	**3.9**	3.6	4.5
ADB-SRL-14		4.0	very to extremely abrasive			
ADB-SRL-38		4.5	extremely abrasive			
ADB-SRL-39		3.8	very abrasive			
ADB-SRL-12		3.6	very abrasive			
ADB-SRL-25	Quartzite	3.8	very abrasive	**4.2**	3.7	5.4
ADB-SRL-26		4.4	extremely abrasive			
ADB-SRL-27		3.7	very abrasive			
ADB-SRL-36		5.4	extremely abrasive			
ADB-SRL-01		3.7	very abrasive			

As can be seen in table 3 and 4, the CERCHAR-Abrasivity-Index (CAI) is highly spreading. Especially the Calc-gneiss sample (ADB-SRL-18) shows a low CAI of minimum 0.8 (slightly abrasive). As expected, quartzite sample (ADB-SRL-36) has the absolute maximum of about 5.4 (extremely abrasive).

Table 4: Summary of the mean CAI-values of ABD-SRL-1 to -40.

Rock Type	CAI mean value		CAI minimum		CAI maximum	
	CAI	**Classification**	CAI	Classification	CAI	Classification
Calc gneiss	**1.6**	**medium abrasive**	0.8	slightly abrasive	3.5	very abrasive
Charnokitic gneiss	**2.9**	**very abrasive**	2.5	very abrasive	3.4	very abrasive
Garnet Hornblend Biotite gneiss	**4.3**	**extremely abrasive**	4.2	extremely abrasive	4.4	extremely abrasive
Granitic gneiss	**4.3**	**extremely abrasive**	3.7	very abrasive	4.9	extremely abrasive
Hornblend Biotite gneiss	**3.5**	**very abrasive**	2.1	very abrasive	4.7	extremely abrasive
Khondolite	**3.4**	**very abrasive**	2.3	very abrasive	4.3	extremely abrasive
Quartz feldspathic gneiss	**3.9**	**very abrasive**	3.6	very abrasive	4.5	extremely abrasive
Quartzite	**4.2**	**extremely abrasive**	3.7	very abrasive	5.4	extremely abrasive

Table 4 shows that the rock type “Calc gneiss” has the lowest mean CAI-values (1.6 ≙ medium abrasive), which is a result of the low quartz content.

Other rock types like “Charnokitic gneiss” (2.9), “Hornblend Biotite gneiss” (3.5), “Khondolite” (3.4) and “Quartz feldspathic gneiss” (3.9) are classified in the mean as very abrasive. The reason here is the higher quartz content which results in an increased wear on the CERCHAR-pin.

The highest values result from the “Garnet Hornblend Biotite Gneiss” (4.3), “Granitic gneiss” (4.3) and the “Quartzite” (4.2). These rock samples are all in the mean classified as extremely abrasive. Some reasons for this case are the mostly fine grained structure, the high quartz content and the high rock strength of the samples.

Munich, November 19th 2014

Peter Ellecosta	Dr.	Prof. Dr.
M.Sc.	Heiko Käsling	Kurosch Thuro

Project:

Asian Development Bank (ADB)

Sri Lanka

Documentation of the Cerchar-Abrasivity-Tests

Appendix I

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-01
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-01

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quartzite with few garnet

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	88	65	23	99	52	-	-	-	-	-
Measurement 1 [mm]	0,38	0,36	0,35	0,32	0,44	-	-	-	-	-
Measurement 2 [mm]	0,40	0,37	0,35	0,32	0,47	-	-	-	-	-
Measurement 3 [mm]	0,36	0,36	0,34	0,33	0,46	-	-	-	-	-
Measurement 4 [mm]	0,38	0,38	0,35	0,31	0,44	-	-	-	-	-
Wear [mm]	**0,38**	**0,37**	**0,35**	**0,32**	**0,45**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,37**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,7** **Classification:** **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,44 Standard error s_m = 0,20

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-02
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-02

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

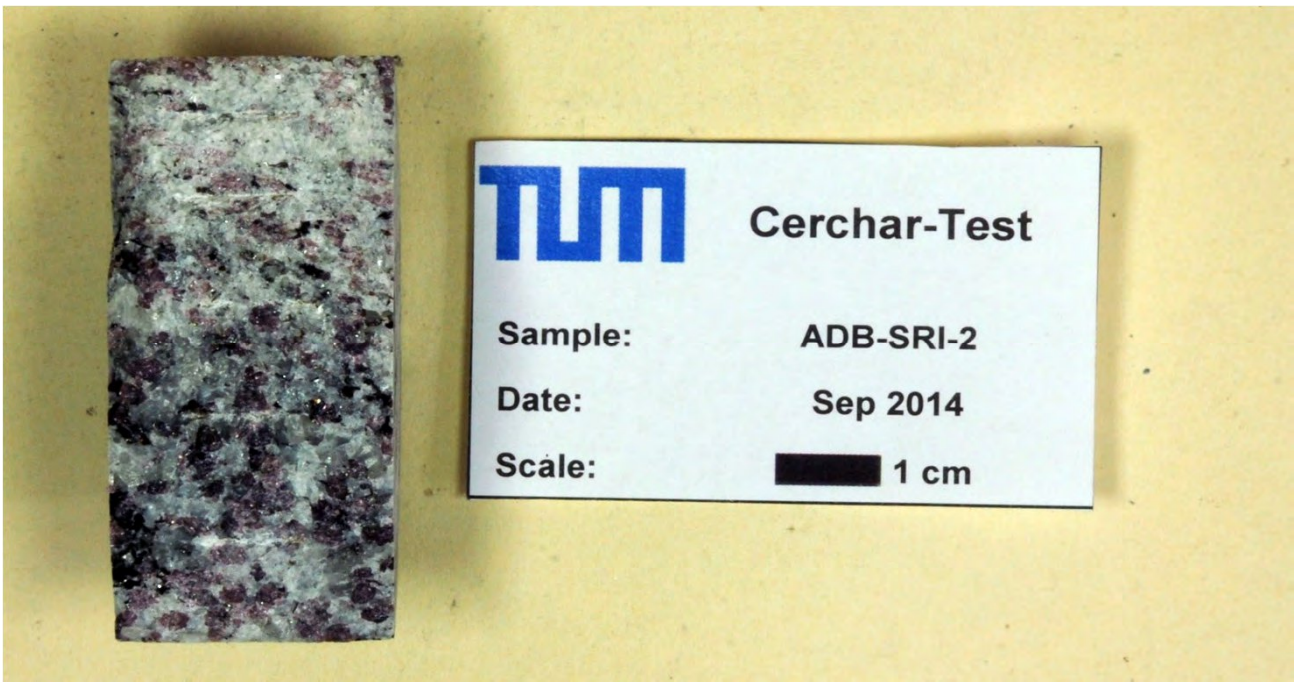
Rock description: Khondolite (Garnet Sillimanite Graphite Gneiss)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	30	38	92	40	96	-	-	-	-	-
Measurement 1 [mm]	0,14	0,13	0,20	0,25	0,31	-	-	-	-	-
Measurement 2 [mm]	0,17	0,14	0,24	0,27	0,32	-	-	-	-	-
Measurement 3 [mm]	0,20	0,16	0,26	0,30	0,33	-	-	-	-	-
Measurement 4 [mm]	0,18	0,14	0,24	0,27	0,31	-	-	-	-	-
Wear [mm]	**0,17**	**0,14**	**0,24**	**0,27**	**0,32**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,23**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **2,3** **Classification:** **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,64 Standard error s_m = 0,29



Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-03
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-03**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Calc gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	44	28	258	50	43	-	-	-	-	-
Measurement 1 [mm]	0,13	0,19	0,12	0,05	0,12	-	-	-	-	-
Measurement 2 [mm]	0,17	0,21	0,08	0,06	0,10	-	-	-	-	-
Measurement 3 [mm]	0,12	0,21	0,10	0,06	0,11	-	-	-	-	-
Measurement 4 [mm]	0,14	0,20	0,11	0,04	0,12	-	-	-	-	-
Wear [mm]	**0,14**	**0,20**	**0,10**	**0,05**	**0,11**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,12**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **1,2** **Classification:** **abrasiv** (abrasive)

Standard deviation σ = 0,49 Standard error s_m = 0,22

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-04
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-04

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Quartz feldspatic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	76	100	94	49	53	-	-	-	-	-
Measurement 1 [mm]	0,20	0,32	0,36	0,55	0,32	-	-	-	-	-
Measurement 2 [mm]	0,24	0,34	0,35	0,54	0,32	-	-	-	-	-
Measurement 3 [mm]	0,24	0,33	0,36	0,56	0,33	-	-	-	-	-
Measurement 4 [mm]	0,30	0,33	0,35	0,56	0,34	-	-	-	-	-
Wear [mm]	**0,25**	**0,33**	**0,36**	**0,55**	**0,33**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **: 0,36**

Cerchar-Abrasivity-Index (CAI) [ ] **: 3,6**

Classification: sehr abrasiv (very abrasive)

Standard deviation σ = 1,02

Standard error s_m = 0,46

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-05
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-05**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Garnet Hornblend Biotite gneiss (medium grain)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	47	37	2	56	55	-	-	-	-	-
Measurement 1 [mm]	0,42	0,41	0,56	0,40	0,37	-	-	-	-	-
Measurement 2 [mm]	0,43	0,43	0,60	0,37	0,37	-	-	-	-	-
Measurement 3 [mm]	0,39	0,42	0,61	0,40	0,38	-	-	-	-	-
Measurement 4 [mm]	0,40	0,41	0,59	0,38	0,38	-	-	-	-	-
Wear [mm]	**0,41**	**0,42**	**0,59**	**0,39**	**0,38**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,44**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,4** **Classification:** **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,78 Standard error s_m = 0,35

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-06
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-06**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Garnet Hornblend Biotite gneiss (fine grain)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	5	58	66	60	87	-	-	-	-	-
Measurement 1 [mm]	0,30	0,37	0,56	0,39	0,42	-	-	-	-	-
Measurement 2 [mm]	0,32	0,39	0,57	0,38	0,37	-	-	-	-	-
Measurement 3 [mm]	0,33	0,40	0,60	0,38	0,44	-	-	-	-	-
Measurement 4 [mm]	0,33	0,41	0,59	0,40	0,38	-	-	-	-	-
Wear [mm]	**0,32**	**0,39**	**0,58**	**0,39**	**0,40**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,42**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,2**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,87

Standard error s_m = 0,39

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-07
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-07**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	17	75	91	89	93	-	-	-	-	-
Measurement 1 [mm]	0,37	0,61	0,25	0,38	0,38	-	-	-	-	-
Measurement 2 [mm]	0,38	0,62	0,25	0,40	0,34	-	-	-	-	-
Measurement 3 [mm]	0,39	0,62	0,26	0,41	0,37	-	-	-	-	-
Measurement 4 [mm]	0,39	0,63	0,24	0,39	0,37	-	-	-	-	-
Wear [mm]	**0,38**	**0,62**	**0,25**	**0,40**	**0,37**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,40**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,0**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 1,20

Standard error s_m = 0,54

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-08
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-08**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	19	9	27	24	26	-	-	-	-	-
Measurement 1 [mm]	0,44	0,48	0,31	0,30	0,36	-	-	-	-	-
Measurement 2 [mm]	0,42	0,47	0,32	0,32	0,36	-	-	-	-	-
Measurement 3 [mm]	0,41	0,47	0,30	0,28	0,38	-	-	-	-	-
Measurement 4 [mm]	0,41	0,46	0,30	0,29	0,40	-	-	-	-	-
Wear [mm]	**0,42**	**0,47**	**0,31**	**0,30**	**0,38**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,37**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,7**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,66

Standard error s_m = 0,29

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-09
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-09

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	22	42	3	83	57	-	-	-	-	-
Measurement 1 [mm]	0,15	0,44	0,28	0,18	0,27	-	-	-	-	-
Measurement 2 [mm]	0,17	0,47	0,32	0,22	0,24	-	-	-	-	-
Measurement 3 [mm]	0,18	0,49	0,33	0,23	0,25	-	-	-	-	-
Measurement 4 [mm]	0,20	0,49	0,30	0,21	0,27	-	-	-	-	-
Wear [mm]	**0,18**	**0,47**	**0,31**	**0,21**	**0,26**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **: 0,28**

Cerchar-Abrasivity-Index (CAI) [ ] **: 2,8**

Classification: sehr abrasiv (very abrasive)

Standard deviation σ = 1,04

Standard error s_m = 0,47

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-10
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-10**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Granitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	71	68	7	35	86	-	-	-	-	-
Measurement 1 [mm]	0,48	0,49	0,60	0,38	0,44	-	-	-	-	-
Measurement 2 [mm]	0,52	0,48	0,61	0,39	0,48	-	-	-	-	-
Measurement 3 [mm]	0,53	0,50	0,62	0,36	0,48	-	-	-	-	-
Measurement 4 [mm]	0,50	0,49	0,60	0,38	0,47	-	-	-	-	-
Wear [mm]	**0,51**	**0,49**	**0,61**	**0,38**	**0,47**	**-**	**-**	**-**	**-**	**-**

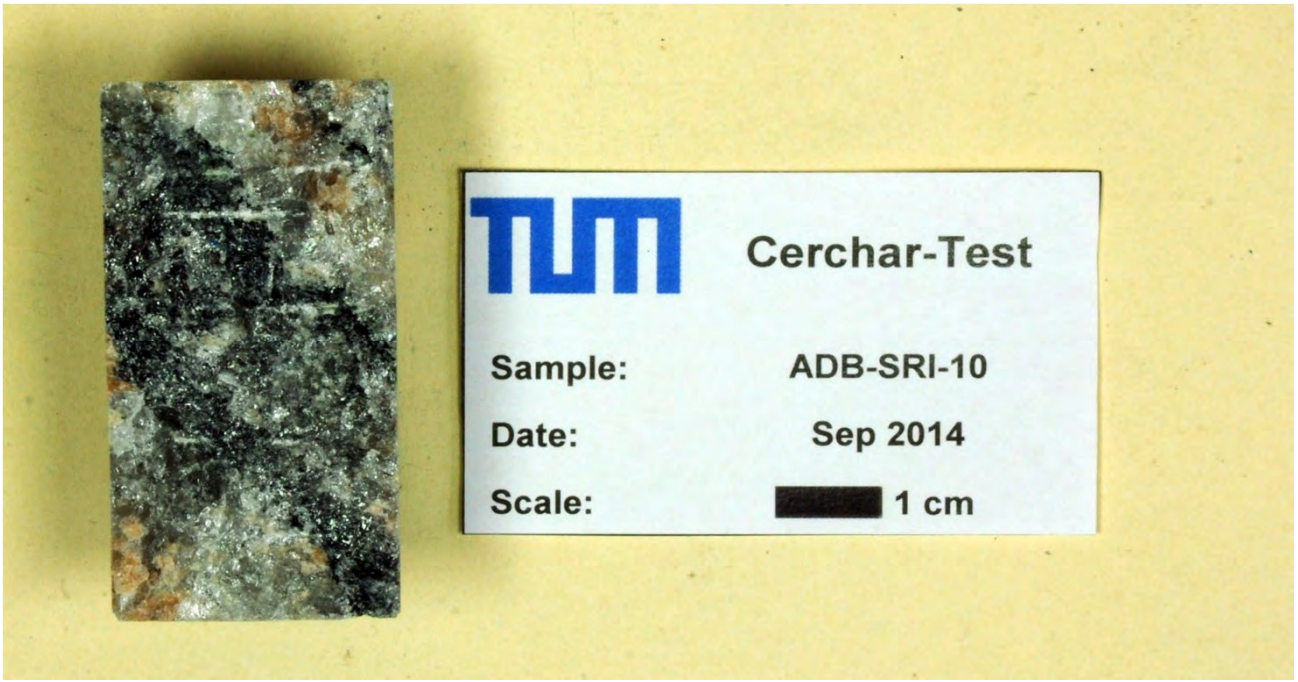
Average Wear [mm] **:** **0,49**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,9**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,74

Standard error s_m = 0,33



Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-11
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-11**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Granitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	77	36	73	101	31	-	-	-	-	-
Measurement 1 [mm]	0,31	0,58	0,44	0,33	0,32	-	-	-	-	-
Measurement 2 [mm]	0,33	0,57	0,39	0,37	0,33	-	-	-	-	-
Measurement 3 [mm]	0,34	0,57	0,38	0,34	0,32	-	-	-	-	-
Measurement 4 [mm]	0,31	0,56	0,42	0,36	0,31	-	-	-	-	-
Wear [mm]	**0,32**	**0,57**	**0,41**	**0,35**	**0,32**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **: 0,39**

Cerchar-Abrasivity-Index (CAI) [ ] **: 3,9**

Classification: sehr abrasiv (very abrasive)

Standard deviation σ = 0,93

Standard error s_m = 0,42

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-12
Sampling date:	14-Aug-14	**Date tested:**	01-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-12**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quartz feldspatic gneiss (Diopside)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	41	62	1	15	11	-	-	-	-	-
Measurement 1 [mm]	0,21	0,40	0,38	0,42	0,33	-	-	-	-	-
Measurement 2 [mm]	0,30	0,33	0,39	0,43	0,34	-	-	-	-	-
Measurement 3 [mm]	0,28	0,39	0,40	0,41	0,32	-	-	-	-	-
Measurement 4 [mm]	0,30	0,36	0,38	0,41	0,36	-	-	-	-	-
Wear [mm]	**0,27**	**0,37**	**0,39**	**0,42**	**0,34**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,36**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,6**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,50

Standard error s_m = 0,22

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-13
Sampling date:	14-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-13

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Granitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	64	32	44	53	28	-	-	-	-	-
Measurement 1 [mm]	0,50	0,30	0,44	0,47	0,40	-	-	-	-	-
Measurement 2 [mm]	0,56	0,27	0,50	0,50	0,39	-	-	-	-	-
Measurement 3 [mm]	0,51	0,26	0,47	0,42	0,41	-	-	-	-	-
Measurement 4 [mm]	0,52	0,29	0,46	0,43	0,41	-	-	-	-	-
Wear [mm]	**0,52**	**0,28**	**0,47**	**0,46**	**0,40**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,43**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,3**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,82

Standard error s_m = 0,37

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-14
Sampling date:	14-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-14

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quartz feldspatic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	47	49	100	37	50	-	-	-	-	-
Measurement 1 [mm]	0,41	0,45	0,23	0,54	0,37	-	-	-	-	-
Measurement 2 [mm]	0,38	0,45	0,25	0,58	0,36	-	-	-	-	-
Measurement 3 [mm]	0,37	0,47	0,23	0,59	0,34	-	-	-	-	-
Measurement 4 [mm]	0,38	0,46	0,22	0,59	0,37	-	-	-	-	-
Wear [mm]	**0,39**	**0,46**	**0,23**	**0,58**	**0,36**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,40**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,0**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 1,13

Standard error s_m = 0,51

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-15
Sampling date:	14-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-15**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Granitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	87	66	2	56	40	-	-	-	-	-
Measurement 1 [mm]	0,54	0,58	0,48	0,33	0,39	-	-	-	-	-
Measurement 2 [mm]	0,55	0,58	0,49	0,32	0,40	-	-	-	-	-
Measurement 3 [mm]	0,53	0,57	0,49	0,30	0,40	-	-	-	-	-
Measurement 4 [mm]	0,53	0,55	0,51	0,33	0,40	-	-	-	-	-
Wear [mm]	**0,54**	**0,57**	**0,49**	**0,32**	**0,40**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,46**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,6** **Classification:** **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,92 Standard error s_m = 0,41

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-16
Sampling date:	14-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-16**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Granitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	60	96	58	76	23	-	-	-	-	-
Measurement 1 [mm]	0,40	0,42	0,36	0,37	0,30	-	-	-	-	-
Measurement 2 [mm]	0,37	0,40	0,38	0,39	0,30	-	-	-	-	-
Measurement 3 [mm]	0,36	0,40	0,38	0,40	0,29	-	-	-	-	-
Measurement 4 [mm]	0,36	0,41	0,35	0,38	0,28	-	-	-	-	-
Wear [mm]	**0,37**	**0,41**	**0,37**	**0,39**	**0,29**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,37**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,7** **Classification:** **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,39 Standard error s_m = 0,17

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-17
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-17

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Charnockitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	65	92	38	88	99	-	-	-	-	-
Measurement 1 [mm]	0,31	0,43	0,36	0,35	0,20	-	-	-	-	-
Measurement 2 [mm]	0,32	0,46	0,34	0,39	0,20	-	-	-	-	-
Measurement 3 [mm]	0,35	0,49	0,33	0,40	0,19	-	-	-	-	-
Measurement 4 [mm]	0,35	0,46	0,34	0,40	0,18	-	-	-	-	-
Wear [mm]	**0,33**	**0,46**	**0,34**	**0,39**	**0,19**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,34**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,4**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,87

Standard error s_m = 0,39

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-18
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-18**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Calc gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	55	94	30	43	25	-	-	-	-	-
Measurement 1 [mm]	0,10	0,06	0,08	0,07	0,08	-	-	-	-	-
Measurement 2 [mm]	0,10	0,05	0,07	0,07	0,08	-	-	-	-	-
Measurement 3 [mm]	0,10	0,06	0,10	0,08	0,10	-	-	-	-	-
Measurement 4 [mm]	0,11	0,07	0,09	0,06	0,08	-	-	-	-	-
Wear [mm]	**0,10**	**0,06**	**0,09**	**0,07**	**0,09**	**-**	**-**	**-**	**-**	**-**

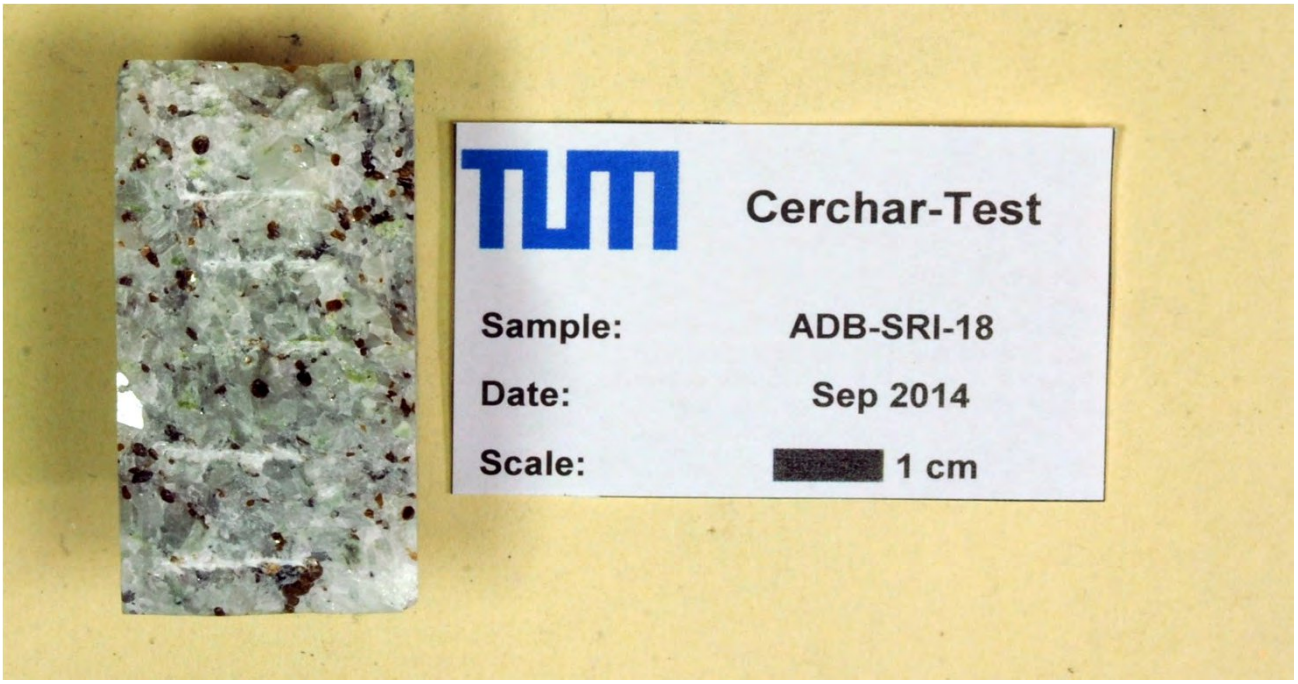
Average Wear [mm] **:** **0,08**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **0,8**

Classification: **schwach abrasiv** (slightly abrasive)

Standard deviation σ = 0,15

Standard error s_m = 0,06



Remarks: No reaction on testing with HCl

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-19
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-19

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Charnockitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	52	5	68	7	35	-	-	-	-	-
Measurement 1 [mm]	0,16	0,25	0,24	0,32	0,20	-	-	-	-	-
Measurement 2 [mm]	0,17	0,28	0,24	0,34	0,18	-	-	-	-	-
Measurement 3 [mm]	0,17	0,30	0,25	0,32	0,22	-	-	-	-	-
Measurement 4 [mm]	0,18	0,32	0,26	0,31	0,20	-	-	-	-	-
Wear [mm]	**0,17**	**0,29**	**0,25**	**0,32**	**0,20**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **: 0,25**

Cerchar-Abrasivity-Index (CAI) [ ] **: 2,5**

Classification: sehr abrasiv (very abrasive)

Standard deviation σ = 0,56

Standard error s_m = 0,25

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-20
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-20**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Charnockitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	22	42	86	71	15	-	-	-	-	-
Measurement 1 [mm]	0,40	0,29	0,20	0,30	0,20	-	-	-	-	-
Measurement 2 [mm]	0,39	0,30	0,19	0,29	0,20	-	-	-	-	-
Measurement 3 [mm]	0,41	0,31	0,20	0,34	0,21	-	-	-	-	-
Measurement 4 [mm]	0,41	0,30	0,20	0,33	0,22	-	-	-	-	-
Wear [mm]	**0,40**	**0,30**	**0,20**	**0,32**	**0,21**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,28**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **2,8** **Classification: sehr abrasiv** (very abrasive)

Standard deviation σ = 0,76 Standard error s_m = 0,34

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-21
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-21**

Surface character rough x / saw cut o

Bedding/ Foliation: normal: x / parallel: o

Rock description: Charnockitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	77	36	11	1	62	-	-	-	-	-
Measurement 1 [mm]	0,37	0,40	0,32	0,31	0,26	-	-	-	-	-
Measurement 2 [mm]	0,34	0,40	0,30	0,26	0,30	-	-	-	-	-
Measurement 3 [mm]	0,39	0,40	0,29	0,26	0,30	-	-	-	-	-
Measurement 4 [mm]	0,38	0,39	0,32	0,32	0,29	-	-	-	-	-
Wear [mm]	**0,37**	**0,40**	**0,31**	**0,29**	**0,29**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,33**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,3** **Classification: sehr abrasiv** (very abrasive)

Standard deviation σ = 0,45 Standard error s_m = 0,20

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-22
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-22

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Charnockitic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	101	31	73	9	27	-	-	-	-	-
Measurement 1 [mm]	0,20	0,22	0,29	0,32	0,18	-	-	-	-	-
Measurement 2 [mm]	0,23	0,22	0,26	0,36	0,22	-	-	-	-	-
Measurement 3 [mm]	0,24	0,21	0,28	0,36	0,23	-	-	-	-	-
Measurement 4 [mm]	0,22	0,23	0,28	0,33	0,21	-	-	-	-	-
Wear [mm]	**0,22**	**0,22**	**0,28**	**0,34**	**0,21**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **: 0,25**

Cerchar-Abrasivity-Index (CAI) [ ] **: 2,5**

Classification: sehr abrasiv (very abrasive)

Standard deviation σ = 0,50

Standard error s_m = 0,22

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-23
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-23

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Calc gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	26	19	24	93	57	-	-	-	-	-
Measurement 1 [mm]	0,25	0,31	0,40	0,41	0,35	-	-	-	-	-
Measurement 2 [mm]	0,30	0,32	0,42	0,41	0,36	-	-	-	-	-
Measurement 3 [mm]	0,27	0,32	0,40	0,41	0,36	-	-	-	-	-
Measurement 4 [mm]	0,29	0,30	0,41	0,40	0,37	-	-	-	-	-
Wear [mm]	**0,28**	**0,31**	**0,41**	**0,41**	**0,36**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,35**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,5** **Classification: sehr abrasiv** (very abrasive)

Standard deviation σ = 0,51 Standard error s_m = 0,23

Remarks: No reaction on testing with HCl

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-24
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-24

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Calc gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	91	3	89	83	75	-	-	-	-	-
Measurement 1 [mm]	0,08	0,13	0,06	0,08	0,11	-	-	-	-	-
Measurement 2 [mm]	0,11	0,16	0,07	0,08	0,12	-	-	-	-	-
Measurement 3 [mm]	0,10	0,14	0,08	0,09	0,15	-	-	-	-	-
Measurement 4 [mm]	0,10	0,13	0,07	0,08	0,11	-	-	-	-	-
Wear [mm]	**0,10**	**0,14**	**0,07**	**0,08**	**0,12**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,10**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **1,0**

Classification: **abrasiv** (abrasive)

Standard deviation σ = 0,26

Standard error s_m = 0,11

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-25
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-25**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quarzite

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	17	82	18	41	16	-	-	-	-	-
Measurement 1 [mm]	0,19	0,36	0,49	0,31	0,50	-	-	-	-	-
Measurement 2 [mm]	0,21	0,38	0,50	0,34	0,45	-	-	-	-	-
Measurement 3 [mm]	0,24	0,39	0,52	0,34	0,47	-	-	-	-	-
Measurement 4 [mm]	0,21	0,40	0,50	0,35	0,47	-	-	-	-	-
Wear [mm]	**0,21**	**0,38**	**0,50**	**0,34**	**0,47**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,38**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,8** **Classification: sehr abrasiv** (very abrasive)

Standard deviation σ = 1,04 Standard error s_m = 0,46

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-26
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: **ADB-SRI-26**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quarzite

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	55	68	30	94	5	-	-	-	-	-
Measurement 1 [mm]	0,45	0,44	0,47	0,38	0,40	-	-	-	-	-
Measurement 2 [mm]	0,47	0,42	0,49	0,39	0,40	-	-	-	-	-
Measurement 3 [mm]	0,50	0,43	0,50	0,39	0,42	-	-	-	-	-
Measurement 4 [mm]	0,50	0,43	0,49	0,37	0,40	-	-	-	-	-
Wear [mm]	**0,48**	**0,43**	**0,49**	**0,38**	**0,41**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,44**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,4** **Classification: extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,41 Standard error s_m = 0,18

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-27
Sampling date:	15-Aug-14	**Date tested:**	05-Sep-14
Sample taken by:	-	**Tested by:**	Schwaier

Sample-ID.: ADB-SRI-27

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quarzite

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	35	43	7	25	52	-	-	-	-	-
Measurement 1 [mm]	0,31	0,38	0,47	0,30	0,36	-	-	-	-	-
Measurement 2 [mm]	0,35	0,39	0,48	0,28	0,36	-	-	-	-	-
Measurement 3 [mm]	0,33	0,40	0,48	0,27	0,37	-	-	-	-	-
Measurement 4 [mm]	0,33	0,39	0,48	0,28	0,36	-	-	-	-	-
Wear [mm]	**0,33**	**0,39**	**0,48**	**0,28**	**0,36**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,37**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,7**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,65

Standard error s_m = 0,29

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-28
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-28

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Khondolite (Garnet SillimaniteGraphite Gneiss) (Slightly Weathered)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	18	19	21	32	88	-	-	-	-	-
Measurement 1 [mm]	0,24	0,32	0,08	0,16	0,40	-	-	-	-	-
Measurement 2 [mm]	0,32	0,33	0,11	0,13	0,40	-	-	-	-	-
Measurement 3 [mm]	0,28	0,30	0,14	0,16	0,33	-	-	-	-	-
Measurement 4 [mm]	0,30	0,32	0,13	0,18	0,40	-	-	-	-	-
Wear [mm]	**0,29**	**0,32**	**0,12**	**0,16**	**0,38**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,25**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **2,5**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 1,00

Standard error s_m = 0,45

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-29
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-29

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	10	44	58	76	95	-	-	-	-	-
Measurement 1 [mm]	0,33	0,50	0,39	0,30	0,41	-	-	-	-	-
Measurement 2 [mm]	0,36	0,41	0,37	0,24	0,40	-	-	-	-	-
Measurement 3 [mm]	0,42	0,51	0,38	0,26	0,37	-	-	-	-	-
Measurement 4 [mm]	0,40	0,40	0,31	0,24	0,38	-	-	-	-	-
Wear [mm]	**0,38**	**0,46**	**0,36**	**0,26**	**0,39**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,37**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,7**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,63

Standard error s_m = 0,28

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-30
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: **ADB-SRI-30**

Surface character rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Calc Gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	60	68	80	84	98	-	-	-	-	-
Measurement 1 [mm]	0,12	0,21	0,10	0,10	0,14	-	-	-	-	-
Measurement 2 [mm]	0,16	0,24	0,12	0,11	0,16	-	-	-	-	-
Measurement 3 [mm]	0,13	0,22	0,12	0,10	0,15	-	-	-	-	-
Measurement 4 [mm]	0,11	0,23	0,14	0,12	0,17	-	-	-	-	-
Wear [mm]	**0,13**	**0,23**	**0,12**	**0,11**	**0,16**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,15**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **1,5** **Classification:** **abrasiv** (abrasive)

Standard deviation σ = 0,42 Standard error s_m = 0,19

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-31
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-31

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Khondolite (Garnet Sillimanite Graphite Gneiss)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	5	35	43	47	52	-	-	-	-	-
Measurement 1 [mm]	0,40	0,39	0,47	0,34	0,33	-	-	-	-	-
Measurement 2 [mm]	0,44	0,37	0,41	0,33	0,35	-	-	-	-	-
Measurement 3 [mm]	0,42	0,43	0,45	0,35	0,32	-	-	-	-	-
Measurement 4 [mm]	0,36	0,39	0,47	0,28	0,34	-	-	-	-	-
Wear [mm]	**0,41**	**0,40**	**0,45**	**0,33**	**0,34**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,38**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,8**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,46

Standard error s_m = 0,21

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-32
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-32

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	34	36	39	75	101	-	-	-	-	-
Measurement 1 [mm]	0,12	0,13	0,20	0,31	0,28	-	-	-	-	-
Measurement 2 [mm]	0,10	0,12	0,21	0,28	0,29	-	-	-	-	-
Measurement 3 [mm]	0,11	0,10	0,21	0,30	0,29	-	-	-	-	-
Measurement 4 [mm]	0,12	0,13	0,20	0,32	0,30	-	-	-	-	-
Wear [mm]	**0,11**	**0,12**	**0,21**	**0,30**	**0,29**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,21**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **2,1**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,81

Standard error s_m = 0,36

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-33
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-33

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Khondolite (Garnet Sillimanite Graphite Gneiss)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	11	24	25	33	93	-	-	-	-	-
Measurement 1 [mm]	0,45	0,61	0,47	0,31	0,25	-	-	-	-	-
Measurement 2 [mm]	0,44	0,50	0,42	0,34	0,22	-	-	-	-	-
Measurement 3 [mm]	0,46	0,64	0,39	0,31	0,23	-	-	-	-	-
Measurement 4 [mm]	0,48	0,51	0,50	0,36	0,25	-	-	-	-	-
Wear [mm]	**0,46**	**0,57**	**0,45**	**0,33**	**0,24**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,41**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,1**

Classification: extrem abrasiv (extremely abrasive)

Standard deviation σ = 1,13

Standard error s_m = 0,50

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-34
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-34

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Garnet Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	26	37	38	48	50	-	-	-	-	-
Measurement 1 [mm]	0,43	0,49	0,38	0,61	0,41	-	-	-	-	-
Measurement 2 [mm]	0,46	0,52	0,37	0,53	0,40	-	-	-	-	-
Measurement 3 [mm]	0,45	0,48	0,40	0,62	0,39	-	-	-	-	-
Measurement 4 [mm]	0,50	0,53	0,38	0,52	0,43	-	-	-	-	-
Wear [mm]	**0,46**	**0,51**	**0,38**	**0,57**	**0,41**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,47**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,7**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,67

Standard error s_m = 0,30

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-35
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-35

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Khondolite (Garnet Sillimanite Graphite Gneiss)

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	53	62	64	72	82	-	-	-	-	-
Measurement 1 [mm]	0,48	0,48	0,44	0,30	0,40	-	-	-	-	-
Measurement 2 [mm]	0,47	0,48	0,48	0,30	0,41	-	-	-	-	-
Measurement 3 [mm]	0,48	0,44	0,47	0,32	0,42	-	-	-	-	-
Measurement 4 [mm]	0,50	0,50	0,46	0,32	0,45	-	-	-	-	-
Wear [mm]	**0,48**	**0,48**	**0,46**	**0,31**	**0,42**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,43**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,3**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,64

Standard error s_m = 0,29

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-36
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: **ADB-SRI-36**

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quarzite

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	85	86	89	91	99	-	-	-	-	-
Measurement 1 [mm]	0,57	0,58	0,57	0,40	0,56	-	-	-	-	-
Measurement 2 [mm]	0,55	0,60	0,52	0,41	0,53	-	-	-	-	-
Measurement 3 [mm]	0,55	0,60	0,57	0,48	0,54	-	-	-	-	-
Measurement 4 [mm]	0,54	0,63	0,55	0,48	0,58	-	-	-	-	-
Wear [mm]	**0,55**	**0,60**	**0,55**	**0,44**	**0,55**	**-**	**-**	**-**	**-**	**-**

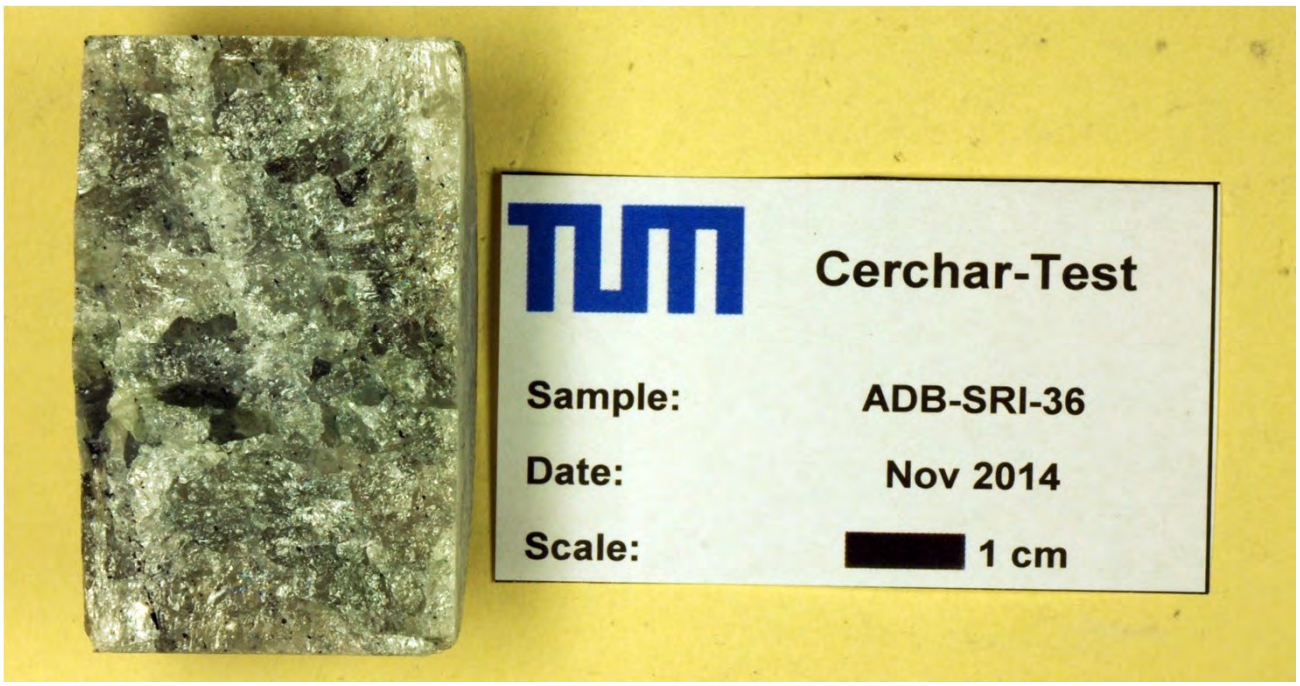
Average Wear [mm] **:** **0,54**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **5,4**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,53

Standard error s_m = 0,24



Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-37
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-37

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Garnet Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	9	15	16	23	73	-	-	-	-	-
Measurement 1 [mm]	0,52	0,40	0,38	0,37	0,40	-	-	-	-	-
Measurement 2 [mm]	0,55	0,47	0,39	0,36	0,37	-	-	-	-	-
Measurement 3 [mm]	0,55	0,42	0,30	0,33	0,34	-	-	-	-	-
Measurement 4 [mm]	0,56	0,52	0,42	0,32	0,35	-	-	-	-	-
Wear [mm]	**0,55**	**0,45**	**0,37**	**0,35**	**0,37**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,42**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,2**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,74

Standard error s_m = 0,33

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-38
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-38

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quarzo feldspathic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	2	3	4	49	63	-	-	-	-	-
Measurement 1 [mm]	0,46	0,41	0,40	0,47	0,35	-	-	-	-	-
Measurement 2 [mm]	0,52	0,52	0,39	0,44	0,46	-	-	-	-	-
Measurement 3 [mm]	0,47	0,38	0,45	0,46	0,44	-	-	-	-	-
Measurement 4 [mm]	0,50	0,52	0,46	0,42	0,45	-	-	-	-	-
Wear [mm]	**0,49**	**0,46**	**0,43**	**0,45**	**0,43**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,45**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,5**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,23

Standard error s_m = 0,10

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-39
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-39

Surface character: rough x, saw cut o

Bedding/ Foliation: normal: x, parallel: o

Rock description: Quarzo feldspathic gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	8	56	80	84	98	-	-	-	-	-
Measurement 1 [mm]	0,42	0,32	0,56	0,41	0,30	-	-	-	-	-
Measurement 2 [mm]	0,33	0,34	0,51	0,48	0,27	-	-	-	-	-
Measurement 3 [mm]	0,36	0,34	0,48	0,43	0,24	-	-	-	-	-
Measurement 4 [mm]	0,40	0,35	0,50	0,40	0,24	-	-	-	-	-
Wear [mm]	**0,38**	**0,34**	**0,51**	**0,43**	**0,26**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,38**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **3,8**

Classification: **sehr abrasiv** (very abrasive)

Standard deviation σ = 0,84

Standard error s_m = 0,38

Remarks:

Cerchar Abrasivity Index (CAI)

Determination of Abrasiveness of Hard Rock

Project:	ADB SRI	**Rock type:**	Please see below
Location:	Sri Lanka	**Sample-ID.:**	ADB-SRI-40
Sampling date:	03-Nov-14	**Date tested:**	12-Nov-14
Sample taken by:	-	**Tested by:**	Schmid/Hölscher

Sample-ID.: ADB-SRI-40

Surface character: rough x; saw cut o

Bedding/ Foliation: normal: x; parallel: o

Rock description: Garnet Hornblend Biotite gneiss

Single Test	1	2	3	4	5	6	7	8	9	10
Pin-No.:	40	41	42	65	70	-	-	-	-	-
Measurement 1 [mm]	0,41	0,42	0,51	0,34	0,40	-	-	-	-	-
Measurement 2 [mm]	0,43	0,44	0,58	0,32	0,38	-	-	-	-	-
Measurement 3 [mm]	0,40	0,46	0,52	0,31	0,39	-	-	-	-	-
Measurement 4 [mm]	0,44	0,47	0,60	0,32	0,40	-	-	-	-	-
Wear [mm]	**0,42**	**0,45**	**0,55**	**0,32**	**0,39**	**-**	**-**	**-**	**-**	**-**

Average Wear [mm] **:** **0,43**

Cerchar-Abrasivity-Index (CAI) [ ] **:** **4,3**

Classification: **extrem abrasiv** (extremely abrasive)

Standard deviation σ = 0,75

Standard error s_m = 0,34

Remarks:

APPENDIX 7

COST ESTIMATES

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM (FINAL - 26 NOVEMBER 2014)

Contract Package	Description	Project	Tranche	LKR (M)	US$ (M)
Minipe Left Bank Canal Rehabilitation					
WRIDP/MIWRM/MLBCR/NCB-1	Rehabilitation of Minipe LB Canal (0+000 km to 30+140 km) - Stage 1	1	1	357.94	2.75
WRIDP/MIWRM/MLBCR/NCB-2	Rehabilitation of Minipe LB Canal (30+140 km to 49+820 km) - Stage 2	1	1	177.36	1.36
WRIDP/MIWRM/MLBCR/NCB-3	Rehabilitation of Minipe LB Canal (49-820 km to 63+650 km) - Stage 3	1	1	701.80	5.40
WRIDP/MIWRM/MLBCR/NCB-4	Rehabilitation of Minipe LB Canal (63+650 km to 73+960 km) - Stage 4	1	1	327.84	2.52
WRIDP/MIWRM/MLBCR/NCB-5	Rehabilitation & Electrification of 8 Nos. Radial Gated Structures and Improvements to 2 Nos. Cross Regulators of Minipe LB Canal	1	1	148.90	1.15
WRIDP/MIWRM/MLBCR/ICB-1	Raising of Crest of Minipe Anicut Including Water Control and Measurement Facilities for LB and RB Canals	1	1	743.39	5.72
	Sub Total - 1 (MLBCR)			**2,457.23**	**18.90**
North Western Province Canal (NWPC)					
WRIDP/MIWRM/NWPC/NCB-1	Construction of Main Canal from Wemedilla LBMC to Nebadagahawatta Wewa (0+000 km to 5+250 km) and New Sluice & Tail Canal(0+000 km to 0+600 km)	1	1	744.38	5.73
WRIDP/MIWRM/NWPC/ICB-1	Construction of Mahakithula Inlet Tunnel, Mahakithula and Mahakirula Reservoirs, Feeder Canal Length 3.66 km from Mahakithula to Mahakirula Reservoir	1	1	6,397.55	49.21
WRIDP/MIWRM/NWPC/ICB-2	Construction of Main Canal from Nabadagahawatta Wewa to Mahakithula Reservoir Inlet Tunnel (5+250 km to 22+460 km)	1	1	2,864.32	22.03
WRIDP/MIWRM/NWPC/NCB-2	Construction of Mi Oya RB1 Canal from Mahakirula to Galgiriyawa (0+00 km to 13+731 km)	3	3	1,130.54	8.70
WRIDP/MIWRM/NWPC/NCB-3	Construction of Mi Oya RB2 Main Canal from Galgiriyawa to Kaduruwewa (13+731 km to 21+232 km)	3	3	459.86	3.54
WRIDP/MIWRM/NWPC/NCB-4	Construction of Main Canal from Mahakithula Reservoir to Potuwila Tank (0+000 km to 1+491 km) and Potuwila Tank to Upper Mediyawa (0+000 km to 19+980 km)	3	3	1,517.91	11.68
WRIDP/MIWRM/NWPC/NCB-5	Construction of Yapahuwa Canal From Mediyawa Canal (0+000 km to 11+200 km)	3	3	790.19	6.08
WRIDP/MIWRM/NWPC/NCB-6	Construction of Main Canal from Dambuluoya to Wemedilla LBMC including Dambuluoya diversion structure (0+000 km to 8+590 km)	3	3	1,603.53	12.33
	Sub Total - 2 (NWPC)			**15,508.27**	**119.29**
Upper Elahera Canal (UEC) and Kaluganga Moragahakanda Transfer Canal (KMTC)					
WRDIP/MIWRM/UEC/ICB-1	Construction of Upper Elahera Canal (0+100 km to 6+226 km)	1	1	3,312.45	25.48
WRDIP/MIWRM/UEC/ICB-2	Construction of Main Tunnel of Upper Elahera Canal by TBM (27+509 km to 54+249 km)	2	2	31,086.72	239.13
	Construction of Kaluganga - Moragahakanda Transfer Canal with Tunnels (0+292 km to 9+161 km)	2	2	5,441.23	41.86
WRDIP/MIWRM/UEC/ICB-3	Construction of Upper Elahera Canal (6+226 km to 27+509 km)	3	3	6,231.46	47.93
WRDIP/MIWRM/UEC/ICB-4	Construction of Upper Elahera Canal (54+249 km to 65+500 km)	3	3	5,729.89	44.08
WRDIP/MIWRM/UEC/ICB-5	Construction of Feeder Canal from UEC to Manankattiya-Eruwewa Stream & Widening the Eruwewa-Mahakanadarawa Stream	3	3	2,597.40	19.98
	Sub Total - 3 (UEC & KMTC)			**54,399.15**	**418.46**
	Total			**72,364.64**	**556.65**

ICB- International Competitive Bidding
NCB- National Competitive Bidding

ENGINEER'S ESTIMATE

Package 01:Rehabilitation of Minipe Left Bank Canal From 0+000 to 30+140 km (MLBCR)

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	19,675,000.00
Bill No. 2	Civil Works	304,618,893.48
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	324,293,893.48
B	Total of Bills 1 to 3	325,398,893.48
C	Provisional Sum - Contingencies 10% of B	32,539,889.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**357,938,782.48**
E	VAT- 12 % of Bid Price (0.12 x D)	42,952,654.00
F	**Grand Total including VAT**	**400,891,436.48**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	14,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	584,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	584,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	876,500.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineer at Contractors camp.	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	2,220,000.00
1.3.2	Construction management service.	month	24	525,000.00	12,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)				***19,675,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Clearing vegetation and secondary growth jungle along the canal	ha	12	41,330.00	495,960.00
2.1.1.2	Clearing vegetation water weeds including removing roots in canal bed by machinery and dump out side the reservation	m^2	30,000	25.00	750,000.00
2.1.1.3	cutting overhanging branches of trees along the both banks	No.	300	750.00	225,000.00
2.1.1.4	Demolition and removal of redundant/damaged structures as directed	m^3	455.1	4,045.00	1,840,879.50
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation and spoil to waste or fill material as directed by Engineer	m^3	12,688	579.50	7,352,406.25
2.1.2.2	desilting along canal bed spoilto waste outside reservation including transport	m^3	8,000	950.00	7,600,000.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation and spoil to waste/quarry products as directed by Engineer	m^3	400	1,847.00	738,800.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	1,687	288.25	486,364.23
2.1.4.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	9,876.5	573.00	5,659,234.50
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Borrow puddle type Clay (CH/CL), blend, prepare and place in cut-off with compaction	m^3	2,805	1,546.00	4,336,530.00
2.1.6	**Gravel Surfacing for Roadway / Bund formation**				
2.1.6.1	grading and levelling the O & M road filling pot holes with excess earth in sides to prepare the surface for gravelling using machinery	m^2	60,000	8.35	501,000.00
2.1.6.2	Furnishing placing and compacting gravel Wearing Surface	m^3	5,000	1,164.00	5,820,000.00
	Sub total Bill No 2.1 -Canal Earthworks				***35,806,174.48***
2.2	**CANAL STRUCTURES**				
2.2.1	**Removal of Existing Structures**				
2.2.1.1	Removal of Existing cast iron gates as directed by Engineer	No.	45	1,200.00	54,000.00
2.2.1.2	Chipping and cleaning the existing concrete surfaces of abutments and piers before placing curtain wall by manually	m^2	5,688	130.00	739,440.00
2.2.2	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	8,605	291.50	2,508,488.68
2.2.2.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	9,877	864.00	8,533,296.00

2.2.2.3	Furnishing , planting Turf on newly formed earth surface around structures and watering until turf takes root	m^2	4,652	376.75	1,752,641.00
2.2.3	**Formwork**				
2.2.3.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	20,848	1,398.00	29,144,944.80
2.2.4	**Reinforcement**				
2.2.4.1	Furnishing, placing, fixing 6mm dia hard drawn steel wirefabric (BRC)	m^2	3,700	1,000.00	3,700,000.00
2.2.4.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	98,235	219.25	21,538,089.53
2.2.5	**Concrete ,Rubble Masonry Work and Plastering, gabion**				
2.2.5.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	1,859	14,737.00	27,393,135.60
2.2.5.2	Furnishing, Placing and Compacting Grade 25 ct. concrete excluding formwork	m^3	2,532	18,545.00	46,955,012.75
2.2.5.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	1,320	20,484.00	27,045,025.20
2.2.5.4	150-225mm random rubble masonry in 1:5 ct. mt.	m^3	50	9,978.00	498,900.00
2.2.5.5	Cement Mortar plastering with 20mm thick , 1:3 mix finished rough.	m^2	200	571.00	114,200.00
2.2.5.6	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	54.00	3,403.00	183,762.00
2.2.5.7	Furnishing and placing gabion	m^3	6,687	8,413.00	56,257,731.00
2.2.5.8	Furnishing and placing of gabion mattresses	m^3	120	19,000.00	2,280,000.00
2.2.6	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.6.1	Furnish & install in turnout 150mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	16	31,332.00	501,312.00
2.2.6.2	Furnish & install in turnout 225mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	15	35,447.00	531,705.00
2.2.6.3	Furnish & install in turnout 300mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	10	39,563.00	395,630.00
2.2.6.4	Furnish & install in turnout 380mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	6	65,528.00	393,168.00
2.2.6.5	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	3	77,128.00	231,384.00
2.2.6.6	Furnish & install in turnout 600mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	2	106,422.00	212,844.00
2.2.6.7	Furnish and install in regulator 1.2x1.2 m steel gate including all necessary accessories	No.	13	221,772.00	2,883,036.00
2.2.6.8	furnishing and fixing 1.5 x 2.0 m steel sliding gate with all accessories	No.	14	696,972.00	9,757,608.00
2.2.7	**RCC Spun Pipes and Collars in Structures/ Pre-cast item**				
2.2.7.1	Furnish, lay and joint 150mmdia. RCC spun pipes incl. trenching and back fill.	m	38	3,252.00	123,576.00

2.2.7.2	Furnish, lay and joint 225mmdia. RCC spun pipes incl. trenching and back fill.	m	60	4,360.00	261,600.00
2.2.7.3	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	79	5,284.00	417,436.00
2.2.7.4	Furnish, lay and joint 380mmdia. RCC spun pipes incl. trenching and back fill.	m	19	5,818.00	110,542.00
2.2.7.5	Establishing precast KM posts along the canal and boundary posts in canal reservation area	No.	330	2,585.00	853,050.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Drilling holes for fixing dowels (dowel size 25mm)	No.	3,053	360.00	1,099,080.00
2.2.8.2	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	3,053	439.00	1,340,267.00
2.2.8.3	Furnishing and fixing 100x200mm ceramic tile gauge according to Engineer's instruction	No.	74	1,483.00	109,742.00
2.2.8.4	Marking location and specified number in all canal structures including turnout canal spills ,cross regulators,siphons,troughs as per specifications	No.	103	374.75	38,599.25
2.2.8.5	Furnishing and placing 200x150x6 mm H iron for gate installation with necessary rag bolts including painting	m	96	7,500.00	720,000.00
2.2.8.6	Furnishing and fixing 50x50x6 mm angle iron for the gate groove	m	225	1,405.00	316,125.00
2.2.8.7	Supplying and fixing Timber shoring for clay cut-off trench	m^2	2,320	800.00	1,856,000.00
2.2.8.8	Furnishing and fixing 3.5m x 1.0 m gate for the trash rack	m^2	84	12,000.00	1,008,000.00
2.2.8.9	Dealing with water during the construction	Lump Sum			4,317,767.00
2.2.9	**Masonry and Plastering**				
2.2.9.1	115mm brick masonry in 1:5 ct mortar in super structure (average height 4.5m)	m^2	108	1,528.00	165,024.00
2.2.9.2	Cement Mortar plastering with 12mm thick , 1:3 mix ,finished rough	m^2	44	463.00	20,557.20
	Sub total Bill No 2.2 -Canal Structures				***256,362,719.00***
2.4	**Implementation of environmental mitigation measued proposed by the EIA Study**	Provisional Sum			12,450,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of ENGINEER'S ESTIMATE)				***304,618,893.48***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	No.	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of ENGINEER'S ESTIMATE)				***1,105,000.00***

ENGINEER'S ESTIMATE

Rehabilitation of Minipe LB Canal (30+140 km to 49+820 km) - Stage 2

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	20,055,500.00
Bill No. 2	Civil Works	140,079,585.21
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	160,135,085.21
B	Total of Bills 1 to 3	161,240,085.21
C	Provisional Sum - Contingencies 10% of B	16,124,009.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**177,364,094.21**
E	VAT- 12 % of Bid Price (0.12 x D)	21,283,691.00
F	**Grand Total including VAT**	**198,647,785.21**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	6,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	267,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	267,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	400,000.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineer at Contractors camp.	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	3,720,000.00
1.3.2	Construction management service.	month	24	525,000.00	12,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)				***20,055,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Clearing vegetation and secondary growth jungle along the canal	ha	11.2	41,330.00	462,896.00
2.1.1.2	Felling and uprooting trees girth upto 0.5-1.0 m and disposing as directed and then tyding up site	No.	5	3,236.00	16,180.00
2.1.1.3	Demolition and removal of redundant/damaged structures as directed	m^3	50	4,045.00	202,250.00
2.1.1.4	Clearing vegetation water weeds including removing roots in canal bed by machinery and dump out side the reservation	m^2	40,000	25.00	1,000,000.00
2.1.1.5	Cutting overhanging branches of trees along the both banks	No.	90	750.00	67,500.00
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation and spoil to waste or fill material as directed by Engineer	m^3	4,785.68	579.50	2,773,301.56
2.1.2.2	Desilting along canal bed spoil to waste outside reservation including transport	m^3	5,600	950.00	5,320,000.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	80	1,847.00	147,760.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^3	932	288.25	268,649.00
2.1.4.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	4,676.9	746.00	3,488,967.40
2.1.5	**Slope Protection for Earth Work**				
2.1.5.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^3	1,500	*376.75*	565,125.00
2.1.5.2	Furnishing, Placing gabion as directed by Engineer	m^3	4,104	8,413.00	34,526,952.00
2.1.5.3	Furnishing and placing of gabion mattresses	m^3	130	19,000.00	2,470,000.00
	Sub total Bill No 2.1 -Canal Earthworks				***51,309,580.96***
2.2	**CANAL STRUCTURES**				
2.2.1	**Removal of Existing Structures**				
2.2.1.1	Clearing ,demolishing and preparation around the structure as directed by Engineer	No.	120	2,400.00	288,000.00
2.2.1.2	Removal of Existing cast iron gates as directed by Engineer	No.	30	1,200.00	36,000.00
2.2.2	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation manually and spoil to waste or fill material	m^3	2,048.4	924.00	1,892,721.60
2.2.2.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	2,520	746.00	1,879,920.00

2.2.2.3	Furnishing , planting Turf on newly formed earth surface around structures and watering until turf takes root	m^2	2,051	376.75	772,714.25
2.2.3	**Formwork**				
2.2.3.1	Furnishing , making , fixing and removing formwork including all operation	m^2	10,623.38	1,330.00	14,129,095.40
2.2.4	**Reinforcement**				
2.2.4.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	61,701.36	219.25	13,528,023.18
2.2.5	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.5.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	1,135.36	14,737.00	16,731,800.32
2.2.5.2	Furnishing, Placing and Compacting Grade 25 ct. concrete excluding formwork	m^3	705.25	18,545.00	13,078,861.25
2.2.5.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	406	20,540.00	8,339,240.00
2.2.5.4	Cement Mortar plastering with 20mm thick , 1:3 mix finished rough.	m^2	280	571.00	159,880.00
2.2.5.5	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	72	3,403.00	245,016.00
2.2.6	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.6.1	Furnish & install in turnout 150mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	6	31,332.00	187,992.00
2.2.6.2	Furnish & install in turnout 225mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	11	35,447.00	389,917.00
2.2.6.3	Furnish & install in turnout 300mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	4	39,563.00	158,252.00
2.2.6.4	Furnish & install in turnout 380mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	1	65,528.00	65,528.00
2.2.6.5	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	4	77,128.00	308,512.00
2.2.6.6	Furnish & install in turnout 600mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	4	106,422.00	425,688.00
2.2.6.7	Furnish & install in turnout 900mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	7	173,309.00	1,213,163.00
2.2.6.8	Furnish and install in regulator 1.2x1.2 m steel gate including all necessary accessories	No.	6	453,600.00	2,721,600.00
2.2.6.9	Furnish and install in regulator 1.5x1.5 m steel gate including all necessary accessories	No.	2	546,000.00	1,092,000.00
2.2.7	**RCC Spun Pipes and Collars in Structures & Pre-cast Items**				
2.2.7.1	Furnish, lay and joint 150mm dia. RCC spun pipes incl. trenching and back fill.	m	14.64	3,252.00	47,609.28
2.2.7.2	Furnish, lay and joint 225mm dia. RCC spun pipes incl. trenching and back fill.	m	26.84	4,360.00	117,022.40

2.2.7.3	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	28.92	5,284.00	152,813.28
2.2.7.4	Furnish, lay and joint 380mm dia. RCC spun pipes incl. trenching and back fill.	m	2.44	5,818.00	14,195.92
2.2.7.5	Furnish, lay and joint 450mm dia. RCC spun pipes incl. trenching and back fill.	m	9.76	8,075.00	78,812.00
2.2.7.6	Furnish, lay and joint 600mm dia. RCC spun pipes incl. trenching and back fill.	m	9.76	9,688.00	94,554.88
2.2.7.7	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	17.08	13,128.00	224,226.24
2.2.7.8	Establishing precast KM posts along the canal and boundary posts in canal reservation area	No	220	2,585.00	568,700.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Drilling holes for fixing dowels (dowel size 25mm)	No.	280	360.00	100,800.00
2.2.8.2	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	280	439.00	122,920.00
2.2.8.3	Furnishing and fixing 100x200mm ceramic tile gauge according to Engineer's instruction	No.	95	1,483.00	140,885.00
2.2.8.4	Marking location and specified number in all canal structures including turnout canal spills ,cross regulators,siphons,troughs as per specifications	No	51	374.75	19,112.25
2.2.8.5	Furnishing and placing 200x150x6 mm H iron for gate installation with necessary rag bolts including painting	m	98	7,500.00	735,000.00
2.2.8.6	Furnishing and fixing 50x50x6 mm angle iron for the gate groove	m	174	1,405.00	244,470.00
2.2.8.7	Chipping and cleaning the existing concrete surfaces of abutments and piers before placing curtain wall by manually	m^2	790	400.00	316,000.00
2.2.8.9	Dealing with water during the construction	Lump Sum			1,978,959.00
	Sub total Bill No 2.2 -Canal Structures				***82,600,004.25***
2.4	**Implementation of environmental mitigation measued proposed by the EIA Study**	Provisional Sum			6,170,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of ENGINEER'S ESTIMATE)				***140,079,585.21***

ENGINEER'S ESTIMATE

Rehabilitation of Minipe LB Canal (49-820 km to 63+650 km) - Stage 3

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	23,179,500.00
Bill No. 2	Civil Works	613,717,464.48
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	636,896,964.48
B	Total of Bills 1 to 3	638,001,964.48
C	Provisional Sum - Contingencies 10% of B	63,800,196.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**701,802,160.48**
E	VAT- 12 % of Bid Price (0.12 x D)	84,216,259.00
F	**Grand Total including VAT**	**786,018,419.48**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	29,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	1,153,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	1,153,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	1,729,500.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineer at Contractors camp.	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	3,720,000.00
1.3.2	Construction management service.	month	24	525,000.00	12,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)				***23,179,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Clearing vegetation and secondary growth jungle along the canal	ha	15.68	41,330.00	648,054.40
2.1.1.2	cutting overhanging branches of trees along the both banks	No.	42	750.00	31,500.00
2.1.1.3	Felling and uprooting trees girth upto 0.5-1.0 m and disposing as directed and then tyding up site	No.	6	3,236.00	19,416.00
2.1.1.4	Demolition and removal of redundant/damaged structures as directed	m^3	114	4,045.00	461,130.00
2.1.1.5	desilting along canal bed spoil to waste outside reservation including transport	m^3	6,300	950.00	5,985,000.00
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	1,015.8	579.50	588,656.10
2.1.3	**Ground Preparation/Earthfill in Embankments**				
2.1.3.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	8,453.2	288.25	2,436,634.90
2.1.3.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	27,821.43	746.00	20,754,783.05
2.1.4	**Gravel Surfacing for Roadway / Bund formation**				
2.1.4.1	Furnishing placing and compacting gravel Wearing Surface	m^3	816.84	1,164.00	950,801.76
2.1.5	**Slope Protection for Earth Work**				
2.1.5.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	4,500	376.75	1,695,375.00
2.1.5.2	Furnishing and placing gabion	m^3	25,865.75	8,413.00	217,608,554.75
	Sub total Bill No 2.1 -Canal Earthworks				***251,179,905.96***
2.2	**CANAL STRUCTURES**				
2.2.1	**Removal of Existing Structures**				
2.2.1.1	Removal of Existing cast iron gates as directed by Engineer	No.	26	1,200.00	31,200.00
2.2.1.2	Chipping and cleaning the existing concrete surfaces of abutments and piers before placing curtain wall by manually	m^2	152	130.00	19,760.00
2.2.2	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	10,359.5	291.50	3,019,794.25
2.2.2.2	Common Earth Excavation in foundation and spoil to waste or fill material	m^3	2,952.47	924.00	2,728,082.28
2.2.2.3	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	27,821.43	746.00	20,754,783.05

2.2.2.4	Furnishing , planting Turf on newly formed earth surface around structures and watering until turf takes root	m^2	6,876	376.75	2,590,533.00
2.2.3	**Formwork**				
2.2.3.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	28,794.08	1,330.00	38,296,119.75
2.2.4	**Reinforcement**				
2.2.4.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	267,462.07	219.25	58,641,057.75
2.2.5	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.5.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	3,063.35	14,737.00	45,144,515.27
2.2.5.2	Furnishing, Placing and Compacting Grade 25 ct. concrete excluding formwork	m^3	7,863.84	18,545.00	145,834,820.08
2.2.5.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	601.69	20,540.00	12,358,712.60
2.2.5.4	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	36	3,403.00	122,508.00
2.2.6	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.6.1	Furnish & install in turnout 225mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	9	35,447.00	319,023.00
2.2.6.2	Furnish & install in turnout 300mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	13	39,563.00	514,319.00
2.2.6.3	Furnish & install in turnout 380mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	1	65,528.00	65,528.00
2.2.6.4	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	2	77,128.00	154,256.00
2.2.6.5	Furnish & install in turnout 600mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	4	106,422.00	425,688.00
2.2.6.6	Furnish & install in turnout 900mm dia. cast iron gate & hoist complete with spindle, handle etc.	No.	5	173,309.00	866,545.00
2.2.6.7	Furnish and install in regulator 1.2x1.2 m steel gate including all necessary accessories	No.	8	221,772.00	1,774,176.00
2.2.6.8	Furnishing, and installing 100 mm dia FERRO CEMENT GATE, & hoist complete with and other accessories	No.	26	4,500.00	117,000.00
2.2.6.9	Furnishing, and installing 150 mm dia FERRO CEMENT GATE, & hoist complete with and other accessories	No.	8	4,500.00	36,000.00
2.2.6.10	Furnishing, and installing 225 mm dia FERRO CEMENT GATE, & hoist complete with and other accessories	No.	1	6,000.00	6,000.00
2.2.6.11	Furnishing, and installing 300 mm dia FERRO CEMENT GATE, & hoist complete with and other accessories	No.	4	6,000.00	24,000.00
2.2.7	**RCC Spun Pipes and Collars in Structures**				

2.2.7.1	Furnish, lay and joint 150mm dia. RCC spun pipes incl. trenching and back fill.	m	170	3,252.00	552,840.00
2.2.7.2	Furnish, lay and joint 225mm dia. RCC spun pipes incl. trenching and back fill.	m	5	4,360.00	21,800.00
2.2.7.3	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	38	5,284.00	200,792.00
2.2.7.4	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	20	15,596.00	311,920.00
2.2.7.5	Establishing precast KM posts along the canal and boundary posts in canal reservation area	No.	154	2,585.00	398,090.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	80	439.00	35,120.00
2.2.8.2	Furnishing and fixing 100x200mm ceramic tile gauge according to Engineer's instruction	No.	80	1,483.00	118,640.00
2.2.8.3	Clearing vegetation water weeds including removing roots in canal bed by machinery and dump out side the reservation	m^2	84,000	25.00	2,100,000.00
2.2.8.4	Marking location and specified number in all canal structures including turnout canal spills ,cross regulators,siphons,troughs as per specifications	No.	33	374.75	12,366.75
2.2.8.5	Furnishing and placing 200x150x6 mm H iron for gate installation with necessary rag bolts including painting	m	54.25	7,500.00	406,875.00
2.2.8.6	Furnishing and fixing 50x50x6 mm angle iron for the gate groove	m	88.75	1,405.00	124,693.75
2.2.8.7	Dealing with water during the construction	Lum Sum			8,839,612.00
	Sub total Bill No 2.2 -Canal Structures				***338,127,558.52***
2.4	**Implimentation of envirenmental mitigation measued proposed by the EIA Study**	Provisional Sum			24,410,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of ENGINEER'S ESTIMATE)				***613,717,464.48***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00

3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	No..	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of ENGINEER'S ESTIMATE)				***1,105,000.00***

ENGINEER'S ESTIMATE

Rehabilitation of Minipe LB Canal (63+650 km to 73+960 km) - Stage 4

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	20,763,000.00
Bill No. 2	Civil Works	276,164,807.64
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	296,927,807.64
B	Total of Bills 1 to 3	298,032,807.64
C	Provisional Sum - Contingencies 10% of B	29,803,281.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**327,836,088.64**
E	VAT- 12 % of Bid Price (0.12 x D)	39,340,331.00
F	**Grand Total including VAT**	**367,176,419.64**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	11,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	467,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	467,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	701,500.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineer at Contractors camp.	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	3,720,000.00
1.3.2	Construction management service.	month	24	525,000.00	12,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)				***20,763,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Clearing vegetation and secondary growth jungle along the canal	ha	5.15	41,330.00	212,849.50
2.1.1.2	cutting overhanging branches of trees along the both banks	Nos	20	750.00	15,000.00
2.1.1.3	Clearing vegetation water weeds including removing roots in canal bed by machinery and dump out side the reservation	m2	16,480	25.00	412,000.00
2.1.1.4	Felling and uprooting trees girth upto 0.5 m and disposing as directed and then tyding up site	No.	795	1,079.00	857,805.00
2.1.1.5	Demolition and removal of redundant/damaged structures as directed	m^3	32	4,045.00	129,440.00
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from depth and spoil to waste or fill material as directed by Engineer	m^3	55,716.44	586.25	32,663,762.95
2.1.2.2	Desilting along canal bed spoilto waste outside reservation including transport	m3	1,200	950.00	1,140,000.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,421.9	1,919.50	10,407,337.05
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^3	244.3	288.25	70,419.48
2.1.4.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	656.4	708.50	465,059.40
2.1.5	**Slope Protection for Earth Work**				
2.1.5.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	7,500	376.75	2,825,625.00
2.1.5.2	Furnishing and placing gabion 1mx3m	m^3	1,424	8,413.00	11,980,112.00
	Sub total Bill No 2.1 -Canal Earthworks				***61,179,410.38***
2.2	**CANAL STRUCTURES**				
2.2.1	**Removal of Existing Structures**				
2.2.1.1	Removal of Existing cast iron gates as directed by Engineer	No.	8	1,200.00	9,600.00
2.2.1.2	Chipping and cleaning the exisitng concrete surfaces of abutments and piers before placing curtain wall by manually	m2	439	130.00	57,070.00
2.2.2	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material	m^3	278	924.00	256,872.00
2.2.2.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	3,503.3	490.50	1,718,368.65
2.2.2.3	Furnishing , planting Turf on newly formed earth surface around structures and watering until turf takes root	m^2	6,600	376.75	2,486,550.00
2.2.3	**Formwork**				

2.2.3.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	17,703.63	1,398.00	24,749,674.74
2.2.4	**Reinforcement**				
2.2.4.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	157,478.87	219.25	34,527,242.25
2.2.5	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.5.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	966.9	14,737.00	14,249,131.62
2.2.5.2	Furnishing, Placing and Compacting Grade 25 ct. concrete excluding formwork	m^3	4,775.13	18,545.00	88,554,785.85
2.2.5.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	142.4	20,540.00	2,924,896.00
2.2.5.4	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	36	3,403.00	122,508.00
2.2.6	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.6.1	Furnish & install in turnout 150mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	1	31,332.00	31,332.00
2.2.6.2	Furnish & install in turnout 225mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	1	35,447.00	35,447.00
2.2.6.3	Furnish & install in turnout 300mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	2	39,563.00	79,126.00
2.2.6.4	Furnish & install in turnout 380mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	1	65,528.00	65,528.00
2.2.6.5	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	2	77,128.00	154,256.00
2.2.6.6	Furnish & install in turnout 900mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	4	173,309.00	693,236.00
2.2.6.7	Furnish and install in regulator 1.2x1.2 m steel gate including all necessary accessories	No.	8	221,772.00	1,774,176.00
2.2.7	**RCC Spun Pipes and Collars in Structures**				
2.2.7.1	Furnish, lay and joint 150mmdia. RCC spun pipes incl. trenching and back fill.	m	2.44	3,252.00	7,934.88
2.2.7.2	Furnish, lay and joint 225mmdia. RCC spun pipes incl. trenching and back fill.	m	2.44	4,360.00	10,638.40
2.2.7.3	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	18	5,284.00	95,112.00
2.2.7.4	Furnish, lay and joint 380mmdia. RCC spun pipes incl. trenching and back fill.	m	2.44	5,818.00	14,195.92
2.2.7.5	Furnish, lay and joint450mmdia. RCC spun pipes incl. trenching and back fill.	m	4.88	8,075.00	39,406.00
2.2.7.6	Furnish, lay and joint 900mmdia. RCC spun pipes incl. trenching and back fill.	m	9.76	15,596.00	152,216.96

2.2.7.7	Establishing precast KM posts along the canal and boundary posts in canal reservation area	No	110	2,585.00	284,350.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	550	439.00	241,450.00
2.2.8.2	Furnishing and fixing 100x200mm ceramic tile gauge according to Engineer's instruction	No.	2	1,483.00	2,966.00
2.2.8.3	Marking location and specified number in all canal structures including turnout canal spills ,cross regulators,siphones,troughts as per specifications	No	13	374.75	4,871.75
2.2.8.4	Furnishing and placing 200x150x6 mm H iron for gate installation with necessary rag bolts including painting	m	43.75	7,500.00	328,125.00
2.2.8.5	Furnishing and fixing 50x50x6 mm angle iron for the gate groove	m	85.25	1,405.00	119,776.25
2.2.8.9	Dealing with water during the construction	Lump Sum			3,524,554.00
	Sub total Bill No 2.2 -Canal Structures				***177,315,397.26***
2.4	**Implementation of environmental mitigation measued proposed by the EIA Study**	Provisional Sum			37,670,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of ENGINEER'S ESTIMATE)				***276,164,807.64***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00

	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of ENGINEER'S ESTIMATE)				***1,105,000.00***

ENGINEER'S ESTIMATE

Rehabilitation & Electrification of 8 Nos. Radial Gated Structures and Improvements to 2 Nos. Cross Regulators of Minipe LB Canal

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	19,214,500.00
Bill No. 2	Civil Works	116,153,600.00
Bill No. 3	Dayworks	-
A	Total of Bills 1 & 2	135,368,100.00
B	Total of Bills 1 to 3	135,368,100.00
C	Provisional Sum - Contingencies 10% of B	13,536,810.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**148,904,910.00**
E	VAT- 12 % of Bid Price (0.12 x D)	17,868,589.00
F	**Grand Total including VAT**	**166,773,499.00**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	6,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	232,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	232,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	348,500.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineers .	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	3,000,000.00
1.3.2	Construction management service.	month	24	525,000.00	12,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)				***19,214,500.00***

BILL NO:02-Electro Mechanical Works

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1.1	**Furnish and install Steel Gates/Stop Logs and Repairing of existing structures per specifications and Engineer's instructions**				
2.1.1.1	Sand blasting, surface treatment and painting of the gate and lifting arrangement.	No	9.00	200,000.00	1,800,000.00
2.1.1.2	Replacement bottom rubber seal and seal fxtures.	No	9.00	42,000.00	378,000.00
2.1.1.3	Replacement side metal seals and seal fxtures.	No	9.00	75,000.00	675,000.00
2.1.1.4	embedded parts	No	9.00	180,000.00	1,620,000.00
2.1.1.5	Replacement of lifting cables or its associated parts to its original state.	No	9.00	75,000.00	675,000.00
2.1.1.6	Provide hand wheel for gate operation.	No	9.00	8,000.00	72,000.00
2.1.1.7	Introduce mechanical sysytem for gate position indication.	No	33.00	130,000.00	4,290,000.00
2.1.1.8	Supllying galvanized steelgratings	No	9.00	40,000.00	360,000.00
2.1.1.9	Supplying and fixing AWLRs at cross regulators	No	8.00	1,000,000.00	8,000,000.00
2.1.1.10	Supplying and fixing Automatic Weather Station at three Field Unit Offices and at Irrigation Engineers Office Minipe	No	3.00	400,000.00	1,200,000.00
2.1.1.11	Removal of silt deposits from stop log grooves and ensure proper sealing with stoplogs.	No	24.00	20,000.00	480,000.00
2.1.1.12	Increase the height of the gate by 600mm to prevent over flow.	No	24.00	465,000.00	11,160,000.00
2.1.1.13	Sand blasting, surface treatment and painting of the radial gate and lifting arrangement.	No	24.00	700,000.00	16,800,000.00
2.1.1.14	Replacement of all rubber seals with Neoprene material and replacement/rehabilitation of support plates, nuts and bolts with SS material.	No	24.00	530,400.00	12,729,600.00
2.1.1.15	Replacement of sill beam and side seals seating surfaces and/or rehabilitation including associated civil works.	No	24.00	300,000.00	7,200,000.00
2.1.1.16	Improving the lifting means with an electric motor drive.	No	24.00	756,000.00	18,144,000.00
2.1.1.17	parts.	No	24.00	95,000.00	2,280,000.00
2.1.1.18	Introduce Safety ladders for trunnion inspection & maintenance.	No	24.00	70,000.00	1,680,000.00
2.1.1.19	Introduce maintenance platforms with safety handrails.	No	24.00	140,000.00	3,360,000.00
2.1.1.20	Inspection and rectification/reinstatement of trunnion box and lubrication system (grease lines etc.)	No	24.00	425,000.00	10,200,000.00
2.1.1.21	Inspection and rectification of lifting mechanism with gear box (gears, cable drums, cables, clamps etc.) or its associated parts.	No	24.00	350,000.00	8,400,000.00
2.1.1.22	Execute all other required works for proper operation of the gate, commisioning and testing,training personals and submission of O&M manuals.	No	24.00	35,000.00	840,000.00
2.1.1.23	Relocation of gates further downstream around 3.5 Mtrs. This includes only mechanical works (Installation of new embedded parts). Gates to be re used. **For Hasalaka Mahiyangana Road sluice gates**	No	3.00	250,000.00	750,000.00
2.1.1.24	Dismantle, repair gearbox, and repair whole lifting arrangement.	No	9.00	130,000.00	1,170,000.00
2.1.1.25	Inspection and rectification of guide wheel system, guide wheel fixtures and associated parts.	No	9.00	135,000.00	1,215,000.00
2.1.1.26	Execute all other required works for proper operation of the gate, commisioning and testing,training personals and submission of O&M manuals.	No	9.00	75,000.00	675,000.00
	Total Cost for Bill No:02 - Electromechanical Works (Carried to Summary of ENGINEER'S ESTIMATE)				***116,153,600.00***

ENGINEER'S ESTIMATE

Package 01: Raising of Crest of Minipe Anicut Including Water Control and Measurement Facilities for LB and RB Canals

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	68,467,500.00
Bill No. 2	Civil Works	603,797,190.75
Bill No. 3	Dayworks	3,540,000.00
A	Total of Bills 1 & 2	672,264,690.75
B	Total of Bills 1 to 3	675,804,690.75
C	Provisional Sum - Contingencies 10% of B	67,580,469.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**743,385,159.75**
E	VAT- 12 % of Bid Price (0.12 x D)	89,206,219.00
F	**Grand Total including VAT**	**832,591,378.75**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	30,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	1,207,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	1,207,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	1,811,500.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineer	Provisional Sum	-	-	25,000,000.00
1.2.2	Allow for Geological investigation additional required	Provisional Sum	-	-	2,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.3.2	Construction management service. (Project manager, Engineer Concrete /structure/quality controle, Engineer Planning/Design, Engineer health & Safety	month	24	1,250,000.00	30,000,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	36,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	75,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	150,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	960,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)					***68,467,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Felling and uprooting trees girth upto 1.0-2.0 m and disposing as directed and then tyding up site	No.	6	4,315.00	25,890.00
2.1.1.2	Felling and uprooting trees girth upto 2.0-3.0 m and disposing as directed and then tyding up site	No.	6	7,550.00	45,300.00
2.1.1.3	Demolition the existing retaining wall in the pool area, existing intake structure of the LB approach canal, and part of the side weir and dispose as directed	m^3	1,303	4,045.00	5,270,635.00
2.1.1.4	Chipping, cleaning and washing the existing surface of the weir to receive new concrete	m^2	5,500	130.75	719,125.00
2.1.2.	Allow for Dealing with water during the construction	Lump Sum			55,000,000.00
2.1.3	**Common Excavation**				
2.1.3.1	Common excavation and spoil to waste or fill material as directed by Engineer	m^3	26,080	579.50	15,113,360.00
2.1.4	**Rock Excavation**				
2.1.4.1	Rock excavation and spoil to waste/quarry products as directed by Engineer	m^3	3,245	1,847.00	5,993,515.00
2.1.5	**Ground Preparation/Earthfill in Embankments**				
2.1.5.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^3	500	288.25	144,125.00
2.1.5.2	Furnishing, placing and compacting fill material as per Engineers instructions	m^3	8,090	904.00	7,313,360.00
2.1.6	**Consolidate and contact grouting**				
2.1.6.1	Drilling holes for Consolidate and contact grouting including all operations	m	1,963	9,150.00	17,961,450.00
2.1.6.2	Cement for Consolidate and contact grouting including all operations	Kg	98,000	31.00	3,038,000.00
2.1.6.3	Water pressure test	No	40	11,500.00	460,000.00
2.1.7	**Slope Protection for Earth Work**				
2.1.7.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	1,500	376.75	565,125.00
2.1.7.2	Furnishing and placing 450 mm rip-rap as directed by Engineer	m^2	25.00	2,629.00	65,725.00
2.1.7.3	Furnishing and placing gabion (1m x 3m)	m^3	2,430	8,413.00	20,443,590.00
2.1.8	**Formwork**				
2.1.8.1	Furnishing , making , fixing and removing formwork (Class F3 Finish)	m^2	7,952	2,261.00	17,979,472.00
2.1.9	**Reinforcement**				
2.1.9.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	473,435	219.25	103,800,623.75
2.1.10	**Concrete ,Rubble Masonry Work and Plastering, gabion**				

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1.10.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	499	14,737.00	7,353,763.00
2.1.10.2	Furnishing, Placing and Compacting Grade 35 ct. concrete excluding formwork	m^3	13,431	21,241.00	285,287,871.00
2.1.11	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.1.11.1	Furnishing and fixing 1.5 x 1.5m steel gate with lifting mechanism for middle silt ejector including all necessary accessories	No.	2.00	544,800.00	1,089,600.00
2.1.11.2	Furnish and install hot dipped GI trash rack made of 250x90x9mm angle irons and 16mm dia MS rods	m^2	141	6,000.00	846,000.00
2.1.10.3	Furnish and install stop logs including all necessary accessories	No	3	1,500,000.00	4,500,000.00
2.1.10.4	Furnish and install gantry crane with rails	No.	1	3,500,000.00	3,500,000.00
2.1.12	**RCC Spun Pipes and Collars in Structures/ Pre-cast item**				
2.1.12.1	Furnish, lay and joint 1500mm dia. RCC spun pipes including collars for the middle silt ejector	m	20	31,801.00	636,020.00
2.1.13	**Pre-cast Items**				
2.1.13.1	Furnish and install steel expansion joint as per Engineer's instruction	m	125	15,726.00	1,965,750.00
2.1.14	**Miscellaneous Work**				
2.1.14.1	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order. as per detail	m	824	2,200.00	1,812,800.00
2.1.14.2	Providing 50mm dia weep holes with filter as per details given in drawings	No.	160	1,500.00	240,000.00
2.1.14.3	Supplying and fixing safety fence for the Automatic gated sluice as shown in the drawing with 25mm dia bars and BRC fabric	m^2	200	4,500.00	900,000.00
2.1.14.4	Drilling holes for fixing dowels (dowel size 25mm)	No.	960	360.00	345,600.00
2.1.14.5	Supply , cut, bend and Fix 25 mm Tor steel dowels including cement grouting	No.	960	549.00	527,040.00
2.1.14.6	Supplying and fixing 200 x 100mm H iron section for middle silt ejector	m	20	1,000.00	20,000.00
2.1.14.7	Supplying and fixing 100*50 C section for gate groove of middle silt ejector	m	40	1,000.00	40,000.00
2.1.14.8	Supply and fixing of Steel Handrails as per drawing	m	379	3,505.00	1,328,395.00
2.1.14.9	Supplying and fixing 150mm + 300mm + 150mm Iron Rungs with 25mm MS Bars @ 400mm intervals as ladder along inside of vertical wall.	No.	42	708.00	29,736.00
2.1.14.10	Placing 150mm dia pvc pipe with fill material at 3 x 3m interval for the stilling basin as specified in drawings	No.	33	2,000.00	66,000.00
2.1.14.11	Furnishing and fixing 100x200mm ceramic tile gauge according to Engineer's instruction	No.	40	1,483.00	59,320.00
2.1.14.12	Allow for Designing, furnishing and installing Automatic water level recording system	Provisional Sum			5,000,000.00
2.1.14.13	Allow for Establishment of early warning system for downsteam reservoir	Provisional Sum			5,000,000.00
2.2	**Implimentation of envirenmental mitigation measued proposed by the EIA Study**	Provisional Sum			29,310,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of ENGINEER'S ESTIMATE)				**603,797,190.75**

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	300	200.00	60,000.00
3.1.2	Unskilled labour	hr	375	150.00	56,250.00
3.1.3	Mason	hr	150	200.00	30,000.00
3.1.4	Carpenter	hr	150	200.00	30,000.00
3.1.5	Plumber	hr	75	250.00	18,750.00
3.1.6	Mechanic	hr	30	250.00	7,500.00
3.1.7	Welder	hr	30	250.00	7,500.00
3.1.8	Driver	hr	150	200.00	30,000.00
	Total for Labour				**240,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	No.	150	1,200.00	180,000.00
3.2.2	Sand	m^3	300	3,000.00	900,000.00
3.2.3	Gravel	m^3	300	750.00	225,000.00
3.2.4	Mild steel reinforcement	ton	1.5	150,000.00	225,000.00
3.2.5	Tor steel reinforcement	ton	0.6	200,000.00	120,000.00
	Total for Material				**1,650,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	75	3,125.00	234,375.00
3.3.2	Loader 100 HP	hr	75	3,125.00	234,375.00
3.3.3	Motor Grader 130HP	hr	90	3,125.00	281,250.00
3.3.4	Dump truck / Tipper 20T	hr	300	1,250.00	375,000.00
3.3.5	Tractor/Trailer 100HP	hr	150	1,000.00	150,000.00
3.3.6	Concrete Mixer 1 m^3	hr	150	1,000.00	150,000.00
3.3.7	Truck Mixer 8 m3	hr	150	1,500.00	225,000.00
	Total for Equipment				**1,650,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of ENGINEER'S ESTIMATE)				***3,540,000.00***

Package 01: Construction of Mahakithula Inlet Tunnel ,Mahakithula Reservoir , Mahakirula Reservoir , 3.66 km long Feeder canal from Mahakithula Reservoir to Mahakirula Reservoir , Mahakirula Reservoir

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	173,709,500.00
Bill No. 2	Civil Works	5,154,194,776.45
Bill No. 3	Dayworks	3,390,000.00
A	Total of Bills 1 & 2	5,327,904,276.45
B	Total of Bills 1 to 3	5,331,294,276.45
C	Provisional Sum - Contingencies 20% of B	1,066,258,855.00
D	**Total Estmated Cost (B + C)**	**6,397,553,131.45**
E	VAT- 12 % of Bid Price (0.12 x D)	767,706,376.00
F	**Total Estmated Cost including VAT**	**7,165,259,507.45**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	4,832,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	9,664,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	9,664,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	14,497,000.00
1.2	**Employer's Requirements**				
1.2.1	Constructiion furnishing and maintenance of Employer and Engineers ofOffice, Canteen, housing, camp and security facilities.	Provisional Sum	-	-	50,000,000.00
1.2.2	Additional geological investigations during contract period.	Provisional Sum			11,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.3.2	Construction management service. (Project manager, Engineer Concrete /structure, Engineer Earthwork, Engineer Planning/Design, Engineer Material/quality controle,Engineer health & Safety	month	36	1850000	66,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			36,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			75,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			150,000.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			1,080,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***173,709,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	375.80	153,436.00	57,661,248.80
2.1.1.2	Clearing and Grubbing light jungle by machinery	ha	0.50	82,660.00	41,330.00
2.1.2	**Common Excavation**				
2.1.2.1	Common Excavation in Existing Canal /Bund and spoil to waste or fill material as directed by Engineer	m^3	712.80	343.50	244,846.80
2.1.2.2	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	358,785.30	332.00	119,116,719.60
2.1.2.3	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	48,824.70	343.00	16,746,872.10
2.1.2.4	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	13,249.90	361.00	4,783,213.90
2.1.2.5	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	2,712.80	371.00	1,006,448.80
2.1.2.6	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	8.00	388.25	3,106.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,557.20	1,590.00	8,835,948.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,510.10	1,624.00	2,452,402.40
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	845.80	1,631.00	1,379,499.80
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	301.50	1,638.00	493,857.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	1.50	1,645.00	2,467.50
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	6,512.10	16.70	108,752.07
2.1.4.2	Furnishing, placing and compacting earth from borrow area and from excavated material in Bund as directed by the Engineer.	m^3	1,431,076.00	697.25	997,817,741.00
2.1.4.3	Furnishing, placing and compacting earth from borrow area and from excavated material in canal as directed by the Engineer.	m^3	7,803.70	262.00	2,044,569.40
2.1.4.4	Allow for geological investigations, grouting and other foundation treatment	Item Allow			450,000,000.00
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Furnishing, placing and compacting 150-225mm rubble in filters/toe drains, .	m^3	4,974.00	3,403.00	16,926,522.00

2.1.5.2	Supplying and Placing Well Graded Aggregate (20 - 37.5mm metal) in the Filter as per Drawing	m^3	757.00	5,249.00	3,973,493.00
2.1.5.3	Borrow puddle type Clay (CH/CL), blend, prepare and place in cut-off with compaction	m^3	458,650.00	1,055.00	483,875,750.00
2.1.5.5	Furnishing, Placing River Sand and Compacting along 600mm thick layer and at the bottom layer of the Toe Filter as per Drawing.	m^3	101,919.00	2,874.00	292,915,206.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	52,091.70	376.75	19,625,547.98
2.1.6.2	Furnishing and placing gravel bedding .	m^3	44,969.00	1,164.00	52,343,916.00
2.1.6.3	Furnishing, Placing Boulders for 600mm thick Rip Rap Protection and packing along the Designated Up Stream Slope	m^3	75,070.00	2,629.00	197,359,030.00
2.1.7	**Gravel Surfacing for Roadway**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	3,223.50	1,164.00	3,752,154.00
	Sub total Bill No 2.1 -Canal Earthworks				***2,733,510,642.15***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	41,386.60	291.50	12,064,193.90
2.2.2.2	Furnishing, placing and compacting earth from borrow area and from excavated material in Structures as directed by the Engineer.	m^3	6,171.10	859.75	5,305,603.23
2.2.2.3	Furnishing , planting Turf on newly formed earth surface around structures and watering until turf takes root	m^2	200.00	376.75	75,350.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	48,231.00	1,398.00	67,426,938.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	1,804,805.10	219.25	395,703,518.18
2.2.4	**Concrete & Rubble Masonry Work**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	1,750.20	14,737.00	25,792,697.40
2.2.4.2	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	6,583.00	20,484.00	134,846,172.00
2.2.4.3	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	10,057.90	22,000.00	221,273,800.00
2.2.4.4	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	15.00	3,403.00	51,045.00
2.2.4.5	Furnishing, Placing gabion as directed by the Engineer.	m^3	320.00	8,413.00	2,692,160.00
2.2.6.2	**Tunneling by Drilling & Blasting Method**				0.00
2.2.6.2.1	Rock Excavation in tunnel by drill and blast method and spoil to waste/quarry products as directed by Engineer	m^3	15,594.20	7,248.00	113,026,761.60
2.2.6.2.2	Furnishing, Placing and Compacting Grade 30 ct. concrete for tunnel Lining.	m^3	2,667.80	20,484.00	54,647,215.20
2.2.6.2.3	Furnishing, Placing and Compacting Grade 35 ct. concrete for shotcrete lining,	m^3	1,533.30	24,348.00	37,332,788.40

2.2.6.2.4	Furnishing cutting bending and placing mild steel reinforcement in place for shotcrete lining	kg	61,774.80	216.50	13,374,244.20
2.2.6.2.5	Furnishing cutting bending and placing Tor steel reinforcement in place for lining	kg	213,417.60	219.00	46,738,454.40
2.2.6.2.6	Supplying and fixing of Rock bolt (length=3m)where necessary.	pcs	500.00	14,302.00	7,151,000.00
2.2.6.2.7	Supplying and fixing of Rock bolt (length=4m)where necessary.	pcs	0.00	19,069.00	0.00
2.2.6.2.8	Supplying and fixing of Rock bolt (length=5m)where necessary.	pcs	728.00	23,837.00	17,353,336.00
2.2.6.2.9	Supplying and fixing of Rock bolt (length=6m)where necessary.	pcs	1,782.00	28,604.00	50,972,328.00
2.2.6.2.10	Furnishing and placing grout	Kg	81,600.00	137.25	11,199,600.00
2.2.6.2.11	Supplying and fixing of Rock dowel	pcs	8,460.00	909.00	7,690,140.00
2.2.6.2.12	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	3,760.00	1,398.00	5,256,480.00
2.2.6.2.13	Supplying and fixing of Rock ribs where necessary.	Kg	170,905.40	216.50	37,001,019.10
2.2.6.2.14	Allow for Additional cost for Tunnel portals .	Provisional Sum			586,000,000.00
2.2.6	**Furnish and install Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.7.3	Furnish & install in turnout 300mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	1.00	39,563.00	39,563.00
2.2.6.1	Furnish and install in regulator 2.0x 1.5m steel gate including all necessary accessories	No.	2.00	679,200.00	1,358,400.00
2.2.6.2	Furnish and install GI Trash Rack made of 40 dia HD GI pipes	m^2	52.80	5,400.00	285,120.00
2.2.6.3	Furnish and install 1.55x2.05m steel Sluice gate with Lifting arrangement including necessary fittings etc.	No.	2.00	9,831,600.00	19,663,200.00
2.2.6.4	Furnish and install in 1.70x2.15 m steel stop log gate with Lifting arrangement including necessary fittings etc.	No.	3.00	8,554,800.00	25,664,400.00
2.2.6.5	Furnish and install 1.9x2.2m steel Sluice gate with Lifting arrangement including necessary fittings etc.	No.	2.00	11,760,000.00	23,520,000.00
2.2.6.6	Furnish and install in 2.2x2.3 m steel stop log gate with Lifting arrangement including necessary fittings etc.	No.	3.00	9,840,000.00	29,520,000.00
2.2.6.7	Furnish and install 1.45x1.85m steel Sluice gate with Lifting arrangement including necessary fittings etc.	No.	2.00	11,616,000.00	23,232,000.00
2.2.6.8	Furnish and install in 1.6x1.95 m steel stop log gate with Lifting arrangement including necessary fittings etc.	No.	3.00	9,744,000.00	29,232,000.00
2.2.8	**RCC Spun Pipes and Collars in Structures**				
2.2.8.3	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	7.30	5,284.00	38,573.20
2.2.7	**Miscellaneous Work**				
2.2.7.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail	m	800.00	1,800.00	1,440,000.00
2.2.7.2	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order. as per detail	m	3,375.20	2,200.00	7,425,440.00
2.2.7.3	Furnishing, laying and jointing 100mm Diameter PVC Pipes for Drain outlet	m	30.00	1,465.00	43,950.00
2.2.7.4	Supplying and fixing Gauging staff, W= 100mm, I= 1500-2000mm class	No.	2.00	15,000.00	30,000.00

2.2.7.5	Furnishing, Placing the Geo-Textile as directed by the engineer	m²	91,734.00	262.75	24,103,108.50
2.2.7.6	Supply and fixing of 110mm dia T 1000 perforated PVC pipes with filter cloth surround including jointing to 300 mm dia pipe	m	3,664.00	1,618.00	5,928,352.00
2.2.7.7	Supply and fixing of Steel Handrails as per drawing	m	274.00	3,505.00	960,370.00
2.2.7.8	Supply and fixing of open-bar grating type, with 30 mm deep load bearing bars at 41 mm centres, and cross bars at 100 mm centres.	m²	68.00	10,328.00	702,304.00
2.2.7.9	**Dealing with water during the construction**	**Lum Sum**			**55,608,384.00**
2.2.8	**Inspection and Monitoring facilities**				
2.2.8.1	Supply and installation of 5 No. Piezometers in downstream edge of dam as directed by the engineer	m	547.00	10,200.00	5,579,400.00
2.2.8.2	Supply and installation of 5 No. Piezometers in downstream edge of berm at elevation as directed by the engineer	m	251.00	8,700.00	2,183,700.00
2.2.8.3	Supply and installation of 5 No. Piezometers in downstream slope mid-way between berm and toe drain as directed by the engineer	m	120.00	7,200.00	864,000.00
2.2.8.4	Supply and installation of fix points connected to national survey grid at dam abutments as directed by the engineer	No.	6.00	14,400.00	86,400.00
2.2.8.5	Supply and installation of Type A levelling monuments at 100m intervals along the upstream edge of the dam top as directed by the engineer	No.	93.00	14,400.00	1,339,200.00
2.2.8.6	Supply and installation of Type B levelling monuments at 100m intervals along the upstream berm as directed by the engineer.	No.	31.00	15,000.00	465,000.00
2.3	***Sub total Bill No 2.2 -Canal Structures***				***2,112,287,709.30***
2.3.1	**BUILDING WORKS IN SLUICE TOWER**				
2.3.1.1	**Masonry and Plastering**				
2.3.1.2	115mm brick masonry in 1:5 ct mortar in super structure (average height 4.5m)	m^2	174.00	1,528.00	265,872.00
2.3.1.3	Cement Mortar plastering with 12mm thick , 1:3 mix ,finished rough	m^2	348.00	463.00	161,124.00
2.3.2.1	**Carpentry**				
2.3.2.2	Window in 100x75mm Frame with 75x25mm slats, 25mm thick sash comprising 3 mm thick glass, brass fitting incl. 2Nos.butt hinges, 2 Nos. butt hinges, 2 Nos. Barrel Bolts, 1 No. Casement stay and 1 No. Casement Fastener for each sash all complete to working order.	m^2	6.00	14,723.00	88,338.00
2.3.3	Door in 100x75mm Frame with 75x25mm slats, ordinary ply wood sash, brass fitting incl. 3Nos.butt hinges, 2 Nos. barrel bolts and quality mortise lock with keys in duplicate, all complete to working order.	m^2	6.00	13,573.00	81,438.00
2.3.3.1	**Roofing**				
	Calicut Tile roof on sawn timber frame, treated with 2 coats of wood preservative, including ridge plates, wall plates, purlins, beams, struts, rafters fixed at an interval of 600mm, reepers etc.	m^2	87.00	4,019.00	349,653.00
	Sub total Bill No 2.3 -Building Works				***946,425.00***
2.4	**Implementation of environmental mitigation measured proposed by the EIA Study**	Provisional Sum			307,450,000.00

	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***5,154,194,776.45***

BILL NO:03-DAYWORKS

Item No.					
3.1	**Description**	**Unit**	**Nominal Quantity**	**Rate (LKR)**	**Amount (LKR)**
3.1.1	**Labour**				
3.1.2	Skilled labour	hr	300	200.00	60,000.00
3.1.3	Unskilled labour	hr	375	150.00	56,250.00
3.1.4	Mason	hr	150	200.00	30,000.00
3.1.5	Carpenter	hr	150	200.00	30,000.00
3.1.6	Plumber	hr	75	250.00	18,750.00
3.1.7	Mechanic	hr	30	250.00	7,500.00
3.1.8	Welder	hr	30	250.00	7,500.00
	Driver	hr	150	200.00	30,000.00
3.2	**Total for Labour**				**240,000.00**
3.2.1	**Material**				
3.2.2	Cement (50 Kg bags)	Nos	150	1,200.00	180,000.00
3.2.3	Sand	m^3	300	3,000.00	900,000.00
3.2.4	Gravel	m^3	300	750.00	225,000.00
3.2.5	Mild steel reinforcement	ton	1.5	150,000.00	225,000.00
	Tor steel reinforcement	ton	0.6	200,000.00	120,000.00
3.3	**Total for Material**				**1,650,000.00**
3.3.1	**Equipment**				
3.3.2	Hydraulic excavator 130 HP	hr	75	3,125.00	234,375.00
3.3.3	Loader 100 HP	hr	75	3,125.00	234,375.00
3.3.4	Motor Grader 130HP	hr	90	3,125.00	281,250.00
3.3.5	Dump truck / Tipper 20T	hr	300	1,250.00	375,000.00
3.3.6	Tractor/Trailer 100HP	hr	150	1,000.00	150,000.00
	Concrete Mixer 1 m^3	hr	150	1,000.00	150,000.00
4.3.7	Truck Mixer 8 m3	hr	50	1,500.00	75,000.00
	Total for Equipment				**1,500,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of Engineer's Estimate)				***3,390,000.00***

Package 02: Construction of Main Canal from Nebadagahawatta Reservoir to Mahakithula Reservoir Inlet Tunnel (5 +250km - 23+642km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	101,254,500.00
Bill No. 2	Civil Works	2,501,563,048.50
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	2,602,817,548.50
B	Total of Bills 1 to 3	2,603,922,548.50
C	Provisional Sum - Contingencies 10% of B	260,392,255.00
D	**Total Estimated Cost (B + C)**	**2,864,314,803.50**
E	VAT- 12 % of Bid Price (0.12 x D)	343,717,776.00
F	**Total Estimated Cost including VAT**	**3,208,032,579.50**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	2,493,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	4,986,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	4,986,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	7,480,000.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	5,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.3.2	Construction management service.	month	36	1,850,000.00	66,600,000.00
1.3.3					
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	18,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	75,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	425,000.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	1,080,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***101,254,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	52.4	153,436.00	8,040,046.40
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	821,389	469.50	385,642,135.50
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	367,300	480.25	176,395,825.00
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	119,243	498.25	59,412,824.75
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	45,600	508.00	23,164,800.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	35,097	525.50	18,443,473.50
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	8,297	1,720.00	14,270,840.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	11,360	1,752.00	19,902,720.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	7,612	1,760.00	13,397,120.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,067	1,768.00	8,958,456.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	3,729	1,775.00	6,618,975.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	3,714	1,781.00	6,614,634.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^3	76,963	16.70	1,285,282.10
2.1.4.4	Furnishing, placing and compacting earth from borrow area and from excavated material in canal as directed by the Engineer.	m^3	117,695	243.00	28,599,885.00
2.1.5	**Filters for Canal Lining**				
2.1.5.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	13,587	6,907.00	93,845,409.00
2.1.6	**Slope Protection for Earth Work**				

2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	26,951	376.75	10,153,789.25
2.1.6.2	Furnishing and placing 300 mm rip-rap .	m^3	139	3,024.00	420,336.00
2.1.7	**Gravel Surfacing for Roadway**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	8,153	1,164.00	9,490,092.00
	Sub total Bill No 2.1 -Canal Earthworks				***884,656,643.50***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling**				
2.2.1.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	21,281	291.50	6,203,411.50
2.2.1.2	Furnishing, placing and compacting earth from borrow area and from excavated material around the structures as directed by the Engineer.	m^3	7,821	850.00	6,647,850.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	27,766	376.75	10,460,840.50
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	57,777	1,398.00	80,772,246.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	Kg	3,923	216.50	849,329.50
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	1,683,003	219.25	368,998,407.75
2.2.4	**Concrete and Rubble Masonry Work**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	5,296	14,737.00	78,047,152.00
2.2.4.2	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	60	16,916.00	1,014,960.00
2.2.4.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	5,973	20,484.00	122,350,932.00
2.2.4.4	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	17,596	25,604.00	450,527,984.00
2.2.4.5	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	15,521	22,000.00	341,462,000.00
2.2.4.6	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	191,577	67.45	12,921,868.65
2.2.4.7	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	160	3,403.00	544,480.00
2.2.5	**Furnish and install Turnout Structures/ Steel Gates as per specifications and Engineer's instructions**				
2.2.5.1	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	15	77,128.00	1,156,920.00
2.2.5.2	Furnish and install in regulator 1.4x2.0 m steel gate including all necessary accessories	No.	20	877,200.00	17,544,000.00
2.2.6	**RCC Spun Pipes and Collars in Structures**				

2.2.6.1	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	814	5,284.00	4,301,176.00
2.2.8.6	Furnish, lay and joint 600mm dia. RCC spun pipes incl. trenching and back fill.	m	110	8,075.00	888,250.00
2.2.6.3	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	72	15,596.00	1,122,912.00
2.2.6.4	Furnish, lay and joint 1200mm dia. RCC spun pipes incl. trenching and back fill.	m	0	24,992.00	0.00
2.2.7	**Pre-cast Bridge**				
2.2.7.1	Furnish and install bridge beam 13.5m x 4.22t in place by crane	No.	65	203,676.00	13,238,940.00
2.2.7.2	Furnish and install bridge beam 14.5m x 4.53t in place by crane	No.	116	226,696.00	26,296,736.00
2.2.7.3	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	532	3,390.00	1,803,480.00
2.2.7.4	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	448	3,832.00	1,716,736.00
2.2.7.5	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	1,218	3,799.00	4,627,182.00
2.2.7.6	Furnish and install steel expansion joint as per Engineer's instruction	m	176	15,726.00	2,767,776.00
2.2.7.7	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m²	125	2,700.00	337,500.00
2.2.7.8	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	372	1,793.00	666,996.00
2.2.7.9	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	125	98.80	12,350.00
2.2.7.10	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	181	404.50	73,214.50
2.2.8	**Miscellaneous Work**				
2.2.8.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	0	1,800.00	0.00
2.2.8.2	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order. as per detail A in Drg No:NWP/STR/P1/012	m	1,860	2,200.00	4,092,000.00
2.2.8.3	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	189	1,109.00	209,601.00
2.2.8.4	Supplying and fixing Gauging staff, W= 100mm, l= 1500-2000mm class	No.	5	15,000.00	75,000.00
2.2.8.5	Providing Bituminous filler expansion joint etc.	m	2,234	177.25	395,976.50
2.2.8.6	Supply and fix GI Trash Rack made of 40 dia HD GI pipes	m²	69	4,500.00	310,500.00
2.2.8.7	Supplying and laying filter cloth	m^2	606	1,280.00	775,680.00
2.2.8.8	Supply and lay 230mm galvanized mesh cage packed with rubble	m^2	285	5,730.00	1,633,050.00
2.2.8.9	Supply and fixing of Steel Handrails as per drawing	m	227	0.00	0.00
2.2.8.10	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	119,621	59.10	7,069,601.10
2.2.8.11	**Dealing with water during the construction**	**Lum Sum**	**44969.00**	**1,164.00**	**36,739,366.00**
2.3	**BUILDING WORKS IN SLUICE TOWER**				

2.3.1	**Masonry and Plastering**				
	Sub total Bill No 2.2 -Canal Structures				***1,608,656,405.00***
2.4	**Implementation of environmental mitigation measued proposed by the EIA Study**	Provisional Sum			8,250,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***2,501,563,048.50***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of Engineer's Estimate)				***1,105,000.00***

ENGINEER'S ESTIMATE

Package 01:Main Canal from Wemedilla LBMC to Nebadagahawatta (0+000 -5+250) and Construction of New Sluice Structure and Tail Canal (0 +000 - 0+600km)

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	26,968,500.00
Bill No. 2	Civil Works	648,638,136.35
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	675,606,636.35
B	Total of Bills 1 to 3	676,711,636.35
C	Provisional Sum - Contingencies 10% of B	67,671,164.00
D	**Total of Bid price carried to Letter of Bid (B + C)**	**744,382,800.35**
E	VAT- 12 % of Bid Price (0.12 x D)	89,325,936.00
F	**Grand Total including VAT**	**833,708,736.35**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	32,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	1,297,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	1,297,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	1,946,000.00
1.2	**Facilities for Employer**				
1.2.1	Provision of facilities for Engineer at Contractors camp.	Provisional Sum	-	-	1,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.3.2	Construction management service.	month	24	525,000.00	12,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No: 01 Preliminaries-Excluding Provisional Sum Items (Carried to Summary of ENGINEER'S ESTIMATE)				**26,968,500.00**

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	1	153,436.00	153,436.00
2.1.1.2	Clearing vegetation and secondary growth jungle along the canal	ha	12	41,330.00	495,960.00
2.1.1.3	Felling and uprooting trees girth upto 0.5 m and disposing as directed and then tyding up site	No.	5	1,079.00	5,395.00
2.1.1.4	Felling and uprooting trees girth upto 0.5-1.0 m and disposing as directed and then tyding up site	No.	7	3,236.00	22,652.00
2.1.1.5	Felling and uprooting trees girth upto 1.0-2.0 m and disposing as directed and then tyding up site	No.	4	4,315.00	17,260.00
2.1.1.6	Felling and uprooting trees girth upto 2.0-3.0 m and disposing as directed and then tyding up site	No.	2	7,550.00	15,100.00
2.1.1.7	Removal of Ant Hills as directed	No.	50	1,403.00	70,150.00
2.1.2	**Common Excavation**				
2.1.2.1	Common Excavation in Existing Canal /Bund and spoil to waste or fill material as directed by Engineer	m^3	62,917	585.00	36,806,445.00
2.1.2.2	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	31,212	579.50	18,087,354.00
2.1.2.3	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	10,612	590.50	6,266,386.00
2.1.2.4	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	3,944	609.00	2,401,896.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,643	1,847.00	3,034,621.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,873	1,966.00	3,682,318.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	3,226	2,101.00	6,777,826.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	159,821	28.80	4,602,844.80
2.1.4.3	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	42,157	522.00	22,005,954.00
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drawing	m	5,776	6,907.00	39,894,832.00
2.1.6	**Slope Protection for Earth Work**				

2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	64,004	376.75	24,113,507.00
2.1.7	**Gravel Surfacing for Roadway / Bund formation**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	3,466	1,164.00	4,034,424.00
	Sub total Bill No 2.1 -Canal Earthworks				***172,488,360.80***
2.2	**CANAL STRUCTURES**				
2.2.1	**Removal of Existing Structures**				
2.2.1.1	Demolishing and Disposal of concrete as directed by Engineer	m^3	231	4,800.00	1,108,800.00
2.2.2.2	Removal of Existing cast iron gates as directed by Engineer	No.	13	1,200.00	15,600.00
2.2.2.3	Removal of Existing concrete pipes as directed by Engineer	m	170	539.50	91,715.00
2.2.2	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	10,935	291.50	3,187,552.50
2.2.2.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	5,197	864.00	4,490,208.00
2.2.3	**Formwork**				
2.2.3.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	9,667	1,398.00	13,514,466.00
2.2.4	**Reinforcement**				
2.2.4.1	Furnishing cutting bending and placing Mild steel reinforcement in place	Kg	2,434	216.50	526,961.00
2.2.4.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	169,928	219.25	37,256,714.00
2.2.5	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.5.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	1,987	14,737.00	29,282,419.00
2.2.5.2	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	26	16,916.00	439,816.00
2.2.5.3	Furnishing, Placing and Compacting Grade 25 ct. concrete excluding formwork	m^3	115	18,545.00	2,132,675.00
2.2.5.4	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	3,079	20,484.00	63,070,236.00
2.2.5.5	Furnishing, Placing and Compacting Grade 30 self compacting concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	8,054	25,604.00	206,214,616.00
2.2.5.6	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	76,941	67.45	5,189,670.45
2.2.5.7	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	281	3,403.00	956,243.00
2.2.6	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.6.1	Furnish & install in turnout 300mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	9	39,563.00	356,067.00
2.2.6.2	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	2	77,128.00	154,256.00

2.2.6.3	Furnish & install in turnout 600mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	2	106,422.00	212,844.00
2.2.6.4	Furnish and install in regulator 2.0 x 2.1m steel gate including all necessary accessories	No.	8	877,200.00	7,017,600.00
2.2.6.5	Furnish and install in regulator 1.90 x 1.7m steel gate including all necessary accessories	No.	3	723,600.00	2,170,800.00
2.2.6.6	Furnish and install 1.5x2.0m steel Sluice gate with Lifting arrangement including necessary fittings etc. in Wemedilla as per drawing	No.	2	9,600,000.00	19,200,000.00
2.2.6.7	Furnish and install in 1.8x2.1 m steel stop log gate with Lifting arrangement including necessary fittings etc. in Wemedilla as per drawing	No.	3	8,400,000.00	25,200,000.00
2.2.7	**RCC Spun Pipes and Collars in Structures**				
2.2.7.1	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	440	5,284.00	2,324,960.00
2.2.7.2	Furnish, lay and joint 450mm dia. RCC spun pipes incl. trenching and back fill.	m	20	8,075.00	161,500.00
2.2.7.3	Furnish, lay and joint 600mm dia. RCC spun pipes incl. trenching and back fill.	m	20	9,688.00	193,760.00
2.2.7.4	Furnish, lay and joint 750mm dia. RCC spun pipes incl. trenching and back fill.	m	12	13,128.00	157,536.00
2.2.7.5	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	44	15,596.00	686,224.00
2.2.8	**Pre-cast Bridge**				
2.2.8.1	Furnish and install bridge beam 11.5m x 3.05t in place by crane	No.	13	157,498.00	2,047,474.00
2.2.8.2	Furnish and install bridge beam 13.5m x 4.22t in place by crane	No.	97	203,676.00	19,756,572.00
2.2.8.3	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	302	3,390.00	1,023,780.00
2.2.8.4	Furnish and install facia slab of 38x 900x1200mmx 105.7 kg. in place by crane	No.	120	6,175.00	741,000.00
2.2.8.5	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	252	3,832.00	965,664.00
2.2.8.6	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	678	3,799.00	2,575,722.00
2.2.8.7	Furnish and install steel expansion joint as per Engineer's instruction	m	96	15,726.00	1,509,696.00
2.2.8.8	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	No.	72	2,700.00	194,400.00
2.2.8.9	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	266	1,793.00	476,938.00
2.2.8.10	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	4	98.80	395.20
2.2.8.11	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	104	404.50	42,068.00
2.2.9	**Miscellaneous Work**				
2.2.9.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	79	1,800.00	142,200.00

2.2.9.2	Supply and fixing of Centre bubble Water stop, PVC, 300mm with necessary accessories all complete to working order.as per detail A in Drg No:NWP/STR/P1/013	m	205	2,600.00	533,000.00
2.2.9.3	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	105	1,109.00	116,445.00
2.2.9.4	Drilling holes for fixing dowels (dowel size 25mm)	No.	219	360.00	78,840.00
2.2.9.5	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	219	439.00	96,141.00
2.2.9.6	Supplying and fixing Elastomeric bearing pad, 75 x 12mm	m	16	641.65	10,266.40
2.2.9.7	Supplying and fixing Gauging staff, W= 100mm, l= 1500-2000mm class	No.	18	15,000.00	270,000.00
2.2.9.8	Providing Bituminous filler expansion joint etc.	m	487	180.00	87,660.00
2.2.9.9	Supplying and laying filter cloth	m^2	121	1,280.00	154,880.00
2.2.9.10	Supply and fixing of Steel Handrails as per drawing	m	412	3,505.00	1,444,060.00
2.2.9.11	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	42,352	199.25	8,438,636.00
2.2.9.12	Flat bar grating with 25mm pitch hot dip galvernizing type ASTMA123 BS 729 material JISG 3101 SS 400.	m^2	16	5,380.00	86,080.00
2.2.9.13	Supply and fix GI Trash Rack made of 40 dia HD GI pipes	m^2	12	4,500.00	54,000.00
2.2.9.14	**Dealing with water during the construction**	**Lum Sum**			**9,643,744.00**
	Sub total Bill No 2.2 -Canal Structures				***475,802,900.55***
2.3	**BUILDING WORKS IN SLUICE TOWER**				
2.3.1	**Masonry and Plastering**				
2.3.1.1	115mm brick masonry in 1:5 ct mortar in super structure (average height 4.5m)	m^2	58	1,528.00	88,624.00
2.3.1.2	Cement Mortar plastering with 12mm thick , 1:3 mix ,finished rough	m^2	116	463.00	53,708.00
2.3.2	**Carpentry**				
2.3.2.1	Window in 100x75mm Frame with 75x25mm slats, 25mm thick sash comprising 3 mm thick glass, brass fitting incl. 2Nos.butt hinges, 2 Nos. butt hinges, 2 Nos. Barrel Bolts, 1 No. Casement stay and 1 No. Casement Fastener for each sash all complete to working order.	m^2	2	14,723.00	29,446.00
2.3.2.2	Door in 100x75mm Frame with 75x25mm slats, ordinary ply wood sash, brass fitting incl. 3Nos.butt hinges, 2 Nos. barrel bolts and quality mortise lock with keys in duplicate, all complete to working order.	m^2	2	13,573.00	27,146.00
2.3.3	**Roofing**				
2.3.3.1	Calicut Tile roof on sawn timber frame, treated with 2 coats of wood preservative, including ridge plates, wall plates, purlins, beams, struts, rafters fixed at an interval of 600mm, reepers etc.	m^2	29	4,019.00	116,551.00
2.3.4	**Decorator**				
2.3.4.1	Application of two coats of weathersheild of approved tint and quality includind preparation of surface.	m^2	116	250.00	29,000.00
2.3.4.2	Application of two coats of Enamal paint of approved tint and quality includind preparation of surface.	m^2	8	300.00	2,400.00

	Sub total Bill No 2.3 -Building Works	***346,875.00***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of ENGINEER'S ESTIMATE)	***648,638,136.35***

726,951

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of ENGINEER'S ESTIMATE)				***1,105,000.00***

Package 02: Construction of Mi Oya RB1 Canal Mahakirula Reservoir to Galgiriyawa (0 +000 - 13+731 km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project
(VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	48,440,500.00
Bill No. 2	Civil Works	978,213,221.90
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	1,026,653,721.90
B	Total of Bills 1 to 3	1,027,758,721.90
C	Provisional Sum - Contingencies 10% of B	102,775,872.00
D	**Total Estimated Cost (B + C)**	**1,130,534,593.90**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	135,664,151.00
F	**Total Estimated Cost including VAT**	**1,266,198,744.90**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	978,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	1,956,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	1,956,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	2,934,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	1,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
	Construction management service.	month	36	575,000.00	20,700,000.00
1.4	**Provisional Sum for Civil Works**				
1.4.1	Provisional sum for construction of Railway bridge at 5+778 km.	Provisional Sum	-	-	10,000,000.00
1.5	**Other Requirements**				
1.5.1	Stamp duty	Lump Sum	-	-	10,000.00
1.5.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.5.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.5.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.5.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.5.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***48,440,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	41.2	153,436.00	6,321,563.20
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	367,813	469.50	172,688,203.50
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	60,297	480.25	28,957,634.25
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	5,490	498.25	2,735,392.50
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	2	508.00	1,016.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	19,359	1,720.00	33,297,480.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	6,700	1,752.00	11,738,400.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,373	1,760.00	2,416,480.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	1	1,768.00	1,768.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	131,678	8.35	1,099,511.30
2.1.4.2	Furnishing, placing and compacting earth from borrow area and from excavated material in Canal as directed by the Engineer.	m^3	169,321	190.25	32,213,320.25
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	19,586	6,907.00	135,280,502.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	65,201	376.75	24,564,476.75
2.1.7	**Gravel Surfacing for Roadway / Bund formation**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	9,075	1,164.00	10,563,300.00
2.1.7.2	Furnishing placing and compacting gravel sub base	m^3	80	1,196.00	95,680.00
	Sub total Bill No 2.1 -Canal Earthworks				***461,974,727.75***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling/Turfing**				
2.2.1.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	6,838	291.50	1,993,277.00
2.2.1.2	Common Earth Excavation in foundation manually and spoil to waste or fill material	m^3	1,505	924.00	1,390,620.00
2.2.1.3	Furnishing, placing and compacting earth from borrow area and from excavated material in Canal as directed by the Engineer.	m^3	3,234	864.00	2,794,176.00

2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	9,476	1,398.00	13,247,448.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	Kg	6,312	216.50	1,366,548.00
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	80,979	219.25	17,754,645.75
2.2.3.3	Furnishing cutting bending and placing 50x50x3mm GI reinforcement mesh.	m^2	3,753	1,349.00	5,062,797.00
2.2.4	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	820	14,737.00	12,084,340.00
2.2.4.2	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	4,913	20,484.00	100,637,892.00
2.2.4.3	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	10,927	25,604.00	279,774,908.00
2.2.4.4	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	114,950	67.45	7,753,377.50
2.2.4.5	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	226	3,403.00	769,078.00
2.2.5	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.5.1	Furnish & install in turnout 600mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	19	106,422.00	2,022,018.00
2.2.5.2	Furnish & install Steel slide gate, 1.5 x 1.8m - Gear Type and hoist complete with spindle, handle etc. as per Drawing.	No.	3	563,598.00	1,690,794.00
2.2.6	**RCC Spun Pipes and Collars in Structures**				
2.2.6.1	Furnish, lay and joint 600mm dia. RCC spun pipes incl. trenching and back fill.	m	186	9,688.00	1,801,968.00
2.2.6.2	Furnish, lay and joint 1200mm dia. RCC spun pipes incl. trenching and back fill.	m	330	24,992.00	8,247,360.00
2.2.7	**Pre-cast Bridge**				
2.2.7.1	Furnish and install bridge beam 9.75m x 2.59t in place by crane	No.	212	138,851.00	29,436,412.00
2.2.7.2	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	442	3,390.00	1,498,380.00
2.2.7.3	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	408	3,832.00	1,563,456.00
2.2.7.4	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	971	3,799.00	3,688,829.00
2.2.7.5	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m^2	152	2,700.00	410,400.00
2.2.7.6	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	456	1,793.00	817,608.00
2.2.7.7	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	475	98.80	46,930.00
2.2.7.8	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	228	404.50	92,226.00
2.2.7.9	Supplying and fixing of end pilaster as per Drawing No:	No.	60	4,720.00	283,200.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	593	1,800.00	1,067,400.00

2.2.8.2	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	150	1,109.00	166,350.00
2.2.8.3	Providing Bituminous filler expansion joint etc.	m	532	180.00	95,760.00
2.2.8.4	Supply of padlock 50mm (with long U shackle)	No.	19	741.50	14,088.50
2.2.8.5	Supply and fixing of Steel Handrails as per drawing	m	92	3,505.00	322,460.00
2.2.8.6	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	68,574	59.10	4,052,723.40
2.2.8.7	Supplying and fixing water level measuring gauges accuracy 5mm	No.	19	1,483.00	28,177.00
2.2.8.8	Providing 40mm thick bituminous wearing surface	m^2	672	1,800.00	1,209,600.00
2.2.8.9	**Dealing with water during the construction**	**Lump Sum**			**13,053,247.00**
	Sub total Bill No 2.2 -Canal Structures				***516,238,494.15***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***978,213,221.90***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***1,105,000.00***

Package 03: Construction of Mi Oya RB2 Main Canal from Galgiriyawa to Kaduruwewa (13+731km - 21+232km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	21,439,000.00
Bill No. 2	Civil Works	395,509,569.55
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	416,948,569.55
B	Total of Bills 1 to 3	418,053,569.55
C	Provisional Sum - Contingencies 10% of B	41,805,357.00
D	**Total Estimated Cost (B + C)**	**459,858,926.55**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	55,183,071.00
F	**Total Estimated Cost including VAT**	**515,041,997.55**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	395,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	791,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	791,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	1,186,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	240,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Lump Sum	-	-	1,115,000.00
1.3.2	Construction management service.	month	24	575,000.00	13,800,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			75,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***21,439,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	22.6	153,436.00	3,467,653.60
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	257,544	469.50	120,916,908.00
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	57,886	480.25	27,799,751.50
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	18,103	498.25	9,019,819.75
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	6,429	508.00	3,265,932.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	1,591	525.50	836,070.50
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	13,555	1,720.00	23,314,600.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	6,432	1,752.00	11,268,864.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,526	1,760.00	7,965,760.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,286	1,768.00	7,577,648.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,193	1,775.00	9,217,575.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	2,630	1,781.00	4,684,030.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	25,112	8.35	209,685.20
2.1.4.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	4,071	719.00	2,927,049.00
2.1.4.3	Placing and compacting earth in canal/embankment	m^3	48,346	135.50	6,550,883.00
2.1.5	**Slope Protection for Earth Work**				
2.1.5.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	14,287	376.75	5,382,627.25
	Sub total Bill No 2.1 -Canal Earthworks				***244,404,856.80***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling**				

2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	2,304	291.50	671,616.00
2.2.2.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	1,245	864.00	1,075,680.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	15,414	1,398.00	21,548,772.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	kg	540	216.50	116,910.00
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	kg	234,777	219.25	51,474,857.25
2.2.4	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	668	14,737.00	9,844,316.00
2.2.4.2	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	2,083	20,484.00	42,668,172.00
2.2.4.3	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	105	22,000.00	2,310,000.00
2.2.4.4	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	85,390	67.45	5,759,555.50
2.2.4.5	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	88	3,403.00	299,464.00
2.2.5	**Furnish and install Turnout Structures as per specifications and Engineer's instructions**				
2.2.5.1	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	14	77,128.00	1,079,792.00
2.2.6	**RCC Spun Pipes and Collars in Structures**				
2.2.6.1	Furnish, lay and joint 450mm dia. RCC spun pipes incl. trenching and back fill.	m	103	8,075.00	831,725.00
2.2.6.2	Furnish, lay and joint 1200mm dia. RCC spun pipes incl. trenching and back fill.	m	205	24,992.00	5,123,360.00
2.2.7	**Pre-cast Bridge**				
2.2.7.1	Furnish and install bridge beam 9.75m x 2.59t in place by crane	No.	36	138,851.00	4,998,636.00
2.2.7.2	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	78	3,390.00	264,420.00
2.2.7.3	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	72	3,832.00	275,904.00
2.2.7.4	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	171	3,799.00	649,629.00
2.2.7.5	Furnish and install steel expansion joint as per Engineer's instruction	m	36	15,726.00	566,136.00
2.2.7.6	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m^2	24	2,700.00	64,800.00
2.2.7.7	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	72	1,793.00	129,096.00
2.2.7.8	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	36	404.50	14,562.00
2.2.8	**Miscellaneous Work**				

2.2.8.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	700	1,800.00	1,260,000.00
2.2.8.2	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	30	1,109.00	33,270.00
2.2.8.3	Providing Bituminous filler expansion joint etc.	m	11	180.00	1,980.00
2.2.8.4	Supply and fixing of Steel Handrails as per drawing	m	12	3,505.00	42,060.00
	Sub total Bill No 2.2 -Canal Structures				***151,104,712.75***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***395,509,569.55***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***1,105,000.00***

Package 04: Construction of Main Canal from Mahakithula Reservoir to Potuwila Tank (0 to 1+491 km) and Potuwila Tank to Upper Mediyawa (0 to 19+930 km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	44,271,000.00
Bill No. 2	Civil Works	1,334,537,761.35
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	1,378,808,761.35
B	Total of Bills 1 to 3	1,379,913,761.35
C	Provisional Sum - Contingencies 10% of B	137,991,376.00
D	**Total Estimated Cost (B + C)**	**1,517,905,137.35**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	182,148,616.00
F	**Total Estimated Cost including VAT**	**1,700,053,753.35**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	1,334,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	2,669,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	2,669,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	4,003,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	1,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
1.3	**Provisional sum for Civil Works**				
1.3.1	Provisional sum for construction of Railway bridge at 5+778 km.	Provisional Sum	-	-	10,000,000.00
1.4	**Contractor's Requirements**				
1.4.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.4.2	Construction management service.	month	24	575,000.00	13,800,000.00
1.5	**Other Requirements**				
1.5.1	Stamp duty	Lump Sum			10,000.00
1.5.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			35,000.00
1.5.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			250,000.00
1.5.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.5.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			510,000.00
1.5.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***44,271,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	31.1	153,436.00	4,771,859.60
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	566,190	469.50	265,826,205.00
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	77,613	480.25	37,273,643.25
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	5,024	498.25	2,503,208.00
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	77	508.00	39,116.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	29,800	1,720.00	51,256,000.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	8,624	1,752.00	15,109,248.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,256	1,760.00	2,210,560.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	52	1,768.00	91,936.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	95,720	8.35	799,262.00
2.1.4.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	0	719.00	0.00
2.1.4.3	Borrow earth from borrow areas, cut 0-3m lift upto 3m, including haul	m^3	9,553	546.00	5,215,938.00
2.1.4.4	Placing and compacting earth in canal/embankment	m^3	95,523	135.50	12,943,366.50
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Furnishing, placing and compacting sand in filters as per Engineers instructions	m^3	52,537	2,874.00	150,991,338.00
2.1.5.2	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	10,351	6,907.00	71,494,357.00
2.1.6	**Gravel Surfacing for Roadway / Bund formation**				
2.1.6.1	Furnishing placing and compacting gravel Wearing Surface	m^3	6,211	1,164.00	7,229,604.00
	Sub total Bill No 2.1 -Canal Earthworks				***627,755,641.35***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling**				

2.2.1.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	18,192	291.50	5,302,968.00
2.2.1.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	7,595	864.00	6,562,080.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	14,509	1,398.00	20,283,582.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	Kg	6,678	216.50	1,445,787.00
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	85,918	219.25	18,837,521.50
2.2.4	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	6,793	14,737.00	100,108,441.00
2.2.4.2	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	60	16,916.00	1,014,960.00
2.2.4.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	3,413	20,484.00	69,911,892.00
2.2.4.4	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	10,898	25,604.00	279,032,392.00
2.2.4.5	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	674,818	67.45	45,516,474.10
2.2.4.6	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	264	3,403.00	898,392.00
2.2.5	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.5.1	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	51	77,128.00	3,933,528.00
2.2.5.2	Furnish and install in regulator 1.4x2.0 m steel gate including all necessary accessories	No.	20	694,800.00	13,896,000.00
2.2.5.3	Furnish & install Steel slide gate, 1.15 x 1.6m - Gear Type and hoist complete with spindle, handle etc. as per Drawing.	No.	7	370,788.00	2,595,516.00
2.2.6	**RCC Spun Pipes and Collars in Structures**				
2.2.6.1	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	579	5,284.00	3,059,436.00
2.2.6.2	Furnish, lay and joint 450mm dia. RCC spun pipes incl. trenching and back fill.	m	374	8,075.00	3,020,050.00
2.2.7	**Pre-cast Bridge**				
2.2.7.1	Furnish and install bridge beam 9.75m x 2.59t in place by crane	No.	3	138,851.00	416,553.00
2.2.7.2	Furnish and install bridge beam 11.5m x 3.05t in place by crane	No.	291	157,498.00	45,831,918.00
2.2.7.3	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	912	3,390.00	3,091,680.00
2.2.7.4	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	768	3,832.00	2,942,976.00
2.2.7.5	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	2,088	3,799.00	7,932,312.00
2.2.7.6	Furnish and install steel expansion joint as per Engineer's instruction	m	288	15,726.00	4,529,088.00

2.2.7.7	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m²	196	2,700.00	529,200.00
2.2.7.8	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	588	1,793.00	1,054,284.00
2.2.7.9	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	218	98.80	21,538.40
2.2.7.10	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	294	404.50	118,923.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	73	1,800.00	131,400.00
2.2.8.2	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	338	1,109.00	374,842.00
2.2.8.3	Supplying and fixing Gauging staff, W= 100mm, l= 1500-2000mm class	No.	2	15,000.00	30,000.00
2.2.8.4	Providing Bituminous filler expansion joint etc.	m	62	180.00	11,160.00
2.2.8.5	Supply and fixing of Steel Handrails as per drawing	m	174	3,505.00	609,870.00
2.2.8.6	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	36,227	1,387.00	50,246,849.00
2.2.10.57	**Dealing with water during the construction**	**Lum Sum**			**13,490,507.00**
	Sub total Bill No 2.2 -Canal Structures				***706,782,120.00***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***1,334,537,761.35***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00

3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***1,105,000.00***

Package 05: Construction of Canal from Mediyawa Canal to Yapahuwa (0 to 11+200 km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	39,127,500.00
Bill No. 2	Civil Works	678,118,415.25
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	717,245,915.25
B	Total of Bills 1 to 3	718,350,915.25
C	Provisional Sum - Contingencies 10% of B	71,835,092.00
D	**Total Estimated Cost (B + C)**	**790,186,007.25**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	94,822,321.00
F	**Total Estimated Cost including VAT**	**885,008,328.25**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	677,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	1,354,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	1,354,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	2,031,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	5,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	1,000,000.00
1.3	**Provisional sum for Civil Works**				
1.3.1	Provisional sum for construction of Railway bridge at 8+416 km.	Provisional Sum	-	-	10,000,000.00
1.4	**Contractor's Requirements**				
1.4.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Lump Sum	-	-	1,115,000.00
1.4.2	Construction management service.	month	24	575,000.00	13,800,000.00
1.5	**Other Requirements**				
1.5.1	Stamp duty	Lump Sum	-	-	10,000.00
1.5.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.5.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.5.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.5.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.5.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***39,127,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	31	153,436.00	4,756,516.00
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	291,120	469.50	136,680,840.00
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	7,169	480.25	3,442,912.25
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	15,323	1,720.00	26,355,560.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	797	1,752.00	1,396,344.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	33,445	8.35	279,265.75
2.1.4.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	0	719.00	0.00
2.1.4.3	Borrow earth from borrow areas, cut 0-3m lift upto 3m, including haul	m^3	2,306	546.00	1,259,076.00
2.1.4.4	Placing and compacting earth in canal/embankment	m^3	23,060	135.50	3,124,630.00
2.1.5	**Filters for Canal Lining**				
2.1.5.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	10,331	6,907.00	71,356,217.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	14,328	376.75	5,398,074.00
2.1.7	**Gravel Surfacing for Roadway**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	7,749	1,164.00	9,019,836.00
	Sub total Bill No 2.1 -Canal Earthworks				***263,069,271.00***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling**				
2.2.1.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	7,418	291.50	2,162,347.00
2.2.1.2	Common Earth Excavation in foundation manually and spoil to waste or fill material	m^3	1,644	924.00	1,519,056.00
2.2.1.3	Furnishing, placing and compacting earth as per Engineers instructions	m^3	3,980	864.00	3,438,720.00
2.2.2	**Formwork**				

2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	6,169	1,398.00	8,624,262.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	Kg	3,060	216.50	662,490.00
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	38,607	219.25	8,464,584.75
2.2.4	**Concrete & Rubble Masonry Work**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	304	14,737.00	4,480,048.00
2.2.4.2	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	3,502	20,484.00	71,734,968.00
2.2.4.3	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	9,665	25,604.00	247,462,660.00
2.2.4.4	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	63,020	67.45	4,250,699.00
2.2.4.5	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	135	3,403.00	459,405.00
2.2.6	**Furnish and install Turnout Structures as per specifications and Engineer's instructions**				
2.2.6.1	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	16	77,128.00	1,234,048.00
2.2.7	**RCC Spun Pipes and Collars in Structures**				
2.2.7.1	Furnish, lay and joint 450mm dia. RCC spun pipes incl. trenching and back fill.	m	157	8,075.00	1,267,775.00
2.2.7.2	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	513	15,596.00	8,000,748.00
2.2.7.3	Furnish, lay and joint 1200mm dia. RCC spun pipes incl. trenching and back fill.	m	66	24,992.00	1,649,472.00
2.2.8	**Pre-cast Bridge**				
2.2.8.1	Furnish and install bridge beam 9.75m x 2.59t in place by crane	No.	204	138,851.00	28,325,604.00
2.2.8.2	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	442	3,390.00	1,498,380.00
2.2.8.3	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	408	3,832.00	1,563,456.00
2.2.8.4	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	969	3,799.00	3,681,231.00
2.2.8.5	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m^2	136	2,700.00	367,200.00
2.2.8.6	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	408	1,793.00	731,544.00
2.2.8.7	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	455	98.80	44,954.00
2.2.8.8	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	204	404.50	82,518.00
2.2.8.9	Supplying and fixing of end pilaster as per Drawing No:	No.	68	4,720.00	320,960.00

2.2.9	**Miscellaneous Work**				
2.2.9.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	67	1,800.00	120,600.00
2.2.9.2	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	170	1,109.00	188,530.00
2.2.9.3	Providing Bituminous filler expansion joint etc.	m	159	180.00	28,620.00
2.2.9.4	Supply of padlock 50mm (with long U shackle)	No.	16	741.50	11,864.00
2.2.9.5	Supply and fixing of Steel Handrails as per drawing	m	22	3,505.00	77,110.00
2.2.9.6	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	58,546	199.25	11,665,290.50
2.2.9.7	**Dealing with water during the construction**	**Lum Sum**			930000
	Sub total Bill No 2.2 -Canal Structures				***415,049,144.25***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***678,118,415.25***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	1	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00

3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***1,105,000.00***

Package 06: Construction of Main Canal from Dambulu Oya to Wemedilla LBMC including Dambulu Oya Diversion Structure (0 to 8+590 km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	34,298,500.00
Bill No. 2	Civil Works	1,422,355,455.60
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	1,456,653,955.60
B	Total of Bills 1 to 3	1,457,758,955.60
C	Provisional Sum - Contingencies 10% of B	145,775,896.00
D	**Total Estimated Cost (B + C)**	**1,603,534,851.60**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	192,424,182.00
F	**Total Estimated Cost including VAT**	**1,795,959,033.60**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	1,422,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	2,844,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	2,844,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	4,267,000.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	1,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.3.2	Construction management service.	month	24	575,000.00	13,800,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	10,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	35,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	250,000.00
1.4.4	Provision of monthly progress reports and photos	month	24	10,000.00	240,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	510,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	75,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***34,298,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	30.8	153,436.00	4,725,828.80
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	377,377	469.50	177,178,501.50
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	156,842	480.25	75,323,370.50
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	53,562	498.25	26,687,266.50
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	8,983	508.00	4,563,364.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	747	525.50	392,548.50
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	19,848	1,720.00	34,138,560.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	17,427	1,752.00	30,532,104.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	13,391	1,760.00	23,568,160.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,989	1,768.00	10,588,552.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	2,808	1,775.00	4,984,200.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	401	1,781.00	714,181.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	123,895	8.35	1,034,523.25
2.1.4.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	4,810	719.00	3,458,390.00
2.1.4.3	Borrow earth from borrow areas, cut 0-3m lift upto 3m, including haul	m^3	98,411	546.00	53,732,406.00
2.1.4.4	Placing and compacting earth in canal/embankment	m^3	226,091	135.50	30,635,330.50
2.1.5	**Filters for Canal Lining**				
2.1.5.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	9,107	6,907.00	62,902,049.00
2.1.6	**Slope Protection for Earth Work**				

2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	71,563	376.75	26,961,360.25
2.1.6.2	Furnishing and placing 300 mm rip-rap .	m^3	261	3,024.00	789,264.00
2.1.6.3	Furnishing and placing 450 mm rip-rap .	m^3	962	2,629.00	2,529,098.00
	Sub total Bill No 2.1 -Canal Earthworks				***575,439,057.80***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling**				
2.2.1.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	14,856	291.50	4,330,524.00
2.2.1.2	Common Earth Excavation in foundation manually and spoil to waste or fill material	m^3	1,373	924.00	1,268,652.00
2.2.1.3	Borrow earth from Soil Dump, cut 0-3m lift upto 3m,	m^3	2,611	436.25	1,139,048.75
2.2.1.4	Placing and Compacting earth in canal / Backfill including Watering	m^3	2,611	135.50	353,790.50
2.2.1.5	Furnishing, placing and compacting earth as per Engineers instructions	m^3	5,465	864.00	4,721,760.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	22,770	1,398.00	31,832,460.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	kg	9,867	216.50	2,136,205.50
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	kg	294,612	219.25	64,593,681.00
2.2.4	**Concrete & Rubble Masonry Work**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	1,037	14,737.00	15,282,269.00
2.2.4.2	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	6,938	20,484.00	142,117,992.00
2.2.4.3	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	12,914	25,604.00	330,650,056.00
2.2.4.4	Furnishing, Placing and Compacting Grade 35ct. concrete excluding formwork	m^3	880	21,241.00	18,692,080.00
2.2.4.5	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	128,409	67.45	8,661,187.05
2.2.4.6	Providing Rubble packing with 225 - 300 mm rubble including supplying	m^3	275	3,403.00	935,825.00
2.2.5	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.5.1	Furnish & install in turnout 450mm dia. cast iron gate & hoist complete with spindle, handle etc	No.	6	77,128.00	462,768.00
2.2.5.2	Furnish and install radial gates 5.0x5.1 m including lifting gear and all accessories	No.	3	7,669,244.00	23,007,732.00
2.2.5.3	Furnish and install steel stop logs 1.55m long 150mm thick	m^2	11	6,472.00	71,192.00
2.2.5.4	Furnish and install steel stop logs 2.455m long 125mm thick	m^2	8	5,797.00	46,376.00
2.2.5.5	Form Guide rails for sluice stop logs 150 X 150mm	m	29	741.50	21,503.50

2.2.5.6	Fabricate and supply steel stop logs for one anicut bay	m^2	37	0.00	0.00
2.2.5.7	Furnish and install Form Guide rails for stop logs 120 X 120mm	m	41	606.50	24,866.50
2.2.5.8	Furnish and install in 2.7x2.0 m steel gate with lifting gear and all accessoriesaccording to Type Drg No:	No	4	15,000,000.00	60,000,000.00
2.2.5.9	Furnish and install in 2.3x2.5 m steel gate with lifting gear and all accessoriesaccording to Type Drg No:	No	3	15,000,000.00	45,000,000.00
2.2.6	**RCC Spun Pipes and Collars in Structures**				
2.2.6.1	Furnish, lay and joint 450mm dia. RCC spun pipes incl. trenching and back fill.	m	44	8,075.00	355,300.00
2.2.6.2	Furnish, lay and joint 1200mm dia. RCC spun pipes incl. trenching and back fill.	m	593	24,992.00	14,820,256.00
2.2.7	**Pre-cast Bridge**				
2.2.7.1	Furnish and install bridge beam 6m x 2.08t in place by crane	No.	30	102,926.00	3,087,780.00
2.2.7.2	Furnish and install bridge beam 9.75m x 2.59t in place by crane	No.	11	138,851.00	1,527,361.00
2.2.7.3	Furnish and install bridge beam 13.5m x 4.22t in place by crane	No.	180	203,676.00	36,661,680.00
2.2.7.4	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	672	3,390.00	2,278,080.00
2.2.7.5	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	672	3,832.00	2,575,104.00
2.2.7.6	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	1,567	3,799.00	5,953,033.00
2.2.7.7	Furnish and install steel expansion joint as per Engineer's instruction	m	179	15,726.00	2,814,954.00
2.2.7.8	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m^2	152	2,700.00	410,400.00
2.2.7.9	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	386	1,793.00	692,098.00
2.2.7.10	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	26	98.80	2,568.80
2.2.7.11	Furnish & Placing 20mm diameter 200mm long Stainless Steel dowels @ 600mm with plastic cap at fixed end	No.	180	404.50	72,810.00
2.2.8	**Miscellaneous Work**				
2.2.8.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	60	1,800.00	108,000.00
2.2.8.2	Supply and fixing of Centre bubble Water stop, PVC, 300mm with necessary accessories all complete to working order.as per detail A in Drg No:NWP/STR/P1/013	m	265	2,600.00	689,000.00
2.2.8.3	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	232	1,109.00	257,288.00
2.2.8.4	Drilling holes for fixing dowels (dowel size 25mm)	No.	600	360.00	216,000.00
2.2.8.5	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	55	439.00	24,145.00
2.2.8.6	Supply , cut, bend and Fix 25 mm Tor steel dowels including cement grouting	No.	600	549.00	329,400.00
2.2.8.7	Supplying and fixing Elastomeric bearing pad, 75 x 12mm	m	48	641.65	30,799.20
2.2.8.8	Supplying and fixing Gauging staff, W= 100mm, l= 1500-2000mm class	No.	3	15,000.00	45,000.00

2.2.8.9	Providing Bituminous filler expansion joint etc.	m	55	180.00	9,900.00
2.2.8.10	Supply and fix GI Trash Rack made of 40 dia HD GI pipes	m²	38	4,500.00	171,000.00
2.2.8.11	Supplying and laying filter cloth	m^2	2,196	1,280.00	2,810,880.00
2.2.8.12	Supply and fixing of Steel Handrails as per drawing	m	359	3,505.00	1,258,295.00
2.2.8.14	Providing 40mm thick bituminous wearing surface	m^2	120	2,022.00	242,640.00
2.2.10.48	**Dealing with water during the construction**	**Lum Sum**			14122657
	Sub total Bill No 2.2 -Canal Structures				***846,916,397.80***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***1,422,355,455.60***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***1,105,000.00***

Upper Elahera Canal Project (UEC) - Stage 01- Construction of Upper Elahera Canal from 0+000 km to 6+226 km

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	168,678,500.00
Bill No. 2	Civil Works	2,839,320,648.35
Bill No. 3	Dayworks	3,315,000.00
A	Total of Bills 1 & 2	3,007,999,148.35
B	Total of Bills 1 to 3	3,011,314,148.35
C	Provisional Sum - Contingencies 10% of B	301,131,415.00
D	**Total Estimated Cost (B + C)**	**3,312,445,563.35**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	397,493,468.00
F	**Total Estimated Cost including VAT**	**3,709,939,031.35**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	2,744,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	5,489,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	5,489,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	8,233,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	50,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	1,000,000.00
1.2.4	Allow for safety equipment	Provisional Sum			500,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	25,000,000.00
1.3.2	Construction management service. (Project manager, Engineer Concrete /structure, Engineer Earthwork, Engineer Planning/Design, Engineer Material/quality controle,Engineer health & Safety	month	36	1,850,000.00	66,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			50,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			70,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			312,500.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			1,080,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***168,678,500.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	14.7	153,436.00	2,255,509.20
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	233,435	469.50	109,597,732.50
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	169,121	480.25	81,220,360.25
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	132,152	498.25	65,844,734.00
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	36,418	508.00	18,500,344.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	2,122	1,720.00	3,649,840.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,101	1,752.00	8,936,952.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	8,587	1,760.00	15,113,120.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,261	1,768.00	7,533,448.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	878.00	16.70	14,662.60
2.1.4.2	Furnishing, placing and compacting earth from borrow area and from excavated material as directed by the Engineer.	m^3	864	190.50	164,592.00
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Furnishing, placing and compacting 150-225mm rubble in filters/toe drains, .	m^3	348	3,403.00	1,184,244.00
2.1.5.2	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per per drawing	m	1,000	6,907.00	6,907,000.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	395	376.75	148,816.25
	Sub total Bill No 2.1 -Canal Earthworks				***321,071,354.80***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	4,224	291.50	1,231,296.00

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	131,022	1,398.00	183,168,756.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	4,008,008	219.25	878,755,754.00
2.2.4	**Concrete**				
2.2.4.1	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	2,406	16,916.00	40,699,896.00
2.2.4.2	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	720	20,484.00	14,748,480.00
2.2.4.3	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	52,197	22,000.00	1,148,334,000.00
2.2.5	**Furnish and install Steel Gates/Stop Logs/Trash Racks as per specifications and Engineer's instructions**				
2.2.5.1	Furnish and install in regulator 2.58x3.96 m steel gate including all necessary accessories	No.	8	5,000,000.00	40,000,000.00
2.2.5.2	Furnish and install Electrical hoist as per specification	No.	8	6,000,000.00	48,000,000.00
2.2.5.3	Furnish and install Lifting beam as per specification	No.	2	1,200,000.00	2,400,000.00
2.2.5.4	Furnish and install stop logs as per specification	No.	6	1,500,000.00	9,000,000.00
2.2.5.5	Furnish and install gantry crain with rails as per specification	No.	2	3,500,000.00	7,000,000.00
2.2.5.6	Furnish and install Trash Rack as per specification	No.	8	1,000,000.00	8,000,000.00
2.2.6	**Miscellaneous Work**				
2.2.6.1	Supply and fixing of Centre bubble Water stop, rubber, 225mm with necessary accessories all complete to working order. as per drawing	m	6,150	2,200.00	13,530,000.00
2.2.6.2	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	12	1,109.00	13,308.00
2.2.6.3	Furnishing, laying and jointing 100mm Diameter PVC Pipes for Drain outlet	m	4	1,465.00	5,860.00
2.2.6.4	Providing Bituminous filler expansion joint etc.	m	5,731	177.25	1,015,819.75
2.2.6.5	Furnishing and fixing of water measuring gauge at regulator including all necessary fittings according to Engineer's instruction.	No.	2	4,180.00	8,360.00
2.2.6.6	Supply and fixing of Steel Handrails as per drawing	m	112	3,505.00	392,560.00
2.2.6.7	Providing Control Joint as per drawing	m	228	59.10	13,474.80
2.2.6.8	**Dealing with water during the construction**	**Lump Sum**			**27,171,729.00**
	Sub total Bill No 2.2 -Canal Structures				***2,423,489,293.55***
2.4	**Implementation of environmental mitigation measued proposed by the EIA Study**	**Provisional Sum**			94,760,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***2,839,320,648.35***

BILL NO:03

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	300	200.00	60,000.00
3.1.2	Unskilled labour	hr	375	150.00	56,250.00
3.1.3	Mason	hr	150	200.00	30,000.00
3.1.4	Carpenter	hr	150	200.00	30,000.00
3.1.5	Plumber	hr	75	250.00	18,750.00
3.1.6	Mechanic	hr	30	250.00	7,500.00
3.1.7	Welder	hr	30	250.00	7,500.00
3.1.8	Driver	hr	150	200.00	30,000.00
	Total for Labour				**240,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	150	1,200.00	180,000.00
3.2.2	Sand	m^3	300	3,000.00	900,000.00
3.2.3	Gravel	m^3	300	750.00	225,000.00
3.2.4	Mild steel reinforcement	ton	1.5	150,000.00	225,000.00
3.2.5	Tor steel reinforcement	ton	0.6	200,000.00	120,000.00
	Total for Material				**1,650,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	75	3,125.00	234,375.00
3.3.2	Loader 100 HP	hr	75	3,125.00	234,375.00
3.3.3	Motor Grader 130HP	hr	90	3,125.00	281,250.00
3.3.4	Dump truck / Tipper 20T	hr	300	1,250.00	375,000.00
3.3.5	Tractor/Trailer 100HP	hr	150	1,000.00	150,000.00
3.3.6	Concrete Mixer 1 m^3	hr	150	1,000.00	150,000.00
	Total for Equipment				**1,425,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***3,315,000.00***

Upper Elahera Canal Project (UEC) - Stage 03- Construction of Upper Elahera Canal from 27+294 km to 53+749 km

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	1,060,042,000.00
Bill No. 2	Civil Works	25,964,809,635.80
Bill No. 3	Dayworks	7,080,000.00
A	Total of Bills 1 & 2	27,024,851,635.80
B	Total of Bills 1 to 3	27,031,931,635.80
C	Provisional Sum - Contingencies 15% of B	4,054,789,745.37
D	**Total Estimated Cost (B + C)**	**31,086,721,381.17**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	3,730,406,566.00
F	**Total Estimated Cost including VAT**	**34,817,127,947.17**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	25,851,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	51,703,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	51,703,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	77,554,500.00
1.2	**Facilities for Employer**				
1.2.1	Constructing, maintaining Engineer's office and camp including provision of furniture and fittings.	Provisional Sum	-	-	150,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	3,000,000.00
1.2.3	Allow for additional geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	50,000,000.00
1.2.4	Allow for Access road and site preparation	Provisional Sum	-	-	150,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp including construction of access road and site preparation work	Lump Sum	-	-	350,000,000.00
1.3.2	Construction management service.	month	66	2,200,000.00	145,200,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	100,000.00
1.4.2	Supply , erection and maintenance of a Name Boards as directed by the Engineer	Lump Sum	-	-	150,000.00

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	1,000,000.00
1.4.4	Provision of monthly progress reports and photos	month	66	25,000.00	1,650,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	1,380,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No.01 - Preliminaries (Carried to Summary of Engineer's Estimate)				***1,060,042,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**Cut & Cover sections and portals Earthworks**				
2.1.1	**Site Clearance**				
2.1.1.2	Clearing and Grubbing common jungle by machinery	ha	8.7	153,436.00	1,334,893.20
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	168,984	469.50	79,337,988.00
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	153,194	480.25	73,571,418.50
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	139,565	498.25	69,538,261.25
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	111,896	508.00	56,843,168.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	196,997	525.50	103,521,923.50
2.1.3	**Rock Excavation (Cut & Cover sections and portals)**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,707	1,720.00	2,936,040.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,738	1,752.00	8,300,976.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	8,909	1,760.00	15,679,840.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	12,433	1,768.00	21,981,544.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	14,990	1,775.00	26,607,250.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	29,787	1,781.00	53,050,647.00
2.1.4	**Filters for transition sections**				
2.1.4.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details	m	36	6,907.00	248,652.00
	Sub total Bill No 2.1 -Canal Earthworks				***512,952,601.45***
2.2	**Concrete Works (Cut & Cover sections and portals)**				
2.2.1	**Formwork**				
2.2.1.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	14,885	1,398.00	20,809,230.00
2.2.2	**Reinforcement**				
2.2.2.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	770,861	219.25	169,011,274.25
2.2.3	**Concrete ,Rubble Masonry Work and Plastering**				

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.2.3.1	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	0.6	16,916.00	10,149.60
2.2.3.2	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	6,196	22,000.00	136,312,000.00
2.2.4	**Tunneling**				
2.2.4.1	**Tunneling by Tunnel Boring Machine (TBM)**				
2.2.4.1.1	Rock Excavation in tunnel by Tunnel Boring Machine and spoil to waste/quarry products as directed by Engineer	m^3	1,276,395	12,188.00	15,556,702,260.00
2.2.4.1.2	Furnishing, Placing and Compacting Grade 35 ct. concrete for shotcrete lining,	m^3	22,544	24,348.00	548,901,312.00
2.2.4.1.3	Furnishing, Placing and Compacting Grade 40 ct. concrete for Prefabricated Concrete Segment	m^3	113,313	34,320.00	3,888,902,160.00
2.2.4.1.4	Furnishing cutting bending and placing Tor steel reinforcement in place for shotcrete lining	kg	1,433,476	216.50	310,347,554.00
2.2.4.1.5	Furnishing cutting bending and placing Tor steel reinforcement in place for segment lining	kg	14,663,432	219.00	3,211,291,608.00
2.2.4.1.6	Supplying and fixing of Rock bolt (length=3m)where necessary.	pcs	6,270	14,302.00	89,673,540.00
2.2.4.1.7	Supplying and fixing of Rock bolt (length=4m)where necessary.	pcs	19,624	19,069.00	374,210,056.00
2.2.4.1.8	Supplying and fixing of Rock bolt (length=5m)where necessary.	pcs	12,415	23,837.00	295,936,355.00
2.2.4.1.9	Furnishing and placing grout	Kg	730,215	138.00	100,769,670.00
2.2.4.2	**Tunneling by Drilling & Blasting Method (Adit and portals)**				
2.2.4.2.1	Rock Excavation in tunnel by drill and blast method and spoil to waste/quarry products as directed by Engineer	m^3	49,442	7,248.00	358,355,616.00
2.2.4.2.2	Furnishing, Placing and Compacting Grade 40 ct. concrete for tunnel Lining.	m^3	895	22,000.00	19,690,000.00
2.2.4.2.3	Furnishing, Placing and Compacting Grade 35 ct. concrete for shotcrete lining,	m^3	1,110	24,348.00	27,026,280.00
2.2.4.2.4	Furnishing cutting bending and placing Tor steel reinforcement in place for shotcrete lining	kg	69,586	216.50	15,065,369.00
2.2.4.2.5	Furnishing cutting bending and placing Tor steel reinforcement in place for lining	kg	71,535	219.00	15,666,165.00
2.2.4.2.6	Supplying and fixing of Rock bolt (length=3m)where necessary.	pcs	0	14,302.00	0.00
2.2.4.2.7	Supplying and fixing of Rock bolt (length=4m)where necessary.	pcs	912	19,069.00	17,390,928.00
2.2.4.2.8	Supplying and fixing of Rock bolt (length=5m)where necessary.	pcs	1,092	23,837.00	26,030,004.00
2.2.4.2.9	Supplying and fixing of Rock bolt (length=6m)where necessary.	pcs	0	28,604.00	0.00
2.2.4.2.10	Furnishing and placing grout	Kg	35,280	138.00	4,868,640.00
2.2.4.2.11	Supplying and fixing of Rock dowel	pcs	869	909.00	789,921.00
2.2.4.2.12	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	1,114	2,261.00	2,518,754.00
2.2.4.2.13	Supplying and fixing of Rock ribs where necessary.	Kg	81,431	216.50	17,629,811.50
2.2.5	**Miscellaneous Work**				

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.2.5.1	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	947	2,200.00	2,083,400.00
2.2.5.2	**Dealing with water during the construction**	**Lum Sum**			**128,614,977.00**
	Sub total Bill No 2.2 -Canal Structures				***25,338,607,034.35***
2.3	**Implementation of environmental mitigation measued proposed by the EIA Study**	Provisional Sum			113,250,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***25,964,809,635.80***

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	600	200.00	120,000.00
3.1.2	Unskilled labour	hr	750	150.00	112,500.00
3.1.3	Mason	hr	300	200.00	60,000.00
3.1.4	Carpenter	hr	300	200.00	60,000.00
3.1.5	Plumber	hr	150	250.00	37,500.00
3.1.6	Mechanic	hr	60	250.00	15,000.00
3.1.7	Welder	hr	60	250.00	15,000.00
3.1.8	Driver	hr	300	200.00	60,000.00
	Total for Labour				**480,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	300	1,200.00	360,000.00
3.2.2	Sand	m^3	600	3,000.00	1,800,000.00
3.2.3	Gravel	m^3	600	750.00	450,000.00
3.2.4	Mild steel reinforcement	ton	3	150,000.00	450,000.00
3.2.5	Tor steel reinforcement	ton	1.2	200,000.00	240,000.00
	Total for Material				**3,300,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	150	3,125.00	468,750.00
3.3.2	Loader 100 HP	hr	150	3,125.00	468,750.00
3.3.3	Motor Grader 130HP	hr	180	3,125.00	562,500.00
3.3.4	Dump truck / Tipper 20T	hr	600	1,250.00	750,000.00
3.3.5	Tractor/Trailer 100HP	hr	300	1,000.00	300,000.00
3.3.6	Concrete Mixer 1 m^3	hr	300	1,000.00	300,000.00
3.3.7	Truck Mixer 8 m^3	hr	300	1,500.00	450,000.00
	Total for Equipment				**3,300,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary of Engineer's Estimate)				***7,080,000.00***

Construction of Kalu Ganga Moragahakanda Tranfer Canal

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	184,312,000.00
Bill No. 2	Civil Works	4,761,154,834.55
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	4,945,466,834.55
B	Total of Bills 1 to 3	4,946,571,834.55
C	Provisional Sum - Contingencies 10% of B	494,657,183.00
D	**Total Estimated Cost (B + C)**	**5,441,229,017.55**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	652,947,482.00
F	**Total Estimated Cost including VAT**	**6,094,176,499.55**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	4,761,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	9,522,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	9,522,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	14,283,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	50,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	25,000,000.00
1.3.2	Construction management service.	month	36	1,850,000.00	66,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			50,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			70,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			312,500.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			1,080,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***184,312,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	5.1	153,436.00	782,523.60
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	107,247	469.50	50,352,466.50
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	70,636	480.25	33,922,939.00
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	52,324	498.25	26,070,433.00
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	43,096	508.00	21,892,768.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	139,410	525.50	73,259,955.00
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,084	1,720.00	1,864,480.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	2,185	1,752.00	3,828,120.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	3,340	1,760.00	5,878,400.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,789	1,768.00	8,466,952.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,302	1,775.00	9,411,050.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	29,073	1,781.00	51,779,013.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	4,938	16.70	82,464.60
2.1.4.7	Furnishing, placing and compacting earth from borrow area and from excavated material inCanal as directed by the Engineer.	m^3	2,774	190.25	527,753.50
2.1.4.1	Furnishing placing and compacting gravel Wearing Surface	m^3	596	1,164.00	693,744.00
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.9	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	1,323	6,907.00	9,137,961.00
2.1.6	**Slope Protection for Earth Work**				

2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	2,856	376.75	1,075,998.00
	Sub total Bill No 2.1 -Canal Earthworks				**299,027,021.20**
2.2	**CANAL STRUCTURES**				
2.2.2	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	1,536	16.70	25,651.20
2.2.2.7	Furnishing, placing and compacting earth as per Engineers instructions	m^3	922	864.00	796,608.00
2.2.1	**Formwork**				
2.2.1.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	20,577	1,398.00	28,766,646.00
2.2.2	**Reinforcement**				
2.2.2.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	808,119	219.25	177,180,090.75
2.2.3	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.5.4	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	327	16,916.00	5,531,532.00
2.2.5.6	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	316	20,484.00	6,472,944.00
2.2.3.1	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	1,525	25,604.00	39,046,100.00
2.2.3.2	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	7,782	22,000.00	171,204,000.00
2.2.3.3	Supply and laying a sheet of 1000 Gauge polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	16,102	67.45	1,086,079.90
2.2.4	**Tunneling**				
2.2.4.1	**Tunneling by Tunnel Boring Machine (TBM)**				
2.2.4.1.1	Rock Excavation in tunnel by Tunnel Boring Machine and spoil to waste/quarry products as directed by Engineer	m^3	0	12,184.00	0.00
2.2.4.1.2	Furnishing, Placing and Compacting Grade 20 ct. concrete for tunnel bottom protection, filling and etc.	m^3	0	16,916.00	0.00
2.2.4.1.3	Furnishing, Placing and Compacting Grade 40 ct. concrete for shotcrete lining,	m^3	0	24,348.00	0.00
2.2.4.1.4	Furnishing, Placing and Compacting Grade 40 ct. concrete for Prefabricated Concrete Segment	m^3	0	28,560.00	0.00
2.2.4.1.5	Furnishing cutting bending and placing Tor steel reinforcement in place for shotcrete lining	kg	0	216.50	0.00
2.2.4.1.6	Furnishing cutting bending and placing Tor steel reinforcement in place for segment lining	kg	0	219.00	0.00
2.2.4.1.7	Supplying and fixing of Rock bolt (length=3m)where necessary.	pcs	0	14,302.00	0.00
2.2.4.1.8	Supplying and fixing of Rock bolt (length=4m)where necessary.	pcs	0	19,069.00	0.00

2.2.4.1.9	Supplying and fixing of Rock bolt (length=5m)where necessary.	pcs	0.00	23,837.00	0.00
2.2.4.1.10	Supplying and fixing of Rock bolt (length=6m)where necessary.	pcs	0.00	28,604.00	0.00
2.2.4.1.11	Furnishing and placing grout	m^3	0.00	137.25	0.00
2.2.4.1.12			0.00	0.00	0.00
2.2.4.1.13			0.00	0.00	0.00
2.2.4.1.14			0.00	0.00	0.00
2.2.4.1.15			0.00	0.00	0.00
2.2.4.2	**Tunneling by Drilling & Blasting Method**				
2.2.4.2.1	Rock Excavation in tunnel by drill and blast method and spoil to waste/quarry products as directed by Engineer	m^3	304,400	7,248.00	2,206,291,200.00
2.2.4.2.2	Furnishing, Placing and Compacting Grade 40 ct. concrete for tunnel Lining.	m^3	45,986	20,484.00	941,977,224.00
2.2.4.2.3	Furnishing, Placing and Compacting Grade 35 ct. concrete for shotcrete lining,	m^3	7,028	24,348.00	171,117,744.00
2.2.4.2.4	Furnishing cutting bending and placing Tor steel reinforcement in place for shotcrete lining	kg	425,487	216.50	92,117,935.50
2.2.4.2.5	Furnishing cutting bending and placing Tor steel reinforcement in place for lining	kg	252,888	219.00	55,382,472.00
2.2.4.2.6	Supplying and fixing of Rock bolt (length=3m)where necessary.	pcs	3,229	14,302.00	46,181,158.00
2.2.4.2.7	Supplying and fixing of Rock bolt (length=4m)where necessary.	pcs	141	19,069.00	2,688,729.00
2.2.4.2.8	Supplying and fixing of Rock bolt (length=5m)where necessary.	pcs	8,507	23,837.00	202,781,359.00
2.2.4.2.9	Supplying and fixing of Rock bolt (length=6m)where necessary.	pcs	0	28,604.00	0.00
2.2.4.2.10	Furnishing and placing grout	Kg	276,435	137.25	37,940,703.75
2.2.4.2.11	Supplying and fixing of Rock dowel	pcs	58,509	909.00	53,184,681.00
2.2.4.2.12	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	57,442	1,398.00	80,303,356.80
2.2.4.2.13	Supplying and fixing of Rock ribs where necessary.	Kg	426,474	216.50	92,331,707.60
2.2.4.2.14			0	0.00	0.00
2.2.4.2.15			0	0.00	0.00
2.2.10	**Miscellaneous Work**				
2.2.10.1	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order. as per detail A in Drg No:NWP/STR/P1/012	m	868	2,200.00	1,909,600.00
2.2.10.2	Providing Bituminous filler expansion joint etc.	m	2,781	177.25	492,932.25
2.2.10.3	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	2,686	59.10	158,742.60
2.2.10.4	**Dealing with water during the construction**	**Lum Sum**			**47,158,616.00**
	Sub total Bill No 2.2 -Canal Structures				**4,462,127,813.35**
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***4,761,154,834.55***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***1,105,000.00***

Upper Elahera Canal Project (UEC) - Stage 02- Construction of Upper Elahera Canal from 6+226 km to 27+294 km

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	188,837,000.00
Bill No. 2	Civil Works	5,475,017,656.20
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	5,663,854,656.20
B	Total of Bills 1 to 3	5,664,959,656.20
C	Provisional Sum - Contingencies 10% of B	566,495,966.00
D	**Total Estimated Cost (B + C)**	**6,231,455,622.20**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	747,774,675.00
F	**Total Estimated Cost including VAT**	**6,979,230,297.20**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	5,327,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	10,653,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	10,653,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	15,980,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	50,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	25,000,000.00
1.3.2	Construction management service.	month	36	1,850,000.00	66,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	50,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	70,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	312,500.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	1,080,000.00

1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No: 01 Preliminaries-(Carried to Summary of Engineer's Estimate)				***188,837,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance/Demolition**				
2.1.1.2	Clearing and Grubbing common jungle by machinery	ha	76.50	153,436.00	11,737,854.00
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	1,179,240.00	469.50	553,653,180.00
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	454,276.00	480.25	218,166,049.00
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	139,347.00	498.25	69,429,642.75
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	33,166.00	508.00	16,848,328.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	9,419.00	525.50	4,949,684.50
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	11,120.00	1,720.00	19,126,400.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	14,029.00	1,752.00	24,578,808.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	9,066.00	1,760.00	15,956,160.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,072.00	1,768.00	7,199,296.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	1,566.00	1,775.00	2,779,650.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	532.00	1,781.00	947,492.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	251,771.00	16.70	4,204,575.70
2.1.4.4	Furnishing, placing and compacting earth from borrow area and from excavated material in Canal as directed by the Engineer.	m^3	453,794.00	290.25	131,713,708.50
2.1.4.7	Furnishing, placing and compacting earth from borrow area and from excavated material in Dam as directed by the Engineer.	m^3	189,909.00	172.50	32,759,302.50
2.1.5	**Filters for Dam Embankments/Canal Lining**				
2.1.5.1	Furnishing, placing and compacting sand in filters as per Engineers instructions	m^3	6,872.00	2,874.00	19,750,128.00
2.1.5.2	Furnishing, placing and compacting 150-225mm rubble in filters/toe drains.	m^3	156.00	3,403.00	530,868.00

2.1.5.3	Supplying and Placing Well Graded Aggregate (20 - 37.5mm metal) in the Filter as per Drawing	m^3	3,256.00	5,249.00	17,090,744.00
2.1.5.4	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details	m	36,492.00	6,907.00	252,050,244.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	149,109.00	376.75	56,176,815.75
2.1.6.2	Furnishing, Placing Boulders for 600mm thick Rip Rap Protection and packing along the Designated Up Stream Slope	m^3	7,052.00	2,629.00	18,539,708.00
2.1.7	**Gravel Surfacing for Roadway / Bund formation**				
A7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	14,613.00	1,164.00	17,009,532.00
2.1.7	**Provision for Rehabilitation of Bogahawewa and Madeththewa level crossing**	**Provisional Sum**			937,950,545.00
	Sub total Bill No 2.1 -Canal Earthworks				***2,433,148,715.70***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling/Turfing**				
2.2.1.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	47,337.00	291.50	13,798,735.50
2.2.1.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	3,548.00	864.00	3,065,472.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork	m^2	43,967.00	1,398.00	61,465,866.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Mild steel reinforcement in place	Kg	5,692.00	216.50	1,232,318.00
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	1,114,342.00	219.25	244,319,483.50
2.2.4	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	442.00	14,737.00	6,513,754.00
2.2.4.2	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	1,086.00	16,916.00	18,370,776.00
2.2.4.3	Furnishing, Placing and Compacting Grade 25 ct. concrete excluding formwork	m^3	880.00	18,545.00	16,319,600.00
2.2.4.4	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	8,909.00	20,484.00	182,491,956.00
2.2.4.5	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	47,540.00	25,604.00	1,217,214,160.00
2.2.4.6	Furnishing, Placing and Compacting Grade 35ct. concrete excluding formwork	m^3	805.00	21,241.00	17,099,005.00
2.2.4.7	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	11,152.00	22,000.00	245,344,000.00
2.2.4.8	Supply and laying a sheet of 100 Gauge polythene between the sub-base and concrete, including providing necessary lapping	m^2	388,922.00	67.45	26,232,788.90
B5	**Tunneling**				
B5.1	**Tunneling by Drilling & Blasting Method**				

B5.1.1	Rock Excavation in tunnel by drill and blast method and spoil to waste/quarry products as directed by Engineer	m^3	7,492.00	7,248.00	54,302,016.00
B5.1.2	Furnishing, Placing and Compacting Grade 40 ct. concrete for tunnel Lining.	m^3	5,786.00	28,560.00	165,248,160.00
B5.1.3	Furnishing, Placing and Compacting Grade 35 ct. concrete for shotcrete lining,	m^3	530.00	24,348.00	12,904,440.00
B5.1.4	Furnishing cutting bending and placing Tor steel reinforcement in place for shotcrete lining	kg	736,687.00	216.50	159,492,735.50
B5.1.5	Furnishing cutting bending and placing Tor steel reinforcement in place for lining	kg	470.00	219.00	102,930.00
B5.1.6	Supplying and fixing of Rock bolt (length=5m)where necessary.	pcs	960.00	23,837.00	22,883,520.00
B5.1.7	Supplying and fixing of Rock dowel	pcs	7,207.20	909.00	6,551,344.80
B5.1.8	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	69,948.00	2,261.00	158,152,428.00
2.2.6	**Furnish and install Turnout Structures/ Steel Gates/Stop Logs as per specifications and Engineer's instructions**				
2.2.6.1	Furnish and install in regulator 2.58x3.96 m steel gate including all necessary accessories	No.	8.00	5,000,000.00	40,000,000.00
2.2.6.2	Furnish and install Electrical hoist as per specification	No.	8.00	6,000,000.00	48,000,000.00
2.2.6.3	Furnish and install Lifting beam as per specification	No.	2.00	1,200,000.00	2,400,000.00
2.2.6.4	Furnish and install stop logs as per specification	No.	6.00	1,500,000.00	9,000,000.00
2.2.6.5	Furnish and install gantry crain with rails as per specification	No.	2.00	3,500,000.00	7,000,000.00
2.2.6.6	Furnish and install rash Rack as per specification	No.	8.00	1,000,000.00	8,000,000.00
2.2.7	**RCC Spun Pipes and Collars in Structures**				
2.2.7.1	Furnish, lay and joint 300mmdia. RCC spun pipes incl. trenching and back fill.	m	537.00	5,284.00	2,837,508.00
2.2.7.2	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	976.00	15,596.00	15,221,696.00
2.2.8	**Pre-cast Bridge**				
2.2.8.1	Furnish and install bridge beam 13.5m x 4.22t in place by crane	No.	156.00	203,676.00	31,773,456.00
2.2.8.2	Furnish and install kerb slab 915mm x50.8kg in place by crane	No.	462.00	3,390.00	1,566,180.00
2.2.8.3	Furnish and install facia slab of 38x 900x1200mmx 105.7 kg. in place by crane	No.	364.00	6,175.00	2,247,700.00
2.2.8.4	Furnish and install upright for hand rails of 83mmx 55.4kg. in place by crane	No.	284.00	3,832.00	1,088,288.00
2.2.8.5	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	644.00	3,799.00	2,446,556.00
2.2.8.6	Furnish and install steel expansion joint as per Engineer's instruction	m	138.00	15,726.00	2,170,188.00
2.2.8.7	Supplying and fixing displacers or polythene tubes filled with light material - 150mm Diameter , 14.5m long in bridge deck	m^2	1,917.00	2,700.00	5,175,900.00
2.2.8.8	Supplying and laying approved hard rubber bearing pads 75x12 mm over capping beams and under the approach slabs	m	150.00	1,793.00	268,950.00
2.2.8.9	Supplying and laying of Bituminous sealing material under beam ends to prevent grout leak on to capping beam	m	372.00	98.80	36,753.60
2.2.8.10	Supplying and fixing of end pilaster as per Drawing No:	No.	8.00	4,720.00	37,760.00

2.2.9	**Miscellaneous Work**				
2.2.9.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail	m	2,704.00	1,800.00	4,867,200.00
2.2.9.2	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order. as per detail	m	220.00	2,200.00	484,000.00
2.2.9.3	Furnishing, laying and jointing 50mm Diameter PVC Pipes for Drain outlet in bridges	m	282.00	1,109.00	312,738.00
2.2.9.4	Furnishing, laying and jointing 100mm Diameter PVC Pipes for Drain outlet	m	4.00	1,465.00	5,860.00
2.2.9.5	Drilling holes for fixing dowels (dowel size 25mm)	No.	396.00	360.00	142,560.00
2.2.9.6	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	396.00	439.00	173,844.00
2.2.9.7	Providing Bituminous filler expansion joint etc.	m	76,686.00	177.25	13,592,593.50
2.2.9.8	Furnishing the Geo-Textile as directed	m²	10,571.00	900.00	9,513,900.00
2.2.9.9	Supply and fixing of Steel Handrails as per drawing	m	1,264.00	3,505.00	4,430,320.00
2.2.9.10	Furnishing and fixing of water measuring gauge at regulator including all necessary fittings according to Engineer's instruction.	No.	2.00	4,180.00	8,360.00
2.2.9.11	Providing Control Joint as per Details	m	73,192.00	59.10	4,325,647.20
2.2.10.57	**Dealing with water during the construction**	**Lum Sum**			**43,375,493.00**
	Sub total Bill No 2.2 -Canal Structures				***2,893,608,940.50***
2.4	**Implimentation of envirenmental mitigation measued proposed by the EIA Study**	Provisional Sum			148,260,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of BOQ)				***5,475,017,656.20***

BILL NO:03-PROVISIONAL SUM ITEMS

Item No.	Description	Unit	Quantity	Rate (LKR)	Amount (LKR)
3.1	**Securities, Insurances etc.,**				
3.1.1	Provision of Performance Security	Provisional Sum	-	-	5,475,000.00
3.1.2	Provision of Security Bonds and Guarantees	Provisional Sum	-	-	10,950,000.00
3.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Provisional Sum	-	-	10,950,000.00
3.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Provisional Sum	-	-	16,425,000.00
3.2	**Employers Requirements**				
3.2.1	temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings provided by, including	Provisional Sum	-	-	50,000,000.00
3.2.2	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
3.2.3	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum			1,000,000.00
3.3	**Other Requirements**				
3.3.1	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00

Total Cost for Bill No:03 - Provisional Sum Items (Carried to Summary of BOQ)					***96,550,000.00***

BILL NO:04-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
4.1	**Labour**				
4.1.1	Skilled labour	hr	100	200.00	20,000.00
4.1.2	Unskilled labour	hr	125	150.00	18,750.00
4.1.3	Mason	hr	50	200.00	10,000.00
4.1.4	Carpenter	hr	50	200.00	10,000.00
4.1.5	Plumber	hr	25	250.00	6,250.00
4.1.6	Mechanic	hr	10	250.00	2,500.00
4.1.7	Welder	hr	10	250.00	2,500.00
4.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
4.2	**Material**				
4.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
4.2.2	Sand	m^3	100	3,000.00	300,000.00
4.2.3	Gravel	m^3	100	750.00	75,000.00
4.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
4.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
4.3	**Equipment**				
4.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
4.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
4.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
4.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
4.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
4.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
Total Cost for Bill No: 04 –Day works (Carried to summary BOQ)					***1,105,000.00***

Upper Elahara Canal Project (UEC) - Stage 04 (53+749 km to 66+340 km)

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	190,610,000.00
Bill No. 2	Civil Works	5,017,278,493.00
Bill No. 3	Dayworks	1,105,000.00
A	Total of Bills 1 & 2	5,207,888,493.00
B	Total of Bills 1 to 3	5,208,993,493.00
C	Provisional Sum - Contingencies 10% of B	520,899,349.00
D	**Total Estimated Cost (B + C)**	**5,729,892,842.00**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	687,587,141.00
F	**Total Estimated Cost including VAT**	**6,417,479,983.00**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	4,761,000.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	9,522,000.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	9,522,000.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	14,282,500.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	50,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum			1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Lump Sum	-	-	25,000,000.00
1.3.2	Construction management service.	month	36	2,025,000.00	72,900,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum	-	-	50,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum	-	-	70,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum	-	-	312,500.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum	-	-	1,080,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum	-	-	750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***190,610,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	88.9	153,436.00	13,640,460.40
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	614,036	469.50	288,289,902.00
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	304,104	480.25	146,045,946.00
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	158,028	498.25	78,737,451.00
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	86,664	508.00	44,025,312.00
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	30,311	525.50	15,928,430.50
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	15,291	1,720.00	26,300,520.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	35,484	1,752.00	62,167,968.00
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	53,432	1,760.00	94,040,320.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	56,610	1,768.00	100,086,480.00
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	179,572	1,775.00	318,740,300.00
2.1.3.6	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	0	1,781.00	0.00
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	72,835	16.70	1,216,344.50
	Furnishing, placing and compacting earth from borrow area and from excavated material in Canal as directed by the Engineer.	m^3	143,339	258.75	37,088,966.25
2.1.4.5	Gravel Excavation from Borrow, Transport by tractor, placing and compaction in forming bund Machinery including watering & haul	m^3	1,237	1,108.00	1,370,596.00
2.1.5	**Filters for Canal Lining**				
2.1.5.1	Furnish, lay and joint 300mm dia. RCC perforated pipes incl. trenching and providing filter arrangement as per Details of Drg No:NWP/STR/TYP/001	m	18,624	6,907.00	128,635,968.00
2.1.6	**Slope Protection for Earth Work**				

2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	93,065	376.75	35,062,238.75
2.1.7	**Gravel Surfacing for Roadway / Bund formation**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	7,025	1,164.00	8,177,100.00
	Sub total Bill No 2.1 -Canal Earthworks				***1,399,554,303.40***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling/Turfing**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	14,240	291.50	4,150,960.00
2.2.2.2	Common Earth Excavation in foundation manually and spoil to waste or fill material	m^3	0	924.00	0.00
2.2.2.3	Furnishing, placing and compacting earth as per Engineers instructions	m^3	590	864.00	509,760.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	130,695	1,398.00	182,711,610.00
2.2.3	**Reinforcement**				
2.2.3.1	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	5,226,758	219.25	1,145,966,691.50
2.2.4	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.4.1	Furnishing, Placing and Compacting Grade 15 ct. concrete excluding formwork	m^3	127	14,737.00	1,871,599.00
2.2.4.2	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	175	16,916.00	2,960,300.00
2.2.4.3	Furnishing, Placing and Compacting Grade 30 ct. concrete excluding formwork	m^3	985	20,484.00	20,176,740.00
2.2.4.4	Furnishing, Placing and Compacting Grade 30 ct. concrete for Trapezoidal lining and Safe Escape for Wildlife	m^3	25,372	25,604.00	649,624,688.00
2.2.4.5	Furnishing, Placing and Compacting Grade 35ct. concrete excluding formwork	m^3	75	21,241.00	1,593,075.00
2.2.4.6	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	50,748	22,000.00	1,116,456,000.00
2.2.4.7	Supply and laying of polythene damp proof membrane between the sub-base and concrete, including providing necessary lapping	m^2	233,308	67.45	15,736,624.60
2.2.6	**Furnish and install Steel Gates/Trash Rack as per specifications and Engineer's instructions**				
2.2.7.14	Furnish and install in regulator 1.5x2.0 m steel gate including all necessary accessories	No.	6	696,972.00	4,181,832.00
B7.17	Furnish and install in regulator 2.58x3.96 m steel gate including all necessary accessories	No.	8.0	5,000,000.00	40,000,000.00
B7.18	Furnish and install Electrical hoist as per specification	No.	8.0	6,000,000.00	48,000,000.00
B7.19	Furnish and install Lifting beam as per specification	No.	3.0	1,200,000.00	3,600,000.00
B7.20	Furnish and install stop logs as per specification	No.	8.0	1,500,000.00	12,000,000.00
B7.21	Furnish and install g antry crain with rails as per specification	No.	3.0	3,500,000.00	10,500,000.00

B7.22	Furnish and install rash Rack as per specification	No.	8.0	1,000,000.00	8,000,000.00
2.2.7	**RCC Spun Pipes and Collars in Structures**				
2.2.7.1	Furnish, lay and joint 900mm dia. RCC spun pipes incl. trenching and back fill.	m	586	15,596.00	9,139,256.00
2.2.8	**Pre-cast Bridge**				
2.2.8.1	Furnish and install bridge beam 14.5m x 4.53t in place by crane	No.	96	226,696.00	21,762,816.00
2.2.8.2	Furnish and install facia slab of 38x 900x1200mmx 105.7 kg. in place by crane	No.	144	6,175.00	889,200.00
2.2.8.3	Furnish and install facia slab of 38x 600x1200mmx 46.3 kg. in place by crane	No.	96	4,723.00	453,408.00
2.2.8.4	Furnish and install hand rails of 76mm dia x 196mm x 47.8kg. in place by crane	No.	128	3,799.00	486,272.00
2.2.8.5	Furnish and install rain water channel of 76mm dia x 153mmx 610mmx14.2kg.	No.	168	1,005.00	168,840.00
2.2.9	**Miscellaneous Work**				
2.2.9.1	Supply and fixing of Centre bubble Water stop, PVC, 150mm with necessary accessories all complete to working order as Per detail A in Drg No:NWP/STR/P1/012	m	437	1,800.00	786,600.00
2.2.9.2	Supplying and fixing of Safety Fence as per Drawing No:	m²	200	4,500.00	900,000.00
2.2.9.3	Drilling holes for fixing dowels (dowel size 25mm)	No.	4,239	360.00	1,526,040.00
2.2.9.4	Supply , cut, bend and Fix 20 mm dia. Tor steel 1500mm long dowels including cement grouting	No.	78	439.00	34,242.00
2.2.9.5	Supply , cut, bend and Fix 25 mm Tor steel dowels including cement grouting	No.	26	549.00	14,274.00
2.2.9.6	Supplying and fixing Elastomeric bearing pad, 75 x 12mm	m	18	641.65	11,549.70
2.2.9.7	Supplying and fixing Anchor bar, dia.=20, length= 300mm	No.	832	750.00	624,000.00
2.2.9.8	Providing Bituminous filler expansion joint etc.	m	38,948	177.25	6,903,533.00
2.2.9.9	Providing Control Joint as per Details-B of Drg No:NWP/STR/P1/012	m	37,008	59.10	2,187,172.80
2.2.9.10	Supply and fixing Flap valve with Filter arrangement as per Details-C of Drg No:NWP/STR/P1/012	No.	14	2,100.00	29,400.00
2.2.9.13	**Dealing with water during the construction**	**Lum Sum**			**47,397,706.00**
	Sub total Bill No 2.2 -Canal Structures				***3,361,354,189.60***
3.3.2	**Implimentation of envirenmental mitigation measued proposed by the EIA Study**	Provisional Sum			256,370,000.00
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***5,017,278,493.00***

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	100	200.00	20,000.00
3.1.2	Unskilled labour	hr	125	150.00	18,750.00
3.1.3	Mason	hr	50	200.00	10,000.00
3.1.4	Carpenter	hr	50	200.00	10,000.00
3.1.5	Plumber	hr	25	250.00	6,250.00
3.1.6	Mechanic	hr	10	250.00	2,500.00
3.1.7	Welder	hr	10	250.00	2,500.00
3.1.8	Driver	hr	50	200.00	10,000.00
	Total for Labour				**80,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	50	1,200.00	60,000.00
3.2.2	Sand	m^3	100	3,000.00	300,000.00
3.2.3	Gravel	m^3	100	750.00	75,000.00
3.2.4	Mild steel reinforcement	ton	0.5	150,000.00	75,000.00
3.2.5	Tor steel reinforcement	ton	0.2	200,000.00	40,000.00
	Total for Material				**550,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	25	3,125.00	78,125.00
3.3.2	Loader 100 HP	hr	25	3,125.00	78,125.00
3.3.3	Motor Grader 130HP	hr	30	3,125.00	93,750.00
3.3.4	Dump truck / Tipper 20T	hr	100	1,250.00	125,000.00
3.3.5	Tractor/Trailer 100HP	hr	50	1,000.00	50,000.00
3.3.6	Concrete Mixer 1 m^3	hr	50	1,000.00	50,000.00
	Total for Equipment				**475,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to summary BOQ)				***1,105,000.00***

Feeder Canal from UEC to Manankattiya-Eruwewa Stream & Widening the Eruwewa-Mahakanadarawa Stream

ENGINEER'S ESTIMATE

This estimate provides for all labour, materials and transport necessary for the implementation of the project (VAT excluded from the Basic Prices, OH & PF Adopted = 20%)

SUMMARY OF ENGINEER'S ESTIMATE

Bill No	General Summary	Amount (LKR)
Bill No. 1	Preliminaries	95,324,000.00
Bill No. 2	Civil Works	2,262,635,178.25
Bill No. 3	Dayworks	3,315,000.00
A	Total of Bills 1 & 2	2,357,959,178.25
B	Total of Bills 1 to 3	2,361,274,178.25
C	Provisional Sum - Contingencies 10% of B	236,127,418.00
D	**Total Estimated Cost (B + C)**	**2,597,401,596.25**
E	VAT- 12 % of Total Estimated Cost (0.12 x D)	311,688,192.00
F	**Total Estimated Cost including VAT**	**2,909,089,788.25**

BILL NO:01-PRELIMINARIES

Item	Description of works	Unit	Total Quantity	Rate (LKR)	Amount(LKR)
1.1	**Securities, Insurances etc.,**				
1.1.1	Provision of Performance Security	Lump Sum	-	-	2,262,500.00
1.1.2	Provision of Security Bonds and Guarantees	Lump Sum	-	-	4,525,500.00
1.1.3	Insurance of Works, Machinery & Equipment , Plant, Materials, third party persons & Employers' personnel & property at site as per contract.	Lump Sum	-	-	4,525,500.00
1.1.4	Insurance against accidents and injury to Contractors personal as per the contract.	Lump Sum	-	-	6,788,000.00
1.2	**Employer's Requirements**				
1.2.1	Constructing, maintaining ,dismantling and removal on completion of the works, a temporary building for the Engineer's office in conformity with the plans necessary furniture and fittings.	Provisional Sum	-	-	1,000,000.00
1.2.2	Allow for Borrow & Construction Material investigations and surveys for detail designs	Provisional Sum	-	-	1,000,000.00
1.2.3	Allow for geological investigations, grouting and other foundation treatment	Provisional Sum	-	-	1,000,000.00
1.3	**Contractor's Requirements**				
1.3.1	Constructing, maintaining ,dismantling and removal on completion of the works, all temporary building for the Contractor at contractor's camp	Lump Sum	-	-	5,000,000.00
1.3.2	Construction management service.	month	36	1,850,000.00	66,600,000.00
1.4	**Other Requirements**				
1.4.1	Stamp duty	Lump Sum			50,000.00
1.4.2	Supply a, erection and maintenance of a Name Board as directed by the Engineer	Lump Sum			70,000.00
1.4.3	Removal of all rubbish and debris and clearing of site on completion	Lump Sum			312,500.00
1.4.4	Provision of monthly progress reports and photos	month	36	10,000.00	360,000.00
1.4.5	Provision of “As-built” drawings and Quality Assurance Reports	Lump Sum			1,080,000.00
1.4.6	Employers share of Adjudicators fees and expenses	Provisional Sum			750,000.00
	Total Cost for Bill No:01 - Prelimineries (Carried to Summary of Engineer's Estimate)				***95,324,000.00***

BILL NO:02-CIVIL WORKS

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1	**CANAL EARTHWORKS**				
2.1.1	**Site Clearance**				
2.1.1.1	Clearing and Grubbing common jungle by machinery	ha	73.7	153,436.00	11,308,233.20
2.1.2	**Common Excavation**				
2.1.2.1	Common excavation from 0-3m depth and spoil to waste or fill material as directed by Engineer	m^3	411,358	469.50	193,132,674.90
2.1.2.2	Common excavation from 3-6m depth and spoil to waste or fill material as directed by Engineer	m^3	294,790	480.25	141,572,849.48
2.1.2.3	Common excavation from 6-9m depth and spoil to waste or fill material as directed by Engineer	m^3	179,152	498.25	89,262,683.30
2.1.2.4	Common excavation from 9-12m depth and spoil to waste or fill material as directed by Engineer	m^3	87,857	508.00	44,631,305.20
2.1.2.5	Common excavation from 12-15m depth and spoil to waste or fill material as directed by Engineer	m^3	38,862	525.50	20,421,823.35
2.1.3	**Rock Excavation**				
2.1.3.1	Rock excavation from 0-3m depth and spoil to waste/quarry products as directed by Engineer	m^3	4,155	1,720.00	7,146,944.00
2.1.3.2	Rock excavation from 3-6m depth and spoil to waste/quarry products as directed by Engineer	m^3	9,117	1,752.00	15,973,509.60
2.1.3.3	Rock excavation from 6-9m depth and spoil to waste/quarry products as directed by Engineer	m^3	21,435	1,760.00	37,726,128.00
2.1.3.4	Rock excavation from 9-12m depth and spoil to waste/quarry products as directed by Engineer	m^3	9,762	1,768.00	17,259,039.20
2.1.3.5	Rock excavation from 12-15m depth and spoil to waste/quarry products as directed by Engineer	m^3	5,260	1,775.00	9,335,790.00
	Rock excavation from 15-18m depth and spoil to waste/quarry products as directed by Engineer	m^3	2,408	1,781.00	4,288,113.70
2.1.4	**Ground Preparation/Earthfill in Embankments**				
2.1.4.1	Stripping top soil to receive new earth including dispose away from the site as directed by Engineer	m^2	5,500.00	16.70	91,850.00
2.1.4.2	Furnishing, placing and compacting earth as per Engineers instructions	m^3	30,000	719.00	21,570,000.00
2.1.6	**Slope Protection for Earth Work**				
2.1.6.1	Furnishing , planting turf on newly formed earth surface and watering until turf takes root	m^2	2,000	376.75	753,500.00

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)
2.1.7	**Gravel Surfacing for Roadway**				
2.1.7.1	Furnishing placing and compacting gravel Wearing Surface	m^3	2,250	1,164.00	2,619,000.00
	Sub total Bill No 2.1 -Canal Earthworks				***617,093,443.93***
2.2	**CANAL STRUCTURES**				
2.2.1	**Excavation / Backfilling**				
2.2.2.1	Common Earth Excavation in foundation and spoil to waste or fill material as directed by Engineer	m^3	500	291.50	145,750.00
2.2.2	**Formwork**				
2.2.2.1	Furnishing , making , fixing and removing formwork including struts and batterns etc.	m^2	128,133	1,398.00	179,129,654.40
2.2.3	**Reinforcement**				
2.2.3.2	Furnishing cutting bending and placing Tor steel reinforcement in place	Kg	2,585,442	219.25	566,858,136.58
2.2.4	**Concrete ,Rubble Masonry Work and Plastering**				
2.2.4.2	Furnishing, Placing and Compacting Grade 20 ct. concrete excluding formwork	m^3	2,788	16,916.00	47,158,424.80
2.2.4.7	Furnishing, Placing and Compacting Grade 40 ct. concrete excluding formwork	m^3	33,318	24,348.00	811,216,924.80
2.2.8	**Miscellaneous Work**				
	Supply and fixing of Centre bubble Water stop, PVC, 225mm with necessary accessories all complete to working order. as per detail A in Drg No:NWP/STR/P1/012	m	7,555	2,200.00	16,621,000.00
2.2.8.5	Providing Bituminous filler expansion joint etc.	m	7,555	177.25	1,339,123.75
2.2.10.57	**Dealing with water during the construction**	**Lum Sum**			**23,072,720.00**
	Sub total Bill No 2.2 -Canal Structures				***1,645,541,734.33***
	Total Cost for Bill No:02 - Civil Works (Carried to Summary of Engineer's Estimate)				***2,262,635,178.25***

ITEM NO:	DESCRIPTION	UNIT	QUANTITY	RATE (LKR)	AMOUNT (LKR)

BILL NO:03-DAYWORKS

Item No.	Description	Unit	Nominal Quantity	Rate (LKR)	Amount (LKR)
3.1	**Labour**				
3.1.1	Skilled labour	hr	300	200.00	60,000.00
3.1.2	Unskilled labour	hr	375	150.00	56,250.00
3.1.3	Mason	hr	150	200.00	30,000.00
3.1.4	Carpenter	hr	150	200.00	30,000.00
3.1.5	Plumber	hr	75	250.00	18,750.00
3.1.6	Mechanic	hr	30	250.00	7,500.00
3.1.7	Welder	hr	30	250.00	7,500.00
3.1.8	Driver	hr	150	200.00	30,000.00
	Total for Labour				**240,000.00**
3.2	**Material**				
3.2.1	Cement (50 Kg bags)	Nos	150	1,200.00	180,000.00
3.2.2	Sand	m^3	300	3,000.00	900,000.00
3.2.3	Gravel	m^3	300	750.00	225,000.00
3.2.4	Mild steel reinforcement	ton	1.5	150,000.00	225,000.00
3.2.5	Tor steel reinforcement	ton	0.6	200,000.00	120,000.00
	Total for Material				**1,650,000.00**
3.3	**Equipment**				
3.3.1	Hydraulic excavator 130 HP	hr	75	3,125.00	234,375.00
3.3.2	Loader 100 HP	hr	75	3,125.00	234,375.00
3.3.3	Motor Grader 130HP	hr	90	3,125.00	281,250.00
3.3.4	Dump truck / Tipper 20T	hr	300	1,250.00	375,000.00
3.3.5	Tractor/Trailer 100HP	hr	150	1,000.00	150,000.00
3.3.6	Concrete Mixer 1 m^3	hr	150	1,000.00	150,000.00
	Total for Equipment				**1,425,000.00**
	Total Cost for Bill No: 03 –Day works (Carried to Summary of Engineer's Estimate)				***3,315,000.00***

APPENDIX 8

IMPLEMENTATION SCHEDULE

Implementation Schedule - Water Resources Development Investment Programme (WRDIP)
2015 to 2024 (10-year Period)

Designs by PPTA/MCB | Designs and Bid Documents by PMDSC | Bidding and Award | Other Tasks | Implementation

No.	Package	Description of Item	2014				2015				2016				2017				2018				2019				2020				2021				2022				2023				2024			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
		TRANCHE 1 (2015 - 2019)																																											
1	**MLBCR**	**Minipe Left Bank Canal Rehabilitation**																																											
		IEE Preparation and Approval																																											
	MLBCR-NCB-1	Rehabilitation of Minipe LB Canal (0+000km to 30+140km) - Stage 1								20%				30%				30%				20%																							
	MLBCR-NCB-2	Rehabilitation of Minipe LB Canal (30+140km to 49+820km) - Stage 2								20%				30%				30%				20%																							
	MLBCR-NCB-3	Rehabilitation of Minipe LB Canal (49-820km to 63+650km) - Stage 3																40%				30%				30%																			
	MLBCR-NCB-4	Rehabilitation of Minipe LB Canal (63+650km to 73+960km) - Stage 4																40%				30%				30%																			
	MLBCR-NCB-5	Rehabilitation & Electrification of 8 Nos. Radial Gated Structures and Improvements to 2 Nos. Cross Regulators of Minipe LB Canal																50%								50%																			
	MLBCR-ICB-1	Raising of Crest of Minipe Anicut Including Water Control and Measurement Facilities for LB and RB Canals								30%				50%				20%																											
2	**NWPC**	**North Western Province Canal - Stage 1**																																											
		EIA Preparation and Approval																																											
		Resettlement Plan Implementation																																											
	NWPC-NCB-1	Main Canal from Wemedilla LBMC to Nabadagahawatta Wewa (0+000 to 5+250km) & construction of new Sluice & tail Canal (0+000 to 0+600km)								20%				30%				30%				20%																							
	NWPC-ICB-1	Mahakithula Inlet Tunnel, Mahakithula and Mahakirula Reservoirs, Feeder Canal Length 3.66km from Mahakithula to Mahakirula Reservoir								30%				50%				20%																											
	NWPC-ICB-2	Main Canal from Nabadagahawatta Wewa to Mahakithula Reservoir Inlet Tunnel (5+250 to 22+460km)								20%				30%				30%				20%																							
3	**UEC**	**Upper Elahera Canal - Stage 1 (0+100 to 6+226km)**																																											
		EIA Preparation and Approval																																											
		Resettlement Plan Implementation																																											
	UEC-ICB-1	Upper Elahera Canal (0+100 to 6+226km)								20%				30%				30%				20%																							
4	**CS**	**Consulting Services**																																											
	CS-1	PMDSC (Program Management, Design Supervison Consultant) Consulting Package								20%				20%				20%				20%				20%																			
	CS-2	Improving System Efficiency and Water Productivity (ISEWP)								30%				50%				20%																											

Implementation Schedule - Water Resources Development Investment Programme (WRDIP)
2015 to 2024 (10-year Period)

Designs by PPTA/MCB | Designs and Bid Documents by PMDSC | Bidding and Award | Other Tasks | Implementation

No.	Package	Description of Item	2014				2015				2016				2017				2018				2019				2020				2021				2022				2023				2024			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
		TRANCHE 2 (2016 - 2024)																																											
5	**UEC**	**Upper Elahera Canal - Stage 2 (27+509 to 54+249km) & KMTC**																																											
	UEC-ICB-2	Upper Elahera Canal (27+509 to 54+249km)																																											
		Geotechnical Investigations																																											
		Design and Finalization of Bidding Documents																																											
		Tendering and Award of Contract																																											
		Manufacture and Shipping of Tunnel Boring Machines (TBMs)																																											
		Establishment On-site Facilities for TBMs (Access/ Shaft/ Adit)																																											
		Establishment and Testing (TBMs)																																											
		Tunneling by TBM (UEC Tunnel 3)												15%				20%				15%				15%				15%				10%				10%									
		Kaluganga - Moragahakanda Transfer Canal (0+292km to 9+161km)																																						60%				40%		

No.	Package	Description of Item	2014				2015				2016				2017				2018				2019				2020				2021				2022				2023				2024			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
		TRANCHE 3 (2018 - 2024)																																											
6	**UEC**	**Upper Elahera Canal - Stage 3 (6+226 to 27+509) & (54+249km to 65+500km)**																																											
	UEC-ICB-3	Upper Elahera Canal (6+226 to 27+509km)																				20%				30%				30%				20%													
	UEC-ICB-4	Upper Elahera Canal (54+249 to 65+500km)																												33%				33%				33%								
	UEC-ICB-5	Construction of Feeder Canal from UEC to Manankattiya-Eruwewa Stream and widening the Eruwewa-Mahakanadarawa Stream																																33%				33%				33%				
	UEC-ICB-6	NCPCP Water Management Software and Control Center																																				33%				33%				33%
7	**NWPC**	**North Western Province Canal - Stage 2**																																											
	NWPC-NCB-02	Mi Oya RB 1 Canal, Mahakirula Resorvoir to Galgiriyawa (0+000km to 13+731km)																												30%				40%				30%								
	NWPC-NCB-03	Mi Oya RB 2 Main Canal From Galgiriyawa to Kaduruwewa (13+731km to 21+231km)																												30%				40%				30%								
	NWPC-NCB-04	Main Canal from Mahakithula Reservoir to Potuwila Tank (0+000 to 1+491km) and Potuwila Tank to Upper Mediyawa (0+000 to 19+980km)																												30%				40%				30%								
	NWPC-NCB-05	Yapahuwa Canal From Mediyawa Canal (0+000 to 11+200km)																												30%				40%				30%								
	NWPC-NCB-06	Main Canal From Dambulu Oya to Wemedilla LBMC including Dambulu Oya Diversion Structure (0+000 to 8+590km)																				30%				40%				30%																
8	**CS**	**Consulting Services**																																											
	CS-3	PMDSC (Program Management, Design Supervison Consultant) Consulting Package																												20%				20%				20%				20%				20%
	CS-4	Strengthening Integrated Water Resources Management (SIWRM)																																50%				50%								

APPENDIX 9

PROCUREMENT CAPACITY ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 9

AGRICULTURE AND WRDIP SECTOR PROCUREMENT CAPACITY ASSESSMENT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
BLI	–	Base Line Indicator
CAG	–	Comptroller and Auditor General
CPI	–	Compliance Performance Indicators
DOI	–	Department of Irrigation
DPC	–	Department Procurement Committee
EOI	–	Expression of Interest
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
ICTAD	–	Institute for Construction Training and Development
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
Rs	–	Sri Lankan Rupees
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
MFP	–	Ministry of Finance and Planning
MPC	–	Ministry Procurement Committee
MPP	–	Master Procurement Plan
MRB	–	Mahaweli River Basin
NCASL	–	The National Construction Association of Sri Lanka
NCPCP	–	North Central Province Canal Project
NPA	–	National Procurement Agency
NWPC	–	North Western Province Canal
PAC	–	Public Accounts Committee
PE	–	procurement entity
PMDC	–	program management and design consultant
PPC	–	Project Procurement Committee
PPP	–	Public private partnership
PPTA	–	project preparatory technical assistance
PSB	–	Procurement Support Bureau
RPC	–	Regional Procurement Committee
SIWRM	–	strengthening integrated water resources management
UEC	–	Upper Elahera Canal
UNICITRAL	–	United Nations Commission on International Trade Law

CONTENTS

ANNEXES

FIGURES

I. EXECUTIVE SUMMARY

A. Overall Assessment of Sector and WRDIP Procurement Risk

1. The agricultural sector and the WRDIP procurement classification is assessed as moderate (Category B). A summary of the assessment is included in **Annex 1**. Detailed completed questionnaires for sector and WRDIP program are presented in **Annex 2** and **Annex 3**, respectively. No changes to recently revised procurement thresholds are proposed.

1. Summary of Identified Weaknesses and Risks

- Inadequate experience in procuring large contracts through competitive mode
- No reliable database of procurement
- Many large projects are being financed bilaterally on non-competitive basis.
- Private sector is competitive only for small contracts. The number of potential firms for large contracts are few; good international bidders participate only for large contracts. For medium sized contracts ($10-40 million), international contractors sublet works.
- The National Procurement Agency (NPA) has been inactive and its autonomy eroded.
- MPC / DPC / PPC / RPC procurement approval thresholds are low ($0.78 million for NCB and $1.57 million for ICB). The CAPC gets over-burdened.
- Contract administration is weak in respect of “Goods” contacts.
- Although there are financial audit procedures in place for State sector organizations, they are not customized for addressing procurement related issues.
- The Appeals Board for CAPC contracts cannot issue enforceable final decisions. There is lack of full transparency as the outcome of appeals reviews are not made public.
- Procurement procedures do not address means of preventing corruption, fraud, conflict of interest and unethical behavior. Although many cases have been investigated, few have resulted in court action.

2. Summary of Mitigation and Management Measures to be Adopted

- It is essential to revive the NPA as an independent agency tasked with procurement reform.
- Since the capacity of local irrigation works contractors is limited to small-size packages, for the WRDIP road sector contractors may be encouraged to bid.

- In the mid-size contracts ($10-40 million), there are few qualified contractors in Sri Lanka; foreign bidders may be less interested. It would therefore be preferable to keep contract packages either small (<$10m) or large (>$40m). State to increase the size of bid packages, enabling local contractors to gain experience in doing larger contracts.
- Consider empowering MPC / DPC / PPC / RPC to approve higher value procurements of works, goods and services.
- The PMO should devise its own procedures to address complaints adequately and transparently.
- Program may consider recruiting an independent professional to independently investigate complaints, protests and provide recommendations to Program Director.
- It is recommended that agencies in the sector be subjected to regular procurement performance audits by independent external auditors.
- Regular hands on procurement training and retention of trained staff essential. Provide a training budget in the WRDIP.
- PMO should be empowered to prepare cost estimates based on realistic market rates while using agency schedule of rates as a reference.

II. SECTOR/AGENCIES PROCUREMENT ASSSESSMENT

A. Overview

2. The Sri Lankan agricultural sector and the Water Resources Development Investment Program (WRDIP) procurement capacity assessment was prepared in accordance with the Approach to Assessing Sector/Agency Procurement Risks. The assessment was undertaken from May 2014 to November 2014 over four field visits. Meetings and discussions were conducted with MIWRM, MASL, MCEB, ADB-SLRM, NCASL, DOI and the World Bank financed Dam Safety Project officers. Preparation activities included reviewing documents, collecting information on completed and ongoing projects procurement performance, review of reports and information from internet (notably assessment report on Sri Lanka procurement system based on OECD-DAC Benchmarking Framework) ADB's ongoing procurement experience, interviews with counterparts and discussions with stakeholders.

1. Investment Program

3. The WRDIP will assist the government complete outstanding water conveyance investments under the Mahaweli Ganga Development Program (MDP). Completion of MDP is a key priority of the government and will maximize the productivity of the Mahaweli River Basin's water resources by transferring available water to the country's northern dry zone areas for irrigation, drinking and commercial purposes. This will accelerate local and national economic growth.

4. The WRDIP will be financed under a $675 million multi-tranche financing facility (MFF). The MFF will comprise three tranches financing three loan "Projects." The North Central Province Canal Project (NCPCP) will be implemented in two sequential phases. The WRDIP will implement Phase 1, comprising three investment projects:

(i) The Kalu Ganga-Moragahakanda Transfer Canal (KMTC) that will convey water between the Kalu Ganga and Moragahakanda Reservoirs (both under construction)

The Upper Elahera Canal (UEC) that will convey water northwards from the Moragahakanda Reservoir to the existing Huruluwela and Manankattiya Reservoirs, which feed existing irrigation and water supply schemes

(ii) The North Western Province Canal (NWPC) that will withdraw water from the Dambulu Oya River and Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located throughout the North Western Province

(iii) Minipe Left Bank Canal Rehabilitation (MLBCR) is located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River and will (a) add upstream storage by heightening the headwork's weir to regulate generation inflows, and (b) rehabilitate the MLBC to improve service to existing farmers

5. The project investment is designed to be implemented over 10 years 2014 to 2023. Tranche1 will be implemented over four years 2014 to 2018.

6. The Executing Agency (EA) for the project will be the Ministry of Irrigation and Water Resources Management (MIWRM). A full time Program Director leads the Project Management Unit (PMU). The Program Director reports directly to the Secretary of the MIWRM. The implementing agencies (IAs) will be the Mahaweli Authority of Sri Lanka (MASL) and the Department of Irrigation (DOI). Both the MASL and DOI are government institutions, under the jurisdiction of the MIWRM.

7. For the WRDIP three tranches are proposed; each tranche will comprise of an individual project or projects. A Project Director will be assigned to manage each of the three projects in Tranche 1. The Project Directors would be supported by construction, procurement, accounts and administration staff.

8. Procurement under the program will conform to ADB's Procurement Guidelines (2013) and Guidelines on the Use of Consultants (2013) as amended from time to time. Civil works contracts above $15 million will be through international competitive bidding (ICB) and those costing less than $15 million will be under national competitive bidding (NCB) procedures acceptable to ADB. Single-stage Two Envelope Bidding with post qualification will be adopted for all NCB and ICB contracts under the Investment Program. Specialized and small community works costing less than $20,000 may be directly awarded to project area community groups and civil society organizations as a community works contract. For the procurement of goods and related services, ICB will be used for contracts of more than $2.0 million and NCB for contracts of less than $2.0 million. For contracts valued at less than $100,000 ADB's shopping procedures will be followed. Works by government-owned entities (for activities which cannot be done by competitive contracting) shall be done by Force Account method.

2. Legislative and Regulatory Framework

9. The aim of the public procurement policy in Sri Lanka is to ensure speed, transparency and integrity in all the development spheres, and in regard to which the procurement function of goods, works and services plays a critical role. The public procurement process is conducted by all government departments and agencies.

10. The Sri Lanka legal system is based on British Common Law, Roman Dutch Law and customary practices of Sinhalese, Tamils and Muslims. The legal system is very well established. There is a hierarchy of courts, the apex body in the country being the Supreme Court of Sri Lanka. The country is divided into five judicial circuits, subdivided into districts with district courts. The lowest courts are conciliation boards with responsibility to deal with minor criminal and civil cases. The Chief Justice of the Supreme Court and two subordinate justices appointed by the President make up the Judicial Service Commission, which has appellate and judicial powers in criminal cases and exclusive powers in most serious criminal cases.

11. The government is a signatory to the Paris Declaration on Aid Effectiveness. In the case of Sri Lanka, successive governments, regardless of political affiliation, have been committed to procurement reform, underpinned by the National Guidelines. Occasional modifications have been in the nature of delegation and transparency. The Guidelines cover all the relevant areas under United Nations Commission on International Trade Law (UNCITRAL), and have been ruled to have the force of law.

12. The Procurement Support Bureau (PSB) was created with assistance from the ADB under the MFP in 1999 to assist in clearance functions relating to awarding and execution of contracts, which was strengthened by the formation in 2004 of the National Procurement Agency (NPA), to regulate public procurement activities of the country. The NPA has been kept distinctly separate from the agencies carrying out procurement functions. One important change from 2009 is while NPA was an independent entity directly reporting to the President of Sri Lanka till 2009, thereafter it is under the administrative control of MFP. A partial loss of operational freedom of the NPA is the result.

13. The National Procurement Agency (NPA) was established in 2004 under Presidential Directive. The institution, which functions under Ministry of Finance and Planning (MFP), is mandated to study, revise and adopt the procedures and processes of public procurement. The NPA brought out a Procurement Guideline and a Procurement Manual in 2006 applicable for goods and works. The Guidelines on Government Tender Procedure (Revised Edition, 1997), Revised Guidelines on Government Tender Procedure for Projects assisted by the Foreign Financing Agencies (Revised Edition, 2000) and Treasury Circulars pertaining to the Guidelines on Government Tender Procedure issued till 2005 are replaced by these Guidelines and Manual. During 2007 standard requests for proposal and guidelines for consultants, non-consultant services, standard bidding documents (SBD) for works and goods and SBD for shopping procedures were issued by the NPA.

14. The procurement guidelines have the backing of the country's laws and are applicable to all government institutions inclusive of ministries, departments, public corporations and statutory bodies, fully-owned government companies, provincial councils and local authorities (including Pradeshiya Sabhas) for the procurement of works, services and supplies and disposal of government assets. These Guidelines have been drafted in association with the major funding agencies such as the World Bank, ADB, the Japan Bank for International Cooperation, to ensure they are harmonized to the maximum extent in order for their usage in foreign-funded projects as well. The Guidelines are available on the NPA’s website as downloadable documents in English, Sinhalese and Tamil.

15. The objectives of the NPA are:

(i) Standardize the government procurement procedures

(ii) Accelerate the procurement process

(iii) Improve transparency and good governance

(iv) Ensure equal opportunity to eligible and desirous of participating in public bidding

(v) Ensure value for money in terms of price, quality and timely delivery

(vi) Ensure that the government procurement system is made efficient and simplified to promote development need of the country

(vii) Monitor the system relating to selection of successful bidders and award of contracts

16. The NPA performs in three main areas: (i) policy and regulation, (ii) monitoring, and (iii) capacity building. Under the area of policy and regulatory initiatives, the NPA covers the issuance of Guidelines, Manuals & Directives for Procurement of Goods, Works, Services and Consultant Services and public private partnerships (PPPs); formulation of SBDs; Indicative Specifications for Procurement of Goods; Appeal Board Procedures; formulation of black-listing procedures; and plays the key advisory role in public procurement.

17. In respect of procurement monitoring, the NPA's role focuses on the preparation of National Procurement Plans, monitoring of procurement activities, accreditation of personnel for Procurement Committees and Technical Evaluation Committees (TECs), appointment of Procurement Committees and TECs, assisting and advising line ministries/agencies on issues related to the procurement process, and facilitating and coordinating publication of information on procurement activities and awards.

18. Preparation of curricula for procurement training, conducting short-term training and diploma programs on every aspect of public procurement and contract administration, conducting training-of-trainers programs, conducting training programs for private sector and professional organizations, establishment and maintenance of a Resource Center on procurement, and conducting research and development activities relating to public procurement were carried out by the NPA in order to strengthen capacity building in public procurement.

B. Procurement Reform Initiatives

19. The NPA increased the efficiency and effectiveness of public procurement and in doing so has introduced a number of initiatives in the three areas of policy, monitoring and capacity building as discussed in the previous section. Some of the important developments have been:

(i) The introduction of pre-procurement activities. In March 2006 the Secretary to the Treasury instructed that all institutions were required to furnish details of procurement preparedness activities when seeking annual financial allocations. This led to the mandating of procurement planning for Treasury budget allocations.

(ii) Ministries and provincial councils prepare Master Procurement Plans based on the institutional plans for the purpose of monitoring.

(iii) The NPA had introduced a web-based system for monitoring large-value procurement based on the master plans.

(iv) Established Procurement Cells in each line ministry and provincial council, headed by a senior a ministry official designated as the Procurement Liaison Officer. In furtherance of this initiative a circular was issued by the General Treasury establishing the Procurement Assistants Service – cadre for providing specialized procurement services.

C. Regulation and Oversight

20. The NPA is primarily a regulatory body, with functions in the following areas:

- Policy: advising the government on procurement policy, submitting reports, reviewing the system, studying other systems and coordinating procurement reforms
- Regulatory framework: issuing guidelines, manuals and SBDs and advising PEs on their interpretation
- Monitoring: collecting procurement and contract implementation statistics, requiring reports from PEs and monitoring procurement
- Information dissemination: operating a procurement website and publishing a bulletin
- Capacity building: arranging training and other programs for public and private sector, arranging accreditation programs for public sector procurement staff
- Regulatory: operating the updated list of the bidders debarred by different PEs

D. Institutional Framework and Management Capacity

21. A multi-layered procurement decision-making structure was instituted, depending on the value of the procurement, with authority levels at the Cabinet Appointed Procurement Committee (CAPC), the Ministry Procurement Committee (MPC), the Department Procurement Committee (DPC) and the Project Procurement Committee (PPC). This system still continues and the authority of the respective procurement committees for contract award recommendation and determination is set for both government and foreign-funded projects. A provincial council has the same authority level as the MPC.

22. Public procurement functions are mostly decentralized. The line ministries and provincial councils are responsible for procurement within their organizations. However, the level of delegation to the contracting authority within these organizations is inadequate. Since tender awards beyond a certain value (>$3.92 million for externally financed contracts and >$1.18 million for State financed contracts) have to be referred to the Cabinet for approval, the possibility of political interference in decision making cannot be ruled out.

23. There is no separate procurement cadre or procurement core group in the country. Most of the staff carrying out procurement functions are from general engineering and accounting cadres, often inexperienced and not trained specifically in procurement. Additionally, contract administration is weak. This has resulted in cost and time overruns.

24. Each procuring entity[1] (PE) is required to establish a procurement unit or designate a unit with responsibility for procurement and contract management. Each PE must also form an evaluation committee. Depending on the size of the annual volume of procurement there may

[1] Procuring Entity means a Government ministry, provincial council, Government department, statutory authority, government corporation, government owned company, local authority or any subdivision thereof or any other body wholly or partly owned by the Government of Sri Lanka or where the Government of Sri Lanka has effective control of such body, that engages in Procurement.

be more than one evaluation committee. It is expected that there would be one Tender Approval Committee for WRDIP and three Tender Evaluation Committees for each of the three investment projects.

25. Staff undertaking procurement are required to have adequate qualifications and knowledge or training on procurement; the NPA has reported inadequate capacity in many PEs. The NPA continues with PEs capacity needs assessment, training and establishment of a national procurement training system.

E. Summary of Procurement Capacity Assessment carried out by NPA (2007)

26. The assessment of the procurement system is based on the OECD-DAC Benchmarking Framework.[2] The NPA as the procurement regulatory agency in the country conducted the pilot exercise, in collaboration with central and provincial government agencies. Guidance and support has been provided by key donor agencies. The purpose of the exercise was to assess the standing of the national procurement system with respect to accepted international practices, to identify shortfalls and develop strategies for improvement. The main elements considered are:

- Equivalence and Acceptability – to determine the extent to which the national procurement system matches internationally accepted procurement policies
- Addressing Gaps – to determine and implement strategies to address shortfalls identified

1. Benchmarking Framework

27. For this assessment a system of indicators referred to as Baseline Indicators (BLI) and Compliance Performance Indicators (CPI) were used. The BLIs are grouped under four categories referred to as “Pillars”. The four pillars are:

Pillar I - Legislative and Regulatory Framework
Pillar II - Institutional Framework and Management Capacity
Pillar III - Procurement Operations and Market Practices
Pillar IV - Integrity of the Public Procurement System

28. The BLIs give a “snapshot” comparison of the actual system against international standards. The CPIs deal with how the procurement system actually operates, and are more closely related to the applications of the regulations and to the prevailing procurement practices in the country.

2. Baseline Indicators

29. On a scoring scheme of 0 to 3.0, it was found that Pillar I (score = 3.0) is fully compliant, and that Pillars II (score = 2.13) and Pillar III (score = 2.04) have some shortcomings which need to be addressed. Major deficiencies are seen in Pillar IV (score = 0.90), the Integrity and Transparency of the Public Procurement System.

[2] *Methodology for the Benchmarking and Assessment of Public Procurement* Systems: Vol.4 – User Guide
OECD – DAC Joint Venture for Procurement

a. Pillar I – Legislative and Regulatory Framework (average = 3.0)

30. Although the NPA is not incorporated by an Act of Parliament, the NPA carries out its duties on behalf of the Cabinet and the NPA Procurement Guidelines are issued with the approval of the Cabinet of Ministers. The assessment of the Pillar I BLIs indicates that there is a well-established quasi-legislative and regulatory framework for the procurement system in Sri Lanka.

b. Pillar II –Institutional Framework and Management Capacity (average = 2.13)

31. In the assessment of the three BLIs comprised of 12 sub-indicators, it is seen that there are short comings in BLI 3 (score of 2.25) and BLI 5 (score of 1.13).

32. For BLI 3 there is a need to ensure the timely preparation of Completion Reports for certification of implementation and reconciliation with budget programs. *Recommendations: contract monitoring to be expanded beyond the CAPC level. Detailed contract completion procedures to be prepared*.

33. For BLI 5 the present manual systems for the collecting and disseminating of procurement information, and monitoring of procurement statistics are cumbersome and ineffective. Further the training and capacity building of government sector staff appears inadequate to meet the need, and is almost non-existent for the private sector. *Recommendations: implementation of interactive website for dissemination of information. Training programs to be expanded.*

c. Pillar III – Procurement Operations and Market Practices (average = 2.04)

34. In the assessment of the three BLIs comprised of 10 sub-indicators, it is seen that there are shortcomings in BLI 6 (score of 2.0), BLI 7 (score of 2.0) and BLI 8 (score of 2.13).

35. For BLI 6 there are no procurement related cadre positions in the government services, and procurement activities are handled by general staff. Although they have received training in basic procurement procedures, updating of skills is not apparent. *Recommendations: a new government sector recruitment structure to include specialized procurement related cadres. Senior staff to be developed as "trainers" for in-house training. Information on available training programs to be widely circulated*.

36. For BLI 7 although there are no constraints to the private sector's access to the procurement markets, there are no established guidelines for PPP. Also the private sector is small, with competition for large contracts being limited to a few of the larger organizations. *Recommendation: guidelines for public-private sector partnerships to be finalized*.

37. Regarding BLI 8, the "Works" contracts, contract administration and dispute resolution are well-defined and practiced, but contract administration is weak in respect of "Goods" contacts. *Recommendation: contract administration procedures for "Goods" contracts to be strengthened.*

d. Pillar IV – Integrity and Transparency of the Public Procurement System (average = 0.90)

38. In the assessment of the four BLIs comprised of 18 sub-indicators, it is seen that there are shortcomings in all, particularly with BLI 9 (score of 0.60), BLI 10 (score of 1.0), BLI 11(score of 1.0) and BLI 12 (score of 1.0).

39. For BLI 9 although there are financial audit procedures in place for government sector organizations, they are not customized for addressing procurement. *Recommendations: Auditor General staff to be trained in procurement procedures. Procurement and contract administration to be included in audits*.

40. For BLI 10 in terms of the country's constitution, the Appeals Board for the CAPC contracts cannot issue enforceable final decisions and hence the Appeals Board has no independence for the resolution of complaints. There is also a lack of transparency as the outcome of appeals reviews are not made public. *Recommendation: although the Appeals Board is constrained by constitutional requirements, maximum publicity should be given to appeals made and the recommendations of the Board*.

41. For BLI 11 access to information in respect of contract awards is minimum, and there is no public information on the decisions made regarding appeals. *Recommendation: the NPA and ministry websites to carry procurement related information at all stages*.

42. Regarding BLI 12, procurement procedures do not address means of preventing corruption, fraud, conflict of interest and unethical behavior. There is a Commission to Investigate Allegations of Bribery and Corruption. Although many cases have been investigated, few have resulted in court action. *Recommendation: procurement procedures to include provision to prevent corrupt practices and actions to be taken*.

3. Compliance Indicators

43. Compliance Performance Indicators [CPI] were derived from the data collected from the seven ministries selected for the pilot project.

a. Procurement carried out through Open Tendering (by Number & Volume)

44. At CAPC-level 79% of the procurement by numbers and 97% by value, are through Open Tendering. Single Source procurement of spare parts for plant and equipment results in the relatively low 79% of open procurement. At MPC level 96% of the procurement by numbers and 99% by value is through Open Tendering.

b. Time (in Days) allowed for Submission of International and National Tenders

45. It is seen that the bulk of the bidding periods lie with 50 days (7 weeks), which is in line with the NPA requirement as specified in the NPA Procurement Manual.

c. Time (in Days) allowed for Evaluation of International and National Tenders

46. For CAPC-level contracts in most cases, in which evaluations are supposed to be completed within a 100-day period, there are a substantial number that take a considerable period of time, with some going beyond a year. In the case of MPC-level contracts, the situation is better with 67% being completed within a 50-day period. The NPA Procurement Manual specifies a time frame for evaluation of bids.

d. Number of Tenders where Award exceeds Estimate (% by which Exceeded)

47. Although procurement planning as a mandatory requirement to get budgetary allocations was introduced in 2006 and was applicable to all government agencies, it is found that budget over-runs are still evident. The NPA monitors procurement planning for high-level procurements. The implementing agencies monitor and report on lower value contracts.

4. Confidence in the System

48. The confidence placed in the procurement system by suppliers of goods, works and services is reflected by the number of bids received for each contract. It is found that for CAPC-level contracts there are on average of 5 bids per contract and for MPC-level contracts an average of 4 bids per contract. In both cases, the figures could be considered as good.

5. Procurement Cells in Ministries

49. The NPA targeted setting up of Procurement Cells in all cabinet-level ministries and non-cabinet level ministries and also in provincial councils. As of 2007, Procurement Cells has been established in 72% of the cabinet ministries, in 10% of non-cabinet level ministries and in 100% of the provincial councils.

6. Training Programs conducted by the NPA

50. The NPA conducts a wide range of training programs for the government sector. A need for more training at the awareness level, and more importantly at the specialized level, is felt. This was reflected in the BLI assessment. Further, the need for awareness and training courses for the private sector is evident. During the period 2004-2007, all government departments and parastatals were trained by the NPA. From 2008, training opportunities are limited to those administered by multilateral development banks and some government programs.

III. PROGRAM PROCUREMENT ENTITIES

A. Ministry of Irrigation and Water Resources Management

51. The MIWRM will be the EA for the WRDIP and its structure is shown below (information about MIWRM, DOI and MASL from MIWRM website).[3]

Divisions & Branches of the Ministry	Institutions of the Ministry
Water Resources	Irrigation Management
Engineering Services	Irrigation Department
Planning & Plan Implementation	Mahaweli Authority of Sri Lanka
Mahaweli Systems	Water Recourses Board
Lands & Land Development	Central Engineering Consultancy Bureau
Finance	
Administration	
Internal Audit Division	

52. The organization chart of MIWRM is shown in **The MIWRM** has a Ministry Procurement Committee (MPC) that takes procurement decisions for which it is empowered. The responsibility of procurement actions is vested with the MIWRM Secretary, who is deemed to be the Chief Accounting Officer.

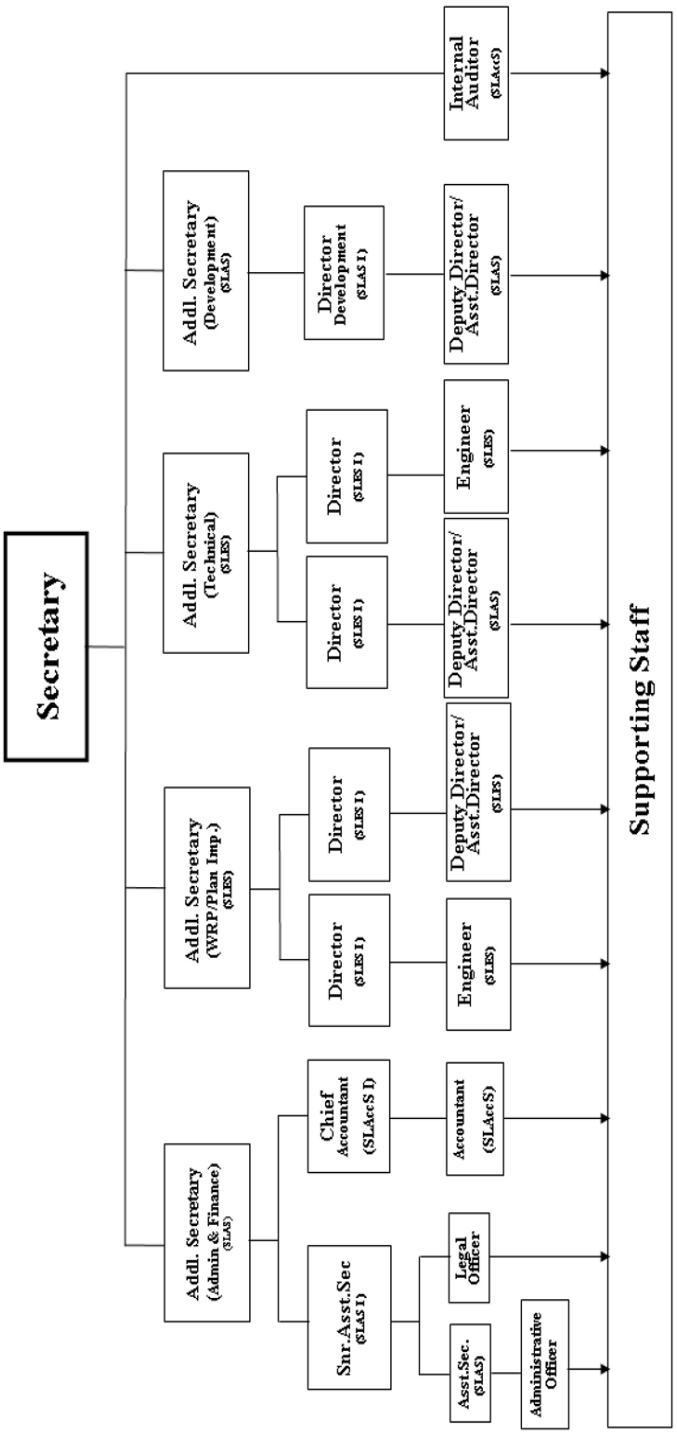
B. Department of Irrigation

53. The DOI carries out the construction work of projects mainly on force account using departmental machinery, as well as hired machinery. Some of the small scale works and supplies are awarded to local contractors. The DOI awards some of the specific construction work (such as maintenance and emergency works) to specialized contractors / agencies after negotiation.

54. The DOI functions under the control of MIWRM. Its organogram is shown at http://www.irrigation.gov.lk/about us/ organization structure. The DOI will be one of the IAs of the WRDIP. It has a Contract and Procurement Division whose key functions are as follows:

[3] Information about MIWRM, DOI and MASL sourced from organizations' official websites.

Figure 1: Organizational Chart of the MIWRM



Source: MIWRM, 2014

- Preparation of bid documents for standard contract for civil works of irrigation projects costing over SLRs 5 million; issuing bid documents; setting up of TEC and submitting report of same to DPC and award of contract and follow up.

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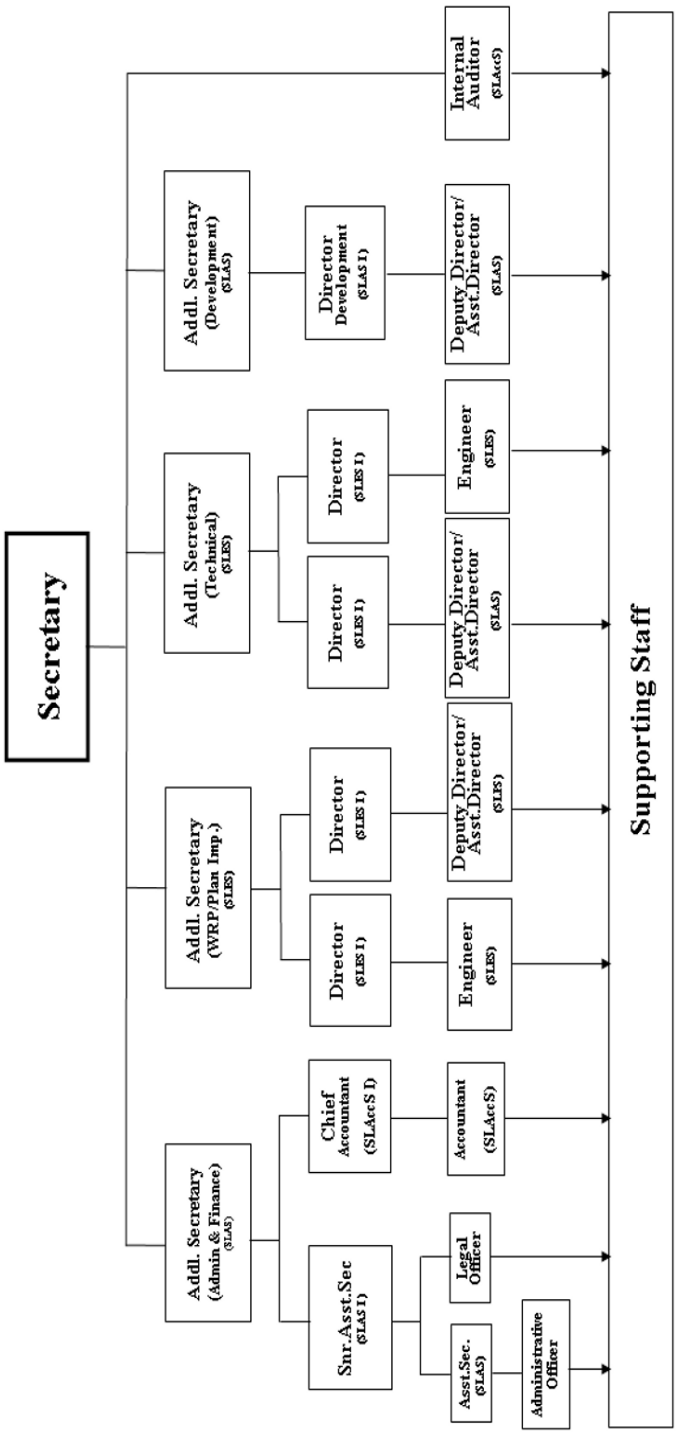


Source: MIWRM, 2014

- Preparation of bid documents for standard contract for civil works of irrigation projects costing over SLRs 5 million; issuing bid documents; setting up of TEC and submitting report of same to DPC and award of contract and follow up.
- Handling DPC activities
- Updating of procedures for standard small, medium and large contracts by initiating action
- Maintenance of a list of defaulted contractors. (available online at ICTAD website www.ictad.lk/ CONTRACTORS THOSE WHO ARE SUBJECTED TO DICIPLINARY ACTION.
- Preparation of procurement plans for goods in the DOI.
- Preparation of a register for registered suppliers and service providers for the year, at the beginning of the year including calling applications for registration
- Preparation of bid/contract documents for purchase of goods under ICB/NCB/NS or any other approved method with the approved specifications and availability of funds
- Calling sealed bids for procurements of goods
- Preparation of purchase orders or contract agreements, and placing the purchase orders under the recommendation of a TEC and approval of DPC
- Opening of letters of credit and handling of ICB contracts
- Preparation of vouchers for payment to be made by the Finance Division

D. Mahaweli Authority of Sri Lanka

59. The MASL functions under the control of the MIWRM. It will be one of the IAs of the WRDIP. The MASL was established in 1979 by a Parliament Act with a mandate to implement the Mahaweli Development Plan (MDP). Presently, its task is to plan and develop the balance of the area proposed by the Master Plan and gazetted areas, as well as maintenance and rehabilitation of irrigation systems, land administration, measures to increase agricultural production and post-settlement activities. Further, the MASL is responsible for managing irrigation water for over 180,000 hectares of irrigable land in the dry zone.

1. Board of Directors

60. The Board of the MASL consists of five directors. Three directors are appointed by the Minister, with the approval of the President, and in addition there are two ex-officio directors, namely the Secretary to the Ministry charged with the subject of Finance and the Secretary to the Ministry charged with the administration of the MASL Act. The Minister with the approval of the President appoints one of the Directors to be the Director General of the Authority.

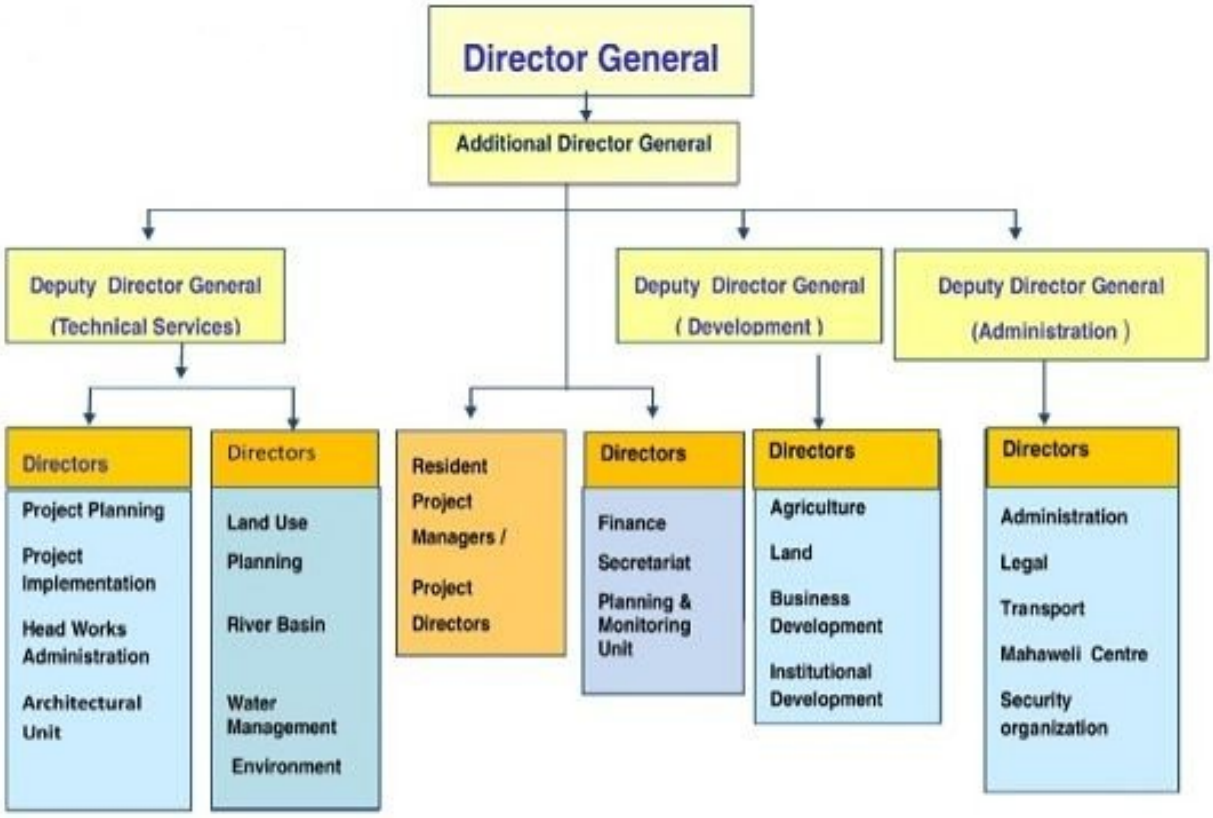
2. Management

61. The Director General is the Chief Executive Officer in the Authority. Four executive directors are assigned in the fields of Technical, Development, River Basin Management and Administration and 20 subject-specialized directors, 2 project directors and 12 resident project managers support the management. The Chief Internal Auditor's Division functions as a separate unit under Director General. MSAL head office is sited in Colombo. There are 17 site offices located in Northern, North-Central, Eastern, Central and Southern provinces. MASL follows the 'Delegation of Functions and Financial Control and Procurement Procedures (March 2013". This delegation is from MIWRM and specifies the value limits, authorization, procurement procedure, payment approval authority in detail within the framework of NPA Procurement Guidelines. Staff recruitment is done after obtaining prior cadre approval from MIWRM.

62. Total capital budget of MASL for the year 2013 was Rs 1,950 million ($15.29 million), actual expenditure was Rs 1,879 million ($14.74 million). Some of the bilaterally financed major projects are being implemented by MASL. The Moragahakanda Reservoir (estimated cost $557 million) contracts has been awarded to Sino-Hydro Cooperation Limited under financial assistance from China Development Bank. The project is due for completion in 2016. The estimated cost for the Kaluganga Reservoir was $283.97 million. The Saudi Fund for Development (SFD), Kuwait Fund for Arab Economic Development (KFAED) and OPEC are financing $99 million for the project.

63. Dam Safety and Water Resource Planning Project financed by World Bank is being implemented by MASL. The total estimated project cost is Rs 8,187 million ($75.8 million) of which Rs. 7,585.64 million ($70.23 million) is financed by the IDA-WB and balance amount is contributed by GOSL. The project has achieved 72% financial progress and 67% physical progress by end of December 2013.

Figure 2: Organizational Structure of the MASL



E. Procurement Operations and Market Practices

1. Important Sections of Procurement Manual and Guidelines

64. The Procurement Guidelines and Procurement Manual for works and goods of Sri Lanka (2006) determine the way public procurement is carried out. The Guidelines and Manual were prepared with the support of multilateral development partners and closely follow the structure and content of ADB procurement guidelines. Important elements of them are presented below. Para references are to the Procurement Guidelines.

65. Para 2.3:*Responsibilities of the Procuring Entity*: Para 2.3.1 Prior to a request being made for the appointment of a PC, the PE shall confirm to the NPA that:

- It has carried out an Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), and all other such procurement preparedness activities as may be relevant to the project.
- It has completed land acquisition and resolved compensation, re-settlement issues, including relocation of utilities and such other matters that are necessary for the uninterrupted implementation of the project.

66. Para 2.4:*Joint responsibilities of Procurement Committees and Technical Evaluation Committees*: 2.4.1 the PC and the TEC shall be responsible for the entire procurement process:

- The relevant PC and the TEC as described in these Guidelines shall carry out the entire procurement process.
- All components of a complex procurement, such as design, different construction aspects (i.e. electrical, structural, piling, etc.) shall be carried out by a single/same PC within applicable limits of authority.

67. Para 2.7.1 to 2.7.7: Under delegated authority by the Cabinet of Ministers, the NPA shall appoint CAPCs to undertake high value procurement. The MPC, DPC, PPC shall be appointed by the Secretary to the line ministry. Department heads having a large number of regional/district offices may set up Regional Procurement Committees (RPC) under delegated authority or with the approval of the Secretary to the line ministry, on a case by case basis. For WRDIP too, CAPC, MPC, DPC would be set up and empowered to undertake procurement as per the financial thresholds indicated in Procurement Guidelines.

68. Para 2.8.1 (a): There shall be TECs for all procurements falling under the purview of the CAPC, MPC, DPC and PPC. No member should serve in both the PC and TEC.

69. Para 2.13: Review of Performance of PCs and TECs by the NPA: Para 2.13.1 The NPA shall:

- Monitor the performance of PCs and TECs
- Conduct random post procurement reviews
- Examine on random basis, the regularity of attendance at meetings and whether the decisions taken by members are in accordance with the accepted procurement procedures and these Guidelines.

70. Para 8.13 *Variation Orders:* Contract variation orders may be authorized by the Head of Department/Project Director provided that the net sum of the variation and any previous variations does not exceed the amount of the contingency provision provided in the approved contract budget. Contingency provision generally should not exceed ten percent (10%) of the estimated contract amount. When the approved contingency provision is exceeded or where there is no contingency provision, the contract variation order should be submitted for approval to the appropriate level of authority given in the Procurement Manual.

71. Para 2.14.1: *Authority of PC for Contract Award Recommendation / Determination* (for works and goods):

Authority	Government-funded Projects (equivalent amounts in parentheses in US$)	Foreign-funded Projects (equivalent amounts in parentheses in US$)
CAPC	More than SLRs 150 million (1.18)	More than SLRs 500 million (3.92)
MPC	Up to SLRs 150 million (1.18)	Up to SLRs 500 million (3.92)
DPC/ PPC	Up to SLRs 50 million (0.39)	Up to SLRs 150 million (1.18)
RPC	Up to SLRs 5 million (0.039)	Up to SLRs 5 million (0.039)

72. As per the Guidelines, in the case of a foreign-funded project, if the foreign funding agency mandates the use of procurement guidelines of such funding agency, such funding agency guidelines shall prevail over these Guidelines to the extent applicable. In the event of a conflict between these Guidelines and that of the funding agency, the funding agency guidelines shall take precedence over these Guidelines.

F. Performance on Externally Financed Projects[4]

73. In the agricultural sector, the Dam Safety and Water Resource Planning Project financed by World Bank, Conflict Affected Region Emergency Project financed by ADB and Pro Poor Economic Advancement and Community Enhancement project of JBIC are under implementation. As inferred from discussions and published sources, the most serious shortfalls in contract award and implementation are due to (i) delays in contract awards resulting from delays in carrying out procurement actions according to the Guidelines, inadequate authority given by EAs to Project Directors, delays in evaluation and approvals by TECs and Tender Boards and unfamiliarity with the procurement guidelines of the financing institutions; (ii) delays in establishment of PMUs and appointment of project staff; (iii) time-consuming procedures for land acquisition and resettlement resulting in delays in on-site mobilization; (iv) delay in preparation of documents and finalization of terms of reference for consultant services; and (v) inadequate counterpart funds and budget allocation.

74. No large contracts (>$15 million) have been procured in World Bank and JBIC financed projects in their Sri Lanka portfolio. The ADB JBIC co-financed Southern Transport Development Project with a contract of $210 million is the largest procurement done to date in the ADB portfolio. Due to changes in road alignment, subsequent resettlement issues, slow contract Implementation and judicial cases, the project took 11 years to be completed as against the planned 5 years. Under the ADB-financed Greater Colombo Water and Sewerage Project, a large contract of $60 million has been procured. While procurement performance of ADB portfolio in Sri Lank including agriculture sector has been satisfactory and has improved significantly from 2012, experience with implementation of large contracts is limited.

75. Perusal of the last four years (2010, 2011, 2012 and 2013) procurement performance indicators of ADB's Sri Lanka portfolio leads to the following inferences.

(i) Against a benchmark of 107 days for NCB contract advertising to award, the average time taken was 178 (in 2010), 101 (in 2011), 88 (in 2012) and 90 (in 2013). Performance in last 3 years is better than the benchmark.

(ii) Against a benchmark of 165 days for ICB contract advertising to award, average time taken is 234 (in 2011), 167 (in 2012) and 177 (in 2013). Performance in last 2 years meets the benchmark.

[4] Sources: (a) World Bank's Sri Lanka Country Procurement Assessment Report Volume -1, 2003 (b) Discussions with National Contractors Association of Sri Lanka, MIWRM, MASL, SLRM (c) publications of ICTAD (d) Data and discussions with Sri Lanka Resident Mission of ADB and (e) GOSL websites.

(iii) A total number of 229 contracts of value $207 million were procured in the four years during 2010-2013. Average value per contract is $0.90 million and average number of bids received per procurement was 4.72. While the size of contracts was small, procurement was largely done in time and competitiveness, as indicated by nearly five bidders per procurement, was good.

(iv) Number of contracts exceeding engineers estimate by 15% was 63 out of 229, appears engineers estimates are slightly on lower side.

(v) Instances of rebids reduced gradually from a high of 44% in 2010 to 7% in 2013.

(vi) Instances of contract termination, major non-compliance of ADB procurement guidelines, and re-evaluation of bids were few. Overall, it can be concluded that the trend is towards improved procurement performance, most of the contracts are small, are processed within acceptable time and deviations from procurement guidelines are minimal.

76. The World Bank-financed Dam Safety and Water Resources Planning Project officers expressed following views; (i) Due to nature of work (repairs and scattered locations), most contracts are small in size, with a total outlay of $69 million, 83 contracts are awarded (25 by MASL, 58 by DOI), the largest being $3 million; (ii) There is a lack of adequate competition and capable contractors in the irrigation sector, primarily due to no new major work being implemented during internal strife; (ii) Overall contractors performance is satisfactory with some delays due to local factors, land acquisition, unsatisfactory contractor performance and the short window of time available for work since irrigation systems cannot be closed for longer periods; (iv) Out of 58 contracts of DOI, 35 are completed, one contract terminated and rest in progress, of the 25 contracts of MASL, 8 are completed, 15 are in progress and 2 are yet to be awarded including an ICB of estimated cost $7.7 million (data as of June 2014).

77. The ADB financed Conflict Affected Region Emergency Project under implementation from 2011 with DOI as the implementing agency presents a similar picture. For an outlay of $17 million, there are 74 contracts with the largest contract value being $2.96 million. The March 2014 project progress report lists same problems as above.

78. Many large projects (ranging from $92-804 million) are being financed bilaterally. Some major ones are financed by EXIM Banks of China and India, Iran, Credit Agricole of France, Australia & New Zealand Investment Bank. Procurement for these are on direct award basis, usually to entities from the financing country. It is felt that such large-scale investment, cannot be handled through normal tender procedures. Presently bulk of Sri Lanka's foreign assistance is no longer largely mobilized through ADB, WB and JBIC. Each had its own procurement system. There were long, time-consuming processes on both sides before a project was finalized. There are concerns in some quarters that these large size procurements on non-competitive basis may not be transparent and value for money. The route of unsolicited proposals, it is widely agreed, is quick. Notwithstanding quality concerns, the Government is getting its infrastructure in place fast.

G. Competitiveness and Participation of Private Sector in Public Procurement

79. The private sector needs to be equally efficient, competent, honest and vigilant if public procurement is to function effectively. The construction industry in Sri Lanka has yet to reach full potential to meet the required capacity for the country's development programs. Until recently all the large contracts were awarded to foreign contractors. The Institution for Construction Training and Development (ICTAD) has been conducting training courses for the construction industry. This training has enabled domestic contractors to improve their efficiency and capability. The consultant services profession however, has not developed sufficiently in the country. Consultants are usually hired from outside the country. Local consulting firms and/or individuals often associate with foreign firms, working as sub-consultants or providing individual experts.

1. Institute for Construction Training and Development

80. The ICTAD was set up by the government to develop the domestic construction industry. Established in 1986, it drew upon the experience of its predecessor, the Construction Industry Training Project to carry forward the training activities for the construction industry. The ICTAD currently functions under the Ministry of Housing and Plantation Infrastructure and enjoys the status of a parastatal body. With its headquarters in Colombo, it acts as a coordinator, facilitator and enabler to develop the construction industry by mobilizing the efforts and resources of the government and private sector.

81. The ICTAD has implemented registration and grading system of domestic construction contractors. Details of contractors registered under various fields ("C" - Building & Civil Engineering, "EM" - Electrical Mechanical Services, "SP" - Specialized Constructions & GP " - Piling) and grades (C10 for Building & Civil Engineering >$7843 to C1 for > $4.71 million) are available at ICTAD website www.ictad.lk. There are 3 contractors graded C1 in the field of irrigation & land drainage and 32 in the field of highway. Once granted the registration is valid for three years & needs to be renewed thereafter. ICTAD registration is a requirement for obtaining government contracts and there are over 2500 Construction Contractors registered with ICTAD.

82. ICTAD has a well-defined procedure for dealing with registration offences and performance offences. Registration offences are submission of false documentation, delay in renewal of registration. Performance offences are contract termination, unauthorized subcontracting, rigging bidding and contract termination due to poor performance. An inquiry panel appointed by Chairman ICTAD shall upon inquiry may downgrade registration or suspend contractor's registration for a maximum period of up to two years.

H. Capacity Assessment of Contractors and Construction Industry Development

83. The National Construction Association of Sri Lanka (NCASL) is the apex body in Sri Lanka for development of the construction industry. It was originally formed as the Association of Construction of Sri Lanka in 1981, with the support of the government of Sri Lanka and the World Bank. Presently, the NCASL has over two thousand five hundred regular members. Major issues of NCASL are (i) Delayed payments; (ii) Shortage of qualified and capable domestic

consultants who can manage projects with siding with the employer; (iii) Difficulty in obtaining bank guarantees for bidding, performance guarantees, especially for smaller contractors; and (iv) GOSL many times awards work directly without competitive bidding to GOSL owned entities, which should be done away with to improve competitiveness and growth of local contractors.

84. Construction Industry Development Bill has been formulated in August 2014 and is to be enacted by GOSL. The Bill proposed setting up of a National Advisory Council on Construction and a Construction Industry Development Authority to regulate and standardize construction activities. The objectives of the National Advisory Council on Construction shall be to (i) Formulate and amend the national policy on construction and its implementation mechanism; (ii) make representations to the Minister on any need for the development of the construction industry; (iii) advise the Minister and make recommendations on any regulation to be made under this Act; (iv) advise and make recommendations to the Authority on strategic issues, policies and legislative proposals that may affect or which is incidental or connected with the construction industry; and (v) propose measures to the Authority which are necessary for the development and sustenance of the construction industry.

85. The objectives of the Construction Industry Development Authority shall be (i) to ensure the implementation of the national policy on construction in keeping with the directions issued by the Minister; (ii) to provide strategic leadership to the stakeholders of the construction industry to stimulate sustainable growth, reform, and improvement of the construction sector; (iii) to register and renew such registration of the stakeholders of the construction industry as may be prescribed from time to time; (iv) to promote sustainable growth of the construction industry with special attention to the design and development of energy efficient buildings and structures; (v) to promote appropriate research and dissemination and publication of research work on any matter relating to the construction industry and its development; (vi) to formulate, in consultation with other relevant authorities, the standards in construction industry and categorize such standards as compulsory and voluntary standards; and (vii) to implement the Codes of conduct, practices, procedures and processes and documentations relating to construction industry as being formulated by the Authority.

86. One of the functions of the Authority is to recommend to any relevant authority to formulate national procurement guidelines related to procurement of works, goods and services in relation to construction industry.

87. Adequate competitiveness exists for small contracts (<$4 million) and for large contracts. Very large contracts, many above $100 million are awarded to mostly foreign firms without bidding. Better capacities exist among road contractors, but much less in irrigation sector contractors for medium sized contracts. Contracts of size $10-40 million would face problems since very few domestic firms would qualify and foreign firms may not be interested. Large contracts (>$40 million) attract international bidders due to perceived good business environment in Sri Lanka.

I. Registration and Participation

88. There are no restrictions on participation in public procurement based on nationality for ICB. Registration is more politically and socially driven in case of low value works at the local level.

J. Procurement Planning

89. Advance procurement actions to be undertaken by PEs are listed in the Procurement Manual and Guidelines. The PE shall prepare the Master Procurement Plan (MPP). Procurement activities envisaged at least for a period of three years shall be listed in the MPP. Procurement activities for the immediately succeeding year shall be prepared in detail. The MPP shall be regularly updated at intervals not exceeding six months. MPP shall assess the relative advantages of the following:

- Centralized versus decentralized procurement
- Packaging/slicing of contracts
- Size of the packages for works

90. A procurement schedule listing various steps (bid preparation, invitation, evaluation, approval and contract award) and total cost estimates are also required to be prepared by the PE. Cost estimates shall include the following contingency provisions:

- Maximum of 5%for procurement preparedness activities
- Maximum of 10%for physical contingencies
- Reasonable estimated amount for price contingencies
- Cost estimate shall also include applicable VAT, shown separately.

K. Procurement Methods

91. The NPA Guidelines describe a variety of procurement methods, with a preference for competitive bidding, and various methods suitable for high and low values and for consultancy services, as well as goods, works and non-consultancy services. Most of the methods are same as ADB's Guidelines. Splitting of requirements to avoid higher procurement method is prohibited.

92. The Guidelines describe various procurement methods that can be used by PEs. The key to the selection of method is to understand what situations are suitable for each of them. Depending on the nature and size of the project and its procurement elements, a PE may use any of the methods set out in the Guidelines, to procure goods, works and services. The choice of procurement method depends on:

- Nature of the goods and services to be procured
- Value of the procurement
- Local availability and cost of goods and services
- Critical dates for delivery
- Agreement with the funding agency
- Transparency of procedures proposed

93. Commonly-used methods of procurement include ICB, NCB, Limited International Bidding, International and National Shopping, Direct Contracting and Force Account. Some other listed methods are Limited National Bidding, Direct Contracting, Repeat Orders, Emergency Procurement and Community Participation in Procurement.

94. Special procurements methods listed are Procurement of Commodities, Procurement of Spare Parts, Repairs to Motor Vehicles and Equipment, Periodicals and Publications, Purchasing of Fuel, Procurement of Pharmaceuticals and Medical Equipment, Information Systems and E-Procurement.

95. Bid procedures followed are two-stage bidding, two-envelope system and pre-qualification of bidders. The two-stage tendering method is to be adopted for turnkey contracts or contracts for a large complex of plants. It may not be possible to prepare complete technical specifications in advance, if a PE lacks the capability to prepare specifications, and alternative technical approaches are not be available within the knowledge of the PE.

96. Shopping is used under following circumstances:

- Readily available off-the-shelf goods
- Low value simple works and physical services
- At least three responsive quotations.

97. Direct Procurement is resorted to when only one supplier or contractor is to submit an offer when it is of (i) proprietary nature, (ii) critical plant components, (iii) exclusive dealer or manufacturer, (iv) government-owned industry or factory using government own funds,(v) small-scale local industries for specialized products, and (vi) not inter-changeable with existing equipment.

98. Direct Procurement is to be used only under exceptional circumstances as follows:

- When the prices or rates are fixed pursuant to legislation by regulatory bodies
- Standardization of equipment, for compatibility with existing equipment, may justify additional purchases of the same type of goods. In such purchases the number of such items in the new procurement shall generally be less than 50% of the existing number
- The required equipment is proprietary and obtainable only from one source such as proprietary software, text books, spare parts, or defense items
- The process design requires the purchase of critical items from a particular supplier as a condition of a performance guarantee

99. Orders placed with the original supplier over a short period of time for the supply of the same goods shall be considered as repeat orders. Repeat orders for the procurement of goods may be authorized only in exceptional circumstances up to a limit of 50% of the original contract value, provided that not more than a six month period has lapsed from the date of award of the original contract.

L. Consultant Procurement

100. For procurement of consulting services, the NPA has issued guidelines including Selection and Employment of Consultants (2007) and Consulting Services Manual (2007). The guidelines were prepared with advice and support of multilateral development institutions and are substantially aligned with ADB Consultant Guidelines. The financial threshold limits of authority for selection are defined in the manual. Consultancies of value more than Rs 100 million (equivalent to $0.78 million) for national and Rs 200 million (equivalent to $1.57 million) for international (for QCBS, QBS, FBS, or LCS) are placed before Cabinet-appointed Consultants Procurement Committees. Lower value consultancies are decided by the MPC, DPC or Project Consultants Procurement Committee. While there is no restriction on contract amount increases, all proposals can be rejected if they are substantially higher than the PE's estimated budget. Before rejecting all proposals, the PE is to investigate the feasibility of increasing the budget or scaling down the scope of services to meet the original budget. The financial threshold limits of various committees vary based on whether the selection if for international or national assignments and method of selection (eg. higher thresholds for QCBS, QBS, FBS, or LCS, and lower thresholds for CQS and SSS). Details of the financial threshold limits of committees are presented in page 24 of the Consulting Services Manual (2007) and are presented in **Annex 2**.

101. The main permitted methods for procuring consultancy services are:

Quality & Cost Based Selection (QCBS): no thresholds; no conditions consider the quality and cost of the services

Quality Based Selection (QBS): when quality of services is of paramount importance and cost is not a major criteria

Fixed Budget Selection (FBS) Conditions: available budget is fixed and the assignment is relatively simple and can be precisely defined.

Least Cost Selection (LCS) Conditions: (i) standard or routine nature (eg, audits, architectural and engineering design of non-complex works with established practice and standards), and (ii) cost is within the threshold.

Consultant's Qualification Selection (CQS) Conditions: full-fledged selection where quality of proposal rather than cost is prime consideration.

Single Source Selection (SSS) Conditions: (i) where rapid selection is essential, (ii) where only one firm or individual consultant has experience of exceptional worth, and (iii) for low value small assignments.

M. Bidding Process for Goods, Works and Non-Consultancy Services

1. Qualifications and Advertising

102. Bidding may be with or without prequalification. Prequalification is recommended for large and complex contracts, and is permitted for other procurement where considered appropriate by the PE.

103. Qualification criteria must be stated in bidding, prequalification or Request for Proposal documents and must relate to areas such as technical qualifications, equipment, past performance. Provisions allowing only a particular class of supplier to participate are not permitted.

104. Invitations to bid or prequalify must be published in daily newspapers of national circulation (or internationally for open international bidding) and on the website of the PE. Invitation for sealed quotations must be published in national or local newspaper. Where prequalification is used, all qualified applicants must be invited to bid.

2. Bidding Documents and the Bidding Process

105. The PEs are required to prepare specifications, plans, drawings, designs or other descriptions based on relevant objective characteristics and functions. Particular brands or trademarks are only permitted where objective description is not possible and on the basis that equivalent products are also acceptable.

106. Standard templates are provided for bidding documents with specified content including clear descriptions of the procurement need, instructions on the bidding process, the evaluation criteria and methodology including any preferences and the terms and conditions of the contract.

107. Bidders may be charged fees for bidding and prequalification documents and are based on the cost incurred in preparation of the documents.

108. A deadline for receipt of bids must be set, with bids kept unopened until this time and any late bids rejected. Minimum period of bidding time shall be maintained as stated below:

- ICB/LIB: 42 days (more for complex procurement)
- NCB/LNB: 21 days
- Restricted competitive bidding under district/divisional-level contracts: 14 days
- Shopping: 7 days minimum
- For emergency procurement the above periods may be reduced.

109. Bid securities are required with a fixed value. For services procurement no bid security is required. Bid securities from foreign banks must be counter-guaranteed by a scheduled bank of Sri Lanka. Conditions for forfeiture of bid securities are bid withdrawal, refusing an arithmetic correction, failing to accept notification of award and sign a contract or to provide performance security.

110. Bids must be opened in the presence of bidders' representatives at the time and place stated in the bidding documents, immediately after the deadline for bid submission.

3. Evaluation

111. Evaluation is based on the criteria stated in the bidding document and evaluation procedures are consistent with internationally accepted practices.

112. No negotiations are permissible for goods and works, in general. But a PE may engage in negotiations with the lowest responsive bidder when there is a budget constraint compared to very high bid price. Such negotiations cannot be held with bidders other than the lowest responsive bidder.

N. Procurement of Consultancy Services

1. Advertising and Short listing

113. Under the competitive proposals method, a notice requesting expressions of interest (EOIs) must be published in newspapers and PE website. The evaluation of EOIs must be based on qualifications, experience and capacity. Shortlists normally consist of 4-7 firms.

2. Request for and Submission of Proposals

114. Standard Requests for Proposal (RFP) templates are issued by the NPA and used by the PEs and customized for specific procurement. The PEs are required to prepare terms of reference stating the nature, time and place of services, tasks and expected outputs, instructions on the submission of proposals, the selection method, evaluation criteria, minimum technical pass mark and weightings, and the terms and conditions of the contract.

115. Proposal submission deadlines are mentioned in RFPs clearly. Minimum bidding periods are (procurement type specific) 28 days for national and 42 days for international. Financial proposals are kept in safe custody of the employer after opening by Bid Opening Committee.

3. Evaluation and Negotiation

116. Ranking based on the methodology and weightings very much correspond to the procurement methods used. For instance:

> **QCBS:** The technical score plus the financial score (using the *weightings* specified in RFP) gives the combined score applied for ranking and the consultant with the highest combined score is invited for negotiations.
>
> **FBS:** highest ranked technical proposal within the budget is found on the basis of technical points secured by the bidders. Weightings not required.
>
> **LCS:** lowest evaluated proposal price among those that secured the minimum technical points. Weightings not required.
>
> **SSS:** straight to negotiation on technical and financial aspects of the proposal.

117. Negotiations are limited to the first ranked consultant and only on failure, are continued successively with the second and the third ranked consultants subject to budgetary constraints and fulfillment of other conditions.

O. Major Challenges in Consultant Procurement and Suggested Remedies

118. Major challenges identified in consultant procurement are:

(i) Capacity to short-list, prepare RFP and evaluate of the proposals

(ii) Some delays in approval process particularly in case of high level procurement, including prior review by the Development Partners

(iii) Inadequate oversight and monitoring by the Client

(iv) Replacements of key professional staff by the Consultant

(v) Delays in Contract, deciding upon contract variation

119. Procurement cells and staff in PEs need to be trained and capacity built so are to be retained. Building up a procurement cadre could be a good solution. Procurement Committees below CAPC level (MPC / DPC / PPC / RPC) could be empowered to decide on higher value procurement (for works, goods and services) by increasing authority thresholds. The scale and scope of procurement is rapidly increasing in Sri Lanka, so delegated authority for higher procurement thresholds is becoming imperative. NPA, PEs and audit departments are to be made responsible for procurement process oversight and monitoring.

P. Contract Award and Management

120. Any complaints in public procurement proceedings up to issuance of Letter of Acceptance by the PE are dealt with by the administrative authority and appeals committee as provided for in the NPA Guidelines to redress the grievances of the Bidders.

121. Contract management, including monitoring actual progress against target, controlling cost overruns, periodic inspection or measurement of accomplishment, supervision of compliance with quality standards such as inspection, testing etc., operation of management information systems, providing technical support to operation staff, and technical assessment and design services needed for implementation and completion of contract, are the responsibility of the PE. In exceptional circumstances, issues such as termination, settlement of disputes, will be subject to adjudication and arbitration.

122. The critical elements in contract management are variations/ extra work orders/ modifications, time extensions, liquidated damages/ bonus, delayed payment, compensation events, price adjustment and rate adjustment. The resources constraints and rapid economic inflation also adversely impact contract management.

123. Contracts must state the mechanism for settlement of disputes. For goods, consultancy and non-consultancy services, this is arbitration as provided in the contract or prevailing law. For works, adjudication or arbitration may be used, depending on the contract value.

Q. E-Procurement

124. The PEs, if they so wish, may carry out the following procurement activities electronically with the prior concurrence of the respective PCs.

- In addition to the general advertising process, publish procurement invitations on website
- The bidders/consultants will be allowed to inspect pre-qualification (PQ) applications and bidding documents, electronically or otherwise, according to their preference;
- The bidders may be allowed to obtain clarifications through electronic media

125. Electronic submission of bids will not be allowed.

R. Integrity and Transparency of the Public Procurement System

1. Bidder Complaints

126. The institutional framework of internal financial control in Sri Lanka is under the supervision of the MFP and external audit under the independent Comptroller and Auditor General (CAG), who audits all public sector expenditures and submits annual and special reports to the Public Accounts Committee (PAC) of the national assembly. The audit reports, to the extent directed towards procurements, highlight only minor procedural lapses and unauthorized expenditures rather than major non-compliance, irregularities, malpractice, or corruption in procurement. Major non-compliances and corruption are handled by established departmental disciplinary procedures and by the Commission to Investigate Allegations of Bribery and Corruption. In the case of contracts where contract award is made by Cabinet Appointed Procurement Committee (CAPC) or Ministry Procurement Committee (MPC), any bidder so wishes to make representation is required to submit its appeal within one week of the notification by the Secretary, to the Procurement Appeal Board (PAB) at the Presidential Secretariat. A copy of the Appeal should be submitted to the Secretary of the Ministry. The appeal shall contain all material required to support the averment and shall be self-contained for the PAB to arrive at a decision.

127. The Secretary to the line ministry shall within one week of being informed of the recommendation of the CAPC/MPC inform in writing to all the bidders of the selection of the successful bidder and the intention to award the contract to such bidder. Unsuccessful bidders can make their representations in writing, (if any) against the recommendation of the CAPC/intention to award the contract to the successful bidder, to the Procurement Appeal Board at the Presidential Secretariat. Such representation of the bidders shall be:

- Submitted within one week of the bidder being informed by the Secretary to the line ministry, of the intention to award the contract to the successful bidder
- Self-contained to enable the Appeal Board to arrive at a conclusion.

128. In case of an MPC, if any representations are received within the said one week period, the Secretary to the line ministry in consultation with the Chairpersons of the MPC and TEC shall organize a joint meeting of the MPC and TEC to consider such representations.

129. The joint committee so appointed shall adopt its own procedure for expeditious inquiry and disposal.

130. The findings/recommendations of the joint committee will be forwarded to the Secretary of the Line Ministry no later than fourteen (14) days of appointment of such committee and the Secretary shall act in accordance with such findings/ recommendations.

2. Prevention of Corruption

131. The procurement guidelines, manuals, bid documents and consultancy RFPs contain codes of conduct for public officials involved in public procurement and for bidders. The former requires officials to act impartially and in the public interest, avoid conflict of interest, maintain confidentiality and not commit corrupt, fraudulent or collusive practices. The code of conduct for bidders covers bribery, misrepresentation, coercion, collusion, interfering with other bidders, seeking to influence the PE and conflict of interest. The guidelines also require bidding documents to state that bids will not be processed where there is a conflict of interest or legal action for fraud or corruption and requires bids to be rejected in cases of collusion.

S. Strengths

132. The strengths of the sector agencies related to procurement are summarized as follows:

- MIWRM, DOI and MASL are organizations with established procurement committees and procedures and have procured and implemented numerous agriculture sector projects.
- Public procurement functions are mostly decentralized. The line ministries and provincial councils are responsible for procurement within their organizations.
- Procurement Methods have been clearly defined in the Procurement Guidelines and Standard Bidding Documents (SBDs) in respect of Goods, Works, and consultant Services are published and available for use.
- Clear separation of engineering, procurement and regulatory functions exists.
- Excellent legislative and regulatory framework. Well established quasi-legislative and regulatory framework for the procurement system in Sri Lanka
- Good institutional framework and management capacity
- For Works contracts, contract administration and dispute resolution are well defined and practiced.
- Sector organizations have experience of satisfactory procurement and implementation of ADB, WB, JICA and other projects.

T. Weaknesses

133. The weaknesses of the sector agencies related to procurement are summarized as follows:

- Inadequate experience in procuring large contracts through competitive mode.
- The level of delegation to the contracting authority within these organizations is inadequate. Since tender awards beyond a certain value (>$3.92 million for externally financed contracts and >$1.18 million for State financed contracts) have to be referred to the Cabinet for approval, the possibility of political interference in decision making cannot be ruled out.
- No dependable database of procurement. Present manual systems for the collecting and disseminating of procurement information, and monitoring of procurement statistics are cumbersome and ineffective. Further the training and capacity building of government sector staff appears inadequate to meet the need, and is almost non-existent for the private sector.
- Many large projects are being financed bilaterally. There are concerns in some quarters that these large size procurements on non-competitive basis may not be transparent and value for money.
- Private sector is small with competition for large contracts being limited to a few of the larger contractors.
- The NPA has been inactive and its autonomy eroded.
- MPC / DPC / PPC / RPC procurement approval thresholds are low ($0.78 million for NCB and $1.57 million for ICB). The CAPC gets over-burdened.
- Contract administration is weak in respect of “Goods” contacts.
- Although there are financial audit procedures in place for State sector organizations, they are not customized for addressing procurement related issues.
- The Appeals Board for CAPC contracts cannot issue enforceable final decisions and hence the Appeals Board has no independence for the resolution of complaints. There is also a lack of full transparency as the outcome of appeals reviews are not made public.
- Access to information in respect of contract awards is minimum, and there is no public information on the decisions made regarding appeals.
- Procurement procedures do not address means of preventing corruption, fraud, conflict of interest and unethical behavior. There is a Commission to Investigate Allegations of Bribery & Corruption which investigates grievances relating to corruption as defined by law, vide the Bribery Act. Although many cases have been investigated, few have resulted in court action.

U. Procurement Risk Assessment and Management Plan (P-RAMP)

134. The Sector / Program procurement risks, their assessed impact, and its likelihood of occurrence and recommended mitigation measures are summarized as follows:

SECTOR / PROGRAM PROCUREMENT RISK ANALYSIS AND MANAGEMENT PLAN

SL. No / Ref	RISK	IMPACT	LIKELIHOOD	MITIGATION MEASURES / RISK MANAGEMENT PLAN
I. Program Procurement Risk Analysis				
A.6.	Agencies do not have a regular procurement training program	S	Likely	- Regular hands on procurement training and retention of trained staff. - Provide training budget in the program
A 19	**Procurement specifications approval** **Goods**: By the Divisional level officers. **Works**: For routine procurements the specifications are approved centrally by MIWRM. Specifications for uncommon specialized items of works are initially drafted by the Divisional level officers and approved by MIWRM.	S	Likely	- Ensure project consultants involvement in drafting procurement specifications - Technical and procurement committees of WRDIP to be fully empowered to approve procurement specifications
B.7.	Copies of invoices not included with the contract papers, separately maintained by Accounts Office.	S	Unlikely	- PMU and Project Directors to ensure invoices are included with the contract papers.
C.16	Advertising to contract award delays; in case of high value procurements more time taken since it has to go up to higher levels of contract approval committee	S	Unlikely	- MIWRM to ensure higher level review and approval committees act in a timely manner.
C.45	Delay in negotiation after the selection of Consultant is approved by appropriate Consultant Selection Committee based on technical and financial evaluation.	S	Unlikely	- PMDC Consultant selection on behalf of WRDIP is being done by ADB - Once PMU is empowered for all program procurement, the delay would be reduced for other consultant procurement
C. 48	Contract signing after negotiations varies from 2 to 5 months depending on the level	S	Likely	- Large sized consultancy contracts are proposed to be procured under WRDIP. Key is to empower PMU for all

	of the approval authority and necessity of prior review by the Development Partner.			procurement.
C.53.	When late payment is made, are the beneficiaries paid interest?	S	Unlikely	- With PMU and finances in place, delays could be minimized. - Payment delays to be regularly monitored by PMU
II. Sector Procurement Risk Analysis				
Sector PCA questionnaire 3.2	Do measures exist in the sector to ensure the adequacy and accuracy of cost estimates before bidding, and to manage contract price variations	S	Unlikely	- Existing processes of cost estimate cannot easily capture costs of items new to Sri Lanka. Also cost estimates have to follow department schedule of rates which do not afford adequate flexibility. - WRDIP will be supported by international consultants and program specific PMO which Should be empowered to prepare cost estimates based on realistic market rates while using department schedule of rates as a reference.
Sector PCA questionnaire 3.3	Have bidders used the complaint and protests mechanisms?	S	Likely	- The Appeals Board has no independence for the resolution of complaints. There is also a lack of transparency as the outcome of appeals reviews are not made public. - The PMO should devise its own procedures to address complaints adequately and transparently. ADB's complaints resolution system could be adopted by the program. - Program my consider having on a retainer basis an independent professional to independently investigate complaints, protests and provide recommendations to Program Director.
Sector PCA questionnaire 4.1	Is there a formal internal control and audit framework in the sector?	S	Likely	- Yes. The audit reports highlight only procedural lapses and unauthorized expenditures rather than major non-compliance, irregularities, malpractice, or corruption in procurement. - It is recommended that agencies in the sector are

				subjected to regular procurement performance audits by independent external auditors. - Increased level of oversight by PMO recommended.

S - substantial

IV. SECTOR/AGENCY PROCUREMENT THRESHOLDS

135. The sector and WRDIP Program Procurement Classification is assessed as Moderate (Category B). The completed Sector and Program Procurement Classification checklist is provided in **Annex 1**.

136. Based on procurement capacity assessment carried out it is recommended that prior review limits for agriculture sector and the WRDIP remain same as shown in the recently revised Procurement Plan template for Sri Lanka. Civil works contracts above $15 million will be through international competitive bidding (ICB) and those costing less than $15 million will be under national competitive bidding (NCB) procedures acceptable to ADB. Single-stage Two Envelope Bidding with post qualification will be adopted for all NCB and ICB contracts under the Investment Program. ADB review of bid documents and evaluation shall be prior for first NCB only and all advance contracting packages. Domestic preference is not applicable. Specialized and small community works costing less than $20,000 may be directly awarded to project area community groups/ NGOs/ societies as a community works contract. For the procurement of goods and related services, ICB will be used for contracts of at least $2.0 million and NCB for contracts of less than $2.0 million. For contracts valued at less than $100,000 ADB's shopping procedures will be followed. No changes are suggested to the NCB Annex of Sri Lanka Procurement Plan template; the NCB Annex is included in **Annex 5**.

V. CONCLUSIONS

137. Based on the procurement capacity assessment of the agriculture sector and WRDIP, the following measures for improvement of procurement capacity are recommended:

- The NPA has been inactive and its autonomy eroded. It is essential to revive it as an independent agency tasked with procurement reform.
- Since the capacity of local irrigation works contractors is limited to small-size packages up to $4.7 million, for the WRDIP road sector contractors may be encouraged to bid.
- The working period is limited due to short closure period of irrigation canals. For such works, specifications could consider providing pre-fabricated lining sections / in-situ pavers instead of conventional methods of canal lining.
- In the mid-size contracts ($10-40 million), there are few qualified contractors in Sri Lanka; foreign bidders may be less interested. It would therefore be preferable to keep contract packages small (<$10m) or large (>$40m). Unless the local contractor's capacity to bid is increased, the competition for the mid-size contracts would be limited. The qualifying criteria may be set at the lower range as suggested in ADB guidelines for simple and repetitive works. The criteria of 50% of similar contract experience instead of 80% and 40% of financial criteria for lead and 20% for other joint venture partners are recommended.
- There is a need to upscale the capacity of experienced small Sri Lankan contractors to enable them to carry out large works by encouraging joint ventures and by adopting relaxed qualifying criteria as suggested in para above. State must increase the size of bid packages, enabling local contractors to gain experience in doing larger contracts. This could be achieved in a medium term period (3-5) years by combining similar works into larger bid packages wherever feasible.
- Consider empowering MPC / DPC / PPC / RPC to approve higher value procurements of works, goods and services. The quantum and scale of projects is increasing in Sri Lanka, delegation of higher authority would help quicker decisions and speed up procurement.
- Provide training and encourage preparation of the technical specifications and development of terms of reference by officers at the field level to ensure work requirements are specifically captured. Such capacity is limited at present.
- Encourage involvement of the mid/senior-level officers in development of procurement plans, bid evaluation and in approval processes.
- Contract administration and management skills with particular focus on contract variations, settlement of claims and disputes, adjudication and arbitration need to be strengthened by regular on the job training by involving expertise from project consultants (such as PMDC) in these activities.
- Skill development of contractors needed in areas of preparation and submission of bids and contract conditions with particular focus on variations/ extra work orders/

repeat orders, orders for additional delivery/ modifications, time extensions, liquidated damages/ bonus, and contract amendments. The skill development programs to cover both NPA guidelines and international approaches (such as FIDIC) to improve contractors understanding.

- Bid documents to explicitly state '*The NPA procedure for appeals is not applicable'* since it seems to have caused confusion in ADB financed contracts previously.
- Quick payments to contractors to be ensured; paying 75% of claim amount after preliminary checking of work done within three working days would go a long way in easing cash flow problems and increasing bidding capacity of contractors.
- Consider including bonus payment clause in bid documents to encourage contractors to complete work in time.
- Capacity development program for high-level officials should be designed to improve the capacity for procurement in the MIWRM, DOI and MASL.

ANNEX 1

Program Procurement Classification

Procurement factors to consider when recommending "Category A" projects

Characteristic	Assessor's rating: 'Yes' or 'No' with brief comments, if 'Yes'
Is the Procurement Environment Risk for this project assessed as "High" based on the country and sector/agency risk assessments according to Figure 4 above?	No
Are multiple (typically more than three) and/or diverse Executing (EAs) and/or Implementing Agencies (IAs) envisaged during project implementation? Do EAs/IAs lack prior experience in ADB project implementation?	No
Are multiple contract packages and/or complex and high value contracts expected (compare to recent donor projects in DMC)?	Yes. High value TBM tunnel contracts not carried out previously under MDB finance. A southern roads project (ADB finance) contract of $210 million took 11 years to implement (scheduled 5 years). A $60 million has been procured in urban sector. WB has not financed any program with large contracts.
Does the project plan to use innovative contracts (PPP, Performance-based, Design & Build, O&M, etc.)?	No
Are contracts distributed in more than three geographical locations?	No
Are there significant ongoing contractual and/or procurement issues under ADB (or other donor) funded projects? Has mis-procurement been declared in the DMC?	No. Mis-procurement declared in a Public Resources Management, MOF project (one off instance).
Does the DMC have prolonged procurement lead times, experience implementation delays, or otherwise consistently fail to meet procurement timeframes?	No.
Do EAs/IAs lack capacity to manage new and ongoing procurement? Have EAs/IAs requested ADB for procurement support under previous projects?	No.
OVERALL PROJECT CATEGORIZATION RECOMMENDED	**B**

Note: If the answer to one or more questions in the above table is 'Yes', the project officer shall make an assessment (with comments, if necessary) and determine if additional procurement support to the EA/IA will be required or if despite the assessment the EA/IA has adequate resources and/or institutional capacity to address procurement issues. The project officer shall also assess if the ADB project team includes sufficient experience/skills to deliver such support or additional support will be required from OSFMD. If additional support is required from OSFMD procurement specialist, the project should be recommended as Category A. If not, it should be recommended as Category B. OSFMD must confirm the classification during interdepartmental circulation of the project concept paper.

Overall recommendation of the concerned project officer

Recommendation of OSFMD's procurement specialist

ANNEX 2
SECTOR PROCUREMENT ASSESSMENT QUESTIONNAIRE

Indicators/Questions	Sector/Agency Questions	Score	Narrative[5]
1. Legislative and Regulatory Framework			
1.1 Does the national public procurement law (including supporting regulations, standard bidding documents and operational manuals/guides) apply to the sector?	Is the sector exempted by legislation from being subject to the national public procurement law?	2	The procurement guidelines have the backing of the country's laws and are applicable to all government institutions inclusive of ministries, departments, public corporations and statutory bodies, fully-owned government companies, provincial councils and local authorities for the procurement of works, services and supplies and disposal of government assets. These Guidelines have been drafted in association with the major funding agencies such as the World Bank, the ADB and the Japan Bank for International Cooperation, to ensure they are harmonized to the maximum extent in order for their usage in foreign-funded projects as well.
	Even if subject to the national public procurement law, does the sector tend to follow it?		Following the national public procurement law is mandatory and all agriculture sector agencies follow it.
	Do agencies in the sector use government-issued public procurement manuals or guidance?		Yes, nationally applicable procurement guidelines and manuals were published in 2006. Agencies in the sector use government-issued public procurement manuals and guides. Guidelines and manuals have been amended many times.
	Have government-issued documents been tailored to meet sector requirements?		The procurement documents are not sector specific.
	In absence of government-issued documents, does the sector have its own standard bidding documents/guidelines?		Not applicable since government-issued documents are mandatory.

[5] Describe how the sector meets the guidance applicable to the score allocated, or other justification for the score.

Indicators/Questions	Sector/Agency Questions	Score	Narrative[5]
1.2 Is the supply market for the sector sufficiently competitive to give full effect to the national procurement law and/or open competitive tendering?	Is competitive bidding a common feature under the sector?	2	Yes.
	Is there a core of suppliers in the sector who regularly submit responsive bids?		Yes for small contracts. Since qualified contractors for larger contracts are few, there is a tendency to split packages. The construction industry in Sri Lanka has yet to reach full potential to meet the required capacity for the country's development programs. Until recently all the large contracts were awarded to foreign contractors.
	What proportion, by %, of the sector's procurement is undertaken through open competitive bidding?		At CAPC-level 79% of the procurement by numbers and 97% by value, are through Open Tendering. Single Source procurement of spare parts for plant and equipment results in the relatively low 79% of open procurement. At MPC level 96% of the procurement by numbers and 99% by value is through Open Tendering.
	What is the average number of bidders for publicly bid contracts?		CAPC -5, MPC -4. ADB projects (all sectors) - 4.55
	Do EAs tend to make sufficient efforts to attract bids (eg. adequate advertising, bidding periods)?		Yes, they follow Sri Lanka's Public Procurement Act and guidelines which mandate advertising and bidding periods.
	Is there availability and quality of suppliers, labor force and/or related goods and services in the domestic market ?		Adequate competitiveness exists for small contracts (<$4 million) and for large contracts. Very large contracts, many above $100 million are awarded to mostly foreign firms without bidding. Better capacities exist among road contractors but much less in irrigation sector contractors for medium sized contracts. Contracts of size $10-40 million would face inadequate competition since very few domestic firms would qualify, foreign firms may not be interested. Large contracts (>$40

Indicators/Questions	Sector/Agency Questions	Score	Narrative[5]
			million) attract international bidders due to perceived good business environment in Sri Lanka.
1.3 If there is a sector specific legal framework, does it support non-discriminatory participation, transparent tender processes (including advertisement, tender documentation, tender evaluation, complaints mechanism)?	Has the sector adopted non-discriminatory, transparent tender processes? What is the average number of bidders for publicly bid contracts?	2	Yes. Complaints resolution mechanism a bit weak; not many convictions. CAPC -5, MPC -4. ADB projects (all sectors) - 4.55
1.4 Is the sector subjected to excessive regulation or government control such that competition is limited or non-existent?	Does the sector apply a domestic preference scheme? Does the sector require pre-registration of bidders? Are there acceptable provisions in the sector for the participation of State Owned Enterprises?	2	There are no restrictions on participation in public procurement based on nationality for ICB. No such requirement for ICB. While there is no domestic preference, all bidders are to be registered with ICTAD for NCB and shopping. Yes. SOEs are treated at par with private sector and get no preferential treatment.
2. Institutional Framework and Management Capacity			
2.1 Is the procurement cycle in the sector required to be tied to an annual budgeting cycle (*i.e.* can a procurement activity commence only when budget has been duly appropriated for it?	Are procurement plans in the sector prepared on as part of the budget planning and formulation process? Do systems and processes in the sector or	3	From March 2006 all institutions are required to furnish details of procurement preparedness activities when seeking annual financial allocations. This led to the mandating of procurement planning for Treasury budget allocations. Ministries and provincial councils prepare Master Procurement Plans based on the institutional plans for the purpose of monitoring. Yes

Indicators/Questions	Sector/Agency Questions	Score	Narrative[5]
	key agencies in the sector require certification of availability of funds before solicitation of tenders?		
2.2 Does the system foster efficiency through the use of adequate planning?	Does the sector, or key agencies in the sector, have a formalized procurement planning process(s)?	3	Yes, as above
2.3 Does the procurement system in the sector feature an oversight /regulatory body?	Does the sector fall under the remit of the national oversight/regulatory body? If a national body does not exist, is there a sector-specific body that oversees/regulates procurement?	3	Yes, NPA Not applicable.
2.4 Is there a public procurement capacity development or professionalization program?	What proportion of procurement-related officers and staff in the sector have been trained under the national or sector capacity development program or participated in any formal procurement training program?	2	Yes, more than 60%. The NPA conducted a wide range of training programs for the government sector. A need for more training at the awareness level, and more importantly at the specialized level, is felt. Further, there is a need for awareness and training courses for the private sector. During the period 2004-2007, all government departments and parastatals were trained by the NPA. From 2008, training opportunities are limited to those administered by multilateral development banks and some government programs.
3. Procurement Operations and Market Practices			
3.1 Is private sector competitive, well organized and able to access the sector market?	Is the private sector well organized and able to access the sector market? Do civil society organizations regard public procurement in the sector to be open and accessible to the market?	2	Yes for small contracts. Limited competitive capacity for large contracts. Qualified yes. Yes for small contracts. No for large contracts
3.2 Do measures exist in the sector to ensure the adequacy and accuracy of cost estimates before	What percentage of contracts are awarded for values less than the original cost estimates?	1	While reliable data is not available, the percentage of contracts awarded for values less than estimated cost are assessed to be under 10%.

Indicators/Questions	Sector/Agency Questions	Score	Narrative[5]
bidding, and to manage contract price variations?	What percentage of contract variations amount to a cumulative impact of more than 10% of the original contract price?	2	ADB contracts exceeding 15% (Y2013) - 0.27% CAPC - 19%, MPC - 46% (from OECD report)
3.3 Is there a mechanism in the sector to receive and handle observations, complaints and protests?	Are there sector-specific procedures to receive and handle observations, complaints and protests? Are complaints and protests in the sector processed within the maximum time limit provided for in the law? Have bidders used the complaint and protests mechanisms?	1	National procedure exists, same is adopted for the sector. Yes. Yes, to a limited extent. The Appeals Board for the CAPC contracts cannot issue enforceable final decisions and hence the Appeals Board has no independence for the resolution of complaints. There is also a lack of full transparency as the outcome of appeals reviews are not made public.
4. Integrity and Transparency of the Sector Public Procurement System			
4.1 Is there a formal internal control and audit framework in the sector?	Do key agencies in the sector have an independent internal audit function? Do key agencies in the sector have adequate internal control mechanisms to oversee the procurement function?	1	Yes. The institutional framework of internal financial control in Sri Lanka is under the supervision of the MFP and external audit under the independent Comptroller and Auditor General (CAG), who audits all public sector expenditures and submits annual and special reports to the Public Accounts Committee (PAC) of the national assembly. The audit reports, to the extent directed towards procurement, highlight only minor procedural lapses and unauthorized expenditures rather than major non-compliance, irregularities, malpractice, or corruption in procurement. Major non compliances and corruption are handled by established departmental disciplinary procedures and by the Commission to Investigate Allegations of Bribery and

Indicators/Questions	Sector/Agency Questions	Score	Narrative[5]
			Corruption.
	Are key agencies in the sector subjected to regular performance or value for money audits?		No
	Are key agencies in the sector subjected to annual financial audits?		Yes
	Are internal or external audit findings /recommendations acted on in a timely fashion?		Acted on, delayed.
4.2 Is information pertaining to public procurement in the sector easy to find, comprehensive and relevant?	What percentage of bids is published in a medium that is easily and freely accessible?	2	99%
	Can bidders easily and freely access bid information?		Yes
	What is the percentage of contract awards announced in medium that is easily and freely accessible?		All competitive procurement results listed in PE website
	Are third party observers invited to attend public biddings?		No
4.3 Does the sector have ethics and anticorruption measures in place?	Are there sector-specific procedures to verify a bidder's legitimate existence, track records, financial capacity and capacity to complete the job?	2	Yes, not sector specific. ICTAD registration procedures which include bidder's verification are applicable countrywide.
	Are there sector-specific procedures to rate performance and/or debar bidders, supplier, contractors and consultants for ethical or integrity violations?		Yes, but not sector specific and are handled by ICTAD.
	Does the sector, or key agencies in the sector, maintain a register of debarred suppliers, contractors and consultants?		Maintained by ICTAD and available on its website.
	Are there sector-specific integrity principles and guidelines?		Yes, not sector specific, NPA set processes including integrity principles are applicable countrywide

SECTOR/AGENCY PROCUREMENT ASSESSMENT
SCORING GUIDE

Indicators/Questions	Sector/Agency Questions	Scoring Guide[6]
1. Legislative and Regulatory Framework		
1.1 Does the national public procurement law (including supporting regulations, standard bidding documents and operational manuals/guides) apply to the sector?	Is the sector exempted by legislation from being subject to the national public procurement law? Even if subject to the national public procurement law, does the sector tend to follow it? Do agencies in the sector use government-issued public procurement manuals or guidance? Have government-issued documents been tailored to meet sector requirements? In absence of government-issued documents, does the sector have its own standard bidding documents/guidelines?	3 – *The sector has its own regulations, processes, guidelines, bidding documents that are superior to those in the national public procurement system.* 2 – *The sector is subject to the national procurement law and tends to follow it. Generally uses the national procurement processes, guidelines, bidding documents* 1 – *The sector is subject to the national procurement law but tends to not follow it. Frequent deviations from national procurement processes, guidelines, bidding documents.* 0 – *The sector is exempt from, or does not follow, the national public procurement system, and does not have its own regulations, processes, guidelines, bidding documents that compensate for this.*
1.2 Is the supply market for the sector sufficiently competitive to give full effect to the national procurement law and/or open competitive tendering?	Is competitive bidding a common feature under the sector? Is there a core of suppliers in the sector who regularly submit responsive bids? What proportion, by %, of the sector's procurement is undertaken through open competitive bidding? What is the average number of bidders for publicly bid contracts? Do EAs tend to make sufficient efforts to attract bids (eg. adequate advertising, bidding periods)? Is there availability and quality of suppliers, labor force and/or related goods and services in	3 – *Competitive bidding is more prevalent (by %) in the sector than generally evident in the country. A core of suppliers in the sector regularly submit responsive bids. At least 5 bidders on average per contract. EAs make sufficient efforts to attract bids.* *2 - Competitive bidding in the sector is consistent with that generally evident in the country. A core of suppliers in the sector regularly submit bids, but often nonresponsive. At least 3 bidders on average per contract. EAs generally make sufficient efforts to attract bids.* *1 - Competitive bidding in the sector is less prevalent than that generally evident in the country. Suppliers tend to submit one-off but often responsive bids. At least 2 bidders on average per contract. EAs often do not make sufficient efforts to attract bids.*

[6] This guide does not replace professional judgment about the capacity of the sector relative to that of the country procurement system. If considerations other than this guide are used, mention them in the 'Narrative' column of the questionnaire.

Indicators/Questions	Sector/Agency Questions	Scoring Guide[6]
	the domestic market ?	0 – *Competitive bidding in the sector is much weaker than that generally seen in the country. Suppliers tend to submit one-off, nonresponsive bids. Less than 2 bidders on average per contract. EAs rarely do not make sufficient efforts to attract bids.*
1.3 If there is a sector specific legal framework, does it support non-discriminatory participation, transparent tender processes (including advertisement, tender documentation, tender evaluation, complaints mechanism)?	Has the sector adopted non-discriminator, transparent tender processes? What is the average number of bidders for publicly bid contracts?	3 – *At least 5 bidders on average per contract* 2 – *At least 3 bidders on average per contract* 1 – *At least 2 bidders on average per contract* 0 – *Less than 2 bidders on average per contract*
1.4 Is the sector subjected to excessive regulation or government control such that competition is limited or non-existent?	Does the sector apply a domestic preference scheme? Does the sector require pre-registration of bidders? Are there acceptable provisions in the sector for the participation of State Owned Enterprises?	3 – *There are no restrictions on nationality of bidders or origins of goods, there is no domestic preference scheme, effective pre-registration processes rigorously followed, acceptable provisions govern participation of state owned enterprises.* 2 – *No restrictions on nationality of bidders or origin of goods, or pre-registration process exists but not rigorously followed, or weak or unclear provisions governing participation of state owned enterprises.* 1 – *Some restrictions on nationality of bidders, or domestic preference scheme exists, improvements needed pre-registration process, lack of clarity on participation by state owned enterprises.* 0 - *Restrictions on nationality of bidders, domestic preference scheme in place, no pre-registration of bidders required, no specific guidance with respect to state owned enterprises*

Indicators/Questions	Sector/Agency Questions	Scoring Guide[6]
2. Institutional Framework and Management Capacity		
2.1 Is the procurement cycle in the sector required to be tied to an annual budgeting cycle (*i.e.* can a procurement activity commence only when budget has been duly appropriated for it?	Are procurement plans in the sector prepared on as part of the budget planning and formulation process? Do systems and processes in the sector or key agencies in the sector require certification of availability of funds before solicitation of tenders?	3 – *Procurement plans are prepared as part of the annual budget process; budget availability confirmed prior to solicitation of tenders.* 2 – *Budget availability confirmed prior to solicitation of tenders; limited procurement planning serving as input to budget formulation* 1 – *Procurement planning factors into budget formulation, but budget availability need not be confirmed prior to solicitation of tenders.* 0 – *Procurement planning does not factor into budget formulation and budget availability need not be confirmed prior to solicitation of tenders*
2.2 Does the system foster efficiency through the use of adequate planning?	Does the sector, or key agencies in the sector, have a formalized procurement planning process(s)?	3 – *There is a regular planning exercise that starts with the preparation of multiyear operating plans followed by annual procurement plans with associated expenditures that forms part of the annual budget formulation process.* 2 – *Multiyear operating plans and annual procurement plans are prepared independently of budget preparation, but these are revised in line with forward budget estimates* 1 – *Annual procurement plans are prepared, but these are not linked to multiyear operating plans an/or not linked to budget formulation.* 0 – *Procurement plans are not prepared*
2.3 Does the procurement system in the sector feature an oversight/regulatory body?	Does the sector fall under the remit of the national oversight/regulatory body? If a national body does not exist, is there a sector-specific body that oversees/regulates procurement?	3 – *There is a national procurement oversight body that covers agency procurement* 2 – *There is no national body, however, a sector specific body oversees and regulates procurement in the sector.* 1 – *There is a national regulatory body, but limited clarity with respect to its scope and or ability to oversee/regulate procurement in the sector* 0 – *There is no body, at the national or sector level, that oversees or regulates procurement*
2.4 Is there a public procurement capacity development or professionalization program?	What proportion of procurement-related officers and staff in the sector have been trained under the national or sector capacity development program or participated in any formal procurement training program?	3 – *At least 80% of procurement staff* 2 – *At least 60% of procurement staff* 1 – *At least 20% of procurement staff* 0 – *Less than 20% of procurement staff*

Indicators/Questions	Sector/Agency Questions	Scoring Guide[6]
3. Procurement Operations and Market Practices		
3.1 Is private sector competitive, well organized and able to access the sector market?	Is the private sector well organized and able to access the sector market? Do civil society organizations regard public procurement in the sector to be open and accessible to the market?	3 – *The private sector is competitive, well organized and able to participate in the competition for sector procurement contracts; there are no major constraints inhibiting private access to sector procurement.* 2 – *There is a reasonable well-functioning private sector serving the agency but competition for large contracts is concentrated in a relatively small number of firms; there are some constraints inhibiting private sector access to sector procurement.* 1 – *The private sector serving the agency is relatively weak and/or competition is limited due to monopolistic or oligopolistic features; there are multiple constraints inhibiting private sector access to sector procurement.* 0 – *The private sector is not well organized and lacks capacity to access sector procurement markets; there are major constraints which discourage competition from the private sector.*
3.2 Do measures exist in the sector to ensure the adequacy and accuracy of cost estimates before bidding, and to manage contract price variations?	What percentage of contracts are awarded for values less than the original cost estimates? What percentage of contract variations amount to a cumulative impact of more than 10% of the original contract price?	3 – *More than 75% of the contract awards sampled* 2 – *50 – 75% of contracts awards sampled* 1 – *20 - 50% of contracts awards sampled* 0 – *Less than 20% of contract awards sampled* 3 – *Less than 10% of contracts sampled* 2 – *10 – 20% of contracts sampled* 1 – *20 – 50% of contracts sampled* 0 – *More than 50% of contracts sampled*
3.3 Is there a mechanism in the sector to receive and handle observations, complaints and protests?	Are there sector-specific procedures to receive and handle observations, complaints and protests? Are complaints and protests in the sector processed within the maximum time limit provided for in the law? Have bidders used the complaint and protests	3 – *The complaint review system has precise and reasonable conditions and timeframes for decision with clear enforcement authority and mechanisms; more than 90% of complaints are processed with stipulated timeframes;* 2 – *There are terms and timeframes for resolution of complaints but authority for enforcement is unclear; more than 75% of complaints are processed within stipulated timeframes;*

Indicators/Questions	Sector/Agency Questions	Scoring Guide[6]
	mechanisms?	1 – *Terms and timeframes for resolution of complaints are vague; the time to resolve complaints is tracked by the agency.* 0 – *There is no effective or functioning complaints mechanism*
4. Integrity and Transparency of the Public Procurement System		
4.1 Is there a formal internal control and audit framework?	Do key agencies in the sector have an independent internal audit function? Do key agencies in the sector have adequate internal control mechanisms to oversee the procurement function? Are key agencies in the sector subjected to regular performance or value for money audits? Are key agencies in the sector subjected to annual financial audits? Are internal or external audit findings/recommendations acted on in a timely fashion?	3 – *The sector has an effective internal control framework including an independent internal audit function; annual financial audits are conducted; audit recommendations are implemented within six months; no significant outstanding audit findings for more than six months.* 2 – *The sector has effective segregation of duties; an internal audit function exists but capacity is weak, or the function is not sufficiently independent; annual financial audits are audited with reasonably time disposition of audit findings.* 1 – *The sector has effective segregations of duties and is subjected to annual audit; There is no internal audit function and/or audit findings are not disposed of in a timely fashion.* 0 – *The internal system is weak, with no internal audit, limited external audit and audit findings are not disposed of in a timely fashion*
4.2 Is information pertaining to public procurement in the sector easy to find, comprehensive and relevant?	What percentage of bids is published in a medium that is easily and freely accessible? Can bidders easily and freely access bid information? What is the percentage of contract awards announced in medium that is easily and freely accessible? Are third party observers invited to attend public biddings?	3 – *At least 80% of bids are published; at least 80% of contract awards are published; bidders can easily and freely access bid and contract award information; third partner observes invited to attend public biddings.* 2 – *A least 60% of bids are published; at least 60% of contract awards are published; bidders can easily and freely access either bid and/or contract award information; third partner observers may attend public biddings.* 1 – *At least 20 % of bids are published; at least 20% of contract awards are published; bidders have some access to bid and contract award information* 0 – *Less than 20% of bids are published, less than 20% of contract awards are published.*

Indicators/Questions	Sector/Agency Questions	Scoring Guide[6]
4.3 Does the sector have ethics and anticorruption measures in place?	Are there sector-specific procedures to verify a bidder's legitimate existence, track records, financial capacity and capacity to complete the job? Are there sector-specific procedures to rate performance and/or debar bidders, supplier, contractors and consultants for ethical or integrity violations? Does the sector, or key agencies in the sector, maintain a register of debarred suppliers, contractors and consultants? Are there sector-specific integrity principles and guidelines?	3 – *The sector has an active anticorruption/ Integrity program(s) in place; the sector has mechanisms to debar firms for failure to perform and/or integrity violations; the sector has sufficient supplier due diligence processes; the sector has clear policy, procedures and/or frameworks governing conflict of interest.* 2 – *The sector has mechanisms to debar firms for failure to perform and/or integrity violations, or mechanisms to report suspected violations to a national or sector wide anticorruption body; they sector has sufficient supplier due diligence processes; the concept of conflict of interest is defined.* 1 – *The sector has sufficient supplier due diligence processes including need to address conflict of interest.* 0 – *The sector does not have a formal system(s) to deal with integrity violations, conflicts of interest, and/or fraud and corruption.*

ANNEX 3

PROCUREMENT CAPACITY ASSESSMENT OF MIWRM, DOI AND MASL

Risk Ratings	High (H)	Substantial (S)	Moderate (A)	Low (L)

I. Specific Assessment and Ratings:

Question	Answer/Finding	Risk
A. ORGANIZATIONAL AND STAFF CAPACITY		
A.1. How many years experience does the head of the procurement department/unit have in a direct procurement role?	More than 10 years for all 3 agencies – MIWRM, DOI, MASL	L
A.2. How many staff in the procurement department/unit are: Full Time? Part Time? Seconded?	Adequate Staff. Decentralized at Ministry, Department, Division and Subdivision Level. All Full time staff Not Applicable Not Applicable	L
A.3. Does the procurement staff have English language proficiency?	Yes	L
A.4. Are the number and qualifications of the staff sufficient to undertake the additional procurement that will be required under the proposed project?	Yes	L
A.5. Does the unit have adequate facilities, such as PCs, internet connections, photocopy facilities, printers, etc., to undertake the planned procurement?	Yes	L
A.6. Does the agency have a procurement training program?	Not a routine program of its own but procurement staff have been trained by the NPA and ADB/ WB programs for projects financed by them.	S
A.7. Does the agency have a Procurement Committee that is independent from the head of the agency?	Yes. Procurement Committees exist at Cabinet, Ministry, Department and Project Levels. In addition, Technical Evaluation Committees exist at all these levels.	L

A.8. Does the agency have a procurement department/unit, including a permanent office that performs the function of a Secretariat for the Procurement Unit, and which serves as the main support unit of the Procurement Committee?	Yes. Technical Evaluation Committees support Procurement Committees. No separate office, both PC and TEC are embedded within the respective organizations. The members of PC / TEC are appointed by NPA for Cabinet Appointed Procurement Committees and by Secretary, MIWRM for MPC, DPC & PPC.	L
A.9. If yes, what type of procurement does it undertake?	Works, goods, services and supplies; both national and international.	L
A.10. At what level does the department/unit report (to the head of agency, deputy etc.)?	Secretary, MIWRM	L
A.11. Do the procurement positions in the agency have job descriptions, which outline specific roles, minimum technical requirements and career routes?	Procurement positions are not specifically designated. Procuring entities such as, Chief Engineer, Superintending Engineer, Executive Engineer, Sub-divisional Engineer, Director, Deputy Director etc. are assigned with the procurement activities, who have their respective job descriptions, which outline their specific roles, minimum technical requirements and career routes.	M
A.12. Is there a procurement process manual for goods and works?	Yes, nationally applicable procurement guidelines and manuals published in 2006.	L
A.13. If there is a manual, is it up to date and does it cover foreign-assisted projects?	Yes, guidelines and manuals are amended many times and are closely aligned with requirement of foreign-assisted projects	L
A.14. Is there a procurement process manual for consulting services?	Yes	L
A.15. If there is a manual, is it up to date and does it cover foreign-assisted projects?	Yes, covers foreign-assisted projects too.	L
A.16. Are there standard documents in use, such as Standard Procurement Documents/Forms, and have they been approved for use on ADB funded	Yes. The draft Standard Documents/Forms issued by NPA are in use for all Multilateral Development Banks including ADB	L

projects?	funded projects.	
A.17. Does the ToR follow a standard format such as background, tasks, inputs, objectives and outputs?	Yes, includes as follows: (i) background of the assignment (ii) objectives of the assignment (iii) scope of services (iv) transfer of knowledge (training), when appropriate (v) list of reports, schedule of deliveries, period of performance (vi) data, personnel facilities & local services to be provided by the Procuring Entity (vii) institutional & organization arrangements	L
A.18. Who drafts the procurement specifications?	Differently done for Goods and Works as follows: **Goods**: Usually the Divisional level Officers with support from Technical experts, where necessary. But where there is Consultant's support, the Consultant. **Works**: For routine procurements the specifications are drawn centrally by MIWRM. Specifications for uncommon specialized items of works are initially drafted by the Divisional level officers. But where there is Consultant's support, the Consultant.	M
A.19. Who approves the procurement specifications?	**Goods**: Usually the Divisional level officers. But where there is Consultant's support, the Consultant recommends. **Works**: For routine procurements the specifications are approved centrally by MIWRM. Specifications for uncommon specialized items of works are initially drafted by the Divisional level officers and	S

	approved by MIWRM. But where there is Consultant's support, the Consultant recommends.	
A.20. Who drafts the bidding documents?	Usually the Divisional level Officers. But where there is Consultant's support, the Consultant.	L
A.21. Who manages the sale of the bidding documents?	Divisional level officer or Procuring Entity (PE).	L
A.22. Who identifies the need for consulting services requirements?	Identified at the project planning and feasibility stage by the senior officers tasked with the project.	L
A.23. Who drafts the terms of reference (ToR)?	Usually the Divisional level Officers. But where there is Consultant's support, the Consultant.	L
A.24. Who prepares the request for proposals (RFPs)?	Usually the Divisional level Officers. But where there is Consultant's support, the Consultant.	L
B. INFORMATION MANAGEMENT		
B.1. Is there a referencing system for procurement files?	Yes	L
B.2. Are there adequate resources allocated to record keeping infrastructure, which includes the record keeping system, space, equipment and personnel to administer the procurement records management functions within the agency?	Yes, but inadequate	M
B.3. For what period are records kept?	Minimum 3 years.	L
B.4. Are copies of bids or proposals retained with the evaluation?	Yes	L
B.5. Are copies of the original advertisements retained with the pre-contract papers?	Yes	L
B.6. Is there a single contract file with a copy of the contract and all subsequent contractual correspondence?	Yes	L
B.7. Are copies of invoices included with the contract papers?	No. Separately maintained by Accounts Office.	S

C. PROCUREMENT PRACTICES		
Goods and Works		
C.1. Has the agency undertaken foreign-assisted procurement of goods or works recently (last 12 months, or last 36 months)? (If yes, please indicate the names of the development partner/s and the Project/s.)	Yes. **ADB**: Conflict affected region emergency project, Loan no. 2626, ongoing project from 2011. MIWRM and DOI are among the implementing agencies. Project substantially complete. **WB**: Dam Safety and Water Resource Planning Project (2008-2018). MIWRM is the EA, MASL and DOI are implementing agencies. Phase 1 of the project substantially complete, Phase 2 has just begun. **JBIC**: The Pro Poor Economic Advancement and Community Enhancement (PEACE) project is being implemented for rehabilitation of Irrigation. Project began in 2006, and is in completion stage.	L
C.2. If the above answer is yes, what were the major challenges?	Major challenges: (i) Time and Cost overrun (ii) Complexity in land Acquisition (iii) Capacity limitation of contractors (iv) working period limited due to short closure period of irrigation canals (v) To many works contracts, overloading project administration	M
C.3. Is there a systematic process to identify procurement requirements (for a period of one year or more)	Yes. Procurement requirements are systematically identified at the pre-implementation stage of the project/program during the planning phase in the form of Procurement Plan for 3 year period. Subsequently, updated annually.	L
C.4. Is there a minimum period for preparation of bids and if yes how long?	• ICB/LIB 42 days (more for complex Procurement) • NCB/LNB 21 days	M

	• Restricted competitive bidding under District/Divisional level Construction Contracts 14 days • Shopping 7 days minimum For emergency Procurement the above periods may be reduced.	
C.5. Are all queries from bidders replied to in writing?	Yes. Pre-bid meeting is optional	L
C.6. Does the bidding document state the date and time of bid opening?	Yes	L
C.7. Is the opening of bids done in public?	Yes.	L
C.8. Can late bids be accepted?	No	L
C.9. Can bids be rejected at bid opening?	No	L
C.10. Are minutes of the bid opening taken?	Yes	L
C.11. Who may have a copy of the minutes?	All those Bidders attending the Bid Opening.	L
C.12. Are the minutes free of charge?	Yes	L
C.13. Who undertakes the evaluation of bids (individual(s), permanent committee, ad-hoc committee)?	TEC is constituted prior to the deadline for submission of Bids.	L
C.14. What are the qualifications of the evaluators with respect to procurement and the goods and/or works under evaluation?	Officers from agencies and Specialists from universities or professional bodies having knowledge in procurement and integrity	L
C.15. Is the decision of the evaluators final or is the evaluation subject to additional approvals?	TEC recommends, Procurement decisions are made by appropriate procurement committee (depending on procurement threshold empowerment as set out in procurement manual). Clear separation of role of TEC and procurement committee maintained.	L
C.16. Using at least three real examples, how long does it normally take from the issuance of the invitation for bids up to contact effectiveness?	Normally within 100 days. In case of high value procurements more time taken since it has to go up to higher levels of contract approval committee.	S

	Real examples: **Contracts of Dam Safety and Water Resources Planning Project financed by WB;** Implementing Agency MASL (a) DSWRPP-1/works/NCB/57, -Contract value $1.12 million -Bid invitation 17 April 2012 -Contract signed 13 July 2012 -Time taken 87 days (b) DSWRPP-1/works/NCB/64, -Contract value $0.11 million -Bid invitation 8 April 2011 -Contract signed 13 July 2011 -Time taken 96 days Implementing Agency DOI (a) DSWRPP-1/works/NCB/6, -Contract value $3.00 million -Bid invitation 1 Nov 2012 -Contract signed 28 May 2013 -Time taken 208 days (b) DSWRPP-1/works/NCB/34, -Contract value $0.14 million -Bid invitation 24 Sept 2013 -Contract signed 31 Jan 2014 -Time taken 127 days **Contracts of Conflict Affected Region Emergency Project financed by ADB;** Implementing Agency DOI (a) CARE/NPC/ID/NCB/W3 -Contract value $0.06 million -Bid invitation 11 Mar 2011 -Contract signed 20 May 2011 -Time taken 69 days . (b) CARE/NPC/ID/NCB/W12 -Contract value $0.20 million	

	-Bid invitation 30 June 2011 -Contract signed 16 Sept 2011 -Time taken 79 days (c) CARE/NPC/ID/NCB/W19 -Contract value $1.15 million -Bid invitation 25 Aug 2011 -Contract signed 9 Apr 2012 -Time taken 227 days (d) CARE/NPC/ID/NCB/W25 -Contract value $2.78 million -Bid invitation 6 June 2011 -Contract signed 16 Sept 2011 -Time taken 102 days	
C.17. Are there processes in place for the collection and clearance of cargo through ports of entry?	Yes	L
C.18. Are there established goods receiving procedures?	Yes	L
C.19. Are all goods that are received recorded as assets or inventory in a register?	Yes	L
C.20. Is the agency/procurement department familiar with letters of credit?	Yes	L
C.21. Does the procurement department register and track warranty and latent defects liability periods?	Yes	L
Consulting Services		
C.22. Has the agency undertaken foreign- assisted procurement of consulting services recently (last 12 months, or last 36 months)? (If yes, please indicate the names of the development partner/s and the Project/s.)	Yes in 2011 for WB project, DOI hired 3 international consulting firms. In 2011 for ADB project one national consulting firm was hired. . **ADB**: Conflict affected region emergency project, Loan no. 2626 **WB**: Dam Safety and Water Resource Planning Project.	L
C.23. If the above answer is yes, what were the major challenges?	Major Challenges: (i) Capacity to short-list, prepare	M

	RFP and evaluate of the proposals (ii) Some delays in approval process particularly in case of high level procurement, including prior review by the Development Partners (iii) Inadequate oversight and monitoring by the Client (iv) Replacements of Key Professional staff by the Consultant (v) Delays in Contract, deciding upon contract variation	
C.24. Are assignments and requests for expressions of interest (EOIs) advertised?	Yes. Also posted on the relevant websites.	L
C.25. Is a consultants' selection committee formed with appropriate individuals, and what is its composition (if any)?	Yes, composition as detailed in consultant procurement manual and guideline.	L
C.26. What criteria is used to evaluate EOIs?	Criteria used to evaluate EOIs generally includes: (i) Consultant's facilities & areas of expertise (ii) descriptions of similar assignments (iii) experience in similar operating environments & conditions (iv) appropriate experience & professional qualifications and adequate resources (v) managerial strength & financial capacity (vi) Others as defined in SRFP	L
C.27. Historically, what is the most common method used (QCBS, QBS, etc.) to select consultants?	QCBS	L
C.28. Do firms have to pay for the RFP document?	No. RFP is issued only to short-listed Consultants free of cost	L
C.29. Does the proposal evaluation criteria follow a pre-determined structure and is it detailed in the RFP?	Yes and the criteria and sub-criteria, with points allocated are detailed in the RFP	L

C.30. Are pre-proposal visits and meetings arranged?	Yes, based on necessity and complexity of the assignments	L
C.31. Are minutes prepared and circulated after pre-proposal meetings?	Yes	L
C.32. To whom are the minutes distributed?	All those short-listed Consultants and members of the Consultant Selection Committee	L
C.33. Are all queries from consultants answered/addressed in writing?	Yes.	L
C.34. Are the technical and financial proposals required to be in separate envelopes?	Yes	L
C.35. Are proposal securities required?	No	L
C.36. Are technical proposals opened in public?	Yes, in presence of consultant's representatives.	L
C.37. Are minutes of the technical opening distributed?	Yes	L
C.38. Do the financial proposals remain sealed until technical evaluation is completed?	Yes. Retained with Employer	L
C.39. Who determines the final technical ranking and how?	Consultant Selection Committee, based on pre-determined evaluation criteria and scoring of proposals.	L
C.40. Are the technical scores sent to all firms?	Technical scores are not sent to the firms but those who secure the minimum pass marks are invited to attend the public opening of Financial proposals.	L
C.41. Are the financial proposal opened in public?	Yes. But limited to technically qualified Consultants only as mentioned in Sl. C.40 above	L
C.42. Are minutes of the financial opening distributed?	Yes.	L
C.43. How is the financial evaluation completed?	Financial evaluations are done by Consultant Selection Committee where cost is a factor for only technically qualified proposals.	L
C.44. Are face to face contract negotiations held?	Contract negotiations are mandatorily held, face to face, between the highest ranked selected Consultant and the Evaluation Committee.	L

C.45. How long after financial evaluation is negotiation held with the selected firm?	After the selection of Consultant is approved by appropriate Consultant Selection Committee based on technical and financial evaluation. Varies from 1 to 4 months	S
C.46. What is the usual basis for negotiation?	The basis of negotiation is to rationalize the cost of the proposal in respect of the aspects as follows: (i) Methodology (ii) Work plan and activity schedule (iii) Organization and staffing (iv) Deliverables & TOR (v) Training inputs, if training is a major component (vi) PE's inputs (vii) Proposed contract price (viii) Reimbursables in case of Time-based Contract (ix) Replacement of experts.	L
C.47. Are minutes of negotiation taken and signed?	Yes, including the draft negotiated contract duly initialed	L
C.48. How long after negotiation is the contract signed?	Varies from 2 to 5 months depending on the level of the approval authority and necessity of prior review by the Development Partner.	S
C.49. Is there an evaluation system for measuring the outputs of consultants?	Yes. Broadly the progress reports and final report submitted by the consultants.	M
Payments		
C.50. Are advance payments made?	Yes, if so provided in the Contract Documents.	L
C.51. What is the standard period for payment included in contracts?	2 months.	L
C.52. On average, how long is it between receiving a firm's invoice and making payment?	General practice is to pay within a month of claim certification for works. No intermediate payments are made for procurement of Goods	L
C.53. When late payment is made, are the beneficiaries paid interest?	No. Generally avoided.	S

D. EFFECTIVENESS		
D.1. Is contractual performance systematically monitored and reported?	Yes	L
D.2. Does the agency monitor and track its contractual payment obligations?	Yes	L
D.3. Is a complaints resolution mechanism described in national procurement documents?	Yes	L
D.4. Is there a formal non-judicial mechanism for dealing with complaints?	Yes	L
D.5. Are procurement decisions and disputes supported by written narratives such as minutes of evaluation, minutes of negotiation, notices of default/withheld payment?	Yes	L
E. ACCOUNTABILITY MEASURES		
E.1. Is there a standard statement of ethics and are those involved in procurement required to formally commit to it?	Yes	L
E.2. Are those involved with procurement required to declare any potential conflict of interest and remove themselves from the procurement process?	Yes	L
E.3. Is the commencement of procurement dependent on external approvals (formal or de-facto) that are outside of the budgeting process?	Mostly no	M
E.4. Who approves procurement and do they have procurement experience and qualifications?	Appropriate procurement committee approves. Comprises of people experienced in procurement,	M
E.5. Which of the following actions require approvals outside the procurement unit or the evaluation committee, as the case may be, and who grants the approval?	None	L
Bidding document, invitation to pre-qualify or RFP		

Advertisement of an invitation for bids, pre-qualification or call for EOIs		
Evaluation reports		
Notice of award		
Invitation to consultants to negotiate		
Contracts		
E.6. Is the same official responsible for: (i) authorizing procurement transactions, procurement invitations, documents, evaluations and contracts; (ii) authorizing payments; (iii) recording procurement transactions and events; and (iv) the custody of assets?	(i) Yes, except for evaluations. (ii) Yes. But payments disbursed by Accounts Office except for projects where Bank Accounts maintained by Project Directors in Development partner funded projects (iii) Yes (iv) Yes	L
E.7. Is there a written auditable trail of procurement decisions attributable to individuals and committees?	Yes Internal, Statutory Comptroller & Auditor General (CAG) audits are carried out. No external audit (by private sector auditors) done.	M

II. General Ratings

Criterion	**Risk**
A. Organizational and Staff Capacity	M
B. Information Management	L
C. Procurement Practices	M
D. Effectiveness	M
E. Accountability Measures	L
OVERALL RISK RATING	**M**

Annex4

AUTHORITY OF CONSULTANT PROCUREMENT COMMITTEES FOR CONTRACT AWARD RECOMMENDATION/DETERMINATION

Details of the financial threshold limits of committees as presented in page 24 of the NPA published Consulting Services Manual (2007)

FIRMS- When Competitive Procedure (QCBS, QBS, FBS, or LCS) following Guideline 3.8, 3.9, 3.10 or 3.11 respectively is used :		
Authority	**Nationally Publicized**	**Internationally & Nationally Publicized**
Cabinet Appointed Consultant Procurement Committee (CPCC)	Greater than or equal to Rs. 100 m ($0.78 m)	Greater than or equal to Rs. 200 m ($1.57 m)
Ministry Consultant Procurement Committee (CPCM)	Less than Rs. 100 m ($0.78 m)	Less than Rs. 200 m ($1.57 m)
Department Consultant Procurement Committee (CPCD) or Project Consultant Procurement Committee (CPCP)	Less than Rs. 20 m ($0.16 m)	Less than Rs. 50 m ($0.4m)
FIRMS - When CQS Procedure (Guideline 3.12) or SS Procedure (Guideline 3.13) is followed:		
Cabinet Appointed Consultant Procurement Committee (CPCC)	Greater than or equal to Rs. 25 m ($0.20m)	Greater than or equal to Rs. 100 m ($0.78m)
Ministry Consultant Procurement Committee (CPCM)	Less than Rs. 25 m ($0.20 m)	Less than Rs. 100 m ($0.78m)
Department Consultant Procurement Committee (CPCD) or Project Consultant Procurement Committee (CPCP)	Less than Rs. 5 m ($0.04 m)	Less than Rs. 20 m ($0.16 m)
CAO Upon a recommendation made by a committee appointed by CAO	Less than Rs. 5 M ($0.04 m)	Less than Rs. 5 m ($0.04 m)
AO/PD Upon a recommendation made by a committee appointed by CAO or by delegation	Less than Rs. 250,000 ($1,961)	Less than Rs. 3 m ($23,529)
138. INDIVIDUALS :		
Cabinet Appointed Consultant Procurement Committee (CPCC)	Greater than or equal to Rs15 m ($0.12 m)	Greater than or equal to Rs. 25 m ($0.20 m)
Ministry Consultant Procurement Committee (CPCM)	Less than Rs. 15 m ($0.12 m)	Less than Rs. 25 m ($0.20 m)
Department Consultant Procurement Committee (CPCD) or Project Consultant Procurement Committee (CPCP)	Less than Rs. 5 m ($0.04 m)	Less than Rs. 10 m ($0.08 m)
CAO	Less than Rs. 3 m	Less than Rs. 5 m

	($23,529)	($0.04 m)
AO/PD	Less than Rs. 1m ($7,843)	Less than Rs. 3m ($23,529)

Approving Authorities:

Before the contract is awarded approval from the following authorities should be obtained for the recommendation/determination made by the CPCs: However, the CAO may delegate the above approval authority to HD/AO/PD.

CPCP - CAO
CPCD - CAO
CPCM - CAO
CPCC - Cabinet

Annex 5
NCB Annex

National Competitive Bidding

1. General

National competitive bidding shall conform to the provisions for "National Competitive Bidding" as prescribed in the *Procurement Guidelines 2006 for Goods and Works* issued in January 2006 by the National Procurement Agency, and the specific procedures prescribed by the *Procurement Manual* issued on March 2006, with the clarifications and modifications described in the following paragraphs required for compliance with the provisions of the ADB Procurement Guidelines.

2. Registration

(i) Bidding shall not be restricted to pre-registered firms under the national registration system of the Institute for Construction, Training and Development (ICTAD), and such registration shall not be a condition for the submission of bids in the bidding process.

(ii) Where registration is required prior to award of contract, bidders: (i) shall be allowed a reasonable time to complete the ICTAD registration process; and (ii) shall not be denied registration for reasons unrelated to their capability and resources to successfully perform the contract, which shall be verified through post-qualification.

(iii) National sanction lists or blacklists may be applied only with prior approval of ADB.

3. Prequalification

Post qualification shall be used unless prequalification is explicitly provided for in the loan agreement/procurement plan. When used for large or complex Works contracts, *i.e.* turnkey, design and build, or management contracts; or custom-designed equipment, industrial plants, and specialized services, prequalification evaluation shall not include the evaluation of equipment and personnel. This assessment shall be undertaken at the bid evaluation stage. Irrespective of the procedure applied (whether prequalification or post-qualification), no domestic or foreign contractor shall be precluded from participation.

4. Advertising

Bidding of NCB contracts estimated at $500,000 or more for goods and related services or $1,000,000 or more for civil works shall be advertised on ADB's website via the posting of the Procurement Plan.

5. Bidding Documents

Procuring entities shall use standard bidding documents acceptable to ADB for the Procurement of Goods, Works and Consulting Services, based ideally on the standard bidding documents issued by ADB.

6. Packaging

Slicing or splitting of contracts within a package shall not be used to change the contract sizes and their corresponding methods of procurement as approved in the Procurement Plan.

7. Bid Security

Where required, bid security shall be in the form of a bank guarantee from a reputable bank.

8. Preferences

(i) No preference of any kind shall be given to domestic bidders or for domestically manufactured goods.

(ii) Foreign suppliers and contractors from ADB member countries shall be allowed to bid, without registration, licensing, and other government authorizations, leaving compliance with these requirements for after award and before signing of contract.

9. Procurement of Works

(i) Specifications for works may be based on specifications recommended by ICTAD to the extent possible, but ICTAD approval shall not be required for adoption of specifications in a particular procurement activity.

(ii) The determination of the financial capacity of a bidder for award of the contract in post-qualification evaluation shall take into account current contract commitments and shall not be confined, for domestic bidders, to the ICTAD registration.

10. Bid Rejection for Unrealistic Rates

Bids shall not be subjected to a test for unrealistic rates. No lowest evaluated and substantially responsive bid shall be rejected on the basis of comparison to rates, including but not limited to market, historical, or agency established rates, without prior approval of ADB.

11. Rejection of All Bids and Rebidding

Bids shall not be rejected and new bids solicited without the ADB's prior concurrence.

12. Price Negotiations

Price negotiation shall be allowed only where the price offered by the lowest evaluated and substantially responsive bidder substantially exceeds costs estimates. Approval of ADB is required prior to any negotiation of prices.

13. Participation by Government-Owned Enterprises

Government-owned enterprises in the Democratic Socialist Republic of Sri Lanka shall be eligible to participate only if they can establish that they are legally and financially autonomous, operate under commercial law, and are not a dependent agency of the procuring entity, or the Project Executing Agency or Implementing Agency.

14. Member Country Restrictions

Bidders must be nationals of member countries of ADB, and offered goods, works and services must be produced in and supplied from member countries of ADB.

APPENDIX 10

ECONOMIC AND FINANCIAL ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 10

ECONOMIC AND FINANCIAL ASSESSMENT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
BLI	–	Base Line Indicator
CAG	–	Comptroller and Auditor General
CPI	–	Compliance Performance Indicators
DOI	–	Department of Irrigation
DPC	–	Department Procurement Committee
EOI	–	Expression of Interest
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
ICTAD	–	Institute for Construction Training and Development
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
Rs	–	Sri Lankan Rupees
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
MFP	–	Ministry of Finance and Planning
MPC	–	Ministry Procurement Committee
MPP	–	Master Procurement Plan
MRB	–	Mahaweli River Basin
NCASL	–	The National Construction Association of Sri Lanka
NCPCP	–	North Central Province Canal Project
NPA	–	National Procurement Agency
NWPC	–	North Western Province Canal
PAC	–	Public Accounts Committee
PE	–	procurement entity
PMDC	–	program management and design consultant
PPC	–	Project Procurement Committee
PPP	–	Public private partnership
PPTA	–	project preparatory technical assistance
PSB	–	Procurement Support Bureau
RPC	–	Regional Procurement Committee
SIWRM	–	strengthening integrated water resources management
UEC	–	Upper Elahera Canal
UNICITRAL	–	United Nations Commission on International Trade Law

CONTENTS

I. INTRODUCTION

1. **Scope.** This supplementary appendix contains a detailed analysis of the economic costs and benefits of the North Central Province Canal Project (NCPCP). The first phase of this project involves the Minipe Left Bank Canal Rehabilitation, the construction of the Northwest Province Canal (NWPC), and the construction of the Kaluganga-Moragahakanda Transfer Canal (KMTC) and adjoining Upper Elahera Canal (UEC). These investments will be co-financed from the proceeds of ADB's proposed Multitranche Financing Facility (MFF) for the Water Resources Development Improvement Program (WRDIP). The construction of the KMTC and UEC, which account for about two-thirds of the cost of Phase 1, is needed to implement Phase 2 of the NCPCP. This second phase mainly consists of the construction of the Kalinganuwara Pumping Station, the Lower Uma Oya, the Randenigala-Kaluganga Transfer Canal and the North Central Province Canal. Because the infrastructure to be financed by the MFF is needed to realize economic benefits that will accrue upon completion of the Phase 2 investments (and is indeed designed at the scale that is required to realize these benefits), the economic analysis presented here covers the entire NCPCP, instead of the part that will be co-financed by the MFF.

2. **Structure.** The remainder of this supplementary appendix is structured as follows. Section II gives an overview of the methodology that was used to estimate the economic costs and benefits of NCPCP. Section III presents estimates of investment costs and incremental O&M costs, expressed in economic prices. Section IV presents estimates of quantifiable economic benefits from: (i) increased agricultural production, (ii) increased provision of raw water for domestic, municipal and industrial (DMI) uses, and (iii) increased hydropower generation. It also discusses economic benefits that cannot be quantified accurately because of methodological difficulties. Section V compares quantifiable economic cost and benefits, and presents sensitivity analyses. Section VI contains a distribution analysis.

II. METHODOLOGY

3. **Overview.** An economic analysis of was prepared for NCPCP in accordance with ADB's *Guidelines for the Economic Analysis of Projects* (1997). The guidelines describe four basic steps to analyzing the economic viability of a project. These steps are:

(i) identify economic costs and benefits

(ii) quantify economic costs and benefits (comparing with-project and without-project situations for each alternative)

(iii) value economic costs and benefits

(iv) compare benefits and costs

4. **Identification and quantification of economic costs and benefits.** The project's incremental economic costs and benefits were identified and (to the extent possible) quantified for the period 2015-2060 (30-year implementation period from completion of Phase 2). All costs and benefits were expressed in mid-2014 economic prices including physical contingencies, but excluding transfer payments (such as taxes, duties and subsidies). The economic cost-benefit analysis was conducted at the domestic price level (domestic price numeraire).

5. **Valuation of economic costs and benefits.** For internationally traded inputs and outputs, economic prices (at farm gate) were derived from international border prices adjusted for the cost of transportation, handling, processing and packing (**Table 1**). For non-traded inputs and outputs, financial prices were obtained from local markets and converted into economic prices using the standard conversion factor (see **Table 2** for an estimation of the SCF). The economic price of farm labor was estimated by applying a shadow wage rate factor (SWRF) of 0.7 to the financial price of this input. For an overview of economic and financial prices of agricultural inputs and outputs used in this analysis, see **Table 3**.

6. **Comparison of economic benefits and costs.** A project is deemed economically feasible if the economic net present value (ENPV) of the project's discounted (net) benefit streams is at least zero, or if economic internal rate of return (EIRR) of these benefit streams exceeds the economical opportunity cost of capital (EOCC) that was employed to finance the project. For the purpose of assessing the economic viability of the project, the assumed EOCC was 12 percent.[1]

[1] The *Guidelines for the Economic Analysis of Projects* state that "The Bank would expect to…accept independent projects and subprojects with an EIRR between 10 and 12 percent for which additional unvalued benefits can be demonstrated, and where they are expected to exceed unvalued costs".

Table 1: Estimation of Farm Gate Prices for Internationally Traded Commodities

Item	Rice	Sugar	Urea	TSO	Potash
International commodity rate ($/ton)*	435	380	316	413	287
Adjustment factor**	1.43	5.00	1.00	1.00	1.00
Adjusted price ($/ton)	305	76	316	413	287
Freight and insurance ($/ton)	30	8	32	41	29
Conversion rate (Rs/$)***	130	130	130	130	130
CIF Colombo price (Rs)	43,618	10,883	45,308	59,141	41,098
Handling and transport from Colombo (Rs)	3,053	762	3,172	4,140	2,877
Price at project area (Rs)	46,671	11,645	48,479	63,281	43,975
less: processing/packing charges (Rs)	1,400	349	-	-	-
less: transport farm to market (Rs)	700	1,747	727	949	660
Farm gate price (Rs)	**44,571**	**9,549**	**47,752**	**62,331**	**43,315**

Item	Ground Nuts	Maize	Dry Chillies	Green Gram	Big Onion
International commodity rate ($/ton)*	1,276	257	1,173	1,230	333
Adjustment factor**	1.02	1.02	1.02	1.02	1.02
Adjusted price ($/ton)	1,251	252	1,150	1,206	326
Freight and insurance ($/ton)	125	25	115	121	33
Conversion rate (Rs/$)***	130	130	130	130	130
CIF Colombo price (Rs)	179,138	36,100	164,660	172,660	46,750
Handling and transport from Colombo (Rs)	12,540	2,527	11,526	12,086	3,273
Price at project area (Rs)	191,678	38,627	176,186	184,746	50,023
less: processing/packing charges (Rs)	5,750	1,159	5,286	5,542	1,501
less: transport farm to market (Rs)	2,875	579	2,643	2,771	750
Farm gate price (Rs)	**183,052**	**36,889**	**168,258**	**176,433**	**47,771**

* Source: World Bank Pink Sheets (Q3-2014), except big onion, dry chillies, maize and green gram (CIF Colombo prices taken from Harti Monthly Food Bulletin, August 2014)

** Adjustment factor of 1.02 applied to ground nuts, maize, dry chillies, green gram and big onion to correct for differences in quantity and quality. Adjustment factor of 1.43 used for rice to enable comparison with paddy (which contains husk). Adjustment factor of 5.00 used for sugar to enable comparison with sugar cane.

*** As of 1 July 2014.

Table 2: Estimation of Standard Conversion Factor (Rs billion)

		2009	2010	2011	2012	Average
Total imports	M	814	974	1,168	1,246	1,050
Total exports	X	1,173	1,520	2,241	2,441	1,844
Import duties*	D	177	179	205	240	200
Sales tax on imports	T	68	100	121	120	102
Subsidies on imports	S	27	26	30	36	30
Export duties	E	2	2	3	3	2
Export rebates	R	-	-	-	-	-
SCF**		**0.90**	**0.91**	**0.92**	**0.92**	**0.91**

Source: ADB, based on Central Bank of Sri Lanka (2014)

* Sum of import duties, import cess levies, ports and airport levy, nation building tax and special commodity levy

** Computed as (M+X) / [(M+T_M) + (X-T_X)], where M: CIF value of imports, X: = FOB value of exports, T_M: net value of taxes on imports (Tm=D+T-S), T_X : net value of taxes on exports (T_X = E-R).

Table 3: Economic and Financial Prices of Agricultural Inputs and Outputs (Rs)

Investment Cost Item	Unit	Economic Price	Financial Price*	Conversion Factor**
Tradable Outputs				
Paddy	kg	44.6	37.0	1.20
Maize	kg	36.9	36.3	1.02
Dry chillies	kg	168.3	150.0	1.12
Green gram	kg	176.4	196.3	0.90
Ground nut	kg	183.1	136.4	1.34
Big onion	kg	47.8	46.8	1.02
Sugarcane	kg	9.5	3.4	2.84
Non-Tradable Outputs				
Banana	kg	57.7	63.1	0.91
Vegetables	kg	34.8	38.1	0.91
Tradable Inputs				
Fertilizer for paddy	kg	48.9***	7.0	6.98
Fertilizer for other agricultural produce	kg	48.9***	25.0	1.96
Non-Tradable Inputs				
Farm labor	day	420	600	0.70
Other non-tradable inputs	(varies by type of input)			0.91

Source: ADB, based on World Bank (104), MCB (2012) and Harti Monthly Food Bulletin (August 2014)
* Financial prices of outputs computed based on average market prices in dry zone (Q4-2013 to Q3-2014).
** Economic Price / Financial Price (implied or directly estimated)
*** Weighted average for urea, TSP and potash (weight computed from import volumes during 2009-2012.

III. ECONOMIC COSTS

7. **Types of economic costs.** An assessment of the economic costs and benefits of a project should only consider costs and benefits that would not arise without that project. The incremental economic costs of the proposed NCPCP consist of the project's:

(i) incremental economic investment cost of Phase 1 and Phase 2 infrastructure

(ii) incremental economic cost of operations and maintenance (O&M) of this infrastructure during the project's economic lifetime

The incremental cost of increased agricultural production (such as increases in the cost of seeds, fertilizer and other agricultural inputs) was not considered here, but taken into account when estimating the net economic benefits arising from such increases. The incremental cost of increases in raw water provision for DMI uses and hydropower generation was treated similarly. The economic cost of adverse social impacts was not estimated separately, because the economic investment cost already includes the cost of compensating affected persons for economic losses caused by the project.[2] The economic cost of adverse environmental impacts was deemed negligible, and the economic investment cost also already contains a provision for environmental mitigation.

8. **Incremental economic investment cost.** This cost consists of the investment cost of the proposed infrastructure for NCPCP, including project management costs, and the cost of environment and social mitigation. The total economic investment cost of NCPCP was estimated at Rs202 billion (or approximately $1.55 billion), of which 35 percent for Phase 1 and the remaining 65 percent for Phase 2 (**Table 4**). As described in Section II, all economic costs are expressed in mid-2014 economic prices including physical contingencies. Phase 1 investments will be undertaken during 2015-2024, and the cost of these investments was based on detailed estimates prepared by the Ministry of Irrigation and Water Resource Management (MIWRM) and adjusted based on reviews by ADB. Phase 2 investments are scheduled for 2015-2017 (Kalinganuwara Pumping Station) and 2020-2029 (other Phase 2 investments). The cost of these investments was based on indicative estimates presented in a pre-feasibility study that was prepared by the Mahaweli Consultancy Bureau (MCB) for MIWRM in 2012.[3] The investment cost of both phases includes an allocation for the cost of rehabilitating minor tanks, to ensure that the benefits from the primary irrigation infrastructure accrue to the intended beneficiaries. As mentioned in paragraph 4, the economic lifetime of the project was conservatively estimated at 30 years from completion of the construction of Phase 2 investments. To reflect the benefits that may accrue after the end of the project's economic lifetime in 2060, the residual value of the project was set at 20 percent of the economic investment cost.

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[2] An alternative approach is to estimate economic losses to affected persons separately, and to treat compensation payments as transfer payments. This exercise would, in all likelihood, have a very similar impact on the net economic benefits of the project, but was not undertaken because resettlement and compensation costs account for less than 0.4% of the total project cost and were therefore not material.

[3] *Economic Analysis in Financial and Economic Terms of the North Central Province Canal Project of Mahaweli Development Program* (MCB, 2012). The Phase 2 investment costs presented in the study were converted into mid-2014 economic prices, assuming that the cost structure of these investments were the same as in Phase 1.

Table 4: Economic Investment Cost of NCPCP, 2015-2029 (constant mid-2014 prices)

Investment Cost Item	Construction Period	Rs b*	%Total
PHASE 1		**71.3**	**35**
Minipe Left Bank Canal Rehabilitation	2015-2019	2.8	1
North Western Province Canal	2015-2022	15.1	8
UEC and KMTC	2015-2024	46.3	23
Other**	2015-2024	7.0	3
PHASE 2*		**130.4**	**65**
Kalinganuwara Pumping Station	2015-2019	24.9	12
Other Phase 2 investments	2020-2029	105.4	52
TOTAL		**201.7**	**100**

Source: ADB, based on MCB (2012)
* Project management, capacity building, environmental mitigation, social mitigation
** Includes the cost of project management and environmental and social mitigation

9. The proposed project is the least-cost option that was identified to achieve the objective of providing water to the project area whilst minimizing adverse impacts on the existing system and the environment. A large number of studies and simulations were undertaken to select the infrastructure that would best achieve this objective. The main reasons for the selected option can be summarized as follows:[4]

(i) shortest transfer route length compared to alternative options studied

(ii) least environmental damage compared to alternative options studied

(iii) optimization of infrastructure to be developed under Moragahakanda and Kalu Ganga

(iv) enhanced flexibility with regard to regulation of flows

10. **Incremental economic O&M cost.** This is the incremental cost of two items:

(i) **Routine O&M.** This cost mainly consists of pumping costs and the cost of cleaning and minor repairs of project assets. Pumping costs were estimated at 1 percent per year of the economic investment cost. The annual cost of other routine O&M costs was estimated at 0.5 percent of the economic investment cost, but does not include incremental O&M costs that will be borne by farmers (which will be taken into account when estimating net economic benefits from increased agricultural production). The O&M cost estimates were verified with MIWRM, and are broadly in line with estimates in MCB's pre-feasibility study of 2012.

(ii) **Replacement.** The economic lifetime of canals, dams and other civil structures is similar to the economic lifetime of NCPCP (30-40 years). This is not the case, however, for hydraulic steel structures and mechanical equipment, which have an estimated economic lifetime of 20-25 years. The replacement cost of these items was estimated at 10 percent of the economic investment cost, and replacement was assumed to take place once during the project's economic lifetime, in 2050.

[4] For details, refer to *Pre-Feasibility Study for the Implementation of North Central Province Canal* (MCB, 2012).

IV. ECONOMIC BENEFITS

11. **Types of economic benefits.** The NCPCP will finance investments in infrastructure that will enable the implementing agencies to divert water from the Mahaweli River to water-scarce areas in and around the North Central Province (NCP). Upon completion of the proposed investments, the available supply of water is expected to increase by over 1,200 million cubic meters (MCM) per year.[5] The increase in available water will be allocated to hydropower, DMI uses and agriculture. The following quantifiable economic benefits were considered:

(i) **Economic benefits from increased agricultural production.** The increase of irrigation water is expected to result in crop yield increases within existing cultivation areas and in increased cultivated areas.

(ii) **Economic benefits from increased provision of raw water for domestic, municipal and industrial uses.** These consist of economic benefits from improved sources of non-piped drinking water (which mainly consists of avoided health costs and reductions in the cost of obtaining water), and the benefits of improved sources of piped drinking water. The latter benefits are derived from reductions in the cost of supplying water and the acceleration of piped water coverage vis-à-vis the "without project" scenario.

(iii) **Economic benefits from increased hydropower generation.** Until the completion Phase 1, the project will provide a modest increase in the country's hydropower generation. The economic benefits of the expected increase are partly offset upon completion of the NCP Canal in 2029, after which overall hydropower generation will then be slightly lower than without the project.

In addition to the quantifiable benefits from increases in agricultural production, DMI water, hydropower generation, the following benefits were assessed qualitatively: increased food self-sufficiency, and increased internal security. Taken together, these non-quantifiable economic benefits were deemed significant.

A. Economic Benefits from Increased Agricultural Production

12. **Overview.** The primary economic benefit of NCPCP is increased agricultural production through improved deliveries of irrigation water. More specifically, improved irrigation water supply is expected to result in:

(i) an increase in yields of existing crops (which currently mostly consists of paddy)

(ii) an increase in the cultivated area within existing irrigation systems (during the dry season, a substantial part of agricultural land is left idle in areas that are currently not adequately served by irrigation systems)

(iii) an increase in the production of high-value crops (such as fruit and vegetables); this effect is not only expected because high-value crops require a reliable supply

[5] *Water Balance Study of NCP Canal Project* (MCB, 2012). This section heavily relies on this study, which is hereinafter also referred to as "the Water Balance Study".

of irrigation water, but also because farmers tend to fulfill their own paddy needs first before growing other food crops

In addition, the project will invest in an institutional support program to help the implementing agencies better manage their existing irrigation infrastructure. These investments are also expected to result in increases in water productivity, which would result either in increases in cropping intensity (defined as the fraction of the cultivated area that is harvested) or maintain the same level of cropping intensity using less water.

13. **Structure of the analysis.** The economic analysis of benefits from increased agricultural production proceeds as follows:

(i) **Step 1: Estimate agricultural production without project.** In the absence of the project, yields are expected to decrease as a result of climate change.

(ii) **Step 2: Estimate increases in cropping intensities.** The project is expected to increase yields in areas that are currently cultivated and irrigate areas that are currently not cultivated. Both types of increases were measured by estimating increases in cropping intensities. The result of the first step is an estimate of the increase in the total harvested area compared to the "without project" scenario.

(iii) **Step 3: Estimate changes in cropping patterns.** The project would enable farmers to increase the production of crops with a higher value added than paddy. The result of this step is the definition of a realistic crop mix in the benefit area.

(iv) **Step 4: Estimate net economic benefits by crop.** Farm gate prices and the cost of agricultural inputs were estimated for each crop in the selected mix, and converted to net economic benefits by crop, expressed in mid-2014 rupees per hectare.

14. **Step 1: Estimate agricultural production without project.** The project will improve irrigation in an area of about 232,500 hectares of irrigable land in Sri Lanka's dry zone ("the Agricultural Benefit Area"). About 214,500 hectares is currently already used to grow crops, mostly paddy, and the remaining 18,000 hectares will be cultivated upon completion of Phase 1. In the "without project" scenario (WOP), it is anticipated that agricultural production will decrease over time as a result of climate change. As described in the climate change vulnerability assessment prepared for the PPTA, there is no consensus about the impacts of climate change on rainfall in the project area (some models indicate that rainfall will increase in the wet season and decrease in the dry season, whereas other models indicate the opposite). There is, however, general agreement that air temperatures (evapotranspiration) will gradually increase. According to a recent analysis, air temperatures in the project area will be 1.3ºC to 1.7ºC higher in 2050 than during 1961-1990.[6] Lobell et al. estimate that paddy yields in South Asia will, on average, decrease by 4.0 percent per 1ºC temperature increase.[7] These parameters were used to estimate the decrease in agricultural production. In 2060, the final year of the project's economic lifetime, total production would be about 5 percent lower than in the "with project" (WP) scenario.

[6] C. S. De Silva. *Impact of Climate Change on Water Resources and Agriculture in Sri Lanka*. Proceedings of the International Conference on Climate Change Impacts and Adaptations (2013).
[7] D.B. Lobell et al. *Prioritizing Climate Change Adaptation Needs for Food Security in 2030* (Science, Feb 2008).

15. **Step 2: Estimate increases in cropping intensities.** At present, cropping intensities in existing cultivated areas in the Agricultural Benefit Area are suppressed, mainly because of persistent shortages of irrigation water (see **Annex 1** for an overview of the relationship between irrigation and paddy yields in the dry zone). Records of the Mahaweli Authority of Sri Lanka (MASL) indicate that cropping intensities are about 50 percent lower in Yala (the dry season, which usually lasts from May to August) than in Maha (the wet season, which starts in September ends in March of the following year). To assess the potential impact of NCPCP on agricultural production, the Agricultural Benefit Area was divided in 27 smaller homogeneous areas. For each of these sub-areas, MIWRM identified current cropping intensities (CIs) based on MASL records and prepared forecasts of cropping intensities that would be realized upon completion of the required irrigation infrastructure. The weighted average CI of the entire Agricultural Benefit Area is projected to increase by about 31 percent, from 1.42 now to 1.86 upon completion of Phase 2. (For comparison, a fixed effect model showed that moving from rainfed to irrigated water supply would increase average paddy yields by 62 percent; see **Box 1**). For obvious reasons, projected increases are higher for areas where irrigation is poor or mediocre than in areas that are already well-irrigated (see **Table 5** for a summary; refer to **Annex 2** for assumptions by sub-area.) The assumed increases are deemed conservative: MIWRM assumes that CIs in well-irrigated areas will increase by about 3 percent, from 1.87 to 1.93; and, upon completion of NCPCP, when the entire Agricultural Benefit Area will receive adequate supplies of irrigation water in both seasons, CIs in areas that are currently not well irrigated are assumed to increase to 1.80, which is 4 percent lower than CIs that are already achieved now in areas with good irrigation (1.87).

Table 5: Current and Projected Cropping Intensities in the Agricultural Benefit Area

Type of area	Current Cropping Intensity			Projected Cropping Intensity*		
	Maha	Yala	Total	Maha	Yala	Total
Currently cultivated						
- Good irrigation (CI>1.5)	1.00	0.87	1.87	1.00	0.93	1.93
- Medium irrigation (CI 1.0-1.5)	0.76	0.47	1.23	1.00	0.80	1.80
- Poor irrigation (CI ≤1.0)	0.79	0.02	0.81	1.00	0.80	1.80
Currently idle land	-	-	-	0.63**	0.89	1.52
ALL AREAS	**0.86**	**0.57**	**1.42**	**0.97**	**0.89**	**1.86**

Source: ADB, based on MASL (current cropping intensities) and MIWRM (projected cropping intensities)

* In first year after completion of relevant irrigation infrastructure

** CI < 1.00 because part of the currently idle land will be allocated to sugar cane, where harvests are assumed to take place during Yala only

16. It is important to note that cropping intensities projected by MIWRM were based on the assumption that improved deliveries of irrigation water will be used exclusively to grow more paddy, both in Maha and Yala ("paddy/paddy", in MCB parlance). This assumption was made to ensure that sufficient irrigation water would be available for increased agricultural production, irrespective of the selected crop mix. Because paddy requires more water per hectare than other food crops (OFCs), any combination of paddy and OFCs will require less water than growing paddy only. Because part of the irrigation water will be used for OFC production, the Water Balance Study contains conservative projections of water available for productive uses.

17. At present, the average CI of the Agricultural Benefit Area is 1.42. This means that (1.42 x 232,500 =) about 331,000 hectares is harvested on an annual basis. Upon completion of the project in 2030, the CI will increase to 1.86. As a result, the harvested area will increase by ([1.86 x 232,500] – 331,000 =) about 102,000 hectares. Unsurprisingly, most of the estimated increase will be realized in Yala, and in areas with poor irrigation (**Table 6**).

Table 6: Increases in Harvested Area upon Completion of NCPCP

Type of area	Increase ('000 hectares)			Increase (% all areas)		
	Maha	Yala	Total	Maha	Yala	Total
Currently cultivated						
- Good irrigation (CI>1.5)	0.4	8.8	9.1	0	9	9
- Medium irrigation (CI 1.0-1.5)	1.7	2.4	4.1	2	2	4
- Poor irrigation (CI ≤1.0)	13.0	48.1	61.1	13	47	60
Currently idle land	11.4	16.0	27.4	11	16	27
ALL AREAS	**26.5**	**75.2**	**101.7**	**26**	**74**	**100**

Source: ADB, based on MASL (current cropping intensities) and MCB (projected cropping intensities)

Box 1: Econometric Analysis of Impact of Irrigation on Paddy Yields

Overview. The Socio Economics and Planning Centre of the Department of Agriculture conducts bi-annual surveys (one in Maha and one in Yala) on the cost of cultivation of major agricultural products. Each survey covers several hundreds of farmers and collects detailed information on yields, type of irrigation, input costs and farm gate prices. This section presents the results of an analysis of the explanatory variables of paddy yields, based on 140 of such surveys undertaken during 2008-2012, representing the results from about 15,000-20,000 interviews. Two fixed effect models were employed to investigate the relationship between season (Maha or Yala), the input cost (in Rs/acre, including the cost of farm labor), the type of irrigation (rainfed or irrigated), and paddy yields (in kg/acre). The models were also used to identify trends in yields over time. In addition, multivariate regression was used to explain variations in yields, input costs and farm gate prices. This box summarizes the results of the models, and then presents conclusions that are relevant for assessing the economic benefits of the project. For details, refer to **Annex 3**.

Fixed effect model 1: yield as a function of season and type. The type of irrigation has a significant effect on yield, but season does not. The model indicates that an increase of one unit in "type" (i.e. moving from rainfed to irrigated water supply) and other factors remain unchanged, on average, the "yield" will be increased by 809. This is equivalent to an increase of 62 percent from the average yield of rainfed areas in the sample. There would be no time effect on yields as yields corresponding to different years were not statistically different.

Fixed effect model 2: yield as a function of season, type and input cost. This model is similar to the previous fixed effect model, but also considers the input cost per acre as an explanatory variable. Including the input costs increases to overall predictive ability of the model. The input cost has a statistically significant impact on the yield, although the effect is minor. If other factors would remain unchanged, an increase of the input cost by one Rs will result in an increase in the yield of 0.025 kg. This means that an increase in the input cost by 1 percent is associated with an increase of about 0.5 percent in the yield.

Multivariate regression analysis 1: yield and input cost as a function of season and type. Input costs are lower in Maha than in Yala (in a statistically significant sense), albeit by a small margin. If the season is Maha and all other variables remains constant, the cost will be reduced by 922Rs/acre, which is equivalent to 3 percent of the average input cost in Yala. The type of irrigation does not have a significant effect on input costs. This suggests that moving from rainfed to irrigated water supply will have a significant positive effect on yields without increasing input costs. As expected, inputs costs

increased over time (on average, every years costs increase by about Rs2,300/acre), but no time effect on yield was identified.

Multivariate regression analysis 2: yield and price as a function of season, type and input cost. This analysis considered input costs as an explanatory (as opposed to) dependent variable and investigated the relationship between these variables and yield and farm gate price. Input costs do not have any significant effect on price. This suggests that farmers are unable to improve the quality of their paddy by increasing input costs in attempt to command a higher farm gate price. Year is statistically significant and has a negative effect on both yield and price, which means that these variables are expected to decrease over time. This finding is inconsistent with the findings of the other models, which detected no trend in yields. It should be noted, however, that this model had a much lower predictive value that the first multivariate regression analysis (for price, the R^2 was only about 40 percent).

Source: ADB

18. **Step 3: Estimate changes in cropping patterns.** At present, MASL manages a series of major irrigation schemes that are located in or near the Agricultural Benefit Area, and which already enjoy an adequate supply of irrigation water, notably System B, C and H. Actual cropping patterns in these systems were analyzed to define cropping patterns in newly harvested areas in the benefit area.[8] Based on the analysis, the following allocation rules were formulated (an exception to the rules is noted below):

(i) **Maha: 100 percent paddy.** It is unusual for farmers in the Agricultural Benefit Area to grow crops other than paddy in Maha, even in well-irrigated areas. For this reason, it was assumed that the entire increase in the harvested area in Maha would be allocated to paddy.

(ii) **Yala, major systems: 75 percent paddy, 25 percent OFCs.** In well-irrigated systems in the dry zone Sri Lanka, 10 to 40 percent of the harvested area is allocated to OFCs in Yala. For the purpose of this analysis, it assumed that 25 percent of the increase in the harvested area in Yala would be allocated to OFCs.

(iii) **Yala, minor systems: 25 percent paddy, 75 percent OFCs.** Farmers tend to use a substantially higher proportion of cultivated land for OFCs in minor systems than in major systems. For this reason, it was assumed that 75 percent of the increase in the harvested area in such systems would be allocated to OFCs in Yala, and the remainder to paddy (three of the 27 sub-areas were classified as such, and had a combined area of about 39,000 hectares or about 16 percent of the total Agricultural Benefit Area)

There is one exception to the above rules. The Water Balance Study assumed that about 6,600 hectares in the Kantale area (which are currently not cultivated) will be allocated to sugarcane to help reduce Sri Lanka's considerable sugar imports. This assumption was also used in this economic analysis. The Kantale area is therefore the only area where a single type of agricultural produce will be harvested throughout the year (in all other areas, there will be a mix of paddy and OFCs). **Table 7** shows the results of applying the above-mentioned allocation rules. Upon completion of NCPCP in 2030, over 60 percent of the expected increase in the harvested area will be absorbed by paddy, 6 percent is allocated to sugarcane and the remaining 32 percent to OFCs.

[8] For details, see Attachment 4 to Volume I of *Preparatory Survey for Moragahakanda Development Project – Final Report* (JICA, 2009).

Table 7: Increases in Harvested Area upon Completion of NCPCP

Crop	Increase ('000 hectares)			Increase (% all areas)		
	Maha	Yala	Total	Maha	Yala	Total
Paddy	26.5	36.4	62.9	26	36	62
OFCs	-	32.3	32.3	-	32	32
Sugarcane	-	6.6	6.6	-	6	6
ALL AREAS*	**26.5**	**75.2**	**101.7**	**26**	**74**	**100**

Source: ADB, based on MASL (current cropping intensities) and MCB (projected cropping intensities)

19. The pre-feasibility study prepared by MCB for MIWRM contains expected cropping patterns for the "with project" scenario.[9] These patterns are broadly comparable to current cropping patterns in Systems B, C and H (as mentioned before, these are well-irrigated areas in or adjacent to the Agricultural Benefit Area, and were therefore seen as representative of irrigation systems to be developed by the project). The study anticipates that about half of the increase in the harvested area for OFCs will be used for banana and maize (24% each), and the remainder for vegetables (14%), green gram (14%), dry chillies (11%), ground nut (11%) and big onions (2%). These assumptions were adopted for the analysis.

20. Upon completion of all irrigation infrastructure in 2030, and taking into account the impacts of climate change, the harvested area will be about 107,000 hectares larger, and annual agricultural production over 1 million tons higher vis-à-vis the "without project" scenario.

Table 8: Harvested Area and Agricultural Production, 2030

Crop	Harvested Area ('000 hectares)			Agricultural Production ('000 tons)		
	WOP	WP	Incremental Area	WOP	WP	Incremental Production
Paddy, Maha	196	226	30	1,001	1,154	153
Paddy, Yala	96	135	38	493	687	194
OFCs	33	66	33	231	462	231
Sugarcane	-	7	7	-	460	460
TOTAL*	**325**	**433**	**107**	**1,725**	**2,763**	**1,038**

Source: ADB (assumed allocation), MASL (other)

* The incremental area in this table is higher than in the increase in the harvested area shown in Tables 6 and 7. This because these tables do not include reduction in the harvested in the in the "without project" case.

21. **Step 4: Estimate net economic benefits by crop.** A simplified economic surplus model was employed to measure project benefits from increased agricultural production. In a standard model, a change in the quantity of a commodity (such as paddy, OFCs or sugarcane) will result in product price changes, and the combined effects of these changes will result in changes to economic welfare, also called "economic surplus". Economic surplus consists of two elements: (i) consumer surplus, and (ii) producer surplus. Consumer surplus is the difference between the minimum amount that customers are willing to pay for a commodity, and the amount that they actually pay. Producer surplus is the difference between the amount that a producer actually

[9] *Economic Analysis in Financial and Economic Terms of the North Central Province Canal Project of Mahaweli Development Program* (MCB, 2012).

receives from the sale of a commodity and the minimum amount that the producer would have been prepared to accept. The economic benefits from increased agricultural production are measured by the change in the total economic surplus (to the extent the change in the surplus is caused by the project). This surplus is the sum of the change in the consumer surplus and the change in the producer surplus. In formula:

$$\Delta TS = \Delta CS + \Delta PS$$

where:

ΔTS: change in total economic surplus
ΔCS: change in consumer surplus
ΔPS: change in producer surplus

22. The traditional measure of consumer surplus is the area below the demand curve and above the price line (at quantity Q_{A0} this is area P_0bc in **Figure 1a**). The producer surplus is measured by the area below the price line and above the supply curve (at quantity Q_{A0} this is area P_0ce in **Figure 1a**). In a competitive market, an increase in the supply of a commodity will result in a decrease in the price of that commodity. If the increase in supply is substantial compared to the national supply, the price will decrease both in the project area and in the rest of the country. In that case, the change in the consumer surplus (ΔCS) consists of the change in the consumer surplus in the project area (P_1bd minus P_0bc in **Figure 1a**), plus the change in the consumer surplus in the rest of Sri Lanka (P_1wz minus P_0wx in **Figure 1b**). Similarly, the change in the producer surplus (ΔPS) consists of the change in the producer surplus in the project area (P_1ad minus P_0ce in **Figure 1a**), plus the change in the producer surplus in the rest of Sri Lanka (P_1vy minus P_0vx in **Figure 1b**). For a given change in the quantity, a change in prices (and therefore in ΔCS and ΔPS) depend on supply and demand elasticities.

Figure 1a: Consumer and Producer Surplus Effects in Project Area (Standard Model)

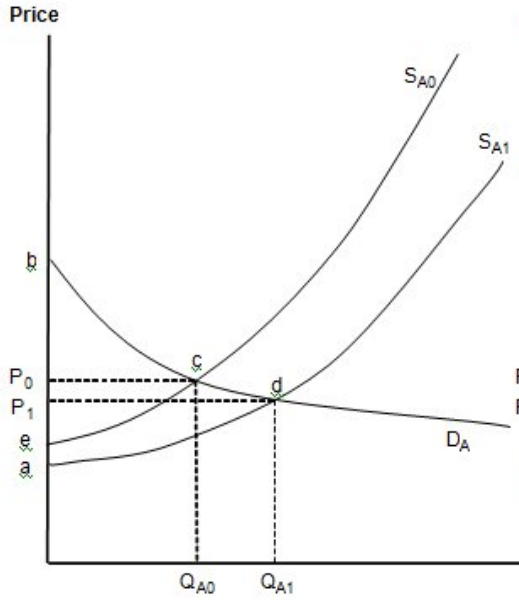
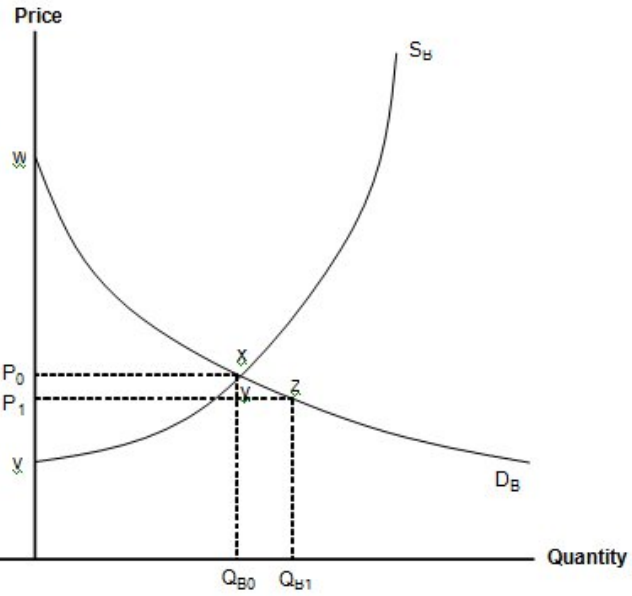


Figure 1b: Consumer and Producer Surplus in Rest of Sri Lanka (Standard Model)



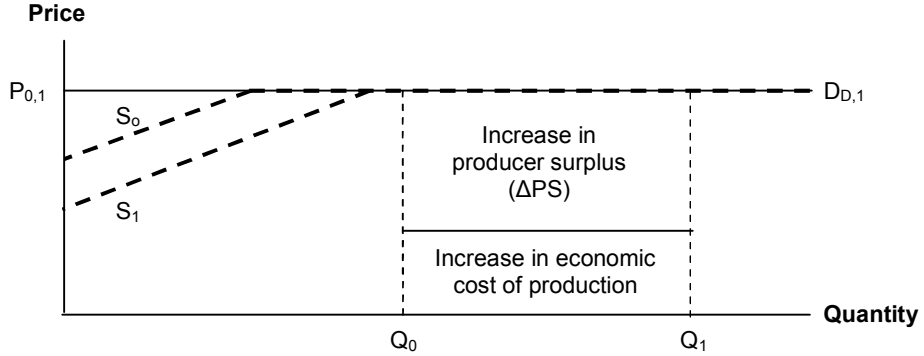
23. For two reasons, the increase in agricultural commodities generated by the project is unlikely to result in a decrease of the price of these commodities:

(i) the government controls to price of paddy and most other internationally traded agricultural products (including big onions, green gram and sugarcane), and

(ii) the incremental production of agricultural commodities that are generated by the project and not subject to price controls is relatively small and therefore *a priori* unlikely to affect price levels in the project area or elsewhere in Sri Lanka.

24. **Price-controlled commodities.** Upon completion of the NCPCP in 2030, commodities subject to price controls will be grown on 94% of the harvested area in the Agricultural Benefit Area. The demand curve for such commodities is flat, because a change in supply will not results in a change to the price. This also means that the incremental production of price-controlled commodities will not result in a change to the customer surplus, because there will be no change to the price that customers will need to pay for such commodities with or without the project. Stated differently: there is no area between the demand curve and the price line before and after the increase in quantity, so ΔCS=0. Any economic benefits from an increase in the production of price-controlled commodities therefore exclusively consist of increases in the producer surplus. Another implication of price controls is that supply curves for price-controlled commodities are truncated; suppliers are free to offer their commodities below but not above the set price (**Figure 2**).

Figure 2: Producer Surplus for Price-Controlled Commodities



25. **Limited supply of other commodities.** The incremental production of commodities that are not subject to price controls (bananas and vegetables) are not significant compared to the entire production of Sri Lanka. As a result, the impact of an increase in the consumer surplus was also assumed zero for such products, and the same method was used for estimating the producer surplus as for price-controlled commodities.

26. **Estimation of producer surplus.** The NCPCP is assumed to increase the production of nine crops in the Agricultural Benefit Area: paddy, sugarcane, and seven OFCs (big onion, maize, dry chillies, green gram, ground nut, banana and vegetables). For each of these crops, estimates were prepared of the producer surplus per hectare of harvested area. The producer surplus was measured as follows:

Economic value of final outputs at farm gate
- Economic value of agricultural inputs (except labor)
+ Economic value of hired and family labor
= Producer surplus

27. The economic value of final outputs, as well as labor and other agricultural inputs, was estimated by converting financial prices into mid-2014 economic prices using the conversion factors mentioned in **Table 3**. An econometric analysis of paddy yields did not identify a time effect on yield (**Box 1**) and no clear trend was identified was yields of other crops. For this reason, the value of final outputs was estimated by multiplying average yields in Systems B, C and H for 2008-2011; for paddy, the average of actual yields for 2008-2012 was used (**Table 9**). This means that the realization of the economic benefits does not rely on assumed increases in agricultural productivity.

28. The financial prices of labor and other inputs in Systems B, C and H were deemed representative for harvested areas to be developed by the project; for paddy, these prices were taken from bi-annual surveys conducted by the Department of Agriculture.[10] For other crops, financial prices were taken from MCB's economic analysis. As described earlier in this section, most of the Agricultural Benefit Area is currently irrigated, although many sub-areas do not receive adequate supplies of irrigation water throughout the year. Farmers in the benefit area tend to adjust the areas they cultivate to the amount of water that is likely to be available. Although there is a substantial difference between input costs (per hectare) between rainfed areas and irrigated areas, there is relatively little variation in input costs and yields among irrigated areas. For the purpose of estimating the incremental economic value of labor and other inputs, it was therefore assumed that an increase in cropping intensity would not result in a lower input cost per hectare. The increase in producer surplus is solely driven by an increase in harvested area (as measured by ΔCI).

Table 9: Average Yields for Selected Crops in Systems B, C and H (ton/hectare)

	2008	2009	2010	2011	2012	Average
Paddy, Maha	5.2	5.3	5.3	4.0	5.2	5.0
Paddy, Yala	5.2	4.9	5.3	5.4	5.2	5.2
Maize	1.9	1.8	2.0	2.2	NA	2.0
Chillies (dry)	1.4	1.8	1.9	1.8	NA	1.7
Green gram	1.0	1.1	1.1	1.3	NA	1.1
Ground nut	1.5	1.6	1.8	1.7	NA	1.6
Banana	18.3	16.6	17.6	19.0	NA	17.9
Big onion	12.9	12.9	13.0	14.7	NA	13.4
Vegetables	10.2	8.6	10.8	13.7	NA	10.8
Sugarcane	-	-	-	-		70.0*

Source: ADB (assumed allocation), MASL (other)
* Average of sugarcane yields elsewhere in Sri Lanka, based on G.C. Samaraweera (2011)

[10] *Cost of Cultivation of Agricultural Crops*. Department of Agriculture (various years). Biannual surveys on the cost of cultivating paddy were collected for all districts in Sri Lanka, for 2007-2012 (Maha and Yala).

29. The producer surplus (expressed in Rs per hectare) is highest for banana and big onion, followed by dry chillies and vegetables. For seven of the nine crops, it was assumed that 100 percent of the producer surplus per hectare will be realized starting in the first year after completion of the relevant irrigation infrastructure. For banana and sugarcane, an alternative method was used. The yield of banana is substantially higher in the first four years of harvesting than in the years thereafter. To reflect this pattern, the value added was estimated separately for the first five years (the value added in subsequent years was set at the level for year 5). Sugarcane cannot be harvested at once, but requires at least two years to grow to maturity. It was therefore assumed that the first sugarcane harvest would take place in 2018, the first year in which the Kantale area will start receiving sufficient irrigation water supplies. Full benefits will be realized starting in 2021.

30. The present value of the economic benefits from increased agricultural production in existing and newly developed harvested areas is estimated at Rs98.9 billion. This amount represents about 90 percent of the total present value of the project's quantifiable benefits.

B. Economic Benefits from Increased Provision of Raw Water for DMI Uses

31. **Overview.** An important secondary economic benefit of the NCPCP project is improved provision of raw water for domestic, municipal and industrial (DMI) uses. The Water Balance Study envisages that, by 2030, the project will provide 162 million cubic meters (MCM) of raw water per year to the districts of Anuradhapura, Matala, Polonnaruwa, Vavuniya and Trincomalee ("the DMI Benefit Area"), which will be used to provide piped water to about 830,000 persons.[11] In that year, the number of beneficiaries will account for approximately 33 percent of the total population of the DMI Benefit Area.[12] It is important to note that this amount is the planned allocation of raw water from canals constructed by the project to the National Water and Sewerage Development Board (NWSDB). The project will not invest in water treatment plants or infrastructure needed to convey water from treatment facilities to final users; this would be the responsibility of the NWSDB, local authorities and other organizations.

32. **Principal sources of drinking water in the DMI Benefit Area.** In 2012, the total population of the DMI Benefit Area was about 2.3 million, or 11 percent of the national total. About 26 percent of households in the area had access to piped water, which was lower than the national average of 31 percent. Most other households relied on private well or communal facilities (such as stand pipes and tube wells) as their principal source of drinking water (Table 10). Increased provision of raw water is expected to lower the economic cost of non-piped water sources (as non-piped water will be more easily accessible and of better quality than is presently the case), and accelerate the increase in piped water coverage.

[11] By 2030, Phase 1 and 2 of the NCPCP will provide an estimated 162MCM of drinking water per year. NWSDB estimates that 70MCM would be required for 358,000 persons in selected parts of the DMI Benefit Area. The total number of beneficiaries was therefore estimated at (358,000 x 162/70 =) about 830,000.

[12] Assuming an average annual growth rate of 0.5% (see footnote 21 for details).

Table 10: Principal Source of Drinking Water in DMI Benefit Area, 2012 (%)

District	Piped Water	Private Well	Communal Facilities*	River or Lake	Other Sources
Anuradhapura	24	54	18	2	2
Pollanaruwa	22	57	19	2	0
Vavuniya	8	71	18	0	3
Trincomalee	36	54	3	2	5
Matale	29	43	23	6	0
All Districts	**26**	**53**	**17**	**3**	**2**

Source: Sri Lanka Statistics Bureau (2014)
* Stand pipes, tube wells and similar facilities

33. **Typology of economic benefits from increased provision of raw water.** The economic benefits of the NCPCP with respect to raw water consist of:

(i) **Economic benefits from improved sources of non-piped drinking water supply.** The proposed irrigation canals will provide more (and more reliable) supplies of raw water to areas that are currently water-scarce. This will provide substantial benefits to persons living in the DMI Benefit Area, also to those without access to piped water, mainly by lowering the cost of obtaining water for domestic uses (easier access to water sources, no need to pay water vendors) and by lowering health costs (better quality water, more reliable supply of water). This is especially relevant given the very high incidence of chronic kidney disease (CKD) in the DMI Benefit Area, which is widely believed to be associated with the absence of safe and clean drinking water supply.[13]

(ii) **Economic benefits from improved sources of piped drinking water supply.** The project will enable the NWSDB to provide piped water at a lower cost than without the project, mainly because of substantial cost savings on transmission mains, source works and groundwater development. In addition, because the project already provides raw water, this would not only lower the cost of providing water, but would presumably enable the Board to achieve its coverage targets for the project area earlier than would otherwise be the case. This would provide economic benefits of piped water (which are higher than the economic benefits of non-piped water) to a sizable number of beneficiaries in the DMI Benefit Area at an earlier stage than without the project.

34. **Economic benefits from improved sources of non-piped drinking water supply.** Upon completion of the irrigation canals and supporting infrastructure, persons without piped water will have improved access to raw water that they can collect, treat and store or consume. This benefit is, however, only likely to accrue in Yala (when water tends to be scarce) and to persons living near the newly constructed irrigation canals. Upon completion of the Upper Elahera Canal in 2023, this "area of influence" will mainly consist of the southern part of the

[13] See for example *Investigation and Evaluation of Chronic Kidney Disease of Uncertain Aetiology in Sri Lanka – Final Report* (WHO, 2012).

Anuradhapura District. Once the NCPCP is completed in 2029, the area of influence will also contain the central and northern parts of the Anuradhapura District and most of the Vavuniya District. In 2012, these areas had a combined population of approximately 550,000, or 24 percent of the total population of the DMI Benefit Area. Of these, 18 percent had access to piped water and the remainder relied on non-piped sources. The most important economic benefit from improved source of non-piped drinking water supply is a reduction in the CKD mortality rate. In addition, the project will provide time savings and other health benefits.

35. At present, about 100,000 persons in Sri Lanka are affected by chronic kidney disease. The disease is heavily concentrated in the DMI Benefit Area, where mortality rates have rapidly increased in recent years. Although the specific causes of CKD are unknown, the CKD is most prevalent in areas with heavily polluted water sources (which are often areas with high fertilizer use). Because many CKD deaths are not recorded, there is considerable uncertainty about the CKD mortality rate. Estimates range from several hundred per year in the dry zone to 5,000 persons in the North Central Province alone. For the purpose of this analysis, a conservative estimate of 500 was used for the area of influence. Most casualties are middle-aged farmers, who work with water that is polluted by fertilizer and pesticides and tend to live in areas without access to adequate medical facilities or water supply systems. There is consensus that the provision of clean water to the affected areas would significantly reduce the CKD mortality rate.[14] The estimated value of avoided loss of life due to CKD was used to estimate economic benefits from the improved provision of raw water by the project. The value of the avoided loss of life was estimated as the present value of 20 years of productive years lost.[15] The avoided loss attributed to the project was only computed for persons in the area influence without access to piped water.

36. In recent years, ADB has financed a series of rural water supply projects in areas in or adjacent to the DMI Benefit Area, of which the Small Towns and Rural Arid Areas Water Supply and Sanitation Project and the Dry Zone Urban Water and Sanitation Project (original loan and additional financing) are the most relevant.[16] For the preparation of these projects, surveys were undertaken to assess the economic cost of non-piped water. The results of the surveys were used as the basis for assessing the avoided costs (i.e. the economic benefits) of moving from the current unreliable source of non-piped water to: (i) an improved source of non-piped water, and (ii) a piped water connection. The avoided costs considered here consist of: (i) resource cost savings (the avoided costs of collecting, treating and storing non-piped water), (ii) time saved from not having to collect water which could translate into productivity gains for those engaged in income-generating activities, and (iii) health benefits (unrelated to a reduction in the CKD mortality rate).[17]

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[14] Myles F. Elledge et. al. *Chronic Kidney Disease of Unknown Etiology in Sri Lanka: Quest for Understanding and Global Implications*. RTI Research Brief, May 2014.

[15] G. Hutton. *Global Costs and Benefits of Drinking Water Supply and Sanitation Interventions to Reach the MDG Target and Universal Coverage* (WHO, 2012).

[16] Dry Zone Urban Water and Sanitation Project – Additional Financing (RRP SRI 37381) and Small Towns and Rural Arid Areas Water Supply and Sanitation (RRP SRI 37381).

[17] The value of incremental water was not included, because the difference between willingness-to-pay levels and the financial cost of piped water (which ADB normally uses to estimate this value) is low in Sri Lanka, especially in peri-urban and rural areas.

37. **Table 11** shows parameters that were used for quantifying the economic benefits of the above-mentioned projects when moving from a non-piped source to a piped source. Economic benefits were conservatively estimated by assuming that the lowest values for resource cost savings (Rs150/m^3) and reduction in morbidity (6-14 cases per 1,000 inhabitants) would be applicable. The economic value of time savings of collecting water was adjusted downward to reflect lower incomes and higher unemployment rates in peri-urban and rural areas (where most of the benefits will be realized) than in urban areas (where the surveys had been taken). Assuming an average household size of 4 and consumption of non-piped water of 80 liters per capita per day, the time and health cost savings were estimated at Rs79/m^3. The total savings, including the resource cost saved, was thus estimated at (150+79=) Rs229/m^3, which is equivalent to Rs251/m^3 in mid-2014 prices. This amount, however, is the reduction in economic costs when moving from a non-piped to a piped water source. In the area of influence, the reduction in economic costs when moving from an existing non-piped water source to an improved non-piped water source will mainly consist of time and health cost savings (upon completion of the project, water will be better accessible and, especially in Yala, also of better quality, which is assumed to reduce health costs). There are no benefits expected from reductions in the resource cost, because this cost mainly consists of treatment and storage, which will need to be undertaken both in the "with project" and "without project" scenario. The value of time and (non-CKD) health cost savings that can be ascribed to an improved source of non-piped water is approximately Rs87/m^3. Because the benefits will only be realized in Yala, they were estimated for half the annual volume of non-piped water consumed by persons living in the area of influence. The present value of the quantifiable benefits from improved sources of non-piped drinking water supply (including health benefits from reduced CKD mortality) is estimated at Rs5.3 billion, or about 5 percent of the total present value of the project's benefits.

Table 11: Parameters Used For Quantifying Economic Benefits of Water Supply

Town	**Resource Cost Saved** (Rs/m3)*	**Time Savings** (Rs/HH/day)*	**Reduction in Morbidity****	
			Severe Case	**Non-Severe Case**
Mannar	181	59	7	17
Chilaw	151	85	7	26
Puttalam	161	103	13	41
Vavuniya	150	157	6	14
Assumption Used	**150**	**18**	**6**	**14**

Source: ADB (2012, 2014)
* 2012 economic prices
**Reduction in morbidity of water-borne diseases caused by project intervention per 1,000 residents in affected area

38. **Economic benefits from improved sources of piped drinking water supply.** In November 2012, ADB and the government signed a loan agreement for additional financing for the Dry Zone Urban Water and Sanitation Project.[18] Most of the loan proceeds will be allocated to finance piped water supply systems in three towns located in or near the DMI Benefit Area; the loan document also contained information on costs of the systems of Muttur and Polonnaruwa,

[18] *Proposed Loan for Additional Financing Democratic Socialist Republic of Sri Lanka: Dry Zone Urban Water and Sanitation Project.* Report and Recommendation of the President to the Board of Directors. ADB. Nov 2012.

which are both located inside the benefit area. The average per capita investment cost of the five systems was approximately US$600 expressed in 2012 financial prices including taxes (**Table 12**); about 30 percent or US$184 per capita consisted of the cost of primary transmission mains, source works and groundwater development. This amount was converted into economic prices to obtain an estimate of cost savings for providing raw water induced by the project.

Table 12: Construction Cost of Selected Piped Water Supply Systems (2012 prices including taxes and duties)

Town	Plant Capacity (m3/day)	Persons Served ('000)*	Subproject Cost (US$ million)	Average Cost (US$/person)
Pollanaruwa	13,500	81	56.1	693
Muttur	8,500	51	30.9	606
Chilaw	9,000	54	31.0	574
Puttalam	9,000	54	38.8	718
Vavuniya	12,000	72	32.8	455
Total	**52,000**	**312**	**189.6**	**608**

Source: ADB (2012, 2014)

* Based on following assumptions: 100% of plant capacity used, losses account for 20% of water production, 90% of water production after losses is consumed for domestic purposes, average consumption is 120 l per capita per day.

39. The government's "Mahinda Chintana Vision for the Future 2010" envisages that 60 percent of the nation's households will have access to piped water supply by the end of 2020, up from 31 percent in 2012.[19] This is an ambitious target, given that access to piped water has increased, on average, by about 1 percent per year since 2000.[20] It is assumed that, in the "without project" scenario, coverage of piped water service in the DMI project area will continue to increase by this historical growth rate, from 26 percent in 2012 to 74 percent in 2060. Assuming that NWSDB and local authorities wish to maximize the benefits from the increase in raw water to be provided by the project, the "with project" scenario assumes that the increase in coverage will be higher than 1 percent per year in two periods: upon completion of Phase 1 (2024) and Phase 2 (2029) of the project. More specifically, it was assumed that the number of persons with access to piped water will increase:

(i) by 358,000 in the five-year period following the completion of the UEC (2025-2029)

(ii) by 471,000 in the five-year period following the completion of the NCPCP (2030-2034)

(iii) by 0.5 percent during per year during 2035-2057; from 2049 onward, the number of persons with access to piped water will be the same as in the "without project" scenario (this means that project-financed infrastructure will achieve intermediate targets earlier, but there is no difference in coverage at the end of the project implementation period)[21]

[19] Quoted in *NWSDB Corporate Plan 2012-2016*, Ministry of Water Supply and Drainage (2011).

[20] According to UNICEF and WHO, the proportion of Sri Lanka's population with piped water on premises was 21% in 2000 and 29% in 2010 (*Progress on Drinking Water and Sanitation – 2012 Update*).

[21] Both scenarios assume that the population in the DMI Benefit Area will continue to increase by 0.5% per year, which is lower than the annual growth rates during 1981-2001 (1.3%) and 2001-2012 (1.1%). The figures of 358,000 and 471,000 were based on NWSDB estimates (see also paragraph 25).

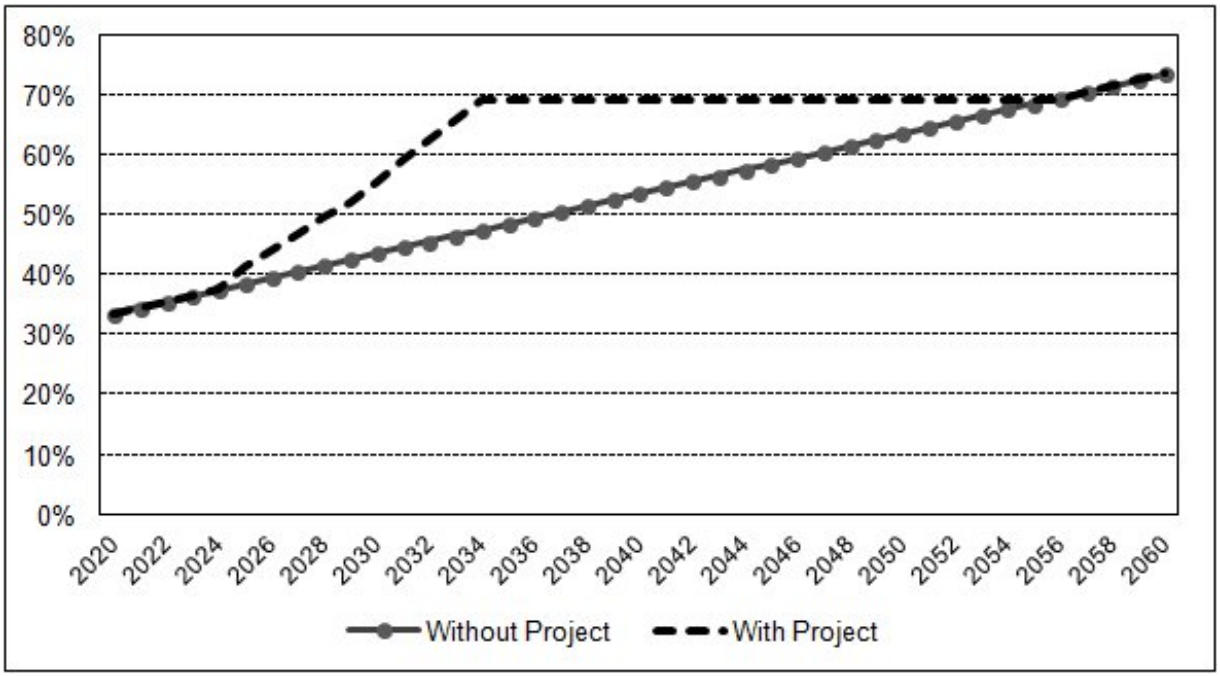
40. As a result of the acceleration of the connection program, the economic benefits of piped water will accrue to several hundreds of thousands of beneficiaries in an earlier stage than without the project (**Figure 3**). The net economic benefits of the acceleration were estimated based on the following assumptions:

(i) Incremental economic benefits of piped water consists of resource cost savings and time savings for collecting water; as described in paragraph 37, these benefits were estimated at Rs229/m^3 of water formerly taken from non-piped sources.

(ii) Incremental economic costs consist of the economic investment cost (which was valued at US$527 per capita for system costs plus US$50 for house connections), and the incremental O&M cost, which was estimated at 25 percent of the investment cost.[22] Because of the cost savings mentioned in paragraph 38, the per capita investment cost will be 30 percent lower in the "with project" case than in the "without project" scenario.

The present value of the acceleration of piped water coverage is estimated at Rs4.8 billion, or about 4 percent of the total present value of the project's benefits. Note that this is a conservative estimate, because the analysis does not include the net economic benefits of piped water accruing to non-residential piped water users.

Figure 3: Coverage Rates of Piped Water Supply in DMI Benefit Area, 2020-2060 (percent population with access to piped water)



Source: ADB estimates (2014)

[22] US$651 is the per capita economic cost of systems improvement expressed in mid-2014 prices. It is equivalent to the financial cost of US$608 in 2012 prices including taxes.

C. Economic Benefits from Increased Hydropower Generation

41. **Overview.** In 2012, hydropower plants in Sri Lanka generated approximately 3,290 GWh of electricity, or 28 percent of the country's total power generation in that year (**Table 13**). Because most of Sri Lanka's hydropower potential has been used, and because demand for electricity is rapidly increasing, the share of hydropower has steadily declined in recent years. To meet increased demand for electricity, the country increasingly relies on thermal power, most of which is generated by independent power producers (IPPs) and purchased by the Ceylon Electricity Board (CEB), which has a statutory monopoly on electricity distribution.

Table 13: Electricity Generation by Source, 2008-2012 (GWh '000)

Source	2008	2009	2010	2011	2012
Thermal	5.76	5.98	5.00	6.79	8.34
Hydropower	4.13	3.88	5.63	4.62	3.29
Other renewables	0.01	0.03	0.09	0.12	0.17
Total	**9.90**	**9.88**	**10.72**	**11.53**	**11.80**
Hydropower as % of total	42	39	53	40	28

Source: Central Bank of Sri Lanka (2014)

42. **Incremental hydropower generation.** At present, there are nine large-scale hydropower plants operating in the Mahaweli Complex. Upon completion of the raising of Minipe Anicut in mid-2018, two of these plants (Bowatenna and Moragahakanda) will together generate an additional 18GWh per year until 2030, when the second phase of the NCPCP will be completed. With the opening of the NCPC, annual hydropower generation will be 42GWh lower than in the "without project" scenario. The amounts of 18GWh and 42GWh are equivalent to 0.5 percent and 1.3 percent of the country's total hydropower generation in 2012, respectively.

43. **Valuation of incremental hydropower generation.** Initially, the project will result in an increase in hydropower generation of 18GWh per year. As a result, CEB will not need to purchase this amount from IPPs, which would otherwise be relied on to meet increases in demand for electricity. In 2012, the average cost of a kWh of electricity generated by an IPP was Rs21.79.[23] Excluding taxes, this was equivalent to Rs21.23 (or US$0.16) in mid-2014 prices. This amount was used as a conservative estimate of the economic benefit of generating one kWh of hydropower (the estimate is conservative because the cost of thermal power generated by IPPs does not fully reflect environmental costs).[24] From mid-2018 to 2029, the economic benefit of incremental hydropower generation was therefore estimated at (18 x 1,000,000 x 21.23 =) about Rs382 million ($2.9m) per year. From 2030 until the end of the project's assumed economic lifetime in 2060, the economic benefit is minus Rs892 million per year. Even though the hydropower losses in 2030 and after are, in absolute terms, greater than the hydropower gains during 2018-2029, the net present value of the hydropower generation is nonetheless positive over the economic lifetime of the project. This is because the gains are realized earlier than the losses. At a discount rate of 12 percent (the assumed economic oppor-

[23] *Generation Performance in Sri Lanka (2012, First Half)*. Public Utilities Commission of Sri Lanka.

[24] Because the hydropower plants in the Mahaweli complex do not need to be modified to increase generation, the economic cost of producing an incremental unit of hydropower was assumed zero.

tunity cost of capital), the net present value of the incremental hydropower generation is about Rs0.2 billion, or approximately 0.2 percent of the total present value of the project's benefits.

D. Other Economic Benefits

44. **Increased food self-sufficiency.** In recent years, Sri Lanka's paddy production covered most of the country's needs, and rice imports accounted for less than 5% of total requirements during 2008-2012 (**Table 14**). This self-sufficiency is precarious, however. Because of prolonged dry weather, this year's Maha harvest of paddy was 15 percent lower than expected, and in June 2014 the government announced plans to import 100,000 tons of milled rice in second half of the year.[25] As shown in **Table 7**, the NCPCP would increase the harvested area of paddy by approximately 63,000 hectares. Assuming an average yield of 5.1 tons per hectare per season, the project would help increase the national paddy production by about 350,000 tons per year (equivalent to 8 percent of Sri Lanka's production in recent years), thereby further improving self-sufficiency in rice. The project would also help to reduce Sri Lanka's dependency on the import of sugar. At present, imports cover over 90 percent the country's demand for sugar. The development of the Kantale area is expected to result in a significant increase in domestic sugar production (in 2012, about 7,000 hectares of sugarcane was harvested nationwide; this is almost the same area as the 6,600 hectares to be developed in Kantale).

Table 14: Domestic Production and Imports of Paddy and Sugar, 2008-2012 ('000 tons)

	2008	2009	2010	2011	2012
Paddy					
Domestic production	3,875	3,652	4,301	3,894	3,846
Rice imports*	120	74	180	40	51
Imports as % of total	3.0	2.0	4.0	1.0	1.3
Sugar					
Domestic production	39	32	31	35	36
Imports	571	466	548	606	569
Imports as % of total	93.5	93.5	94.6	94.6	94.1

Source: Central Bank of Sri Lanka (2014)

* Imports were multiplied by 1.43 (the factor used by the Central Bank of Sri Lanka) to facilitate a direct comparison between paddy and rice.

45. **Increased internal security.** The NCPCP is the capstone of the Mahaweli Development Program (MDP), which was formulated in 1968 with the objective of harnessing the hydropower and irrigation potential of the Mahaweli River. The civil war that ravaged Sri Lanka from the early 1980s until 2009 caused a major delay in the implementation of MDP, and impoverished most of the area that stands to benefit from the NCPCP. This observation especially applies to the districts of Anuradhapura and Vavuniya, which were located in the front line of the conflict, and where most of the project's beneficiaries are living. This means that the project will also serve the higher-level goals of restoring prosperity, indirectly, help prevent the resumption of civil strife in the area.

[25] *Asia Pacific Food Price and Policy Monitor* (July 2014 – Issue 12). FAO Regional Office for Asia and the Pacific.

V. COMPARISON OF ECONOMIC COSTS AND BENEFITS

46. **Assessment of economic feasibility.** The ENPV (discounted at 12 percent) of the project is estimated at Rs4.8 billion ($36.8 million). This means that NCPCP is considered economically feasible. The same conclusion can be derived from the project's EIRR which is estimated at 12.5 percent, higher than the minimum required rate of 12 percent. It should be noted, however, that the project is expected to generate significant non-quantifiable benefits, especially by accelerating the socio-economic development of an area that was adversely affected by internal conflict during most of the past three decades.

47. **Composition of economic benefits.** As expected, increased agricultural production is the most important source of quantifiable economic benefits, accounting for over 90 percent of total benefits (**Table 15**). Benefits from cost savings on raw water provision and the accelerated development of piped water account for most of the remainder. Economic benefits from incremental hydropower generation were not significant.

Table 15: Composition of Quantifiable Economic Benefits of NCPCP

Economic Benefit	Present Value of Benefits	
	Rs billion	% Total
1. Increased agricultural production	98.8	90.5
2. Increased raw water provision	10.1	9.3
3. Increased hydropower generation	0.2	0.2
Total	**109.2**	**100.0**

Source: ADB (2014)

48. **Sensitivity analysis.** Sensitivity tests were conducted by varying the project's investment cost, O&M cost and benefits (**Table 16**). The results of the tests indicate that the economic feasibility of NCPCP is almost equally sensitive to unfavorable changes to the investment cost as to economic benefits. If the investment cost is 4.6 percent higher (or benefits are 4.4 percent lower) than in the base case, the EIRR will fall below the minimum required rate of 12 percent. If, in recognition of the project's substantial non-quantified benefits, a minimum required EIRR of 10 percent would be adopted, the investment cost may be 29.1 percent higher (or benefits 22.0 percent lower) before the project switches from being economically feasible to economically infeasible (based on an analysis of quantifiable benefits). The project's EIRR is relatively insensitive to changes in the O&M cost.

Table 16: Sensitivity of Project EIRR to Changes in Selected Variables [a]

	Change to Base case	ENPV [b] (Rs billion)	EIRR (percent)	Switching Value (percent)	
				EIRR 12%	EIRR 10%
Base case	**-**	**4.8**	**12.5**	**-**	**-**
Investment cost	+10%	-5.4	11.5	+4.6	+29.1
O&M cost	+10%	3.9	12.4	+52.3	+268.4
Benefits	-10%	-5.1	11.5	-4.4	-22.0

Source: ADB estimates.
[a] ENPV: economic net present value, EIRR: economic internal rate of return.
[b] Computed based on assumed economic opportunity cost of capital of 12%.

VI. DISTRIBUTION ANALYSIS

49. **Distribution of project benefits to stakeholder groups.** To quantify the distribution of project benefits by stakeholder group, it is necessary to allocate the present value of the economic benefits and economic costs to each group. The difference is the net gain (or loss) of the project to that stakeholder group. Three stakeholder groups were considered: government, agricultural producers and water consumers. Their gains and losses can be summarized as follows (**Table 17**):

(i) **Government.** The government will finance the investment and O&M cost of the project. Because the project will not generate incremental revenue (with the exception of a small increase in revenue from hydropower), this stakeholder incurs a substantial net loss.

(ii) **Agricultural producers.** The project is expected to generate a substantial producer surplus, mainly because it will increase in the harvested area through better provision of irrigation water and mitigate adverse impacts of climate changes. These benefits accrue to agricultural producers, who therefore capture most of the net gains.

(iii) **Water consumers.** The project will improve the provision of raw water to the benefit area. This will benefit consumers of non-piped water, in the form of health benefits and time saved for the collection and storage of water. It will also benefit consumers of piped water, many of whom will gain access to a piped water connection at an earlier stage than compared to a "without project" scenario.

50. The poverty impact ratio (PIR) was estimated, assuming a national poverty rate of 6.9%, a rural poverty rate of 7.6%, and a poverty rate of small farmers of 40%. Because the net gains from agricultural producers accounted for most of the gains of the project, the PIR is closely related to the poverty rate of small farmers. As shown in **Table 17**, the ratio was estimated at 32%.

Table 17: Distribution of Project Benefits (Rs billion)

Present Value of:	Government	Agricultural Producers	Water Consumers	Total
Economic benefits				
- Agricultural benefits	-	98.8	-	98.8
- Piped water benefits	-	-	4.8	4.8
- Non-piped water benefits	-	-	5.3	5.3
- Hydropower benefits	0.2	-	-	0.2
Economic costs	(104.4)	-	-	(104.4)
GAINS AND LOSSES	**(104.1)**	**98.8**	**10.1**	**4.8**
Proportion to the poor (% total)*	6.7	7.6 / 40.0	7.6 / 40.0	
Benefits to poor	(7.0)	39.5	2.4	35.0
Poverty Impact Ratio (PIR)				**32.0%**

Sources: ADB estimates, WB (2013), IFAD (2014).
* Assumed poverty rates: national 6.9%, rural 7.6%, small farmers 40%.

ANNEX 1
RELATIONSHIP BETWEEN IRRIGATION AND PADDY YIELDS

A1.1 Paddy yields were analyzed for all districts located in the dry zone of Sri Lanka, where climatic conditions are similar to those in the Agricultural Benefit Area. During 2006-2012, the average yield per net hectare (i.e. the harvested area, as opposed to the cultivated area) ranged from 3.34 tons in rainfed areas in Yala to 4.80 tons in areas served by major irrigation schemes in Maha (**Table 1-1**). For each type of irrigation major scheme, minor scheme or no irrigation average yields were higher in Maha than in Yala, albeit by a small margin (less than 10 percent in most years). In contrast, the type of irrigation made a major difference to yields in all years. In both seasons, yields in major schemes were about 45 percent higher than in rainfed areas; yields in minor schemes were about 20 percent higher. A more rigorous econometric analysis, which was based on a more extensive dataset, suggests that moving from a rainfed area to an irrigated area results in even higher yield differentials (see **Annex 3** for details).

Table 1-1: Paddy Yields in the Dry Zone of Sri Lanka, 2006-2012
(ton per net hectare)

Year	Maha			Yala		
	Major Schemes	**Minor Schemes**	**Rainfed Areas**	**Major Schemes**	**Minor Schemes**	**Rainfed Areas**
2006	4.63	3.80	3.45	4.51	3.73	3.32
2007	4.84	4.43	3.76	4.82	4.03	3.30
2008	4.80	3.99	3.53	4.60	3.81	3.36
2009	5.00	4.25	3.55	4.58	4.07	3.41
2010	5.29	4.38	3.98	5.00	4.21	3.62
2011	3.82	3.34	2.91	4.91	4.00	3.32
2012	5.20	4.44	3.83	4.50	3.48	3.06
Average	**4.80**	**4.09**	**3.57**	**4.70**	**3.90**	**3.34**

Source: ADB, based on Department of Census and Statistics (2014)
* In first year after completion of relevant irrigation infrastructure

ANNEX 2
ASSUMED INCREASE IN CROPPING INTENSITIES BY SUB-AREA

			Cropping intensities			Cropping intensities			Cropping intensities		Selected Scenario:MCB	
			WOP			WP			WOP	WP		
System	Type	Area (Ha)	Maha	Yala		Maha	Yala		M+Y	M+Y	Start of Benefits	% Benefits First year
A	Major	7,050	1.00	1.00		1.00	1.00		2.00	2.00	2023	100%
F	Major	3,000	1.00	1.00		1.00	1.00		2.00	2.00	2023	100%
D2	Major	10,480	1.00	0.99		1.00	1.00		1.99	2.00	2018	100%
E	Major	7,530	0.98	0.97		1.00	1.00		1.95	2.00	2018	100%
I/H	Major	1,052	0.98	0.96		1.00	0.96		1.94	1.96	2023	100%
HFC	Major	2,365	1.00	0.92		1.00	0.92		1.92	1.92	2023	100%
D1	Major	26,520	1.00	0.91		1.00	1.00		1.91	2.00	2018	100%
C	Major	22,800	1.00	0.88		1.00	1.00		1.88	2.00	2020	100%
H	Major	32,180	1.00	0.85		1.00	0.86		1.85	1.86	2023	100%
G	Major	6,210	1.00	0.85		1.00	1.00		1.85	2.00	2018	100%
B-Left Bank	Major	18,500	1.00	0.78		1.00	0.80		1.78	1.80	2020	100%
I/H	Major	520	1.00	0.63		1.00	0.80		1.63	1.80	2023	100%
I/H	Major	3,335	0.94	0.66		1.00	0.80		1.60	1.80	2023	100%
M/H-1	Major	4,210	1.00	0.53		1.00	0.80		1.53	1.80	2023	100%
I-1	Major	607	0.86	0.64		1.00	0.80		1.50	1.80	2023	100%
NWP-1	Major	6,505	0.75	0.45		1.00	0.80		1.20	1.80	2019	100%
NWP-2	Minor	4,987	0.80	0.20		1.00	0.80		1.00	1.80	2023	100%
NWP-2	Minor	1,000	1.00	-		1.00	0.80		1.00	1.80	2023	100%
M/H-2	Major	3,500	1.00	-		1.00	0.80		1.00	1.80	2023	100%
NCP2 (Majo	Major	14,500	1.00	-		1.00	0.80		1.00	1.80	2030	100%
I-1	Major	132	0.70	-		1.00	0.80		0.70	1.80	2023	100%
I-2	Major	2,000	0.70	-		1.00	0.80		0.70	1.80	2023	100%
NCP1 (Mino	Minor	33,000	0.70	-		1.00	0.80		0.70	1.80	2030	100%
I-1	Major	2,525	0.41	0.10		1.00	0.80		0.51	1.80	2023	100%
B-Right Ban	Major	10,000	-	-		1.00	0.80		-	1.80	2023	100%
D1 Kaudulla	Major	1,420	-	-		1.00	1.00		-	2.00	2018	100%
D1-Kantale	Major	6,576	-	-		-	1.00		-	1.00	2018	100%
TOTAL		232,504	0.86	0.57		0.97	0.89		1.42	1.86		

ANNEX 3
IDENTIFYING THE IMPACT OF IMPROVED IRRIGATION ON PADDY YIELD: AN ECONOMETRIC ANALYSIS

A3.1 **Introduction.** The Socio Economics and Planning Centre of the Department of Agriculture conducts bi-annual surveys (one in Maha and one in Yala) on the cost of cultivation of major agricultural products. Each survey covers several hundreds of farmers and collects detailed information on yields, type of irrigation, input costs and farm gate prices. This section presents the results of an analysis of the explanatory variables of paddy yields, based on 140 of such surveys undertaken during 2008-2012, representing the results from about 15,000-20,000 interviews. Two fixed effect models were employed to investigate the relationship between season (Maha or Yala), the input cost (in Rs/acre, including the cost of farm labor), the type of irrigation (rainfed or irrigated), and paddy yields (in kg/acre). The models were also used to identify trends in yields over time. In addition, multivariate regression was used to explain variations in yields, input costs and farm gate prices. Refer to **Table 3-1** below for an overview of the analyses that were conducted. The note first summarizes the results of the models, and then presents conclusions that are relevant for assessing the economic benefits of the project. All models were significant, with R^2 in the range of 70 percent in most cases.

Table 3-1: Econometric Models Used to Analyze Determinants of Paddy Yields

Model	Independent variables*	Dependent variables
Fixed Effect Model 1	Season, Type	Yield
Fixed Effect Model 2	Season, Type, Input Cost	Yield
Multivariate Regression Analysis 1	Season, Type	Yield, Input Cost
Multivariate Regression Analysis 2	Season, Type, Input Cost	Yield, Price

* For all models, the impact of "year" was analyzed separately, to identify time effects on yields

A3.2 **Fixed effect model 1: yield as a function of season and type.** The type of irrigation has a significant effect on yield, but season does not. The model indicates that an increase of one unit in "type" (i.e. moving from rainfed to irrigated water supply) and other factors remain unchanged, on average, the "yield" will be increased by 809. This is equivalent to an increase of 62 percent from the average yield of rainfed areas in the sample. There would be no time effect on yields as yields corresponding to different years were not statistically different.

A3.3 **Fixed effect model 2: yield as a function of season, type and input cost.** This model is similar to the previous fixed effect model, but also considers the input cost per acre as an explanatory variable. Including the input costs increases to overall predictive ability of the model. The input cost has a statistically significant impact on the yield, although the effect is minor. If other factors would remain unchanged, an increase of the input cost by one Rs will result in an increase in the yield of 0.025 kg. This means that an increase in the input cost by 1 percent is associated with an increase of about 0.5 percent in the yield.

A3.4 **Multivariate regression analysis 1: yield and input cost as a function of season and type.** Input costs are lower in Maha than in Yala (in a statistically significant sense), albeit by a small margin. If the season is Maha and all other variables remains constant, the cost will

be reduced by 922Rs/acre, which is equivalent to 3 percent of the average input cost in Yala. The type of irrigation does not have a significant effect on input costs. This suggests that moving from rainfed to irrigated water supply will have a significant positive effect on yields without increasing input costs. As expected, inputs costs increased over time (on average, every years costs increase by about Rs2,300/acre), but no time effect on yield was identified.

A3.5 **Multivariate regression analysis 2: yield and price as a function of season, type and input cost.** This analysis considered input costs as an explanatory (as opposed to) dependent variable and investigated the relationship between these variables and yield and farm gate price. Input costs do not have any significant effect on price. This suggests that farmers are unable to improve the quality of their paddy by increasing input costs in attempt to command a higher farm gate price. Year is statistically significant and has a negative effect on both yield and price, which means that these variables are expected to decrease over time. This finding is inconsistent with the findings of the other models, which detected no trend in yields. It should be noted, however, that this model had a much lower predictive value that the first multivariate regression analysis (for price, the R^2 was only about 40 percent).

Data preparation and variable description (applicable to all models):

Maha = 1 if season is *Maha*
= 0 if season is Yala
Irrigated = 1 if type is Irrigated
= 0 if type is Rainfed
***maha*#irrigated** is the interaction effect of season and type.
Year is treated as categorical to test the individual year effect
t is the time variable created using the transformation, t = year – 2007, to find a trend but "year" and "t" were not used simultaneously.

Fixed Effect Model 1 (year as categorical)

Source	SS	df	MS
Model	19689361.4	7	2812765.92
Residual	7814193.13	132	59198.4328
Total	27503554.6	139	197867.299

Number of obs = 140
F(7, 132) = 47.51
Prob > F = 0.0000
R-squared = 0.7159
Adj R-squared = 0.7008
Root MSE = 243.31

yield	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
maha	-36	76.94052	-0.47	0.641	-188.1959	116.1959
irrigated	809.4087	64.3995	12.57	0.000	682.0201	936.7972
maha#irrigated						
0 1	10.12	91.03725	0.11	0.912	-169.9607	190.2007
1 0	0	(omitted)				
1 1	0	(omitted)				
year						
2009	8.961538	67.4813	0.13	0.895	-124.5231	142.4462
2010	117.1326	66.27288	1.77	0.079	-13.96176	248.2269
2011	-116.0192	65.21991	-1.78	0.078	-245.0307	12.99221
2012	-4.452561	65.21991	-0.07	0.946	-133.464	124.5589
_cons	1308.676	68.93126	18.99	0.000	1172.323	1445.028

The model is significant, as indicated by F = 47.51, p-value<.01. R^2 is about 71.6 percent, so about 71.6 percent variation in *yield* is explained by the independent variables (IVs). Seasons do not have any significant effect on yield as it is not significant, t = -0.47, p-value>.05. But *type* has significant effect on *yield*, t = 12.57, p-value<.01, as one unit increase in "irrigated" and other factors remain unchanged, on average, *yield* will be increased by 809.41 unit. *Season* and *type* do not have any interaction effect on *yield* as it is not significant, t = .11, p-value>.05. Also, none of the years are appeared significant at the 5 percent level.

Fixed Effect Model 1 (year as trend)

Source	SS	df	MS
Model	18955353.9	4	4738838.47
Residual	8548200.69	135	63320.0051
Total	27503554.6	139	197867.299

Number of obs	140
F(4, 135)	74.84
Prob > F	0.0000
R-squared	0.6892
Adj R-squared	0.6800
Root MSE	251.63

yield	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
maha	-36	79.57387	-0.45	0.652	-193.3726	121.3726
irrigated	808.5273	66.60085	12.14	0.000	676.8113	940.2433
maha#irrigated						
0 1	10.12	94.15307	0.11	0.915	-176.0858	196.3258
1 0	0	(omitted)				
1 1	0	(omitted)				
t	-14.22731	15.07687	-0.94	0.347	-44.04471	15.59009
_cons	1352.482	72.19285	18.73	0.000	1209.707	1495.257

Discarding the categories of year and including t (trend) in the model produced the same results in terms of significant factors. The trend variable t appeared as non-significant in the model as the categories of year in the previous model. This means there is no time effect on yields; also, yields corresponding to different years were not statistically different.

Fixed Effect Model 2 (year as categorical)

Source	SS	df	MS		
Model	20150341.1	7	2878620.15		
Residual	7353213.51	132	55706.163		
Total	27503554.6	139	197867.299		

Number of obs	=	140		
F(7, 132)	=	51.68		
Prob > F	=	0.0000		
R-squared	=	0.7326		
Adj R-squared	=	0.7185		
Root MSE	=	236.02		

yield	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cost	.025489	.0088536	2.88	0.005	.0079757	.0430023
maha	-19.72221	40.72187	-0.48	0.629	-100.2741	60.82967
irrigated	828.6757	44.46654	18.64	0.000	740.7165	916.6349
year						
2009	-73.16709	71.40657	-1.02	0.307	-214.4163	68.08215
2010	-29.65057	82.05161	-0.36	0.718	-191.9568	132.6556
2011	-305.5012	91.29353	-3.35	0.001	-486.0889	-124.9136
2012	-243.0018	104.252	-2.33	0.021	-449.2225	-36.78115
_cons	546.1142	272.5838	2.00	0.047	6.916367	1085.312

Including *cost* as an independent variable changed the significant independent variables in the model compared to the model without *cost*. Including *cost* as an independent variable, the model is still significant, and increased the R^2, the overall measure of goodness of fit. *Cost* is significant, t = 2.88, p-value<.01, *irrigated* is also significant, t = 18.64, p-value<.01 but *Maha* is not significant, t = -0.48, p-value>.05.

Fixed Effect Model 2 (year as trend)

Source	SS	df	MS		
Model	19510121.2	4	4877530.3		
Residual	7993433.37	135	59210.6176		
Total	27503554.6	139	197867.299		

Number of obs	=	140		
F(4, 135)	=	82.38		
Prob > F	=	0.0000		
R-squared	=	0.7094		
Adj R-squared	=	0.7008		
Root MSE	=	243.33		

yield	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cost	.027454	.0089632	3.06	0.003	.0097275	.0451805
maha	-17.91008	41.95306	-0.43	0.670	-100.8803	65.06015
irrigated	828.956	45.8324	18.09	0.000	738.3136	919.5984
time	-76.87612	25.11796	-3.06	0.003	-126.5517	-27.20053
_cons	577.2841	261.6643	2.21	0.029	59.79262	1094.776

The model is significant, F = 82.38, p-value<.01. R^2, the overall measure of goodness of fit is about 71 percent. All independent variables excluding Maha are significant. Yield has a time

effect or trend as time appeared as significant. On average if other variables remain constant, increasing one year of time will decrease the yield by 76.88 units.

Multivariate Regression Analysis 1 (yield and cost, year as categorical)

Equation	Obs	Parms	RMSE	"R-sq"	F	P
cost	140	7	2311.564	0.6798	47.06795	0.0000
yield	140	7	242.4022	0.7159	55.84587	0.0000

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cost						
maha	-922.21	390.73	-2.36	0.020	-1695.05	-149.37
irrigated	-557.38	432.81	-1.29	0.200	-1413.46	298.70
year						
2009	3222.12	641.11	5.03	0.000	1954.02	4490.21
2010	5758.68	629.63	9.15	0.000	4513.29	7004.06
2011	7433.86	619.63	12.00	0.000	6208.26	8659.46
2012	9358.89	619.63	15.10	0.000	8133.30	10584.49
_cons	30059.02	577.46	52.05	0.000	28916.83	31201.22
yield						
maha	-43.23	40.97	-1.06	0.293	-124.27	37.82
irrigated	814.47	45.39	17.95	0.000	724.70	904.24
year						
2009	8.96	67.23	0.13	0.894	-124.02	141.94
2010	117.13	66.03	1.77	0.078	-13.47	247.73
2011	-116.02	64.98	-1.79	0.076	-244.54	12.50
2012	-4.45	64.98	-0.07	0.945	-132.98	124.07
_cons	1312.29	60.56	21.67	0.000	1192.51	1432.07

The model for *cost* is statistically significant, F = 47.07, p-value<.01. The R^2, the overall measure of goodness of fit is also good, R^2 = .6798. This means that about 68 percent of the variation in *cost* is explained by the model's explanatory variables and within the model. The indicator variable *Maha* is significant, t = -2.36, p-value<.05. So, *Maha* has a negative effect on *cost*. If the season is *Maha* and all other variables remains constant, the cost will be reduced by 922 units. *Irrigated* does not have a significant effect on cost, t = -557.38, p-value>.05. All years have a significant effect on cost (p-values<.01). The results of *yield* are as same as for Fixed Effect Model 1 (which considers year as categorical).

Multivariate Regression Analysis 1 (yield and cost, year as trend)

Equation	Obs	Parms	RMSE	"R-sq"	F	P
cost	140	4	2327.91	0.6680	91.1981	0.0000
yield	140	4	250.7186	0.6892	100.5127	0.0000

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cost						
maha	-922.21	393.49	-2.34	0.021	-1700.36	-144.07
irrigated	-559.80	435.83	-1.28	0.201	-1421.69	302.09
t	2281.95	139.48	16.36	0.000	2006.13	2557.78
_cons	28367.87	591.00	48.00	0.000	27199.14	29536.60
yield						
maha	-43.23	42.38	-1.02	0.310	-127.04	40.58
irrigated	813.59	46.94	17.33	0.000	720.76	906.41
t	-14.23	15.02	-0.95	0.345	-43.93	15.48
_cons	1356.10	63.65	21.31	0.000	1230.22	1481.97

Both models are significant, and the significant variables in the models are also same as in the previous models when year was set as categorical. *Cost* has a time effect as the trend variable t is significant, t = 16.36, p-value<.01. By increasing the year by one, *cost* will increase by about 2,282 units if other variables remain unchanged. But the trend variable t does not have a significant effect on *yield*. The interaction effect between Maha and irrigated was found not significant in the individual model for *yield*.

Multivariate Regression Analysis 2 (yield and price, year as categorical)

Equation	Obs	Parms	RMSE	"R-sq"	F	P
yield	140	9	236.8957	0.7327	44.88608	0.0000
price	140	9	2.305129	0.4040	11.09848	0.0000

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
yield						
maha	-9.17	75.49	-0.12	0.904	-158.51	140.18
irrigated	821.32	62.84	13.07	0.000	697.01	945.63
maha#irrigated						
0 1	14.74	88.65	0.17	0.868	-160.63	190.12
cost	0.03	0.01	2.87	0.005	0.01	0.04
year						
2009	-73.25	71.67	-1.02	0.309	-215.04	68.53
2010	-29.81	82.36	-0.36	0.718	-192.73	133.12
2011	-305.70	91.64	-3.34	0.001	-486.99	-124.42
2012	-243.25	104.65	-2.32	0.022	-450.27	-36.23
_cons	540.04	276.02	1.96	0.053	-5.99	1086.07
price						
maha	1.31	0.73	1.79	0.076	-0.14	2.77
irrigated	-2.97	0.61	-4.86	0.000	-4.18	-1.76
maha#irrigated						
0 1	1.85	0.86	2.15	0.034	0.15	3.56
cost	0.00	0.00	0.61	0.545	-0.00	0.00
year						
2009	0.37	0.70	0.53	0.595	-1.01	1.75
2010	-2.90	0.80	-3.62	0.000	-4.49	-1.32
2011	-2.92	0.89	-3.28	0.001	-4.69	-1.16
2012	-3.59	1.02	-3.53	0.001	-5.61	-1.58
_cons	29.94	2.69	11.15	0.000	24.63	35.26

The regression equation is statistically significant and R^2 remains high, but for price it is only about 40 percent. *Irrigated*, *cost* and the years 2011 and 2012 have a significant effect on yield whereas *Maha* and the interaction effect between *Maha* and *irrigated* is not significant. *Cost* does not have any significant effect on *price* as it appeared as non-significant in the regression model for price. Also, the year 2009 does not have any significant effect on *price*. Interestingly, the interaction effect between *Maha* and *irrigated* appeared significant at the 5 percent level, t = 2.15, p-value<.05 and *Maha* is also significant at 10 percent level. The interaction term signifies that if *Maha* is not included in the model and *irrigated* is included, *price* will increase by 1.85 units.

Multivariate Regression Analysis 2 (yield and price, year as trend)

Equation	Obs	Parms	RMSE	"R-sq"	F	P
yield	140	6	244.2137	0.7094	65.43138	0.0000
price	140	6	2.39388	0.3425	13.9586	0.0000

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
yield						
maha	-7.10	77.80	-0.09	0.927	-160.98	146.78
irrigated	821.42	64.77	12.68	0.000	693.31	949.53
maha#irrigated						
0 1	15.10	91.39	0.17	0.869	-165.66	195.86
cost	0.03	0.01	3.05	0.003	0.01	0.05
time	-76.94	25.21	-3.05	0.003	-126.80	-27.07
_cons	571.14	265.23	2.15	0.033	46.55	1095.72
price						
maha	1.30	0.76	1.71	0.090	-0.21	2.81
irrigated	-2.99	0.63	-4.71	0.000	-4.25	-1.74
maha#irrigated						
0 1	1.85	0.90	2.07	0.041	0.08	3.62
cost	0.00	0.00	0.49	0.628	-0.00	0.00
time	-1.02	0.25	-4.12	0.000	-1.51	-0.53
_cons	31.53	2.60	12.13	0.000	26.39	36.67

The results are same for both regression models when year considered as categorical and as trend. The trend variable *time* is significant in both models for *yield* and *price*. Also, *year* has a negative effect on both yield and price.

APPENDIX 11

FINANCIAL MANAGEMENT ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 11

FINANCIAL MANAGEMENT ASSESSMENT

OF

MINISTRY OF IRRIGATION AND WATER RESOURCE MANAGEMENT
DEPARTMENT OF IRRIGATION
MAHAWELI AUTHORITY OF SRI LANKA

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
ADBS	–	Asian Development Bank Specific
AG	–	Auditor General
CAGR	–	Compounded Annual Growth Rate, %
CEO	–	Chief Executive Officer
CFO	–	Chief Financial Officer
CIA	–	Chief Internal Auditor
CIGAS	–	Computerized Integrated Government Accounting System
DG	–	Director General
DGI	–	Director General of Irrigation
DOI	–	Department of Irrigation
EA	–	Executing Agency
GIS	–	Geographic Information Systems
GOSL	–	Government of Sri Lanka
HA	–	Hectare (1ha = 10,000sqm)
IA	–	Implementing Agency
KPIs	–	Key Performance Indicators
MASL	–	Mahaweli Authority of Sri Lanka
MCM	–	Million Cubic Meters (1 MCM = 811 Acre feet)
MDP	–	Mahaweli Development Program
MIWRM	–	Ministry of Irrigation and Water Resources Management
MFF	–	Multi-tranche Financing Facility
O&M	–	Operating and Maintenance
PPTA	–	Project Preparatory Technical Assistance
TA	–	Technical Assistance
WRDIP	–	Water Resources Development Investment Program
YoY	–	Year on Year increase, %

CONTENTS

FIGURES

I. EXECUTIVE SUMMARY

1. The Water Resources Development Investment Program (WRDIP) will assist the government to complete outstanding water conveyance investments under the Mahaweli Ganga Development Program (MDP). Completion of the MDP will maximize the productivity of the Mahaweli River Basin's water resources by transferring available water to the country's northern dry zone areas for irrigation, drinking and commercial purposes. The WRDIP will be financed under a $675 million multi-tranche financing facility (MFF). The investment program is designed to be implemented over 10 years from 2015 to 2024.

2. The Executing Agency (EA) for the program will be the Ministry of Irrigation and Water Resources Management (MIWRM). The Department of Irrigation (DOI) together with the Mahaweli Authority of Sri Lanka (MASL) will serve as Implementing Agencies (IAs).

3. The financial management assessments (FMAs) of MIWRM, DOI and MASL were conducted from August 2014 to October 2014 in accordance with ADB's Guidelines for the *Financial Management and Analysis of Projects* and Financial Due Diligence: a Methodology Note. The FMA considered the capacity of the MIWRM, DOI and the MASL, including funds-flow arrangements, staffing, accounting and financial reporting systems, financial information systems, internal controls and internal and external auditing arrangements.

4. The EA, the MIWRM, is structured to guide the implementation partners by exercising supervision and progress control of programs and projects that are geared to enhance the productivity in existing systems and new projects to serve all regions of the country including new frontiers contemplated under the MDP. The MIWRM has extensive past experience in executing large foreign-financed projects and currently has an on-going portfolio of development projects under its purview.

5. The MASL, one of the IAs, operates under the MIWRM as a separate institution. The MASL is the cornerstone of the MDP which relates to regulating and harnessing the waters of Mahaweli River for power generation, land settlement and food production and thereby the provision of employment. The MASL has already completed an array of large hydropower and water resource development initiatives and its past experience will serve well for successful implementation of the WRDIP. The MIWRM together with the MASL has a budget allocation of over $300 million for 2014, which reflects the combined magnitude of strength of the two organizations and their scale of technical and administrative expertise.

6. The DOI, the second IA which is also part of the MIWRM but functions as an independent department, has been playing a key role in the irrigation sector of the country for over 100 years and has responsibility for some of the nation's main irrigation systems. The institution is well staffed with the reporting and organizational structures and culture in place to implement the WRDIP. The DOI's 2014 budget is currently estimated to be around $100 million. The DOI also has considerable past experience in implementing major irrigation systems and schemes funded both locally as well as by development partners. The MIWRM, the MASL together with the DOI, therefore appear to have sufficient financial management capacity and expertise to execute and implement the WRDIP considered under this ADB program.

7. The overall pre-mitigation financial management risk is rated as 'Moderate', and although certain risks have been identified, as summarized below, with the proposed risk mitigating measures, the financial management arrangements are considered adequate.

8. Despite the MIWRM, MASL and DOI's capacity and capabilities, there are a few limiting areas which require improvements:

(i) ADB has not engaged with the EA and funded any projects through the MIWRM for more than 10 years. The WRDIP will therefore be the first ADB program the EA and IAs will be executing and implementing which therefore require a comprehensive procedure manual along with training of central and regional financial management staff, on ADB's policies, procedures and guidelines. Capacity building and training through workshops are therefore required prior to implementation of the ADB program – **Responsibility with ADB TA team.**

(ii) There have been instances where the Treasury re-prioritized projects during the fiscal year resulting in some non-disbursements and delays. A firm commitment from the Treasury is therefore required to prioritize the ADB project to ensure timely fund disbursements – **Responsibility with ADB to obtain assurance from Treasury on behalf of EA and IAs.**

(iii) In line with country systems, most government departments that report to the Treasury, including the EA and IAs, do not yet prepare a full set of financial statements including a balance sheet, profit and loss account and a cash flow statement. An appropriation account is prepared on a modified cash basis. The government is already addressing this on a countrywide basis under an accounting reform roadmap. The EA and IAs shall also be requested to incorporate details of ADB funded projects in separate notes to their appropriation account. – **Responsibility with EA and IAs to comply and ADB requirements and implement new accounting system once introduced by the government.**

(iv) Even though the EA and IAs prepare Corporate Plans, these are not detailed and therefore limit the usefulness of the document. In addition, these plans are not updated regularly. The MASL's 5 year Corporate Plan is satisfactory albeit there is room for improvement. It is therefore recommended that comprehensive 5-year Corporate Plans be developed for the EA and IAs and update these periodically on an annual basis which will also improve accuracy of estimates. An initial 5-year Corporate Plan for each of the EA and IAs to be formulated through extensive participation of staff in the form of workshops – **Responsibility with EA and IAs under ADB guidance recommended.**

(v) Review and update KPIs of the EA and IAs to enable effective monitoring of physical progress of project linked with financial targets. It is recommended to introduce a new KPI system using ADB's best practices and guidance. KPIs are also recommended for regular monthly monitoring in Appropriation Accounts. KPIs should be developed with participation of staff through workshops - **Responsibility with EA and IAs under ADB guidance.**

(vi) Explore the possibility of making MASL a separate cost center under the Treasury. This is enable effective budgetary monitoring as well as assist MASL seek direct Treasury assistance for urgent matters – **Responsibility with ADB.**

II. INSTITUTIONAL OVERVIEW

A. Ministry of Irrigation and Water Resources Management

9. The MIWRM is committed to manage the irrigation sector and the water resources of the country, maintaining the equilibrium between the trends in rapid economic development and sustainable use of water resource base. It gains from the support of the implementation agencies under the Ministry, which are manned by competent technical personnel experienced and trained in their respective disciplines.

10. The MIWRM's vision statement is: *"Prosperous Sri Lanka through water and irrigation heritage".*

11. *"Providing well being of community while fulfilling all water needs through water resources management"* is the MIWRM's mission statement.

12. Main functions of the MIWRM include the following:

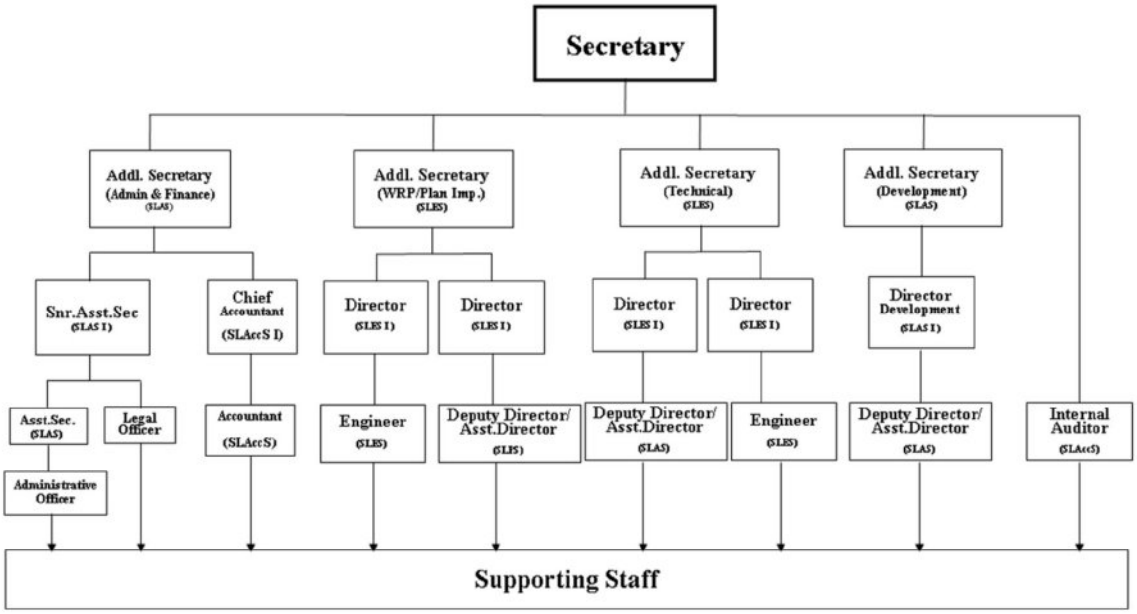
- Formulation of policies and implementation of projects and programs
- Fulfilling obligations under "Mahinda Chinthana – Vision for the Future" and overall national policies
- Promotion, construction, operation, maintenance and management of irrigation systems, rain water harvesting and ground water development
- Salt water exclusion programs
- Drainage and flood protection
- Prevention of the pollution of rivers, streams, reservoirs and other water bodies
- Engineering consultancy services and construction
- Implementation of legislative enactments relevant to the subjects and Institutions under the Ministry
- Matters relating to Mahaweli development

13. The MIWRM has one department and three institutions under its purview. The DOI has been categorized as a department whilst the MASL functions as an institute of the MIWRM. The MIWRM's two other institutes are Water Resources Board and the Central Engineering Consultancy Bureau.

14. The Treasury has allocated expenditure appropriation head number "152" to the MIWRM and number "282" to the DOI. The DOI has a separate appropriation number since it is categorized as a department under the Ministry of Finance and the Treasury.

15. The MIWRM's head office is located at 500, T.B. Jayah Mawatha, Colombo 10. The Secretary to the Minister heads the operations of the Ministry. As shown below, four Additional Secretaries in the fields of administration and finance, water resource planning and implementation, technical, and development report to the Secretary.

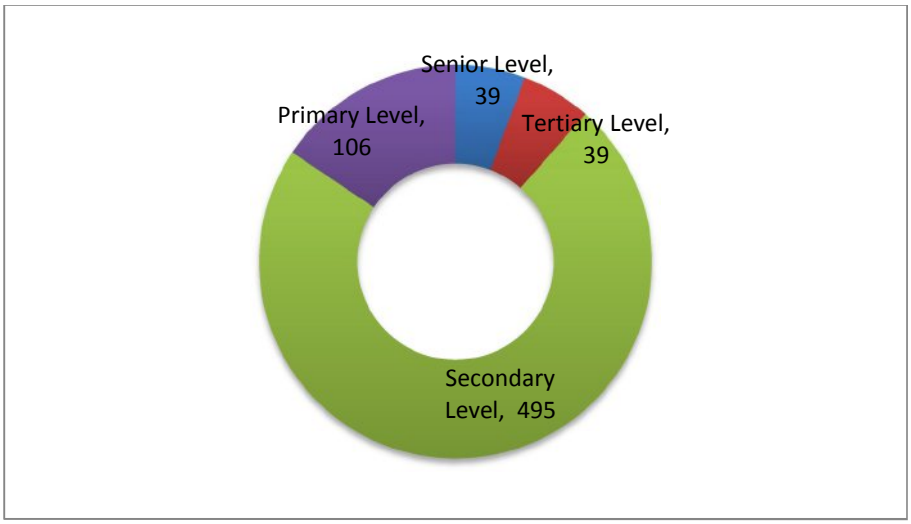
Figure 1: Organizational Structure of the MIWRM



Source: MIWRM

16. The MIWRM has a direct work force of 675 (estimate for 2014). However, in 2013, the MIWRM's staff base was only 295. Accordingly, estimated work force in 2014 represents over 133% year-on-year (YoY) increase. The main area of this increase is at secondary grade level employees. As shown below, secondary level employees now represent around 30% of the cadre base. 14% are employed at senior level and 17% are at tertiary level. Remaining 39% of the MIWRM's direct staff base is made up of primary, casual and contract employees.

Figure 2: Employee Grade Levels of the MIWRM (2014)



Source: MIWRM

B. Mahaweli Authority of Sri Lanka

17. The MASL was established in 1979 by way of a Parliament Act with a mandate to implement the MDP. After successfully completing several large-scale reservoir projects with hydro electricity plants accompanying large extents of irrigable land such as the Victoria dam project, Randenigala, Rantambe, Kothmale, Polgolla and Bowatanne, the MASL is presently planning to develop the balance area proposed by the MDP Master Plan. In addition, the MASL carries out the maintenance and rehabilitation of irrigation network, land administration, increasing agricultural production and post settlement activities. Further, the MASL is responsible for managing irrigation water for over 175,000 ha of irrigable land in the dry zone at present.

18. The Master Plan of the MDP envisages storing 7,400 MCM (6 million acre-feet) of water in 15 reservoirs on the Mahaweli and its tributaries and Maduru Oya Basin. About 60% of water resources available in the Mahaweli Basin is used within the basin and the balance to be diverted to the water shortage areas in the dry zone. The regional boundaries of the project fall within the basins of the Mahaweli, Kalaoya, Malwathu and Yan Oya and the Maduruoya. The MDP project area spreads over 13 administrative districts and covers about 39% of the land area in the country and of 55% of the dry zone area.

19. The MASL's vision statement is: *"The pioneer body of planning, development and manipulating of river valleys and water resources in Sri Lanka".*

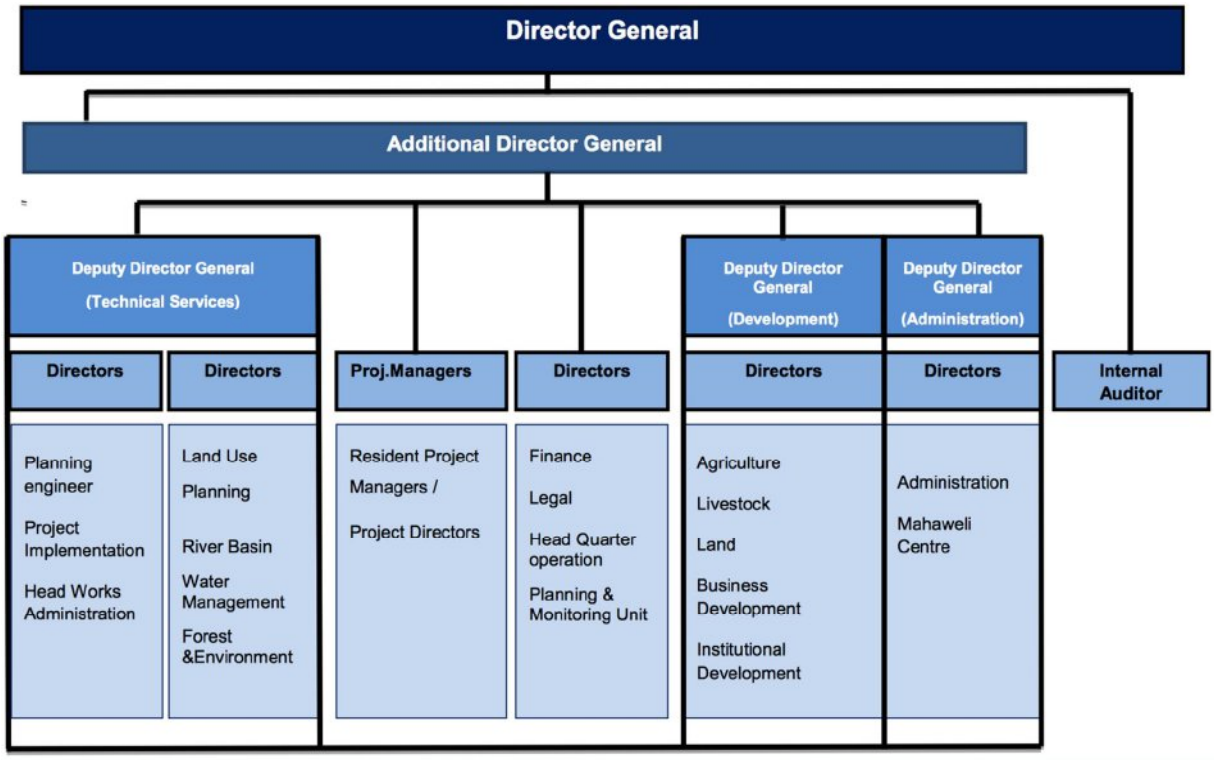
20. *"(a) Increase the national food production together with land and water resource efficiency, (b) transfer the irrigation scheme management to farmer organization by increasing their management ability and (c) increase the water storage capacity of reservoirs and develop new irrigation project to meet the present water need"* is the MASL's mission statement.

21. The MASL's head office is located at 500, T.B. Jayah Mawatha, Colombo 10 with its branch office is at Jawatta Road, Colombo 5. There are 17 site offices located in Northern, North Central, Eastern, Central and Southern Provinces. They are Welioya, Thambuttegama, Dambulla, Huruluwewa, Moragahakanda, Medirigiriya, Welikanda, Dehiattakandiya, Maduru Oya, Mapakada, Randenigala, Victoria, Digana, Kotmale, Embilipitiya and Rambakenoya.

22. The Board of the MASL consists of five members. Three members are appointed by the minister, with the approval of the President, and two ex- officio Directors, namely the Secretary to the Ministry in charge of the subject of Finance and the Secretary to the Ministry in charge of the administration of the MASL. The Minister with the approval of the President appoints one of the directors to be the Director General (DG) of the authority.

23. The DG is the CEO of the MASL. An Additional DG acts as the Deputy CEO. Three Deputy DGs in the fields of technical, development and administration report to the additional DG. Further, 17 subject specialized directors, 2 project directors and 10 resident project managers support the management. The CIA's division functions as a separate unit directly under the DG.

Figure 3: Organizational Structure of the MASL

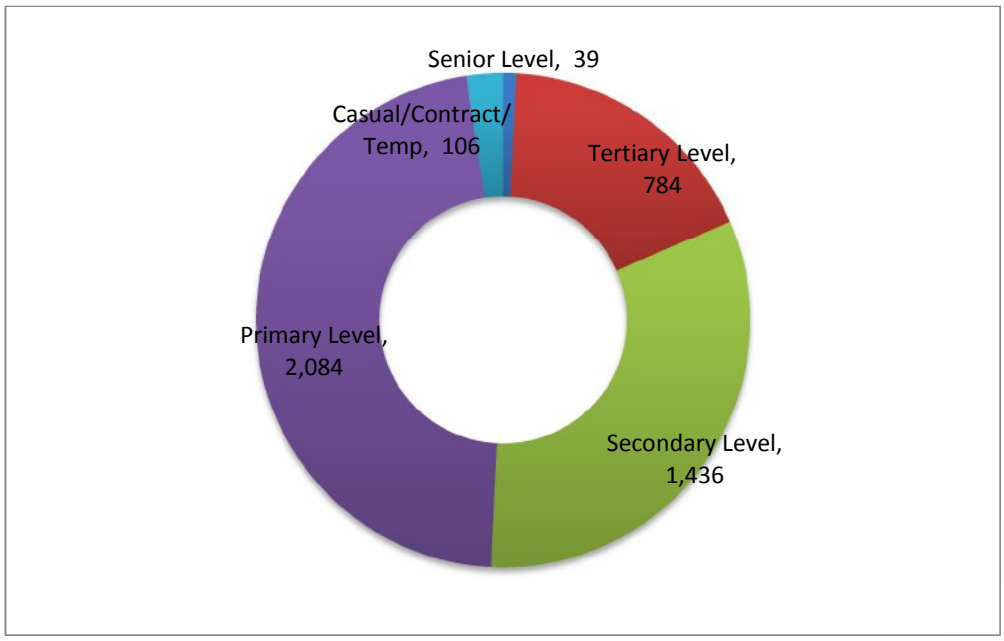


Source: MASL

24. The MASL has professional staff required to manage countries most important and complex water regulatory structures involving dams and reservoirs and trans-basin canal network. It carries well trained experienced professionals, trained locally and abroad, worked remote areas in the dry zone with foreign counterparts, specialized in the fields of civil and mechanical engineering, agriculture, physical planning, settlement planning, business development, land management, institutional development, environmental conservation, accounting and administration.

25. The MASL has a work force of 4,449 (as at October 2013) of whom 523 are at head office while the balance are in the field. The MASL's 2013 staff base represents a 6% increase from 2012 where the total number of staff was 4,205. As shown below, it is noteworthy that less than 1% of the staff is of senior level with nearly 18% are at tertiary level. 79% of the cadre base is made up of primary and secondary level employees with about 2% in casual and contract status.

Figure 4: Employee Grade Levels of the MASL (2013)



Source: MASL

C. Department of Irrigation

26. The DOI was formed over 110 years ago and operates as a separate department under the purview of the MIWRM. The DG of Irrigation (DGI) heads the DOI and reports directly to the Treasury through the Secretary to the MIWRM.

27. The DOI implements the policies and programs of the Ministry, as the principal government organization responsible for the regulation and control of inland waters. The main objectives of the DOI includes the following:

- Development of land and water resources for irrigated agriculture, hydropower, flood control, domestic usage, industrial usage and aquaculture development
- Provision of irrigation and drainage facilities for cultivable lands in irrigation and drainage projects
- Alleviation of poverty of the rural farming community by increasing their farm income and raising their standard of living
- Management of water for sustainable agriculture
- Productivity enhancement of land and water in major/medium irrigation schemes
- Integrated water resources management and participatory management in major, minor and medium irrigation systems

28. The DOI's vision statement is to "*Enhance the development and management of land and water resources towards the socio-economic development of Sri Lanka. Irrigation Department will plan out, design, control and manage land and water resources to derive optimum benefits for irrigated agriculture, hydro power and flood control by harmonizing the modern technologies and human resources*".

29. "*Irrigation department will facilitate sustainable management and improve the land and water resources for food, livelihoods and environment under the framework of government polices*" is the DOI's mission statement.

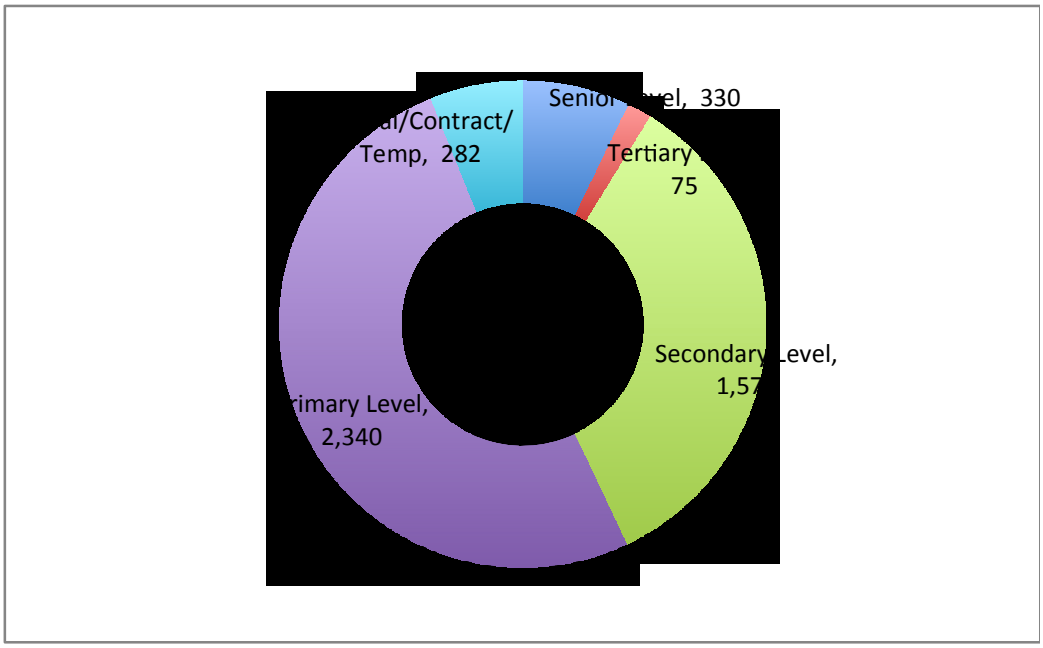
30. The DOI's primary functions include:

- Preparation of master plans for development of the different river basins for the optimum utilization of land and water resources
- Project formulation and detail designs of irrigation, hydro-power, flood control and reclamation projects
- Construction of irrigation and settlement projects for the conservation, diversion and distribution of water under gravity and lift irrigation to new and existing lands for cultivation by farmers for food crop production
- Construction of drainage, flood protection and salt water exclusion projects for the protection of cultivable land to enable the cultivation of such lands with rainfall for food crop production with minimized risk
- Operation, maintenance, improvements, rehabilitation and water management for medium and major gravity, drainage and lift irrigation projects
- Research in hydraulics, hydrology, soil mechanics, engineering, geology, GIS, engineering materials and land use as applied to water resources development projects
- Human resources development for optimum utilization of human resources
- Operation and maintenance of financial management systems, accounting, reporting, auditing systems of the DOI in accordance with the financial regulation of the government
- Providing consultancy services to government departments, statutory boards/ corporations, public and private institutions and individuals; in the fields of water resources development, foundation engineering, quality control of earth work and concrete, hydraulic model testing and land use planning

31. The DOI's head office is located at 230 Bauddhaloka Mawatha, Colombo 07, and operates in 15 districts around the country. Headed by the DGI, the top management of the DOI comprise of five additional DGs overseeing areas such as irrigation and water management, regional development and construction, planning, design and specialized services, and finance and administration.

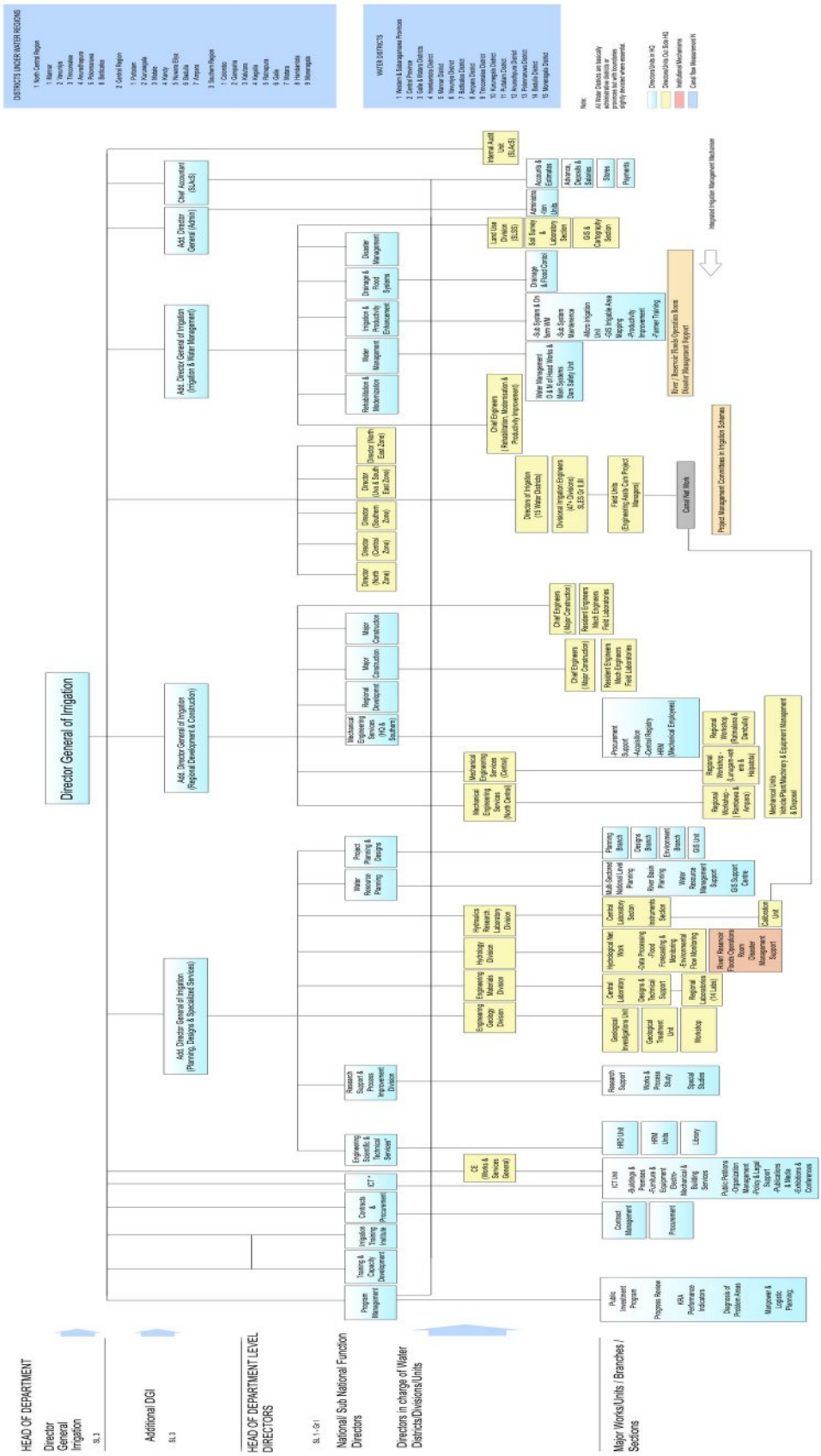
32. At the end of 2013, the DOI had a total staff base around 4,600 employees representing a 3% growth from 2012 where the staff base was around 4,470. It is noteworthy that about 7% of the staff is of senior level whilst only 2% are at tertiary level. 81% of the cadre base is made up of primary, secondary, casual and contract employees.

Figure 5: Employee Grade Levels of the DOI (2013)



Source: DOI

Figure 6: Organizational Structure of the DOI



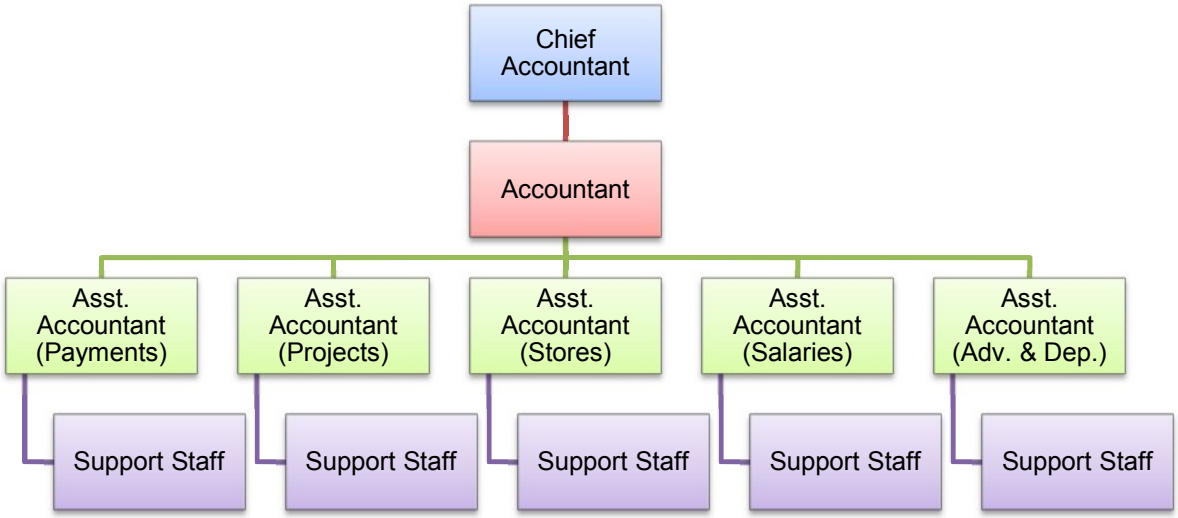
III. FINANCE DEPARTMENTS

A. Ministry of Irrigation and Water Resources Management

33. The chief financial executive of the MIWRM is the chief accountant. He is assisted by the accountant who is engaged in day-to-day finance operations of the Ministry. The chief accountant reports directly to additional Secretary administration and finance as well as to the Secretary of the MIWRM.

34. There are five assistant accountants reporting to the accountant that are responsible for key functional, administrative and operational areas of the MIWRM. There are 17 other support staff reporting to assistant accountants.

Figure 7: MIWRM Finance Department Structure



Source: MIWRM

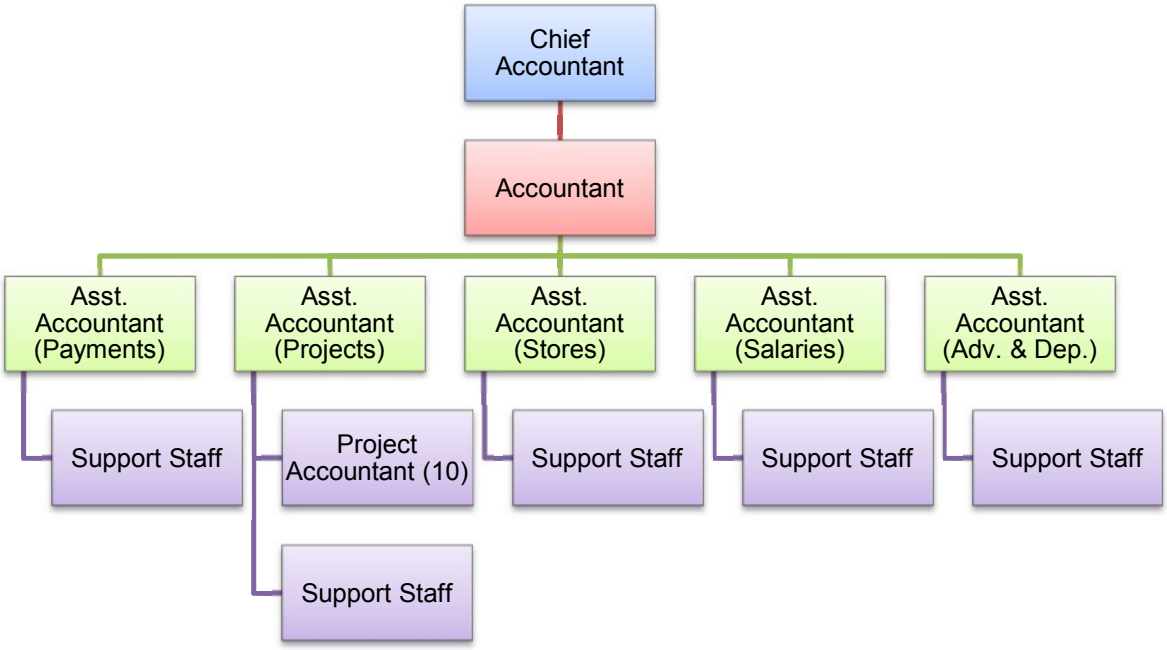
35. The chief accountant, accountant and assistant accountants are qualified accountants. Other supporting staff are currently following accountancy programs and/or undergraduate studies, diplomas in accountancy except for 3 staff members that are employed as clerks/ messengers.

B. Mahaweli Authority of Sri Lanka

36. The chief financial executive of the MASL is the chief accountant. He is assisted by the accountant who is engaged in day-to-day finance operations of the institution. The chief accountant reports directly to the Director finance as well as to the additional DG and DG of the MASL.

37. There are five assistant accountants reporting to the accountant that are responsible for key functional, administrative and operational areas of the MASL, 10 project accountants at each project manager's office, and 14 other support staff reporting to assistant accountants.

Figure 8: MASL Finance Department Structure



Source: MASL

38. Reporting to the assistant accountant – projects are 10 project accountants based in each of MASL's 10 project manager's offices. These accountants are responsible for generating payment vouchers for projects, obtaining approvals from the head of the regional office (typically a qualified engineer) and sending them to head office for payments.

39. The chief accountant, accountant, assistant accountants as well as project accountants at regional offices are qualified accountants. Other supporting staff are currently following accountancy related programs, undergraduate studies and/or diplomas in accountancy related studies except for 5 staff members that are employed as clerks/messengers.

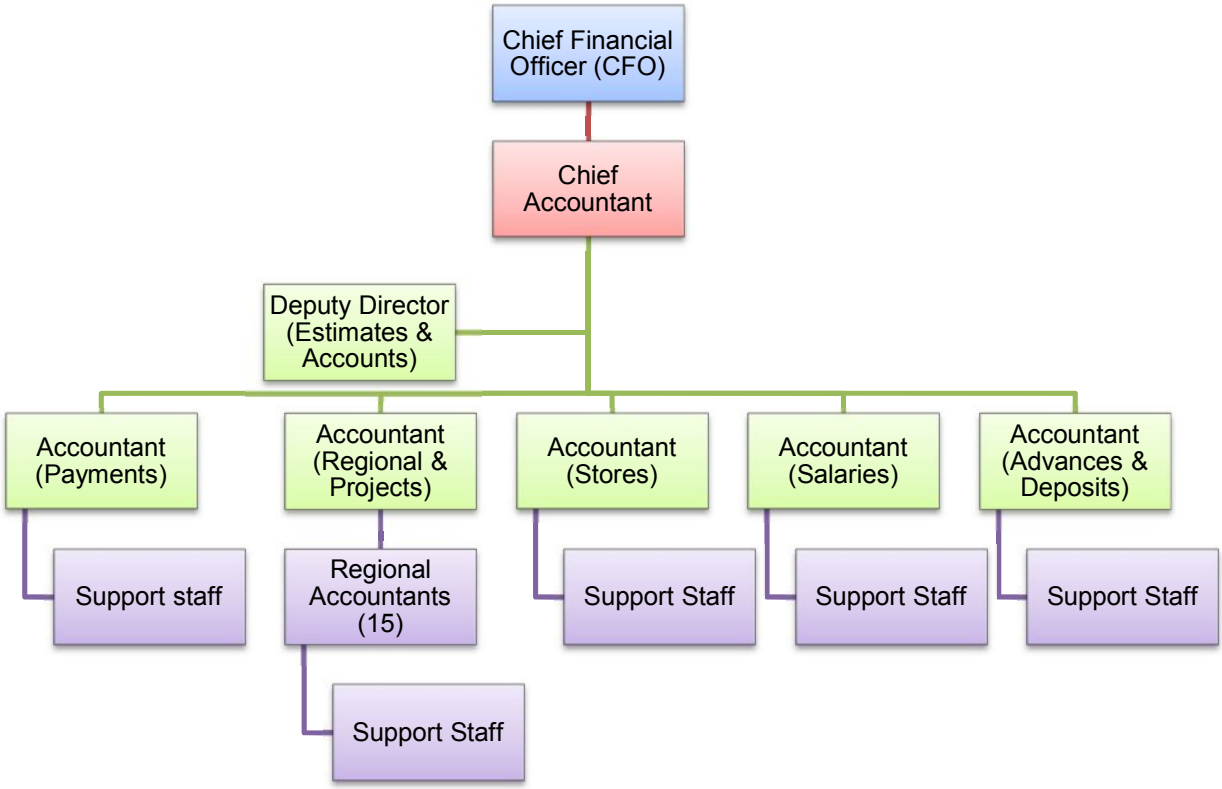
C. Department of Irrigation

40. The chief financial executive of the DOI is the CFO. She is assisted by the chief accountant, who is engaged in day-to-day finance operations of the institution.

41. There are five accountants reporting to the chief accountant. The Deputy Director comes under the supervision of the chief accountant. In addition there are 15 other regional accountants in each of the DOI's regional offices and 8 support staff.

42. The CFO, chief accountant, deputy director and 5 main accountants as well as 15 regional accountants are qualified accountants. Other supporting staff are currently following accountancy programs and/or undergraduate studies, diplomas in accountancy or related studies except for 2 staff members that are employed as clerks/messengers.

Figure 9: DOI Finance Department Structure



Source: DOI

43. In the regional and projects department, there are regional accountants based in each of the DOI's 15 regions. These regional accountants are responsible for generating payment vouchers for projects, obtaining approvals from the head of the regional office (typically a qualified engineer) and sending them to head office for payments.

44. Based on meetings and discussions with the Finance Departments of the MIWRM, MASL and DOI, payment approvals for past and current foreign-funded projects, as well as locally funded projects, and fund disbursements both appear to function well. However, training and workshops in ADB's disbursement, procurement and financial reporting guidelines will be required in relation to the program. These workshops and training programs are best conducted locally at regional office level, which will ensure all regional staff members follow ADB's procedures, guidelines and best practices during the program. It is also recommended to conduct routine training programs and workshops at the head office combining all regional accountants and head office financial staff on a regular basis, at least on a half yearly basis, on ADB guidelines and instill ADB's best practices.

IV. ACCOUNTING AND IT SYSTEMS

45. Accounts of the MIWRM, MASL and DOI are prepared in accordance with Sri Lankan Accounting and Auditing Standards and the financial year corresponds with the normal calendar year ending to 31st December. These institutions maintain its accounts under a modified cash basis of accounting. Under the this modified cash accounting, capital expenditures for fixed assets are accounted at cost, but depreciation is not provided in the accounts while its expenditure and income are recorded on cash basis.

46. Despite the MASL's efforts in the preparation of financial statements, the absence of a comprehensive set of basic financial statements (i.e. profit and loss account, balance sheet and a cash flow statement) is of some concern. However, the MIWRM, MASL and DOI prepare comprehensive Appropriation Accounts with detailed notes on an annual basis. Typically, all institutions that report to the Treasury do not prepare full financials. The government has already identified this weakness and the Treasury is expected review and revise the present system, albeit it is difficult to define an exact timeframe.

47. The Appropriation Account records actual recurrent expenditures (divided into operational and development activities) and capital expenditure (also divided into the same activities) with comparison to the budget. A variation analysis is also provided along with explanations to provide justifications for both over and under expenditure.

48. A statement of claims under foreign reimbursable aids is included as a separate note in Appropriation Account. This is a very useful statement, which provides details of payments and claims relating to foreign-funded projects. It is recommended that these institutions maintain a separate note and a statement to monitor payments and claims relating to any ADB financed-program. Appropriation Account notes structure has the flexibility to introduce such additional notes.

49. The MIWRM, MASL and DOI's accounting systems are common platform employed by most government institutions reporting to the Treasury. The CIGAS has been the core accounting system and it seems to function well. It is an on-line fully integrated system that has established direct links with any regional offices of the institutions. In addition to the Appropriation Account, the CIGAS system generates and uploads monthly reports to the Treasury. Even though there are few limitations in the present IT system, these are not seen as major issues that would have an impact on the proposed ADB-financed program.

50. The Treasury is currently reviewing the existing system and is likely to augment the system across its Ministries and Departments. This will bode well for the ADB program as the new system is likely to introduce separate modules to monitor and report foreign financed projects in more detail. Exact implementation date, however, cannot be established as yet.

V. FINANCIAL PLANNING AND BUDGETING

52. In Sri Lanka, the Treasury reviews and finalizes annual budgets for all government departments through the relevant ministries. Once budgets are finalized, the Treasury through the Finance Minister (typically the President of Sri Lanka) presents the budget to the parliament usually in October/November each year. Once the parliament approves the budget, usually after three to four rounds of budget debates, the Treasury distributes the final budget by the beginning of each year to relevant ministries and institutions.

53. With respect to the MIWRM, MASL and DOI, in May/June of each year, the Finance Department requests all departmental heads and regional offices to submit their expected expenditure for the ensuing year. The estimates are consolidated and discussions are held with all the departmental heads to contain the total expenditure within the estimated budget for the ensuing year. Upon final review by the head of finance and the DG/Secretary, draft budgets are submitted to the Treasury by August each year. Several rounds of discussions then take place with the Treasury to finalize the budget to be presented to the parliament. The entire budgeting process normally takes about four to six months including parliament's approval.

Figure 10: Annual Budgets of the MIWRM and DOI (2012-2016)

Rs '000

Head No	Description	2012	2013 Revised Budget	2014 Estimate	2015 Projections	2016 Projections	2013 - 2016 Total
152-	**Minister of Irrigation and Water Resources Management**						
	Operational Activities	**103,168**	**124,795**	**226,955**	**236,771**	**245,302**	**833,823**
	Recurrent Expenditure	89,872	108,770	118,955	126,571	133,102	487,398
	Capital Expenditure	13,297	16,025	108,000	110,200	112,200	346,425
	Development Activities	**24,702,243**	**33,408,300**	**42,125,420**	**63,303,200**	**66,721,445**	**205,558,365**
	Recurrent Expenditure	1,868,880	2,054,980	2,133,070	2,197,500	2,373,225	8,758,775
	Capital Expenditure	22,833,362	31,353,320	39,992,350	61,105,700	64,348,220	196,799,590
	Total Expenditure	**24,805,411**	**33,533,095**	**42,352,375**	**63,539,971**	**66,966,747**	**206,392,188**
	Recurrent Expenditure	1,958,752	2,163,750	2,252,025	2,324,071	2,506,327	9,246,173
	Capital Expenditure	22,846,659	31,369,345	40,100,350	61,215,900	64,460,420	197,146,015
282-	**Department of Irrigation**						
	Operational Activities	**368,769**	**414,975**	**420,885**	**442,210**	**461,940**	**1,740,010**
	Recurrent Expenditure	337,517	373,350	377,735	389,710	396,240	1,537,035
	Capital Expenditure	31,252	41,625	43,150	52,500	65,700	202,975
	Development Activities	**6,279,471**	**7,736,930**	**12,473,300**	**9,262,060**	**4,957,120**	**34,429,410**
	Recurrent Expenditure	1,002,264	1,062,900	1,126,300	1,154,060	1,165,920	4,509,180
	Capital Expenditure	5,277,207	6,674,030	11,347,000	8,108,000	3,791,200	29,920,230
	Total Expenditure	**6,648,239**	**8,151,905**	**12,894,185**	**9,704,270**	**5,419,060**	**36,169,420**
	Recurrent Expenditure	1,339,781	1,436,250	1,504,035	1,543,770	1,562,160	6,046,215
	Capital Expenditure	5,308,459	6,715,655	11,390,150	8,160,500	3,856,900	30,123,205
	Grand Total	**31,453,651**	**41,685,000**	**55,246,560**	**73,244,241**	**72,385,807**	**242,561,608**
	Total Recurrent	**3,298,533**	**3,600,000**	**3,756,060**	**3,867,841**	**4,068,487**	**15,292,388**
	Total Capital	**28,155,118**	**38,085,000**	**51,490,500**	**69,376,400**	**68,317,320**	**227,269,220**

Note: MIWRM include MASL budget since MASL is considered as an institution of the MIWRM
Source: Ministry of Treasury

54. As shown in **Figure 10**, the MIWRM's (which includes the MASL) and DOI's budgets have been categorized in two main cost activities: (i) operational and (ii) development. In addition, operational and development budgets have been further divided according to the nature of the expenditure: (i) recurrent and (ii) capital.

55. Operational activities include all recurrent administration and establishment expenses of the head office and regional offices as well as any capital expenditure relating to acquisition of plant, property and equipment. Development activities include administration and maintenance costs of all irrigation schemes. Capital expenditure under development activity is the main cost element of the MIWRM, MASL and DOI and include all development capital costs of new reservoir projects as well as major, medium and minor irrigation systems and other development projects and programs.

56. Changes to the budget allocation for government organizations at the Parliament are unusual since the Treasury has already made reallocations to the budget after detailed reviews and several rounds of discussions. Therefore, obtaining approval from the Treasury is the most important step in the Budget Approval process for the MIRWM, MASL and the DOI.

57. Based on the MIWRM, MASL and DOI's previous experience with the Treasury and the budgeting process, the recurrent expenditure budget, which accounts to approximately 7% of total expenses of the 2014 budget, is typically approved without much difficulty. This is due to the fact that these expenses are estimated based on past trend taking in to consideration the recurrent nature of such costs. For majority of these costs such as salaries, rent, electricity, vehicle maintenance etc. organizations have a commitment and an obligation and therefore seeking approval from the Treasury is relatively straightforward. O&M costs relating to on-going and existing development projects are also included under recurrent cost category along with any forecast O&M for future projects in the pipeline.

58. The MIWRM (which includes the MASL) and DOI's capital expenditure budgets have two areas (i) operational and (ii) development. Operational capital expenses account for less than 1% of the total capital expenditure budget for 2014, and include expenses such as improvements to buildings and structures and vehicle acquisition costs. Development costs, which accounts for 99% of the capital expenditure budget, and about 93% of entire budget for 2014, is the largest item and include capital costs relating on-going and planned projects. Obtaining approval from the Treasury for Development Capital Expenditure has been a problem in the past due to the lack of fund allocation to the MIWRM, MASL and DOI by the central Government and insufficient priority to water and irrigation related projects.

59. It is expected that capital costs relating to the proposed ADB financed program will form a part of the MIWRM's and DOI's Development Capital Expenditure budget from 2015 onwards (not included in the **Figure 10**). As evidenced from the past, the MIWRM, MASL and DOI usually experiences a high level of scrutiny and can face difficulties in getting development capital budgets approved by the Treasury, especially for new projects. Accordingly, in order to ensure the implementation of the ADB program within its allocated timeframe, while safeguarding the program's features and without having to compromise on quality, it is vital that

the Treasury extends a firm commitment to prioritize the ADB program and fully allocate the funding requirement to the MIWRM, MASL and DOI during the annual budgetary process.

60. The current process of fund disbursement seems satisfactory based on the experience of past and on-going foreign and locally funded projects executed by the MIWRM and implemented by the MASL and DOI. Requests for funds from IAs are typically sent to the Treasury through the MIWRM. The Treasury acknowledges the request by releasing funds without any major delays if the claims and payment requests are within the budget allocation. It is expected a similar fund disbursement process will continue for the ADB program.

61. Even though there are basic KPIs set by IAs in the past, it is recommended that the MIWRM, MASL and DOI review its existing framework to update the KPIs using ADB's knowledge and best practices based on previous projects done in the region to track physical progress with financial disbursements of projects and programs. This will enable effective decision-making, planning and allocation of resources and funds. The MIWRM, MASL and DOI should track and report physical progress of the projects and link them to financials in a more effective, organized and standardized manner. This could be implemented internally (using MS Excel for instance) without incurring major cost and could be accommodated as a Capacity Building and Development initiative under the ADB program.

62. A 5-year Corporate Plan is also another important planning document for any organization. During the financial management assessment of the MIWRM, MASL and DOI, only the MASL appeared to give prominence to the 5-year Corporate Plan, which is updated yearly. The MASL's Corporate Plan outlines its objectives, identifies its challenges and provides useful insights to its vision for the next 5 years. Although both the MIWRM and DOI have basic Corporate Plans, these are not as detailed as the MASL's document. Accordingly, it is recommended that the MASL's Corporate Plan to be reviewed and introduce ADB's best practices and guidelines, which can then be used as a template for the MIWRM and DOI. This also can be done as a Capacity Building and Development initiative under this ADB program prior to the implementation stage.

VI. FINANCIAL REPORTING, MONITORING AND AUDIT

63. The MIWRM, MASL and DOI's financial reporting and monitoring is performed monthly. Expenditure is incurred and recorded at the departmental and regional levels and at month end, each department and region uploads the monthly expenditure along with the variance analysis to the system through the CIGAS.

64. At the MASL, the chief accountant's office consolidates its head office and regional monthly financial statements and submits to the MIWRM. The Chief Accountant at the MIWRM then prepares consolidated monthly financials of the MIWRM and uploads to the Treasury through the CIGAS. In terms of the DOI, the CFO's office at DOI prepares consolidated monthly expenditure statements and submits directly to the Treasury through MIWRM using the online CIGAS system.

65. If the expenditure for one cost category exceeds the budget, transfers can be made from other cost category budgets as long as overall expenditure remains under the budget ceiling. The chief accountants at the MIWRM and MASL and the CFO at the DOI are required to obtain approval for such adjustments from the Treasury. In most cases, approvals are sought after the event when transfers are made between budget items as long as total expenditure is within the predetermined limit. If however, the budget limit is exceeded, Treasury approval is required prior to the event.

66. Similar to the case of over-spending, the MIRWM, MASL and DOI are also required to submit details of any under-spending/savings at the end of the year. This is seen as a good practice since under-spending could mean either weak budgeting or delays/non-payments from the Treasury.

67. As shown below, based on the past analysis of expenditure, actual recurrent expenditure are by and large in line with the budget. Actual capital expenditure are however, appear to be less than the budget in most instances across MIWRM, MASL and DOI.

Figure 11: Recurrent and Capital Expenditure (Actuals vs. Budget)

LKR (in '000s)	2011 Budget	2011 Actual	*2011 Variance*	2012 Budget	2012 Actual	*2012 Variance*	2013 Budget	2013 Actual	*2013 Variance*
MIWRM & MASL	**16,795,594**	**11,322,146**	**-33%**	**26,170,515**	**24,805,411**	**-5%**	**33,533,095**	**30,980,272**	**-8%**
Reccurent Expenditure	1,998,825	1,976,302	-1%	2,031,065	1,958,752	-4%	2,163,750	2,120,475	-2%
Capital Expenditure	14,796,769	9,345,844	-37%	24,139,450	22,846,659	-5%	31,369,345	28,859,797	-8%
DOI	**7,975,555**	**6,457,221**	**-19%**	**8,455,825**	**6,648,239**	**-21%**	**8,151,905**	**7,505,913**	**-8%**
Reccurent Expenditure	1,254,125	1,222,624	-3%	1,302,375	1,339,781	3%	1,436,250	1,416,705	-1%
Capital Expenditure	6,721,430	5,234,597	-22%	7,153,450	5,308,458	-26%	6,715,655	6,089,208	-9%
Total	**24,771,149**	**17,779,367**	**-28%**	**34,626,340**	**31,453,650**	**-9%**	**41,685,000**	**38,486,185**	**-8%**
Reccurent Expenditure	3,252,950	3,198,926	-2%	3,333,440	3,298,533	-1%	3,600,000	3,537,180	-2%
Capital Expenditure	21,518,199	14,580,441	-32%	31,292,900	28,155,117	-10%	38,085,000	34,949,005	-8%

Source: MIWRM, MASL & DOI

68. Amongst other factors, one of the main reasons for under utilization of capital expenditure budget is due to delays in fund releases by the Treasury. Even though the Treasury allocates a capital budget at the beginning of each year, due to fund constraints and re-prioritization of projects by the government, the Treasury ends up reallocating funds to its Ministries from time to time during the course of the year. This results in delays as well as amendments to implementation schedules of projects.

69. In order to ensure the successful implementation of the ADB financed program, it is vital that the Treasury provides a firm commitment to the MIWRM, MASL and DOI to allocate the fund requirement and release funds without any significant delays. Based on an understanding of the national importance of the ADB program and discussions held to-date in the government, it is anticipated that the Treasury will fully cooperate and provide the funding requirement. However, it is recommended to obtain Treasury commitment formally to ensure fund allocation and disbursements given experiences the MIWRM, MASL and DOI has encountered in the past.

70. After the close of each financial year, the chief accountants of the MIWRM and MASL as well as the CFO at the DOI are required to prepare detailed financial statements. These are very comprehensive documents with detailed notes to the accounts and details of expenditure and income if any. Once reviewed and finalized, these are submitted to the Treasury and to the Auditor General (AG).

71. The accounts of the MIWRM, MASL and DOI are subject to an external audit by the AG or by such officers who are authorized by the AG's office. All institutions including the MIWRM, MASL and DOI that are audited by the AG are required to submit financial statements to AG's office by 31st March of the subsequent year. The AG's office then conducts an annual audit of the accounts. He submits the final audit report to the Treasury and issues a summary to the Parliament through the Treasury. The AG's office typically issues this report to the Treasury by September/October of the subsequent year with findings corresponding to the previous financial year. Most recent audited opinions of the MIRWM, MASL and DOI do not indicate any significant financial issues.

72. In addition to the annual audit by the AG, the MIWRM, MASL and DOI each has an in house CIA conducting regular internal audits. This unit operates as an independent department headed by a qualified accountant. Each of the units directly reports to the head of the institution, for instance at MIRWM CIA reports directly to the Secretary and at MASL and DOI the CIA reports directly to the DG.

73. Each of the CIA's offices at MIWRM, MASL and DOI appear to be adequately staffed with 15-30 employed at each CIA's office. The CIA's unit typically operates in teams of 3 to 4 that are sent to regional offices and head office departments for comprehensive audits (once a year) and for spot audits (once or twice a year). In addition to the CIA being a qualified accountant, team leaders of the CIA office are also qualified accountants. The CIA office ensures that the departments and regional offices comply with policies, requirements and regulations of the institution. The office also conducts examination and analysis of fiscal procedures, checking and verification of accounts and expenditures.

74. In addition to the AG's audit and internal audits, the AG shall also carry out a separate audit of the ADB financed program in accordance with ADBs guidelines. In addition, the CIA at each of the MIWRM, MASL and DOI shall also ensure that the internal audit annual plan covers a separate audit for the ADB financed program including at least two spot audits per year along with an annual comprehensive audit.

75. The Treasury has identified the DOI as a "Department" of the MIWRM and therefore has allocated a separate cost center code to the DOI (number 282). The MIWRM's cost code is 152 (refer to **Figure 10**). Accordingly, the Treasury presents both the MIWRM and DOI's budgets separately. Further, the DOI being a "Department" is treated independent to the MIWRM and has certain advantages over the MIWRM's "Institutions" such as the MASL. Similar to the DOI, the MASL has large operations in the country and has several large projects under its purview. The ADB program will also contribute towards the prominence of the MASL. Therefore, it is suggested to explore the possibility of categorizing the MASL as a "Department" and to allocate a separate cost center number to the MASL. To facilitate this, it is recommended that the ADB mission approach the Treasury during ADB program's pre-implementation stage since cost center allocations are done by the Ministry of Finance and Treasury.

VII. FINANCIAL PERFORMANCE

77. For the purpose of analyzing the MIWRM's financial performance, the MASL's financials have also been included in the MIWRM's financials, however, the DOI's financials have been excluded. This is due to the Treasury considering the DOI as a separate cost center whereas the MASL is considered to be part of the MIWRM.

A. Ministry of Irrigation and Water Resources Management and the Mahaweli Authority of Sri Lanka

78. Summarized in **Figure 12** are the MIWRM's (including MASL) actual expenses for 2011, 2012 and 2013, along with forecast estimates for 2014, 2015 and 2016. This information presented has been extracted from the Treasury (forecasts) and the MIWRM and MASL (actuals). Forecast estimates below exclude the proposed ADB funded program.

Figure 12: MIWRM Financials (including MASL)

LKR (in '000s)	2011 Actual	2012 Actual	2013 Actual	2014 Estimate	2015 Estimate	2016 Estimate
Reccurent Expenditure	**1,976,302**	**1,958,752**	**2,120,475**	**2,252,025**	**2,324,071**	**2,506,327**
Operational Activities	78,813	89,872	106,595	118,955	126,571	133,102
Development Activities	1,897,489	1,868,880	2,013,880	2,133,070	2,197,500	2,373,225
Capital Expenditure	**9,345,844**	**22,846,659**	**28,859,797**	**40,100,350**	**61,215,900**	**64,460,420**
Operational Activitites	21,877	13,297	14,743	108,000	110,200	112,200
Development Activities	9,323,967	22,833,362	28,845,054	39,992,350	61,105,700	64,348,220
TOTAL	**11,322,146**	**24,805,411**	**30,980,272**	**42,352,375**	**63,539,971**	**66,966,747**
TOTAL in USD mn	**87.1**	**190.8**	**238.3**	**325.8**	**488.8**	**515.1**

Source: MIWRM, MASL & Treasury

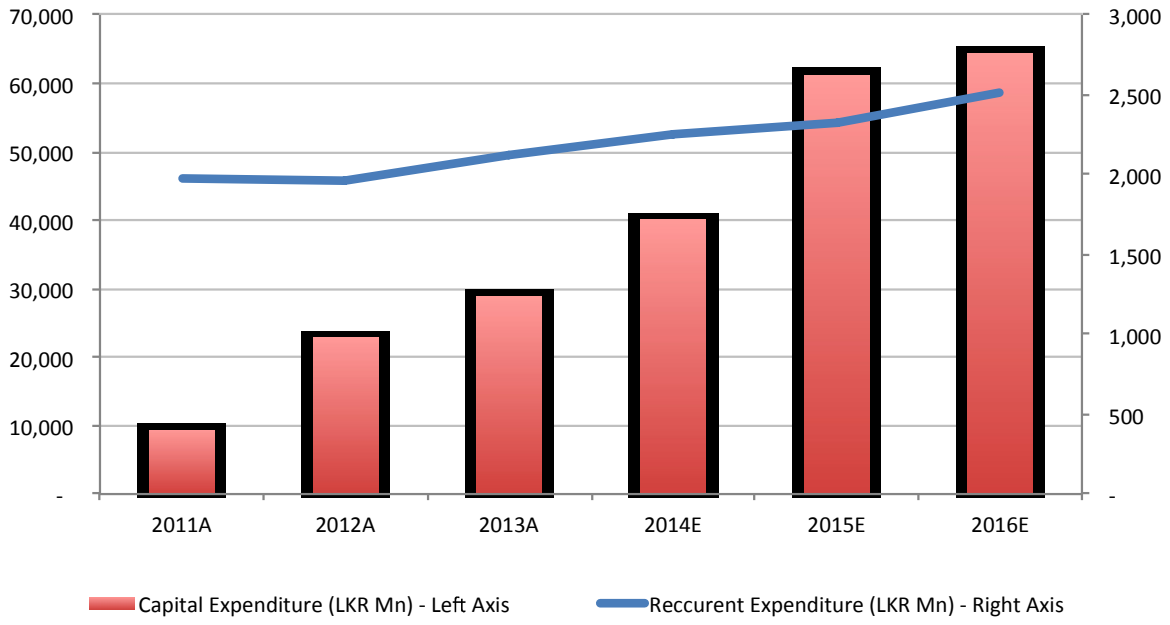
79. Recurrent expenditure as a percentage of total expenses has averaged 11% between 2011 and 2013 and has witnessed a 3.6% CAGR. During 2014 to 2016, recurrent expenditure is expected to grow at a marginally faster rate of around 5.7% CAGR with a relatively steep 7.8% YoY growth estimated in 2016. Due to high levels capital expenditure anticipated from 2014 onwards, recurrent expenditure as a percentage of total expenses is expected to average around 4% between 2014 and 2016.

80. The majority of recurrent expenditures relate to personnel costs, which include salaries and wages, overtime and holiday payments as well as allowances. For instance nearly 90% of the recurrent expenditure of the 2014 Budget is made up of personnel costs, which is consistent when compared to historical data from 2011 to 2013, as well as when compared with estimates for 2015 and 2016.

81. Other recurrent expenditures, which accounts for approximately 10% of the recurrent expenditure budget, includes electricity and water, fuel, stationary, travelling expenses and other administrative expenses.

82. Capital expenditure of the MIWRM accounts for the majority of the Ministry's expenses. During 2011 to 2013, on average 89% of total expenses were capital costs and in 2014 capital expenditure is estimated at 95% of MIWRM's total expenditure budget. Between 2011 and 2013, capital expenses have grown at a rapid phase of around 75.7% CAGR and in 2014 it is anticipated to grow by 53% YoY.

Figure 13: Recurrent and Capital Expenditure (LKR million)



Source: MIWRM, MASL & Treasury

83. The majority of capital expenditures relate to reservoir projects and water systems. For instance, out of the LKR 40 billion capital expenditure projected for 2014, LKR 15 billion has been reserved to the "Uma Oya Diversion Project" co-funded by Iran and LKR 13 billion allocated to the "Moragahakanda and Kaluganga Reservoir Project" co-funded by China, Kuwait and Saudi Arabia. The capital budget also includes capital expenditure relating to development activities, which entails administration and maintenance cost of reservoirs and water systems under the purview of the MIWRM and MASL.

84. Based on the past experience of implementing large projects especially funded by foreign countries, the MIWRM together with the MASL appear to have sufficient financial management capacity to implement the proposed ADB funded program. However, it is important that the capital expenditure budget for the ADB program is prepared and reviewed in detailed to ensure timely disbursement of funds from the Treasury.

B. Department of Irrigation

85. Due to the non-preparation of a full set of financial statements, only expenditure details are available within the DOI. Summarized in **Figure 14** are the DOI's actual expenses for 2011, 2012 and 2013, along with forecast estimates for 2014, 2015 and 2016. This information presented has been extracted from the Treasury (forecasts) and the DOI (actuals). Forecast estimates below exclude the proposed ADB funded program.

Figure 14: Financials Records of the DOI

LKR (in '000s)	2011 Actual	2012 Actual	2013 Actual	2014 Estimate	2015 Estimate	2016 Estimate
Reccurent Expenditure	**1,222,624**	**1,339,781**	**1,416,705**	**1,504,035**	**1,543,770**	**1,562,160**
Operational Activities	289,551	337,517	369,220	377,735	389,710	396,240
Development Activities	933,073	1,002,264	1,047,485	1,126,300	1,154,060	1,165,920
Capital Expenditure	**5,234,597**	**5,308,458**	**6,089,208**	**11,390,150**	**8,160,500**	**3,856,900**
Operational Activitites	34,699	31,252	37,836	43,150	52,500	65,700
Development Activities	1,350,463	1,386,610	1,969,906	1,765,000	1,827,500	1,981,200
Major Irrigation Systems	3,585,388	3,808,840	3,765,326	8,845,000	5,730,500	1,610,000
Minor & Medium Irrigation Syste	264,047	81,757	316,141	737,000	550,000	200,000
TOTAL	**6,457,221**	**6,648,239**	**7,505,913**	**12,894,185**	**9,704,270**	**5,419,060**
TOTAL in USD mn	**49.7**	**51.1**	**57.7**	**99.2**	**74.6**	**41.7**

Source: DOI & Treasury

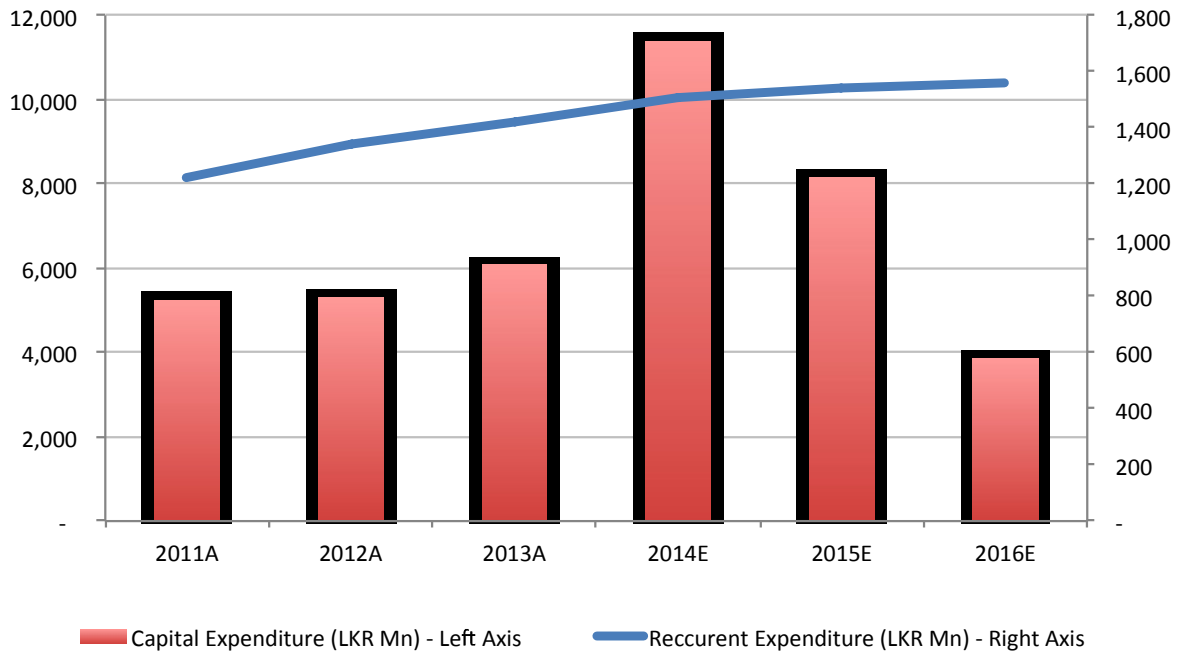
86. Recurrent expenditure as a percentage of total expenses of the DOI has averaged 19% between 2011 and 2013 and has experienced a 7.6% CAGR. During 2014 to 2016, recurrent expenditure is expected to grow at a comparatively lower rate of 3.3% CAGR despite a 6.2% YoY growth in 2014. Therefore, 2015 and 2016 recurrent costs appear to have been relatively understated.

87. The majority of recurrent expenditures relate to personnel costs, which include salaries and wages, overtime and holiday payments as well as allowances. For instance 90% of the recurrent expenditure of the 2014 Budget is made up of personnel costs, which is consistent when compared to historical data from 2011 to 2013, as well as when compared with estimates for 2015 and 2016. Average monthly staff cost per employee in 2014 is estimated around LKR 23,000 or approximately $180, which is in line with market rates prevailing in the country.

88. Other recurrent expenditures, which accounts for approximately 10% of the recurrent expenditure budget of the DOI, includes electricity and water, fuel, stationary, travelling expenses and other administrative expenses. These expenses have experienced an increase of 9% CAGR from 2011 to 2013, while a 5% CAGR is expected between 2014 and 2016. Based on the historical trend analysis, the DOI's estimates seem marginally optimistic. However, the impact on DOI's overall financials of any adverse movements is not likely to be material.

89. Capital expenditure of the DOI accounts for the majority of the department's expenses. During 2011 to 2013, 81% of total expenses of the DOI were capital costs and in 2014 capital expenditure is estimated at 88%. Between 2011 and 2013, capital expenses have grown at 7.9% CAGR and in 2014 it is anticipated to grow by 87% YoY.

Figure 15: Recurrent and Capital Expenditure (LKR million)



Source: DOI & Treasury

90. The majority of capital expenditures relate to major, minor and medium irrigation systems. For instance, in 2014, 84% of the capital cost budget has been allocated towards development of irrigation systems. Out of the LKR 9.6 billion irrigation development expenditures projected for 2014, LKR 5 billion has been reserved to develop a new irrigation system "Yan Oya Project". Planned investments for such large-scale projects have resulted in an 87% growth in total capital expenditure estimate for 2014 YoY.

91. The DOI's 2014 major irrigation program includes 18 projects, including the above captioned Yan Oya Project. Out of these 18 projects, 8 projects will continue into the subsequent year with a majority of the investments earmarked for the Yan Oya Project (LKR 3.1 billion) and the Moragahakanda Reservoir (LKR 1.2 billion) together which represent more than 50% of the capital expenditure budget planned for 2015. From the 8 projects in 2015, 4 are expected continue further in to 2016 where there is an overall capital expenditure budget of LKR 3.8 billion out of which LKR 1.8 billion is allocated to develop new irrigation systems.

92. In addition to the 18 major projects mentioned above, the DOI has another 9 minor and medium projects in the pipeline for 2014. From these 9 projects, 3 are expected to continue in

2015 and only 1 is expected in 2016. It should be noted, however, that out of the total capital expenditure budget only around 5% relates to the development of minor and medium irrigation projects.

93. The capital budget also includes capital expenditure relating to development activities, which entails administration and maintenance cost of irrigation schemes and systems under the purview of the DOI. During 2011 to 2013, such expenditure accounted to approximately 28% of the total capital budget which is expected to average 30% between 2014 and 2016.

94. Based on the past experience of implementing large projects, the DOI appear to have sufficient financial management capacity to implement the proposed ADB financed program. In 2014, the DOI has been allocated approximately $90 million capital budget as new investments for 27 schemes, as well as to operate and maintain existing portfolio of irrigation systems. Considering the future projects in the pipeline are also reducing from 2015 onwards, the DOI should have spare capacity to effectively implement new projects. However, it is important that the capital expenditure budget for the ADB program is prepared and reviewed in detailed to ensure timely disbursement of funds from the Treasury.

VIII. RISK ASSESSMENT OF THE MIWRM, MASL & DOI

Area of Assessment	Risk Rating	Risk Assessment	Mitigation Measures
Country Specific Inherent Risks	M	Most government departments that report to the Treasury, including the MIWRM, MASL & DOI do not prepare full sets of financial statements.	Treasury has realized the importance of maintaining and preparation of the full sets of financial statements. The Treasury is currently conducting a detailed study with the view of implementing new guidelines albeit it is difficult to predict an exact time frame.
Entity and Project Specific Inherent Risks	M	Even though the MIWRM, MASL & DOI has implemented foreign-financed projects, lacks the direct expertise in implementing ADB projects.	The ADB Program requires a detailed Procedure Manual as well as adequate training on ADB's policies and guidelines. Finance Staff and Regional Office staff directly engaged with the ADB project needs additional workshops and training programs.
Overall Inherent Risks			**M**

Area of Assessment	Risk Rating	Risk Assessment	Mitigation Measures
Implementing Agency Control Risks	N	MASL & DOI have implemented foreign projects in the past and it appears that both MASL & DOI have sufficient capacity to implement the proposed ADB project.	
Fund Flow Control Risks	M	The MIWRM has executed large-scale foreign funded projects and both MASL & DOI have previous experience in implementing foreign projects in the past through the use of Imprest Accounts. A similar fund flow process is expected for the ADB Program. However, as seen in the past, the Treasury has the tendency to re-prioritize projects resulting in delays for planned projects.	It is recommended to obtain a firm commitment from the Treasury to the MIWRM, MASL and DOI to release capital funds required by the ADB Program without any undue delays and to prioritize the ADB project for fund disbursements.
Staffing Control Risks	N	MIWRM, MASL & DOI including their finance departments and its regional offices are adequately staffed to implement the ADB Program.	Training on ADB specific policies and guidelines are required.
Accounting Policies and procedures	N	MIWRM, MASL & DOI follows Sri Lanka Accounting and Auditing Standards which are adequate.	Treasury is currently in the process of addressing this issue. Once the Treasury

Area of Assessment	Risk Rating	Risk Assessment	Mitigation Measures
Control Risks		However, depreciation is not considered in accounts due to the mix of cash and accrual based accounting methods.	implements new accrual based accounting system, MIWRM, MASL and DOI have expressed the willingness to adopt to the new system.
Internal Audit Control Risk	N	MIWRM, MASL & DOI's Internal Audit functions well.	Need to ensure Internal Audit's annual audit plan include a separate audit of the ADB Program. Minimum of 2 spot audits per year and an annual comprehensive audit is recommended at each MIWRM, MASL and DOI levels.
External Audit Control Risk	N	AG's office currently conducts MIWRM, MASL & DOI's annual audit which is adequate and audit opinions are generally free of any major issues	
Budgeting Control Risk	M	It is evident from past performance that the MIWRM, MASL & DOI generally under-spends the capital expenditure budget. One of the reasons is inaccuracy in forecasting capital costs. Other than MASL, MIWRM and DOI's 5 year Corporate Plans are not comprehensive and are not updated frequently. Corporate Planning exercise should be done with extensive participation which will improve accuracy of estimates.	MIWRM, MASL and DOI need to ensure expenditures are estimated accurately. Recommended to improve the MASL's 5 year Corporate Plan with ADB best practices and use as a template for MIWRM and DOI to be updated at least annually. This can be done as a Capacity Building exercise prior to implementation of the ADB program.
Reporting and Monitoring Control Risk	M	MIWRM, MASL & DOI's reporting and monitoring function does not include comprehensive set of KPIs and does not have the ability to track physical progress of projects and link them to financials. At present, DOI, being a part of the MIWRM, has a separate cost center allocation code by the Treasury. MASL, which is also part of the MIWRM does not have a separate cost center code.	It is recommended to introduce a system to track physical progress of projects and link to financials as well as to introduce KPIs in monthly reports. This can be done as a Capacity Building exercise prior to implementation of the ADB program. Separate note recommended in appropriation accounts to report and monitor the ADB Project. Similar approach recommended for MASL which will ensure efficient monitoring and planning. This is also enable MASL to approach the Treasury directly for urgent matters.
Information Systems Control	N	MIWRM, MASL & DOI currently runs on the CIGAS system, which is	

Area of Assessment	Risk Rating	Risk Assessment	Mitigation Measures
Risk		employed by departments reporting to the Treasury. This system appears adequate for implementing the ADB Program and monitoring expenses.	
Overall Control Risks			**M**

* H = High, S = Substantial, M = Moderate, N = Negligible or Low.

APPENDIX 12

RESETTLEMENT FRAMEWORK AND RESETTLEMENT IMPLEMENTATION PLANS

Sri Lanka
Project Number: 47381
December 2014

Sri Lanka: Water Resources Development Investment Programme

Resettlement Framework

Ministry of Irrigation and Water Resources Management
Democratic Socialist Republic of Sri Lanka

Contents

ABBREVIATIONS

DOI	Department of Irrigation
DRC	Depreciated recovery cost
DSD	Divisional Secretary Division
EA	Executive Agency
EIA	Environment impact assessment
GNO	*Grama Niladhari* Officer
GND	*Grama Niladhari* Division
GRC	Grievance redress committee
GRM	Grievance redress mechanism
HH	Household
IA	Implementing agency
IR	Involuntary resettlement
ISEWP	improving system efficiencies and water productivity
KMTC	Kaluganga-Moragahakanda Transfer Canal
LAA	Land Acquisition Act, 1950
MASL	Mahaweli Authority of Sri Lanka
MCB	Mahaweli Consultancy Bureau (Pvt) Limited
MFF	Multi-tranche Financing Facility
MLLD	Ministry of Land and Land Development
MDP	Mahaweli Development Programme
MRB	Mahaweli River Basin
MIWRM	Ministry of Irrigation and Water Resources Management
MLBCR	Minipe Left Bank Canal Rehabilitation
MFF	multitranche financing facility
NCPCP	North Central Province Canal Programme
NWPC	North Western Province Canal
PAP	Project-affected person
PIU	Project implementation unit
PMDC	programme management and design consultant
PMU	Project management unit
PPTA	project preparatory technical assistance
RDA	Road Development Authority
RIP	Resettlement Implementation Plan
SIWRM	Strengthening integrated water resources management
SLR	Sri Lanka rupees (US $ = SLR 128)
SPS	Safeguard Policy Statement

GLOSSARY

Cut-off-date: For land to be acquired from titled landowners, the date of notification for acquisition under the Land Acquisition Act (LAA) will be treated as the cut-off date. For non-titleholders such as squatters, encroachers, the starting date of the project census or a designated date declared by EA in consultation with Divisional Secretaries will be considered as the cut-off date**.**

Disturbance**:** Disturbances caused to normal living of a person arising from compulsory acquisition of private land.

Encroacher: A Person who has illegally occupied state land. Any legal title holder to a piece of land becomes an encroacher if he/she establishes boundaries of the holding to include adjacent state land without prior approval.

Entitlement: A variety of measures including compensation, income restoration and interim support, transfer assistance, relocation and other benefits given to project-affected-persons (PAPs) to restore and improve their post-displacement socio-economic conditions.

Entitlement matrix: It identifies categories of eligible persons and their specific entitlements under the project, and what agency/department is responsible to deliver them on time.

Host population: Persons, households and communities who reside in resettlement areas where PAPs are relocated.

Income restoration: Re-establishing income sources and livelihoods of project-affected persons to pre-project level in real terms.

Injurious affection**:** Adverse impact on the value of the remaining land due to acquisition of a part of a land.

Inventory of losses: Complete and accurate count of houses, land, business structures and other assets on land that will be affected by the project.

Involuntary Resettlement: The unavoidable physical or economic displacement of persons arising from a development project. In case of physical displacement, PAPs need assistance to rebuilding their livelihood, income and asset bases and social and cultural systems. If economically displaced, PAPs still need assistance to restore their livelihood and assets.

Project-affected persons (PAPs): Any person, who as a result of the implementation of a project, losses the right to own, use, or otherwise benefit from a built structure, land (residential, agricultural or pasture), annual or perennial crops and trees, or any other fixed or moveable asset, either in full or in part, permanently or temporarily.

Rehabilitation: Re-establishing and improving incomes, livelihoods and social systems of PAPs.

Relocation: Moving PAPs and their moveable assets, rebuilding their houses, developing new land, and providing public infrastructure at the relocation site.

Replacement cost: The method of valuation of assets that helps determine the amount sufficient to replace lost assets and cover transaction costs. In applying this method of valuation, depreciation of structures and assets are not to be taken into account. For losses that cannot easily be valued or compensated in monetary terms such as access to public services, customers and suppliers; to fishing, grazing or forest areas, the project will establish access to equivalent and culturally acceptable resources and earning opportunities.

Resettlement: Involuntary physical or economic displacement of persons caused by a project that covers compensation, relocation and rehabilitation measures to mitigate the effects of such displacement.

Resettlement Budget: A detailed breakdown of all costs of a resettlement implementation plan (RIP). This is a part of project costs.

Resettlement effects: Loss of physical and non-physical assets, including homes, communities, productive land, income earning assets and sources, resources, cultural sites, social structures, networks and ties, cultural identity and mutual help mechanisms.

Resettlement Implementation Plan (RIP): Time bound action plan with a budget setting out resettlement strategy, objectives, entitlement, actions, responsibilities, monitoring, evaluation and reporting.

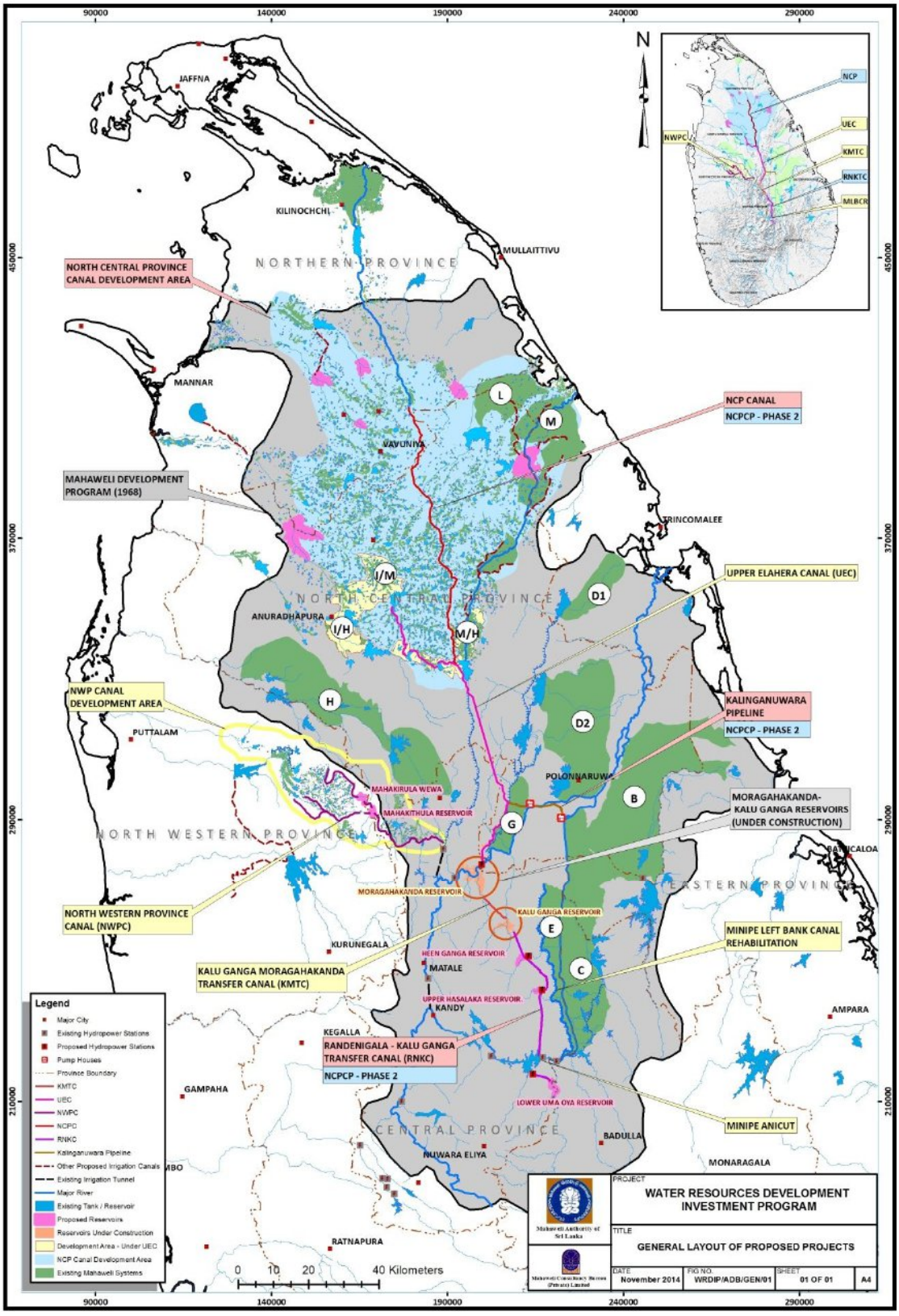
***Severance*:** Dividing a landholding into two or several parts due to acquisition of the middle portion for a public purpose.

Social preparation: a process of consultations with PAPs conducted before key involuntary resettlement decisions are decided

***Squatter*:** A person who occupies a piece of land without a title or any recognizable legal rights to that land.

***Value to owner*:** Valuation based on actual cost to the landowner.

Vulnerable groups: Distinct groups of poor people who might suffer disproportionately from resettlement effects. Among them are the old, the young, the handicapped, the poor, isolated groups and female-headed of households.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210000
N
NCP
UEC
NWPC
KMTC
RNKTC
MLBCR
JAFFNA
KILINOCHCHI
MULLAITTIVU
NORTHERN PROVINCE
NORTH CENTRAL PROVINCE CANAL DEVELOPMENT AREA
MANNAR
VAVUNIYA
NCP CANAL
NCPCP - PHASE 2
MAHAWELI DEVELOPMENT PROGRAM (1968)
TRINCOMALEE
UPPER ELAHERA CANAL (UEC)
NORTH CENTRAL PROVINCE
ANURADHAPURA
NWP CANAL DEVELOPMENT AREA
KALINGANUWARA PIPELINE
NCPCP - PHASE 2
PUTTALAM
POLONNARUWA
MAHAKIRULA WEWA
MAHAKITHULA RESERVOIR
MORAGAHAKANDA-KALU GANGA RESERVOIRS (UNDER CONSTRUCTION)
NORTH WESTERN PROVINCE
BATTICALOA
EASTERN PROVINCE
MORAGAHAKANDA RESERVOIR
KALU GANGA RESERVOIR
NORTH WESTERN PROVINCE CANAL (NWPC)
MINIPE LEFT BANK CANAL REHABILITATION
KURUNEGALA
HEEN GANGA RESERVOIR
MATALE
KALU GANGA MORAGAHAKANDA TRANSFER CANAL (KMTC)
UPPER HASALAKA RESERVOIR
KANDY
AMPARA
KEGALLA
RANDENIGALA - KALU GANGA TRANSFER CANAL (RNKC)
NCPCP - PHASE 2
GAMPAHA
LOWER UMA OYA RESERVOIR
MINIPE ANICUT
CENTRAL PROVINCE
BADULLA
NUWARA ELIYA
MONARAGALA
RATNAPURA
Legend
Major City
Existing Hydropower Stations
Proposed Hydropower Stations
Pump Houses
Province Boundary
KMTC
UEC
NWPC
NCPC
RNKC
Kalinganuwara Pipeline
Other Proposed Irrigation Canals
Existing Irrigation Tunnel
Major River
Existing Tank / Reservoir
Proposed Reservoirs
Reservoirs Under Construction
Development Area - Under UEC
NCP Canal Development Area
Existing Mahaweli Systems
0 10 20 40 Kilometers
PROJECT
WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM
TITLE
GENERAL LAYOUT OF PROPOSED PROJECTS
DATE
November 2014
FIG NO.
WRDIP/ADB/GEN/01
SHEET
01 OF 01
A4

Water Resources Development Investment Programme

Resettlement Framework

1. Introduction

1.1 This Resettlement Framework (RF) outlines the principles and procedures that govern the formulation and implementation of resettlement implementation plans (RIPs) of the SRI: Water Resources Investment Development Programme (WRIDP).These principles and processes are distilled from Sri Lankan laws, regulations, and guidelines, and also from the Safeguard Policy Statement (SPS, 2009) of the Asian Development Bank (ADB).The RF highlights and outlines the specific requirements that the executing agency (EA) of the Programme has to meet in the formulation and implementation of a RIP for a project with potential resettlement impacts, by focusing on their screening and categorization, socio-economic assessment, public consultations, resettlement planning, institutional arrangements for RIP implementation, monitoring of results, grievance redress mechanism and the budget. ADB will review and approve each RIP before it is implemented.

1.2 The Ministry of Irrigation and Water Resources Management (MIWRM) is the EA of the Programme. The EA is responsible for formulating a RIP for each project of the Programme that indicates potential involuntary resettlement (IR) impacts and risks and submitting it to ADB for review and approval.

1.3 In the context of WRIDP, the need for a RF arises from the fact that the Programme will be implemented as a Multitranche Financing Facility (MFF). A MFF requires a RF before ADB approves it in order to clarify RF safeguard principles and requirements governing screening and categorization, social impact assessment, and formulation of the RIPs of projects to be prepared after MFF approval. The Programme will have three tranches and in each tranche, IR impacts are anticipated.

2. The Water Resources Development Investment Programme

2.1 The Programme will assist the Government to complete outstanding water conveyance investments under the Mahaweli Development Programme (MDP). The completion of MDP is a key priority of the Government, as it will maximize the productivity of the water sources of the Mahaweli River Basin by transferring water to the country's northern dry zone areas for irrigation, drinking and commercial purposes. This will, in turn, accelerate local and national economic growth and living standards of local people.

2.2 ADB supports the Government of Sri Lanka to plan and implement WRIDP through the MIWRM by providing finances to the following three investment projects of the planned North Central Province Canal Program (NCPCP) of which Upper Elahera Canal Project (UECP) and the North West Province Canal Project (NWPCP) are components. The WRIDP is a multi-tranche financing facility (MFF) amounting to $675 million. The MFF will comprise three tranches financing three Projects. The Projects will comprise the following individual investment projects:

(i) The Kaluganga-Moragahakanda Transfer Canal (KMTC) will convey up to 771 MCM of water annually between Kaluganga and Moragahakanda Reservoirs, both of which are under construction. The reservoirs will retain local runoff and Mahaweli River flow diversions before commanding downstream irrigation and water supply schemes. The length of the canal is 9 kilometers (km) and comprises about 8 km of tunneling.

The Upper Elahera Canal (UEC) will annually convey up to 974 MCM northwards from Moragahakanda Reservoir, along a 65.5 km canal (including about 20km of tunnels and 16 km of cut-cover conduits), to the existing Huruluwewa and Manankattiya Reservoirs, which in turn feed existing irrigation and water supply schemes.

(ii) The North Western Province Canal (NWPC) will annually withdraw 130 MCM from Dambulu Oya River and the existing Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located throughout North Western Province via 96 km of new and upgraded canals including a new 940 meter (m) tunnel.

(iii) Minipe Left Bank Canal Rehabilitation Project (MLBCRP), located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork's weir by 3.5 meters to regulate generation inflows, and (b) rehabilitate the 76 km Minipe Left Bank Canal to improve conveyance and reliability of service to existing farmers.

2.3 The investment program will be implemented over ten years and its proposed structure is shown in Table 1. The investment program will also include three consulting packages comprising: (i) "improving system efficiencies and water productivity" (ISEWP); (ii) "strengthening of integrated water resources management" (SIWRM); and (iii) the Program Management, Design, and Supervision Consultant (PMDSC), which will support MIWRM manage the Program and prepare packages under the investment program.

Table 1: Tentative Investment Program Structure and Implementation Schedule

Project	Value ($, millions)	Subproject	Schedule
Construction Works			
Project-1	189	UEC Stage 1 NWPC Stage 1 MLBCR	Q1 2015 – Q4 2019
Project-2	287	UEC Stage 2 and KMTC	Q1 2016 – Q4 2024
Project-3	199	UEC Stage 3 NWPC Stage 2	Q1 2018 – Q2 2024
TOTAL	**675.0**		

KMTC = Kaluganga – Moragahakanda Transfer Canal; MLBCR = Minipe Left Bank Canal Rehabilitation; NWPC = North Western Province Canal; UEC = Upper Elahera Canal; Q = quarter of a year.
Source: Asian Development Bank

3. Formulation of a Resettlement Implementation Plan

3.1 A RIP is to be formulated for each project of the Programme that is likely to have resettlement impacts. The EA formulates a RIP with the assistance of Resettlement Specialist of the Program Management Unit (PMU) of the Project and in consultation with project-affected persons (PAPs), other stakeholders and design engineers. It will meet Sri Lanka's resettlement regulatory framework requirements and safeguard policy principles and procedures of ADB. Consultations with PAPs and stakeholders include the disclosure of RIP and resettlement information in Sinhala or Tamil or both at accessible places to the public. A satisfactory RIP will include a census of PAPs, assessment of socio-economic conditions of PAPs, their entitlements, institutional mechanisms to implement RIP, grievance redress mechanism (GRM), robust income restoration and improvement strategy, a relocation plan (if needed), a budget, time schedule, and a monitoring mechanism.

3.2 A RIP could use the Policy Framework, entitlements compensation framework outlined in this RF if the local resettlement regulatory regime and ADB IR safeguard policy principles remain unchanged. Each RIP will be submitted to ADB for review and approval. Guidelines for the formulation of a RIP are given in Annex 1.

3.3 In formulating a RIP, the following procedure will be followed:

- Conduct consultations with PAPs, beneficiaries and other stakeholders to get their views and suggestions, needs, preferences and concerns. Address them in resettlement planning to minimize potential adverse resettlement impacts on persons, households and communities.
- A socio-economic survey of a sample population will be undertaken, unless adequate recent census and household socio-economic data are available. Sample size will be determined in consultation with ADB.
- Undertake census (population record) and asset inventory after detailed measurement surveys are completed. Analyse the data to identify different categories of PAPs based on the significance and scale of IR impacts of the project on them.
- Prepare an entitlement matrix in conformity with the approved RF, based on the findings of the type of land and other property losses, tenure rights, and income and livelihood loses of PAPs. The matrix will summarise major types of losses and the corresponding nature and scope of entitlements in accordance with the local IR regulatory regime and ADB's IR safeguard policy. It will indicate who will be responsible to deliver the entitlements to PAPs and communities affected and the procedures to be followed. The entitlement matrix given in Annex 2 is only indicative of types of losses and types of PAPs affected. It has to be revised and updated to meet the project situation. Where the entitlement matrix does not cover a particular IR impact, it can be elaborated in RIP based on the findings of the socio-economic assessment and census survey.

- The sections of the approved RF on Policies, Laws and Regulations, ADB's IR safeguard principles and requirements, and IR policy principles that apply to the entire Programme can be used as components of a project RIP.
- Formulate a time-bound schedule for RIP implementation, procedures of grievance redress mechanism and monitoring and evaluation.
- Prepare a budget for all IR activities identified and quantified in RIP. Make sure funds are available for prompt compensation payment and relocation of PAPs. Translate the draft RIP into local languages and present it during consultations and public meetings for comments and recommendations. The final RIP will incorporate the comments and suggestions of PAPs and other stakeholders.
- Discuss the RIP with PAPs in detail. Summary of the entitlement matrix, budget, and implementation schedule will be translated and distributed among all PAPs prior to discussions. Record the key topics discussed and agreed.
- Submit RIP to ADB for review and concurrence. The approved RIP will be implemented before starting of any project construction work.
- Approved RIP will be posted on EA and ADB websites.

4. Objectives, Policy Framework, and Entitlements

4.1 The objective of RF is to ensure that projects implemented under the Programme comply with IR policies, laws, regulations and guidelines of Sri Lanka (IR Regulatory Framework) and ADB safeguard objectives, principles and requirements. The RF summarizes national policies, laws and regulations pertaining to consultation, land acquisition, compensation, relocation of PAPs, and income restoration and improvement. By comparing and contrasting these policies, laws and regulations with ADB's involuntary resettlement policy principles and requirement, RF has distilled key IR safeguard principles that are applicable to the Programme. A few gaps between the two exist, and the RF proposes gap-filling strategy so its guidelines for RIP formulation and implementation would meet IR safeguard policy principles and requirements of ADB.

Policy and Legal Framework

4.2 The RF is based on the Land Acquisition Act (LAA), 1950 and its amendments, National Involuntary Resettlement Policy (NIRP), 2001, National Policy for the Payment of Compensation, 2008, the Land Acquisition Regulations of 2008 (LA Regulations 2008), National Environmental Act of 1980 and amendments, and ADB's SPS(2009).

Land Acquisition Act(LAA)

4.3 The LAA provides a legal framework for acquisition of land for a 'public purpose'. It provides detailed procedures for land acquisition, consultations, calculation of compensation for land, structures, and crops at 'market value' and assistance packages. It guarantees that no person is deprived of his land except under the provisions of LAA, and provides a compensation package for acquired land, structures, damaged crops and disturbances caused by the project. The normal procedure for land acquisition begins with a request from a government agency made to the Minister of Land and Land Development (MLLD) to acquire a piece of land for a public purpose. Once acquired, the land is vested in the government agency.

4.4 Provisions of the LAA are inadequate to address all adverse impacts associated with land acquisition and involuntary relocation. The LAA is indifferent to land losers' socio-economic conditions and long-term adverse impacts on their incomes and livelihoods. The LAA prescribes that market value of land should be paid as compensation which amounts the price a property owner could expect if sold in the open market, whereas the SPS (2009) stipulates that 'replacement cost' should be paid as compensation which includes market value and other resettlement assistance packages. Post-acquisition monitoring of IR impacts is not part of the LAA.

National Involuntary Resettlement Policy (NIRP)

4.5 The Government adopted NIRP in 2001 to ensure that (i) PAPs are fairly and adequately compensated, relocated, and rehabilitated; (ii) delays in project implementation and cost overruns are reduced; and (iii) better community relations are restored among PAPs and host communities.

4.6 The NIRP is based on LAA and it amendments, National Environmental Act of 1980 (amended in 1988), and several other applicable laws such as Urban Development Authority Act and Coastal Conservation Act, Regulations of the Acts, and also on legal opinions of courts on land acquisition, compensation, consultation and income restoration.

4.7 Objectives of the Policy are:

- Avoid, minimize, and mitigate negative IR impacts by facilitating the rehabilitation of PAPs on a productive and self-sustaining basis. Ensure that they are fully and promptly compensated and successfully resettled. The livelihoods of the displaced persons should be re-established and the standard of living improved.

- Ensure that no impoverishment of PAPs shall result as a consequence of compulsory land acquisition by the State for development purposes.

- Assist PAPs in dealing with the psychological, cultural, social and economic impacts caused by compulsory land acquisition.

- Make all PAPs aware of processes available for the redress of grievances that are easily accessible and immediately responsive.

- Have in place a consultative, transparent and accountable IR process with a time frame agreed to by the project executing agency and PAPs.

4.8 Principles of the Policy are:

1. IR should be avoided as much as possible by reviewing alternatives to the project as well as alternatives within the project.
2. Where IR is unavoidable, PAPs should be assisted to re-establish themselves and improve their quality of life.
3. Gender equality and equity should be ensured and adhered to throughout.
4. PAPs should be fully involved in the selection of relocation sites, livelihood compensation and development options at the earliest opportunity

5. Replacement land should be an option for compensation in the case of loss of land; and in the absence of replacement land cash compensation should be an option for all PAPs.
6. Compensation for loss of land, structures, other assets and income and livelihood losses should be based on full replacement cost and should be paid promptly. This should include transaction costs.
7. Resettlement should be planned and implemented with full participation of the provincial and local authorities.
8. Participatory measures should be designed and implemented to assist those economically and socially affected to be integrated into their host communities.
9. Common property resources and community and public services should be provided to resettlers.
10. Resettlement should be planned as a development activity for PAPs.
11. PAPs who do not have title deeds to land should receive fair and just treatment.
12. Vulnerable groups should be identified and given appropriate assistance to improve their living standards.
13. Project Executing Agencies should bear the full costs of compensation and resettlement.

4.9 The Policy applies to:

- All development-induced land acquisition or recovery of possession by the State
- All projects regardless of the source of funding
- All projects in the planning phase on the date the policy came into effect and all future projects

4.10 The MLLD is responsible for implementation of the NIRP. This is done in collaboration with a wide network of public agencies including CEA, Survey Department, Valuation Department, Ministries concerned, and Divisional Secretariats.

4.11 The NIRP ensures that PAPs are treated in a fair and equitable manner, and that they are not impoverished in the process of land acquisition and resettlement. The Policy also enables establishing a framework for project planning and implementation that would meet international best practices in involuntary resettlement including involuntary resettlement safeguard policy principles and requirements of ADB.

National Policy on Payment of Compensation (2008) and LA Regulations (2008)

4.12 The Cabinet of Ministers approved the National Policy on Payment of Compensation (NPPC) in November 2008 in order to establish a uniform system of adequate compensation payment, based on LAA, NIRP and several other laws applicable to land acquisition and resettlement, and also to supersede all other *ad hoc* and special compensation packages used by government agencies such as Road Development Authority (RDA). The LA Regulations 2008, ratified by the Parliament of Sri Lanka in 2009 as Regulations of the LAA gave effect to both NIRP and NPPC. The LA Regulations 2008 incorporated NIRP and NPPC principles into Sri Lanka's legal framework thereby improving the congruence between local regulatory framework for land acquisition and resettlement, and international best practices for involuntary resettlement.

National Environmental Act (NEA) 1980 and 1988

4.13 The National Environmental Act (NEA), No.47 of 1980, amended by Act No.56 of 1988, and its regulations are applicable to involuntary resettlement. The Gazette notification No.859/14 of 23 February 1995 determined the projects and undertakings for which Central Environmental Authority (CEA) approval is needed in terms of Part IV – C of the NEA. Item 12 in the Schedule requires the formulation of a RIP to address involuntary resettlement of 100 or more households.

4.14 The NEA further requires an assessment of project impacts on relocating households and other community groups in sufficient detail. This assessment should identify anticipated social problems, proposed mitigation measures, estimated cost involved, and an entitlements package. This assessment should be based on information collected from PAPs, census and survey data, and on interviews with community leaders and site visit or field surveys. The assessment will demonstrate that every possible action has been taken to avoid the relocation of households and businesses. Where relocation is found to be unavoidable, the following issues are to be addressed with an action plan. These requirements are compatible with that of involuntary resettlement safeguard requirements of the SPS of ADB.

- Number of households to be relocated and their socio-economic profiles. A distinction should be made between rented properties and owned properties.
- Availability of comfortable, safe and affordable housing for the displaced households. This discussion should include the prices, size of house (number of rooms), location relative to present houses and accessibility, anticipated loss of employment caused by acquisition of business, industrial or domestic premises.
- Number of commercial and industrial ventures to be relocated: their descriptions, size of premises, number of employees, their income, sales and special needs such as water and power.

- Availability of sites for relocating displaced businesses and the cost/benefit analysis of relocating them.
- A statement that acquisition of property and relocation will be conducted in accordance with the existing laws and regulations such as an Urban Development Law No.141 of 1978 and resources available for compensating all residential and commercial displacements without discrimination.
- A discussion on the financial and other incentive programmes that will be developed to minimize the impact must be included regardless of whether or not alternative sites and/or buildings are available. This discussion may also consider other sources of assistance available to the displaced persons.
- The NEA requires that the resettlement implementation plan outlining the above be submitted for review and approval.

Safeguard Policy Statement of ADB, 2009 (SPS)

4.15 The objectives of the involuntary resettlement safeguards policy of ADB are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

4.16 The IR safeguards covers physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. These IR safeguards apply whether such losses and involuntary restrictions are full or partial, permanent or temporary.

4.17 The IR policy principles are:

- Screen the project early on to identify past, present, and future involuntary resettlement impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons, including a gender analysis, specifically related to resettlement impacts and risks.

- Carry out meaningful consultations with affected persons, host communities, and concerned non-government organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programmes. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations. Establish a grievance redress mechanism to

receive and facilitate resolution of the affected persons' concerns. Support the social and cultural institutions of displaced persons and their host population. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.

- Improve, or at least restore, the livelihoods of all displaced persons through (i) land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement value for land when the loss of land does not undermine livelihoods, (ii) prompt replacement of assets with access to assets of equal or higher value, (iii) prompt compensation at full replacement cost for assets that cannot be restored, and (iv) additional revenues and services through benefit sharing schemes where possible.

- Provide physically and economically displaced persons with needed assistance, including the following: (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities; (ii) transitional support and development assistance such as land development, credit facilities, training or employment opportunities, and (iii) civic infrastructure and community services, as required.

- Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.

- Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status.

- Ensure that displaced persons without titles to land or any recognisable legal rights to land are eligible for resettlement assistance and compensation for loss of non-land assets.

- Prepare a resettlement plan elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule.

- Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to affected persons and other stakeholders. Disclose the final resettlement plan and its updates to affected persons and other stakeholders.

- Conceive and execute involuntary resettlement as part of a development project or

program. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant IR impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.

- Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation.

- Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports.

5. Gap Analysis: Resettlement Regulatory Framework and IR Safeguard Policy of ADB

5.1 As discussed earlier, the LAA is the legal framework for compensation for acquired land and structures and land development. The NRP and LA Regulations 2008 together with LAA provide a comprehensive resettlement regulatory framework which broadly matches IR safeguard policy objectives and principles. A Gap Analysis Matrix is given in Annex 3.

5.2 The key gaps between LAA and IR policy principles of SPS were (i) the entitlements of non-titled PAPs, (ii) compensation at replacement cost, (iii) income restoration and improvement, (iv) consulting PAPs and their host communities on relocation options; (v) special assistance to vulnerable PAPs, (vi) monitoring and assessment of resettlement outcome and impacts, and (vii) the formulation of RIP to address these issues.

5.3 The issue of non-titled PAPs' entitlements is addressed in the LAA and elaborated in NIRP and LA Regulations 2008. Under the LAA any person having a 'right, title or interest in or over the land which is to be acquired or over which a servitude is to be acquired' (section 10(1)) is entitled to compensation. A person who has 'interest' in land' apart from owner and co-owners area mortgagee, a lessee, or an occupier absolutely for himself or in trust for another person or for any charitable, religious or other purpose, or a person having a servitude over the land (section 65, as amended in 1964). The Court of Appeal in 2001 added tenants to this list. The court also held that the occupier 'could not, in any event, be evicted without being compensated in respect of his improvement (if, in fact, he is the owner of such improvements). The court distinguished between 'ownership of the property' and 'ownership of land improvement'. This matches ADB' IR safeguard policy Principle 7 that those who do not hold title to land are eligible for resettlement assistance and compensation for loss of non-land assets.

5.4 The NIRP takes replacement cost as the norm for cash compensation. The LA Regulations 2008 detail how the total compensation package amounts to replacement cost of acquired land and other properties such as dwelling and business structures. MLLD's A Guide for Public Officials on Good Practices (MLLD 2013) guides that in preparing the entitlement matrix 'to determine replacement cost for land and structures which will be acquired to the project'.

5.5 Restoration and improvement of income sources and livelihood of PAP is a key resettlement principle of NIRP. The MLLD (2013) states that in preparing a RIP it is necessary to identify persons and households severely affected in terms of their income and employment losses; conduct consultations to develop an income restoration program for all PAPs; and develop a special income improvement program for vulnerable PAPs.

5.6 Consulting PAPs and their host communities on relocation issues is also a key resettlement principle of NIRP. Special assistance to vulnerable PAPs constitutes a core resettlement principle of NIRP and is elaborated further in LA Regulations 2008.

5.7 Monitoring and assessment of resettlement outcome and impacts which is an IR safeguard policy principle is not addressed in the resettlement regulatory framework. This needs to be addressed in RIPs.

5.8 The NIRP and LA Regulations 2008 require the formulation of a RIP to address IR safeguard requirements. The LA Regulations 2008 states that 'formulation of an RIP and its implementation is the responsibility of the project EA and PMU of a development project.

6 IR Principles for Projects under the Programme

6.1 Based on the comparative review of various resettlement policies, laws, regulations and guidelines of Sri Lanka and the ADB IR Policy, the following broad resettlement principles are distilled for this Programme to apply to its projects:

- Screen each project of the Programme to determine whether it triggers the following involuntary resettlement principles and to determine the scope of resettlement planning required.
- Take every effort to avoid physical displacement and/or any other adverse impacts on livelihood and income sources and community resources and infrastructure by exploring project and design alternatives. If physical displacement and economic displacement are unavoidable, the following actions will be taken to ensure that they improve or at least restore their income and livelihoods and rebuild their socio-cultural systems.
- Consult and inform all PAPs on land acquisition, compensation, and rehabilitation, and their entitlements and grievance redress mechanism.
- Provide special project assistance to meet the needs of affected vulnerable people such as poor, landless, elderly, woman-headed households, informal settlers and squatters.
- Improve or at least restore livelihoods of all affected households through cash-for-land compensation at replacement cost for acquired or damaged non-land property, and cash-for-land or land-for-land for land acquired.
- Provide well-planned and budgeted income restoration and improvement programmes for the benefit of PAPs, especially for the poor and vulnerable groups considering PAP's requirements, expertise, skills, experience, capacity, and available market avenues.
- All common property resources lost due to the project will be replaced or compensated by the project;
- If land acquisition is through negotiated acquisition, the project will ensure that PAPs who enter into negotiated acquisition will maintain the same or better income and livelihood status.
- PAPs without title to land are eligible for resettlement assistance.
- Disclose resettlement information and RIPs including consultation documentation before the project appraisal in a form, manner and language(s) accessible to PAPs and other stakeholders. The final RIPs and their updates, if any, will also be disclosed to PAPs and other stakeholders in the same manner.
- Establish a grievance redress mechanism and ensure all PAP's, beneficiaries, contractors and line agencies are aware of the mechanism and its processes.
- The full costs of resettlement will be included in project costs.

- Pay compensation and provide other entitlements to each eligible displaced person before physical displacement and any construction work starts.
- Monitor and assess the progress of RIP implementation and prepare monitoring reports to share with ADB, PAPs and other stakeholders.

6.2 In accordance with IR principles listed above, all PAPs will be entitled to a combination of compensation packages and resettlement assistance according to the nature of ownership/user/occupier rights and interests on lost assets and the degree of project impacts on socio-economic conditions and vulnerability of PAPs.

7 Screening and Categorisation

7.1 Each identified project of the Programme will be screened and categorised by ADB with the assistance of EA/IA, when preliminary project information is available. The objectives of screening and categorising are to (i) determine whether or not the project involves potential involuntary resettlement impacts and risks; (ii) ascertain the significance of such potential impacts and risks;(iii) identify the level of assessment and institutional and financial resources required for the formulation of satisfactory RIP to avoid involuntary resettlement impacts or risks, or at least to minimise and mitigate them. Finally, (iv) screening and categorisation of a project indicate the levels of information disclosure and consultations required.

7.2 The following checklist helps screen a project to identify its potential resettlement impacts and their significance:

- Will the project acquire land?
- How much land is expected to be acquired? (estimate)
- How many persons and households are estimated to be affected?
- Will the project's IR impacts be permanent or temporary?
- Categories of land tenure? Owner, LDO permit holder, encroacher, squatter, etc.
- Land use patterns? Paddy or highland cultivation? Crops, trees
- Will land acquisition impact on tenants, sharecroppers, leaseholders, encroachers, squatters?
- If state land is acquired, would it affect traditional claims over the land of people?
- If state land is acquired, are there any squatters, encroachers or informal settlers?
- What will be the estimated number of squatters, informal settlers and encroachers?
- Are there any houses, structures, trees and crops that will be affected?
- How many houses will be fully acquired/destroyed? (estimates)
- How many houses will be partially acquired/destroyed? (estimates)
- How many households will be physically displaced? (estimates)
- Will any public or community infrastructure affected partially or fully?
- Will *Veddha* communities be affected?
- What percent of product assets (income generating) will people lose? (estimate)
- What businesses will be affected? Their locations? Number? (estimate)

7.3 Based on the information and data collected above, the project team proposes an initial categorization for the project's potential involuntary resettlement impacts and risks.

Category A – The project is likely to have significant involuntary resettlement impacts. A resettlement implementation plan including an assessment of social impacts, is required.

Category B – The project is likely to have resettlement impacts that are not deemed significant. A resettlement plan, including an assessment of social impacts, is required.

Category C – The project has no resettlement impacts. No further action is required.

7.4 A project's involuntary resettlement category is determined by the category of its most sensitive component in terms of involuntary resettlement impacts. The involuntary resettlement impacts of a project are considered 'significant', if 200 or more persons will experience one or several major impacts. Major impacts are: (i) being physically displaced from housing, or (ii) losing 10% or more of their productive assets (income generating). The level of detail and comprehensiveness of the resettlement plan will be commensurate with the 'significance' of the potential impacts and risks. A project is tentatively categorized after completion of the initial screening of anticipated resettlement impacts and risks. The project team can change it with the concurrence of ADB, as more detailed resettlement information becomes available and project processing proceeds. Annex 4 provides the questions to be included in the categorization form.

Types of Land Tenure of Potential PAPs

7.5 Main land tenure patterns in the Central, North Central, and North Western are summarized below:

- **Private titled deeds**: The private deeds are registered at the Land Registry under the Act of Registration of documents. It can be transferred to any person as a sale or lease or rent on agreed rate and terms by both parties before a Notary Public.
- ***Jayabhoomi* Deeds**: These deeds are issued under the Land Development Ordinance for agricultural and residential purposes with certain conditions. A *Jayabhoomi* land can be transferred to a specified person described in the Schedule of the Land Development Ordinance (LDO)
- **LDO Land Permits**: They are issued under LDO for a specified period of time. It can be transferred to a specified person described in the Schedule of the Land Development Ordinance.
- **Long-term Leases**: These leases are issued under the State Land Development Ordinance for commercial, residential or other purposes described under the Act. Leased period is 30 years with certain conditions. A long-term lease can be transferred to another person with the approval of the concerned authority.

- **Annual Permits**: The permit is a legal document that allows the permit holder to use the state land mainly for agricultural purposes for a period of 12 months. A small levy is charged from the permit holder.
- **Encroached Land**: Use of state land without permission for various purposes mainly to cultivate crops. The encroachment could continue several years. Periodically some of encroachments are 'regularized' by the government mainly as a strategy to alleviate rural poverty.
- **Temple Land**: Hereditary land of Buddhist temples. Households work on them as leaseholders and pay an annual fee in addition to performing rituals and services without charge.

7.6 It is important to identify the tenure status of each PAP, as it would influence procedures of acquisition, compensation, resettlement, and rehabilitation.

8 Socio-economic Information

Initial Social Assessment

8.1 At the project identification stage, a rapid social assessment will be conducted by ADB in association with project proposers to identify the scope of social impacts, impoverishment risks, project benefits and interests and capacities of potential project-affected persons, beneficiaries, and other stakeholders. This is done through meetings among ADB mission members and project proposers and visits to potential project areas to observe current state of affairs. A report based on the initial social assessment will be prepared by ADB titled Initial Poverty and Social Assessment (IPSA).

Socio-economic Surveys

8.2 If the categorization of potential project impacts falls into either A or B category, the EA/IA will conduct a socio-economic survey as early as possible to (i) identify basic socio-economic baseline data in the project areas, (ii) identify persons and households who will be physically displaced and economically displaced by the project,(iii) record affected or lost assets of households, enterprises, and the community; (iv) assess the project's socio-economic impacts on them, and (v) establish monitoring and evaluation parameters to monitor project implementation.

8.3 Category A project will need more planning, resources and survey time to complete socio-economic surveys than a Category B project. A Category A project will also require more probing and in-depth analysis of socio-economic impacts on persons, communities and vulnerable groups.

8.4 The purpose of the socio-economic survey is to identify the nature and significance of potential project impacts. The survey will collect gender-disaggregated socio-economic data. The socio-economic survey is either a sample survey of affected persons and households or the total population. Usually the sample size is 20% of the total affected population chosen through stratified sampling method to include different groups of PAPs based on their income, housing conditions, and degree of losses. If a sample survey is done, it is necessary to agree with ADB the size of the sample. In the Programme, involuntary resettlement impacts will be limited and scattered in a linear form. Therefore, it is recommended to conduct the socio-economic survey taking all identified affected persons and households.

Census

8.5 A census will provide a demographic overview of the total affected population. It will cover PAPs' assets and main sources of livelihood affected and provide gender-

disaggregated socio-economic data. Such data will be used to determine if special actions are needed to assist the poor and vulnerable households to overcome their socio-economic marginality and disarticulation.

8.6 If the socio-economic survey takes place before detailed project designs are completed, a census of all affected persons and households together with an inventory of their assets will be conducted soon after the detailed designs are completed, but before any project's construction activity starts. Based on the census and inventory of losses, the resettlement planner will revise and update the RIP and disclose to all project stakeholders including PAPs. Such updates and revisions will be reflected in its budget and implementation schedule.

Methodology

8.7 Depending on the significance of potential resettlement impacts and the spread of such impacts over the project area, the resettlement planner will decide the methodology of data collection for the socio-economic survey and census. A questionnaire survey of all potential PAPs and households is the most popular methodology, and it is most useful in a linear project such as a canal project that will have minor impacts on households and settlements, but scatter the impacts over a large area.

8.8 The questionnaire will include questions about basic household information disaggregated by gender, land ownership and use patterns, income and expenditure patterns, employment, and potential impacts on income and livelihood sources, residences and other structures and losses, community organizations, awareness about the proposed project, poverty incidence, and vulnerability. It will also include questions on PAPs' perceptions on displacement, and their expectations from the project.

8.9 In addition to the questionnaire, fieldworkers who are engaged in the survey will gather qualitative data and information from interviewing groups of potential PAPs, local leaders, local knowledgeable and representatives of local associations such as farmer organization and cooperative societies. Focus group consultations will supplement such interviews. Group interviews need prior arrangement and information about such meetings is to be disseminated among PAPs n advance through proper channels such as GNO or Divisional Secretariat or through local temples, mosques and churches. Both men and women are to be encouraged to attend the group interviews. The deliberations, decisions and recommendations pertaining to the project will be recorded. Attendance at such meetings will be recorded with full name, address, and signature of each participant. If their cell phone numbers are available, they too are recorded in attendance sheet for easy future reference.

8.10 The resettlement planner will study recent socio-economic studies that have been conducted in project areas to gather more information and data. Key sources are EIA/IEE socio-economic survey reports, cropping data and crop marketing data, data

collected to formulate various development programmes for the benefit of the poor and vulnerable, reports of skill development programmes and general socio-economic databases at GNOs and Divisional Secretariats. Such data are only supplementary data, and primary data and information will be collected through surveys, censuses of population and inventory of physical and community losses.

8.11 Before the socio-economic survey is commenced, the resettlement planner will train fieldworkers in questionnaire survey and groups interview methods, unless they already possess skills in socio-economic surveys.

8.12 All the data and information collected will be fed into a data base which will be used in formulating RIPs. Based on the socio-economic survey, census and other sources of data and information, a social impact assessment (SIA) will be done which will focus on potential social impacts, impact on income sources and livelihoods of displaced persons and gender-disaggregated information pertaining to economic and socio-cultural conditions of displaced persons. The project's potential social impacts and risks will be assessed at personal, household and community level to formulate the entitlements of PAPs, households and communities. The results will be presented in summary and form a chapter of RIP. Such tabulated data and information will direct the objectives and scope of RIP and help determine requirement for further consultations with stakeholders, scope of grievance redress mechanism, budget, and implementation schedule.

Gender Impacts, Vulnerabilities, and Mitigation Measures

8.13 Socio-economic surveys will generate gender-disaggregated data. This will facilitate identifying gender-specific project issues and needs, and determining how the project would differentially impact on them. Land tenure and income sources are generally dominated by men in rural agricultural communities. The survey will identify the causes of these disparities and the socio-economic analysis will recommend specific measures to address them. It will also indicate how women could become project beneficiaries and the obstacles that are required to overcome. Where women play a significant role in local organizations or agricultural production or marketing activities, RIP will suggest ways and means to sustain and improve their participation in project activities.

8.14 Among vulnerable households are the female-headed households. During the socio-economic survey, these households will be identified in order to analyse their current economic status and how the project will impact on them. Based on the findings of the analysis, RIPs will recommend special assistance programmes to help them to overcome their vulnerabilities and also to improve their socio-economic status, so that they too could benefit from projects. The RIP plan will include measures to ensure that socio-economic conditions, needs and priorities of women are identified and the process of land acquisition and resettlement does not disadvantage women. It will ensure that gender impacts are adequately addressed and mitigated. Women's focus groups discussions will be conducted to address specific women's issues.

8.15 As part of the SIA, the resettlement planner will identify individuals and groups who may be differentially or disproportionately affected by the project (such as female-headed households, old and sick PAPs, gypsies, and low castes) because of their disadvantaged or vulnerable status in the community. Where such individuals and groups are identified, RIP will propose targeted measures so that adverse impacts do not fall disproportionately on them, and they will not be disadvantaged in sharing project benefits and opportunities resulting from development with others.

8.16 The communication strategy of a project will include women group discussions that focus on possible displacement and relocation, potential impacts on their socio-cultural systems, any potential threats regarding their safety during construction owing to the presence of labourers from outside, potential opportunities for women to engage in project activities to earn an income, and on special care to be taken by contractors during project construction activities, if women are recruited as workers.

Cut-off-Date

8.17 For land to be acquired from titled landowners, the date of notification for acquisition under the LAA will be treated as the cut-off date. For non-titleholders such as squatters and informal settlers, encroachers, tenants and leaseholders, the starting date of the project census or a designated date declared by EA in consultation with Divisional Secretaries will be considered as the cut-off date. The relevant local authorities will be requested through GNO to refrain from granting approvals for new constructions within the project area after the cut-off-date. The EA/IA will disseminate information regarding the cut-off date throughout the project area through GNOs and DSs. Persons who occupy land in the project area after the cut-off-date are not eligible for compensation or resettlement assistance. Structures such as houses, crops, fruits, trees and wood lots established after this date are also not eligible for compensation.

9 Consultation, Participation, and Disclosure

Consultation and Participation

9.1 The EA/IA will consult PAPs and other stakeholders on the scope of the project, its benefits and potential adverse impacts and proposed mitigation measures. The EA/IA will actively engage them in examining project alternatives, scope of land acquisition, potential direct and indirect impacts on economic activities, and social and cultural identity and networks of people, resettlement planning, implementation, and monitoring.

9.2 If a project plans to relocate physically displaced PAPs, plans for consultations and participation will include host communities as well. If present in the project area, representatives of community-based organizations (CBOs) such as farmer organisation and women groups, NGOs will also be invited to consultations. They will engage in resettlement planning and implementation together with PAPs. Among the stakeholders are representatives of relevant government agencies (GNs, representative of the Divisional Secretary of the area), religious and community leaders, and local business community.

9.3 The consultations will be done through interviews, public meetings, and group discussions. The EA/IA will ensure that disadvantaged or vulnerable groups, especially the poor, landless, elderly, women, female-headed households, and non-titled users of land too are included in consultations. EA/IA will pay special attention to their views, needs and suggestions. If anticipated resettlement impacts are severe or significant on livelihoods and household income sources of vulnerable PAPs, focused group consultations will also be held with project-affected women and vulnerable groups.

9.4 Consultations start during the ‘project preparation phase’ and will continue throughout the project life. All consultations are undertaken in an atmosphere conducive to free exchange of views and recommendations without any intimidation. Consultations and participation of PAPs in resettlement planning and implementation will be gender-inclusive, gender-responsive, and gender-sensitive, and will be designed to address special needs of vulnerable project-affected households and groups. By doing so resettlement planner will be able to incorporate views and recommendations of all segments of PAPs and other stakeholders into the project design, mitigation measures, and strategies of sharing of development benefits and opportunities. The organisers of stakeholder consultations will keep record of all discussions, suggestions and recommendations arising out of the consultative process at each consultation meeting. Each participant will sign the attendance sheet giving information on gender, national identity card number and address including cell phone number. The minutes of the meeting will be supplemented with photographs of the proceedings. The minutes and photographs will become annexes of the RIP. The formulators of the RIP will use the minutes in preparing RIP and address the issues listed in minutes.

9.5 Project information on measurement of losses, detailed asset valuations, entitlements and special provisions, grievance redress procedures, timetable for cash compensation payment, physical displacement schedule and project construction schedule will be disseminated by the EA/IA through public consultations and brochures, leaflets, or booklets written in local languages. For non-literate people, other communication methods such as small group discussions and posters will be used.

9.6 Each RIP will be prepared and implemented in close consultation with the stakeholders, particularly with PAPs through focus group discussions and stakeholder consultation meetings. Women's participation will be ensured by involving them in public consultations at various stages of project preparation and implementation, and by arrangements which would enhance their ability to attend such meetings.

9.7 Each RIP will be made available in local language(s) during the public meetings at the community level. Copies of RIPs will also be made available at the local level public offices, such as Division Secretariat, GNOs. The RIPs will be disclosed on ADB's and EA's websites. EA will inform ADB the date of posting of RIP on web.

9.8 A Public Consultation and Disclosure Plan will be prepared by PMU/PIU/NGO for each project following the format below:

Consultation and Disclosure Plan

Activity	Task	Timing (Date/ Period)	No. of Persons Attended (if applicable)	Agencies Attended (if applicable)	Feedback/ Issues/ Concerns	Remarks
Stakeholder/PAP Identification	Mapping of the project area					
Project information Dissemination	Distribution of information leaflets to PAPs					
Consultative meetings with PAPs during scoping phase	Discuss potential resettlement impacts of the project					
Public Notification	Publish list of affected lands/sites at Divisional Secretariat/GNOs; Publish eligibility cut-off date					
Socio-economic survey	Collect socio-economic information and					

Activity	Task	Timing (Date/ Period)	No. of Persons Attended (if applicable)	Agencies Attended (if applicable)	Feedback/ Issues/ Concerns	Remarks
	PAPs' perception on resettlement impacts					
Consultative meetings on resettlement mitigation measures	Discuss entitlements, compensation rates, grievance redress mechanisms					
Publicize RIP or at least its entitlement matrix	Distribute leaflets or booklets in local language					
Full disclosure of the RIP to PAPs	Distribute RIP in local language to PAPs					
Internet disclosure of the RIP	RP posted on ADB And EA website					
Consultative meetings during detailed measurement survey(DMS)	Face- to-face meetings with PAPs					
Disclosure after DMS	Disclose updated RIP to PAPs					
Internet disclosure of the updated RP	Updated RP posted on ADB and EA website					

9.9 The organizers of each meeting, consultation and interview will keep records of key topics discussed and decisions arrived at. Photographs of such meetings and interviews are to be attached to the records.

Disclosure

9.10 The EA/IA will disclose RIP and/or adequate resettlement information to PAPs and other stakeholders in a timely manner at accessible locations in Sinhala (and/or Tamil).

9.11 Resettlement information including the entitlement matrix, GRM, budget, and implementation schedule as leaflet or a booklet will be disclosed before the determination of compensation and resettlement assistance. A copy of RIP will be disclosed on MIWRM and Programme websites and Programme-related websites. Sinhala or Tamil versions of RIP will be available for public reference at MIWRM, Programme Offices, Divisional Secretariats and GNOs in project areas PMU and PIUs.

9.12 The EA/IA will submit the following planning documents to ADB for disclosure on ADB's website:

(i) Draft Resettlement Framework

(ii) RIP before project appraisal

(iii) Final RIP based on the census of PAPs completed after the detailed project designs, if a draft RIP based on a sample socio-economic survey was submitted earlier

(iv) A new RIP or an updated RIP, and a Corrective Action Plan (CAP), if any, prepared during project implementation

(v) Resettlement monitoring reports

10 Compensation, Income Restoration and Relocation

Valuation of Lost and Affected Assets

10.1 The EA/IA and PAPs will participate in determining the replacement cost of acquired property for a project. The LAA, NIRP and LA Regulations 2008, outlined in Section 4 above, constitute the resettlement regulatory framework for determining the replacement cost. Replacement cost comprises fair market value of the property and other compensation packages that are elaborated in NIRP and LA Regulations 2008 (see below).The valuation of acquired property will be done by the Valuation Department on the request of by the Divisional Secretary of the area where land is located. The DS is the land acquiring officer. The Valuation Department will calculate the replacement cost of fully acquired, partially acquired and damaged or partially damaged structures, guide by the 2008 LAA Regulations.

10.2 Those holding legal rights to land acquired are entitled to compensation at replacement cost of the land and structures on the lost land or to replacement land and replacement cost of structures on the land. Those persons who do not own land but have 'interests' such as squatters on acquired land are entitled only for replacement cost of dwellings and other structures, improvements to the land, only if the person had occupied the land or the structure prior to the cut-off-date for eligibility for resettlement assistance.

10.3 In case of PAPs whose livelihoods are land-based, the EA/IA will give priority to find replacement land for them. It is the responsibility of the EA/IA to find suitable land of equal size or quality where PAPs are willing to relocate. Where replacement land is offered, displaced persons will be given a plot of land at least equivalent to the quality and size of the land acquired. The replacement land will allow them to improve or at least to restore their livelihoods such as agriculture at the relocation site with necessary infrastructure, extension facilities and community support. If there is any time gap between displacement and relocation, the EA/IA will provide cash and subsistence assistance to the displaced persons until such households are given land and resettlement assistance at resettlement locations. These facilities are to be provided in accordance with the entitlement matrix.

10.4 The value of land will be based on updated official records, field observations, recent land market rates in the vicinity, if available, and valuation done by the Valuation Department. The land records containing information such as legal title and classification of land will be taken into consideration in determining its value. All land parcels identified to be acquired for the project will be compensated based on the replacement cost of the land and will be paid in cash unless the land-for-land option is opted by PAPs.

Negotiated Land Acquisition

10.5 The LAA refers to 'willing seller' as a precondition for negotiated land acquisition. This avoids expropriation and use of governmental authority to remove people and acquire land. It is based on meaningful consultation with PAPs including those who occupied land without legal titles. Obtaining lands through negotiated land acquisition still involves a formal acquisition as per LAA. This is mainly to avoid land with title defects get passed on to the State. Within the LAA framework, it is difficult to apply negotiated land acquisition modality, although the LAA recognizes negotiated land acquisition as a method of calculating compensation. The Supreme Court defined the test of a willing seller as being 'likely to receive prompt compensation of the market value'. The Court pointed out the impracticality of negotiated land acquisition because of 'delays, technicalities, and expenses' associated with the LAA mandatory procedures for land acquisition and compensation payment. Therefore, what is feasible and efficient is to negotiate and agree replacement cost of land, dwellings and other structures, and the market value of crops and trees. Such negotiated prices could be used in determining compensation for acquired property.

Assessment of 'Replacement Cost'

10.6 The LAA provides for determining compensation based on 'market value'. It defines market value as 'the amount which the land might be expected to have realized if sold by a willing seller in the open market as a separate entity on the date of publication of that notice in the Gazette … [Section 46(1)]. The NIRP states that compensation will be based on 'replacement cost' of acquired land and structures. 'Compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly. This should include transaction costs [Principle 6].

10.7 The LA Regulations of 2008 under section 63(2) (f) of the LAA did not adopt 'replacement cost' as the basis for compensation as the LAA does not use the concept; instead it used 'market value' as defined in the LAA together with several safeguard provisions to eliminate inequities arising from methods of valuation and determining 'market value' thereby upgrading compensation to the level of the replacement cost.

10.8 The current IR regulatory framework ensures that persons affected by land acquisition receives replacement cost, so that they could maintain the same socio-economic status that they enjoyed prior to land acquisition, or that their living standards are raised to a higher level compared with the pre-acquisition level particularly in case of the poor. As outlined above, LA Regulations of 2008 under 'Disturbances' make the necessary provisions for compensating every possible cost incurred by a PAP during the acquisition of their properties. Section 3.11 of the LA regulations 2008 within the framework of 'value to owner' provides a range of 'disturbances' caused by land acquisition. The total package of compensation and other payments would bring compensation to the level of 'replacement cost' which is also a best international practice. The LA Regulations 2008 provides the following compensation packages to those who lost land to a public project.

- Where part of a land is acquired and when its value as a separate entity deems to realize a value proportionately lower than the market value of the main land, the compensation will be proportionate to the value of the main land.
- A building used for occupation or for business purpose, or was intended to be used for occupation or business purpose on the date the intention to acquire was published, the difference between the cost of re-construction and the value of building based for determination of market value will be paid as additional compensation.
- Value based on 'development potential' is considered in determining the value of land when a paddy land plot is acquired if the Agrarian Services Commissioner General's approval has already been obtained to convert it into a non-agricultural land.
- Where an acquired building is occupied by a tenant/statutory tenant protected under the provision of the Rent Act No 7 of 1972 (as amended thereafter) compensation will be ascertained in proportion having regard to the provisions of Rent (amendment) Act No 26 of 2006.
- Damages caused by injurious affection and severance should be allowed fully. Compensation for disturbance is based on the "value to owner" will be paid based on written claims:
- Expenses incurred during appearing under LAA section 9 Inquiry: maximum payment is Rs 10,000.
- Expense of finding an alternative accommodation: maximum rental of Rs 10,000 per month for properties located in urban council areas, and Rs 5,000 per month for properties located in *pradeshiya sabha* areas. If the anticipated physical displacement is temporary, maximum of three months rental; if the anticipated physical displacement is permanent, a maximum of 6 months rental of Rs 10,000 per month is payable for a house where floor area is less than 1,000 square feet.
- Cost incurred in change of residence: Rs 10,000 for houses where floor area is less than 1,000 square feet and Rs 15,000 for houses where floor area is between 1,000 and 2,000 square feet. Rs 25,000 for houses where floor area is more than 2,000

square feet. If sub families live in a house, the payment should be divided proportionately. For other properties, maximum of Rs 25,000 is paid based on the nature of the occupation.

- Cost of advertising: permanent displacement of informal business establishment will get Rs 2,500 and a formal business establishment, Rs 15,000.
- Re-fixing cost of fixtures and fittings; transport expenses: Rs 5,000 for a house/residence. In case of a business premises or any other structure of specific nature, the amount should be based on actual expenses
- Loss of earnings from business: Rs 15,000 a month for informal businesses. For formal businesses compensation amount is based on accounts and tax returns pertaining to preceding three years.
- Increased overhead expenses will be paid according to the circumstances.
- Double payments, for example, rent or rates: This is to be calculated based on actual expenditure; all other expenses incurred by the owner in relation to the acquisition: losses sustained because of the compulsory sale of the business due to the acquisition, for example, sale of livestock.
- Other additional expenses for disturbance or compensation not considered under any other compensation item above: disturbance experienced by tenants fall into this category. A payment in respect of vulnerable persons such as old and disabled people who are dependent on affected persons. Another category is self-employment. The maximum payment for any of these disturbances is Rs 15,000.
- When an owner of a house or of an investment property is displaced, additional 10% of the market value is paid as compensation. This is conditional upon leaving the acquired property on the stipulated date.
- When a value of a piece of land acquired is based on its agricultural potential, the displacement cost and loss of income will be taken into consideration in determining its value.

Special Arrangements for Paying Compensation

10.9 In addition to the normal procedures of land acquisition, there are several special arrangements for paying compensation for acquired land and structures. The key arrangements are listed below.

- Projects under the Programme are likely to acquire narrow strips of land for canals and water conveyance facilities. In such case, the valuer will be given specific directions under LA Regulations 2008. Irrespective of the size of the main land, determine the site value of a buildable front block and adopt the same rate for acquired portion uniformly.

- Lands with various shapes: When the front land is a narrow strip used as access/garden to rear main land and part of the front land is acquired, valuation should be based on 'use' subject to highest and best use.
- When a part of a building is acquired and the remaining part is still usable: compensation will be based on depreciated replacement cost (DRC) only for the part acquired. Reinstatement cost will be paid for the balance part of the building.
- When a part of a building is acquired and the remaining part is unusable: justification is required that the balance part cannot be used further. When justified, DRC value of the entire building will be paid. Reinstatement cost will be paid subsequently as additional compensation.
- Some lands occupied by PAPs may belong to Buddhist temples. Such lands are managed by the chief incumbent of the temple. Compensation for acquired temple lands, however, is paid to the Public Trustee Department.

Reinstatement cost of buildings and compensation for other developments on encroached lands

10.10 The following steps will be followed in determining compensation for improvements on encroached lands.

- The Land Acquiring Officer should include the encroacher as an 'interested party' under Section 10 (1) (a) of LAA.
- Encroachments on state lands: with the concurrence of the Divisional Secretary in writing, reinstatement value for developments/improvements done by the encroacher may be paid.
- Encroachments on private land: where the landowner has not contested the encumbrances in a Court of Law, the person who improved land qualifies will receive the value of such improvements.

10.11 In summary, determination of replacement cost of acquired property will take into consideration the following:

- Compensation = Market value of land acquired + severance and injurious affection to land retained + disturbance and other losses

Common Property

10.12 The EA will restore or reinstall common resources, structures and facilities affected by the project as outlined in the Entitlement Matrix. If access is restricted to such resources, alternative access to similar resources will be provided by the EA/IA. Compensation for trees will also be based on the current market value of timber for timber trees, the annual

net product market value multiplied by remaining productive years for perennial and fruit trees. The EA/IA will consult the Department of Agriculture for valuation.

Temporary Impacts

10.13 For temporary impacts, cash compensation and other entitlements prescribed in the entitlement matrix will be provided to each entitled affected person before taking acquiring land or properties.

Income Restoration

10.14 The EA/IA will improve or at least, restore lost or affected income sources and livelihoods of PAPs in real terms to the pre-project levels. The EA/IA will identify the number of eligible PAPs from the socio-economic survey and census and formulate detailed income restoration and improvement plans such as skill development programmes in consultation with PAPs, CBOs, NGOs, government officials and other agencies in the project areas. The EA/IA will also formulate income improvement programmes for the benefit of vulnerable households. These plans will be included in RIP with a budget, institutional support, and an implementation schedule.

10.15 Income restoration and improvement will have several components. Compensation at full replacement cost and other cash components of the compensation packages will allow PAPs to invest some portion of cash received in income generating activities. The PMU/PIU will guide PAPs on financial management and investment. Such investments are augmented by ex-gratia payments that will be paid to eligible PAPs by the project. Among ex-gratia payments are shifting assistance, initial living assistance, and special grant for vulnerable households.

10.16 In project areas, the majority of PAPs are rural agriculturalists who depend on small plots of paddy and highland to earn their living. If these plots are fully or partially affected by the project, the EA/IA will prepare a comprehensive plan to find land-for-land and to develop relocation sites for their benefits. No land acquisition will take place before relocating the physically displaced persons. While compensation is required to be paid before displacement, full implementation of relocation plans might take longer. The gap period is to be dealt with exgratia assistance such as living allowances and temporary housing. Such complicated programmes are to be in place before land acquisition starts and certainly before any project construction activity begins.

10.17 Project-sponsored skill training programmes and micro-credit programmes will provide basic knowhow and capital respectively especially to the displaced youth helping them to find or generate income sources or livelihoods. The EA/IA will introduce PAPs to national and local employment development programmes, and will also secure priority enrollment for them in such programmes. The EA/IA will also encourage project contractors to hire skilled, semi-skilled and daily wage workers from among PAPs, if they are seeking such

employments from the project. Priority will be sought for vulnerable PAPs. Women workers will be encouraged to engage in project construction activities. The EA/IA will negotiate with contractor's special assistance programmes for them and ensure their safety at work sites. Such assistance requires prior planning and negotiations. The EA/IA will initiate such dialogue with concerned agencies and contractors before land are acquired.

10.18 A cohesive and comprehensive income restoration and improvement strategy based on local skills, resources, and PAPs' expectations and needs will be developed by the EA/IA as a key component of RIP with key monitoring indictors and a secured adequate budget. In developing such programmes, project authorities will consult GNs and DSs to explore the possibility of combining them with current local income-generating programmes.

Relocation

10.19 The EA will decide in consultation with IAs, provincial and divisional authorities the locations for relocation of physically displaced PAPs and the resettlement assistance package for each PAP or displaced household. This information should be disclosed to all PAPs during the formulation of RIP for a project. It is necessary to describe in RIP relocation sites, how and why they have been selected, how many PAPs are to be relocated at each of relocation site; the size of highland and wetland land plots identified for each PAP, the temporary housing arrangements if residential units are under construction; and basic infrastructure facilities and assured budget for all identified resettlement activities at relocation sites.

10.20 The selection of relocation sites are to be done in consultation with PAPs. Their willingness to move to the relocation sites, expectations, worries and concerns are to be probed through group and individual consultations. The results of such consultations are to be recorded and attached to the RIP. Resettlement administration, responsibility for each task will be outlined in the RIP.

10.21 The RIP will describe the resettlement assistance package which is given in addition to the land compensation package. Resettlement assistance package will include transportation of household good and salvaged items from the demolished/damaged house, house construction assistance programmes; temporary shelter and food supplies; and special security arrangement for women.

10.22 If PAPs are predominantly farmers, the EA will provide land suitable for agriculture for them with cultivation assistance such as tractors to plough land and build bunds (embankments) and tertiary canals.

10.23 If PAPs of an affected village or hamlet want to live together as a community at

relocation sites, the EA will take necessary actions to fulfil this requirement. Such formation of a community at a new location will help them to cope with displacement trauma, anxiety and fear. A community would also provide them mutual labour and subsistence at the initial stage of relocation.

11 Institutional Arrangements

Grievance Redress Mechanism

11.1 Each project which is likely to have resettlement impacts will have a formally instituted transparent and time-bound project level grievance redress mechanism (GRM) to receive and resolve PAPs' grievance locally about the delivery of their entitlements, in particular, and project impacts, in general. (The EA/IA will determine whether a common GRM could handle both resettlement and environmental complaints of PAPs or two separate GRMs are need in the context of the project.)

11.2 The GRM is an accessible and trusted platform for PAPs to seek solutions and relief for their grievances related to IR activities of the project. The GRM will reveal PAPs' capacity for consultations and desire to resolve grievances through discussion and negotiation. The EA and IAs will make sure that PAP's, beneficiaries, and line agencies understand and apply the GRM to resolve issues pertaining to compensation, relocation and income and livelihood restoration and improvement..

11.3 The objective of the GRM is to resolve land acquisition, compensation and resettlement disputes and construction related issues at the grass-roots level in order to avoid lengthy and costly judicial process. However, the GRM will not deal with matters pending in Courts of Law. The grievance redress committee (GRC) of the GRM will have no jurisdiction over the 'rates' of compensation.

11.4 Grievances from PAPs are primarily dealt with by GNOs through consultation and involvement of resettlement officers, as required. Complaints that cannot be addressed at the level of GNO will be forwarded to GRC.

11.5 The structure and organization of a GRM will depend on the significance and complexity of anticipated IR impacts and risks of the project. The number of tiers a GRM will have is to be decided by EA/IA in consultation with the Divisional Secretariats in the project area in light of the number of PAPs, the nature of project impact on them, and the significance of anticipated resettlement impacts. Generally, a GRM will have minimum of two tiers, namely, the divisional level GRC and the Appellate GRC at the project level. The presence of GRM or seeking relief from GRM is not a bar to take grievances to national courts for arbitration.

11.6 All disputes related to land acquisition, delays in providing cash compensation and resettlement assistance, handing over of resettlement land, land issues such as land ownership disputes will be dealt by GRCs. A PAP can submit a complaint to the secretary of GRC in writing or verbally to the GN or a resettlement officer at the Project Office. Such verbal complaints will be recorded and forwarded to the chairperson of GRC.

11.7 The GRC will meet according to a published timetable. This information will be disseminated among all PAPs. It will call public meetings to arbitrate grievances. Each session/meeting will be held at a place which is convenient to PAPs to attend. The GRC procedures will be publicized through notices and community meetings. The PAPs will be made aware of the presence of GRM, its powers and benefits during consultations and group discussions. At such gatherings, PAPs will be encouraged to discuss their views on the structure and functions of GRM.

11.8 The GRC at the divisional level will address PAPs' complaints and grievances promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of PAPs at no costs and without retribution. It will be chaired by the Division Secretary. It will have a secretary and several committee members, a surveyor, GOs of the Division, IA resettlement specialist/officer, three or four PAP representatives (at least two will be women PAPs), and representatives of project-related agencies. The Secretary will receive complaints. A record of each complaint will be maintained at the Division Secretariat. The Appellate GRC at the project level will be chaired by the Project Director. The other members of the committee are a representative of the Survey Department, a representative of MLLD, a valuer from the Valuation Department, and representatives of PAPs. All GRC meeting deliberations and decisions will be recorded and will be available for public reference.

Resettlement Administration

11.9 Each RIP will succinctly outline the institutional arrangements to implement resettlement within the institutional framework of the project. The institutional arrangements for the RIP implementation will present both as a narration and a diagram showing the responsibilities and reporting arrangements. The MIWRM is the EA of the Programme.

11.10 As Annex 3 shows, the EA possesses sufficient knowledge of and experience in involuntary resettlement planning and implementation. As a result, capacity development of EA and IAs for the Programme is not a key requirement. However, the willingness to apply the current IR regulatory regime found in LAA, NIRP and LA Regulations 2008 is to be ascertained during resettlement planning and implementation for the Programme.

Programme Management Unit (PMU)

11.11 The Programme will have a program Management Unit (PMU) established at the MIWRM. It will oversee social safeguard compliance during social impact assessments, formulation of RIPs, their implementation and monitoring of implementation progress. The PMU will have Resettlement Unit or Cell with a full time specialist (s) who will assist the formulation of RIPs, resettlement due diligence reports and resettlement monitoring reports. The PMU will develop the specialists' terms of reference (ToR) and forward them to ADB for review. The specialist(s) key activities include: (i) screening of proposed projects for potential resettlement impacts and risks;(ii) reviewing of project alternatives

to avoid or minimize resettlement impacts; (iii) assessing social impacts of the project; (iii) formulating an appropriate strategy for public consultations and resettlement information disclosure; (iv) formulating RIPs with resettlement consultants; and (v) establishing the GRM and monitoring of their effectiveness.

Resettlement Staff and Consultants

11.12 While the EA will be responsible for overall coordination, planning, and financing of resettlement programme, the implementation of RIP is the responsibility of the PMU. Before commencing socio-economic surveys and the formulation of the RIP, the EA will recruit a social development specialist(s)as a staff member of the PMU who is familiar with land and resettlement regulatory framework and ADB involuntary resettlement policy and procedures. The specialist(s) conduct surveys and formulates the RIPs of the project. The specialist(s) through EA/IA could hire resettlement consultants to assist resettlement planning and implementation.

11.13 Involuntary resettlement is a sensitive process and officials who are engaged in resettlement programme need field experience in resettlement and rehabilitation and community development. In order to facilitate good rapport with affected communities and oversee resettlement implementation, experienced and well-qualified civil society organizations could be hired in project areas to assist the PMU/PIU in RIP implementation especially in case of Category 'A' project. Such organizations could play the role of facilitator and will work as a link between the PMU and affected communities. They will assist PAPs in income restoration through training in skill development and getting access to various government development schemes and to agencies that provide financial assistance and loans for small enterprises.

Project Implementation Unit

11.14 The PMU will be supported by PIUs in the field. Each project will have a PIU working under the supervision of the PMU, Resettlement officers will be hired to assist the PIU to conduct social impact assessment, formulation of RIP and their implementation and monitoring.

11.15 The roles and responsibilities of various agencies to be involved in resettlement planning process and implementation of resettlement activities are summarized below.

Roles and Responsibilities of Agencies in Resettlement Planning and Implementation	
Activity	**Agency Responsible**
Establishment of Resettlement Unit at EA and appointment of a Resettlement Specialist (RS)	EA
Hiring of resettlement consultants (RC), external monitors (EM)	EA
Organizing resettlement training workshop (optional)	EA, RC
Screen project affected area for resettlement effects	RS, RC
Determine the scope of RIP	EA in consultation with ADB
Social Assessment and preparation of land acquisition plan, Census, Socio-economic Surveys, RIP	EA/PMU and RS and RC
Hiring of Civil Society Organizations (NGOs)	EA
Public consultation and disclosure of RIP	RS,RC, NGO/CBO
Co-ordination with divisional administration for land acquisition	IA, PMU/PIU, RS and RC
Declaration of cut-off date	EA, Divisional Secretary (DS), RS
Review and obtaining of approval of RIP from ADB	EA
Appointment of GRC	EA/ PMU/PIU
Submission of land acquisition proposals to Divisional Secretary (DS)	PIU
Compensation award and payment of compensation	DS, PMU/PIU, RS
Payment of replacement cost and allowance	DS, PIU
Taking possession of acquired land and structures	DS
Handing over the acquired land to contractors for construction	DS
Notify the date of commencement of construction to PAPs	RS, RC, PMU/PIU, NGO
Assistance in relocation, particularly for vulnerable groups	RS, PMU/PIU, NGO, DS
Internal monitoring of overall RP Implementation	PIU, RS, RC,NGO
External Monitoring and Evaluation (M&E)	EM

12. Monitoring and Reporting

12.1 The PMU/PIU will monitor the RIPs' implementation to determine whether resettlement goals have been achieved and livelihood and living standards have been restored, and to recommend how to further improve implementation. For this, each project will elaborate specific, relevant and detailed monitoring indicators.[1] The PMU/PIU will prepare half-yearly monitoring reports to submit to EA and ADB. The reports will focus on whether resettlement activities have complied with IR safeguard principles and loan covenants of the project. The report will also document consultations conducted with PAPs and summaries of issues identified and actions taken to resolve them. It will also provide a summary of grievances or complaints lodged by PAPs and actions taken to redress them and the specific activities conducted to restore and improve income sources and livelihoods of PAPs.

12.2 The scope and frequency of resettlement monitoring will commensurate with the degree of significance of resettlement impacts and risks. Resettlement monitoring will involve (i) administrative monitoring to ensure that implementation is on schedule and problems are dealt with on a timely basis; (ii) socio-economic monitoring including income restoration and improvement during and after any resettlement impacts, utilizing baseline information established during socio-economic surveys; and (iii) overall monitoring to assess the socio-economic status of PAPs. If any deviations from resettlement loan covenants or safeguard principles are reported in monitoring reports, EA/IA will prepare a CAP and will submit to ADB for review and approval. The monitoring reports and CAP will be posted on ADB website.

12.3 In case a project is categorized as "A" for involuntary resettlement impacts or a significant IR impact is found which was not envisaged at the time RIP formulation of a category "B" project EA/IA will engage a qualified and experienced external monitor (EM) who is not associated with the project planning and implementation to examine it and to suggest how to address them. In such a situation, the need to prepare an addendum to the RIP will be considered.

12.4 In addition, the EM will document good practices as well as difficulties encountered in implementing the RIP. This document will provide guidance for subsequent projects. A sample monitoring format is given below which needs to be elaborated during the RIP implementation stage.

12.5 A draft monitoring framework for resettlement issues is given below.

[1] Please see (http://www.adb.org/documents/involuntary-resettlement-safeguards-planning-and-implementation-good-practice-sourcebook-d) for sample internal and external monitoring indicators.

Monitoring Framework

Activity	Progress	Remarks
Assessment of IR impacts of changes in project design, if any,		
Updating of RIP based on changes in project design, if any.		
Approval of updated RIP by ADB		
Appointment NGO, if required		
Disclosure of updated RIP		
Establishment of GRM/Committee		
Capacity building of EA/IA, if required		
Verification of Census; assessment on compensation and assistance, and readjustment		
Land Acquisition		
Payment of compensation at replacement cost of land & assets to PAPs		
Disbursement of resettlement assistance to title holder PAPs		
Disbursement of assistance to non-title holder PAPs		
Disbursement of special assistance to vulnerable groups		
Number of vocational training provided to PAPs		
Linking PAPs with local, provincial Development schemes		
Planning for resettlement sites as per RIP		
Shifting PAPs to resettlement sites as per RIP		
Replacement/ shifting of community property resources		
Reinstallation of public utilities		
Preparation/ updating of Indigenous Peoples Development Plan based on changes in project design		

13. Resettlement Budget

13.1 Detailed budget estimates for each RIP will be prepared by the PMU/PIU to include in the overall tranche budget. The budget will include: (i) detailed costs of land acquisition, and livelihood and income restoration and improvement; (ii) source of funding; (iii) administrative, including staff training; (iv) monitoring costs; (v) cost of hiring consultants and the NGO; (vi) arrangement for approval, and (vii) flow of funds and contingency arrangements. All land acquisition, compensation, and rehabilitation, administrative, monitoring and consultant cost, income and livelihood restoration cost will be considered as an integral component of project costs and will be borne by the EA. The EA will ensure timely disbursement of sufficient funds for RIP implementation. The EA, through its IA and in consultation with PAPs and appropriate divisional and provincial officials will determine the cost of land acquisition, resettlement and rehabilitation. The approved cost will be allocated in advance in the annual budget of the EA. All cash compensation packages will be paid to PAPs before any construction activity of the project commences. Resettlement assistance programmes will start before construction works start and may continue during the project implementation phase. Budgetary provisions should be available in advance to resolve compensation issues without any delay.

13.2 The disbursement of cash compensation to PAPs for land and other property losses and damages will be done by the Division Secretariats in the project areas. The approved amount will be deposited by the EA/ IA in the Divisional Secretariat accounts and the disbursement will be done by the divisional administration.

13.3 Resettlement assistance and other rehabilitation measures will be provided to PAPs by the EA/IA. The implementing NGO, if recruited by the project, will involve in facilitating the disbursement process and rehabilitation programme. An outline of a budget is given below.

Resettlement Budget and Cost Estimates

Item			Unit Rates	Total Quantity	Compensation (in Rs.)	R&R Costs (Rs.)
A: Compensation for Acquisition of Private Properties						
1	Agriculture Land					-
2	Homestead Land for Residential/Commercial					-
3	Residential Structures					-
4	Commercial Structures					
5	**Trees**	Fruit-bearing				
		Timber				
		Perennial Crops				
		Standing Corps				
6	Special payments (if any)					
7	Interest accrued for delays in compensation payment					
			Sub-total			
B: Resettlement and Rehabilitation Assistance						
1. Agricultural Land (top up value to meet replacement cost)						
2. Homestead Land for Residential /Commercial (top up value to meet replacement cost)						
3. Residential Structure (top up value to meet replacement cost)						
4. Commercial Structure(top up value to meet replacement cost)						
5. Non-titleholder Structures						
6. Transitional Allowance						
7. Shifting Allowance						
8. Training Assistance						
9. Assistance to Employees/ Agricultural Labourer/ Sharecroppers						
10. Additional Support to Vulnerable Households						
Sub-Total						
C: Community Infrastructure/Common Property Resources						
1. Community Infrastructure Improvement/ Installation						
2. Religious Structures						
3. Government Buildings						
D: Support Implementation of RIP						
1. Independent Monitoring & Evaluation Agency						
2. NGOs Assistance for RP Implementation						
Sub-Total						
TOTAL (in Rs.)						
Contingency (15% of the total)						
Grand total (in Rs.)						

14. Implementation Schedule

14.1 The schedule of the RIPs' implementation will vary from project to project. The process could become lengthy because of frequent disputes regarding land acquisition and delays in compensation calculation and payment. Resettlement programme of a project comprises three key phases: RIP preparation, land acquisition, and rehabilitation of PAPs. The key involuntary resettlement-related activities of these three phases such as census and socio-economic survey, cut-off-date publication, resettlement planning, public consultation, disclosure of resettlement information, land acquisition, compensation payment, relocation, income restoration and improvement, monitoring and evaluation of resettlement implementation will be detailed in the implementation schedule.

14.2 The EA/IA will ensure that no physical/or economic displacement of affected households will occur until: (i) compensation at full replacement cost has been paid to each displaced person for project components or sections that are ready to be constructed; (ii) other entitlements listed in the resettlement plan are provided to PAPs; and (iii) a comprehensive income and livelihood rehabilitation programme, supported by adequate budget, is in place to help displaced persons, improve, or at least restore, their incomes and livelihoods.

Implementation Schedule

Resettlement Activity	Time Schedule	Progress
Screen project areas to identify potential resettlement impacts		
Determine the scope of resettlement planning and resources required		
Socio-economic Survey		
Census		
Declaration of cut-off date		
Determine land acquisition plan (by segment or as a whole)		
Preparation of RIP		
Hiring of Civil Society Organizations (NGOs), if required		
Public consultation and disclosure of RIP		
Co-ordination with divisional administration on land acquisition		
Approval of the RIP by ADB		
Submission of land acquisition proposals to Divisional Secretaries		
Compensation award and payment of compensation		
Payment of replacement cost and other IR allowances		
Taking possession of acquired land and structures		
Handing over of acquired land to contractors		
Notify the date of commencement of construction to PAPs		
Assistance to PAPs, especially to vulnerable groups		
Internal monitoring of RP Implementation		
External Monitoring and Evaluation (M&E), if applicable		
Project Completion Report		

Annex 1: Formulation of a Resettlement Implementation Plan - Guidelines

Guidelines for a Resettlement Implementation Plan

Tasks/activities	Guidelines
Conduct an initial social assessment	- Identify social and involuntary resettlement issues and their scope - Define project area and develop a database of its socio-economic conditions - Identify key stakeholders and conduct a stakeholder analysis - Consult and involve other stakeholders such as local government officials, non-government organizations. - Explore viable project alternatives to minimize social impacts, especially involuntary displacement, and assess whether resettlement and social impacts are significant or not
Conduct a social impact assessment using a sample survey and an inventory of losses survey	- Identify past, present, and future social impacts and review EIA/IEE reports of the project, if available, to gather supplementary data and information - Conduct a sample socio-economic survey and an inventory of displaced persons and affected assets - Assess involuntary resettlement impacts on communities other than displaced persons, and potential impacts on vulnerable groups, common property and other public resources - Develop data collection methods, strategies for hiring and fielding investigators, field supervision, data processing and analysis
Prepare an entitlement matrix	- Determine the cut-off date for qualifying compensation. Enumerate and register APs according to their respective locations (This would help in establishing a list of legitimate beneficiaries who live at the locations prior to project planning and to avoid false claims by those moving in to the project area to collect compensation and project benefits) - Identify the types of losses and set up a database of APs and the impacts (prepare an Inventory of Losses (IOL) at the household, commercial, and community level) - Set out eligibility criteria for their different losses - Determine replacement cost for land and structures which will be acquired to the project - Prepare an entitlement matrix for each type of loss and categories of affected persons

	(women, indigenous people, customary land users, encroachers, squatters, the poor, severely affected persons)
Conduct consultations with PAPs and other stakeholders and design information disclosure and a grievance redress mechanisms	- Conduct stakeholder consultation workshops and record findings and suggestions - Disseminate information on resettlement plan, project activities, entitlements, and obtain views and preferences of stakeholders - List out strategies for information campaign and procedures for APs to negotiate their entitlements - Include a 'social preparation phase' when resettlement activities are likely to cause protests/objections - Study existing procedures of grievance redress systems and introduce robust mechanisms to deal with complaints from APs
Review legal and policy framework of involuntary resettlement	- Review the national legal framework and policies for land acquisition, compensation, relocation and income restoration, and identify gaps, if any, to address them in the entitlement matrix
Conduct a gender analysis	- Identify the needs of women who are affected by land acquisition, relocation and other project activities - Consult women and women groups to identify their needs, opinions, project impacts on them, and special assistance that they may require - Address their vulnerability arising from loss of livelihood and familiar living surroundings
Identify needs of vulnerable groups	- Identify and consult vulnerable groups including the poor - Assess the special needs of vulnerable households
Design income restoration/improvement programmes	- Identify persons/households severely affected in terms of their income and employment losses - Conduct consultations to develop an income restoration programme for all APs - Develop a special income improvement programme for vulnerable APs
Prepare a budget and an implementation schedule	- Estimate the costs of key activities of resettlement operations and provide necessary budgetary provisions - Maintain a contingency budget to address unanticipated resettlement impacts - Establish a timeframe for completion of activities such as information campaign, compensation payments, and relocation
Identify sources of funding to implement RIP	- Identify local and foreign funding sources - Estimate their adequacy to pay compensation

	at replacement cost - Pay special attention to income restoration and improvement programmes and their budgets
Establish institutional arrangements to implement RAP/RIP and to monitor their implementation	- Assess the institutional framework and capacity building requirements, if any, to implement RP - Identify agencies responsible for implementation and management of the resettlement process - Establish a Resettlement Unit with resettlement staff, if the project is large and complex - Establish a coordination committee at project and subproject level for resettlement management - Appoint a local NGO/CBO or a local authority to monitor implementation of RP - Include a list of monitoring indicators into RP
Outline arrangements for RIP disclosure, review and approval	- Disclose the draft RIP for comments/observations from APs and other stakeholders - Indicate who will review the RP - Translate into Sinhala/Tamil - Indicate the approval authority and timeframe for approval

Source: Land Acquisition and Implementation of the National Involuntary Resettlement Policy: A Guide for Public Officials on Good Practices, MLLD, Government of Sri Lanka, 2013

Annex 2: Entitlement Matrix

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of Agricultural Land	Land acquired for the canal and related facilities such as service roads	Owner of titled land	a) Compensation for land at replacement cost – statutory compensation and special grant or replacement land of equal size and quality b) Market value for trees and crops.	EA/PIU	1. Compensation rates are determined based on, LAA, NIRP, LDO and LA Regulations, 2009 2. Replacement land: PAH will purchase replacement land in the same locality using the statutory compensation and special grant provided by the Project. Special grant is paid regardless of the tenure type of the land acquired. 3. Other assistance outlined in RIP will also be provided by PIU
Loss of Agricultural Land	-do-	Leasehol-der of state land	a) Compensation for loss of lease-hold land right; b) Market value for trees and crops	-do-	
Loss of Agricultural Land	-do-	Owner of State grant land	a) Compensation for land at replacement cost, b) Trees and crops at market value	-do-	
Loss of access to agricultural land	-do-	Owner of titled land	a)Compensation for land on replacement cost b) Compensation for crops and trees at market value	-do-	
Loss of access to agricultural land	-do-	*Ande* Farmer (Share cropper)	a) Compensation for loss of *Ande* right b) compensation for crops destroyed/damaged c) A registered tenant is entitled to get a 1.5 acres of irrigated land and .5 acres of homestead at a Mahaweli relocation site in Polonnaruwa District	-do-	
Loss of access to agricultural land	-do-	Non-titled user or squatter on State land	a) Compensation for land development b) Replacement cost of structures built c) Compensation for trees and crops at market value d) Grant to buy land.	-do-	
Residential Land and Structures					
Loss of Residential land and	Land acquired for canal, related facilities such	Owner of titled land	a) Compensation for structures and land at replacement cost,	EA /PIU	1. Compensation rates are determined based on NIRP, LAA, and LA

structures	as service roads		b) trees and crops at market value. c) Salvage materials from structures and trees without cost. c) Cash grant for purchase of housing allotment. d) Transport cost and other transaction cost e) Cash grant for temporary shed (Rs 50,000)		Regulations, 2009 2. A replacement homestead will be purchased by each physically displaced household for relocation in the same locality with the cash grant provided by PIU or request PIU to buy land on their behalf The cash grant will be sufficient to replacement land 4. other assistance outlined in RIP will also be provided by PIU
Loss of Residential land and structures	-do-	Owner with State grant land (Main HH)	a) Compensation for structures and land at replacement cost, b)Trees and crops at market value. c) Salvage materials of structures and trees without cost. d) Cash grant to purchase of housing allotment. e) Transport cost and other transaction cost f) Cash grant for temporary shed (Rs 50,000)	-do-	
Loss of Residential land and structures	-do-	Leasehol der of state land	a) Compensation for structures at replacement cost b) trees and crops at market value, compensation for leasehold right for land c) Salvage materials of structures and trees without cost. d) Cash grant for purchase of housing allotment. e) Transport cost and other transaction cost. f) Cash grant for temporary shed.	-do-	
Secondary Structures and Common Property					
Partial or complete loss of other property or	Land acquired for canals,	Owners of structures regardles	a) Compensation for structure and land at replacement cost b) Salvage materials without	EA /PIU	1. Compensation rates are determined based on NIRP, LAA, and LA

secondary structure (i.e. sheds, outdoor latrines, rice stores, animal pens etc.)	related facilities such as service road	s of land tenure	cost c) Cash grant for temporary shed (Rs 50,000)		Regulations, 2009 2. other assistance outlined in RIP will also be provided by PIU
Loss of tombs or graves	-do-	All owners	a) In case of a family cemetery, compensation will be paid for the lost land and structure b) If it is a public facility run by a local authority, compensation will be paid to the local authority	-do-	
Livelihood Restoration and Rehabilitation Assistance					
Materials Transport Allowance					
i) Loss of house and other structures		PAHs rebuilding house and other structures on same plot	a) Shifting allowance	EA/ PIU	
ii) Loss of house and other structures		PAH rebuilding house and other structures at a relocation site.	a) Shifting allowance b) Transport allowance	EA/PIU	
Transition Subsistence Allowance					
Loss of house		Severely affected household	. Rs, 25,000 ex gratia payment per PAH	EA / PIU	As per LA 2009 Regulations
Livelihood Restoration (Grant and Training)					
Loss of source of income or livelihood		PAPs/ household	a) Vocational & skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	

Permanent loss of income or livelihood sources		One member per household	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Permanent loss of income or livelihood sources		Severely affected household remaining on the affected land	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Special Assistance					
Loss of income or livelihood sources		Vulnerable PAHs including the poor and woman-headed household	a) Rs.25,000/= cash grant b) Priority in membership in Income restoration and improvement programmes c) Assistance in official document search and registration.		
Community Assets					
Loss of local roads, footpaths, bridges, irrigation, water ways		Divisional Secretary's Division, Local Authority and local community	a) All lost infrastructure facilities will be rehabilitated to their original conditions. b) If such affected infrastructure facilities cannot be provided, alternative infrastructure facilities will be provided	EA / PIU	- do-

HH = household; PIU = Project Implementing Unit, EA = Executive Agency,

Annex 3: Gap Analysis - Program's Involuntary Resettlement Safeguards and ADB Involuntary Safeguard Policy Principles, and Program's Safeguard Implementation Capacity

ADB Policy Principle	Triggered by the Program	Assessment	
		Assessment of Adequacy of the Program IR Safeguard Regime to Meet SPS IR Safeguard Requirements Actions	Assessment of Implementation Capacity
1. Screen the project to identify involuntary resettlement (IR) impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons and a gender analysis	Yes	IR country safeguard system provides for screening IR and risks as part of resettlement planning. NIRP requires that a RIP is prepared for projects where 20 or more households are affected. If less than 20 households are affected a RIP is to be prepared at a 'lesser level of detail'. Part of resettlement planning is identifying key stakeholders and exploration of viable project alternatives to minimize social impacts especially involuntary displacement, and assess whether resettlement and social impacts are significant or not. See 2008 LAA Regulations	MLLD is responsible for implementing of NIRP in collaboration with network of public and CSOs including CEA, PEA, the Ministries concerned and Divisional Secretaries.These agencies and EA have sufficient experience in applying this principle in formulating RIPs for projects.
2. Conduct meaningful consultations with affected persons (APs), host communities, and NGOs. Inform APs of their entitlements and resettlement options. Ensure APs, especially vulnerable household participation in project planning, implementation and monitoring. Establish a grievance redress mechanism. Support socio-cultural institutions of APs. If IR impacts are complex and sensitive, provide social preparation phase	Yes	The country safeguard system (CSS) has specific guidelines on consultations with PAPs, vulnerable groups and other stakeholders and NGOs; establishment of a GRM; recording of decisions at consultative meetings; and social preparation phase of RIP planning.	EA and IAs of the program have excellent experience in conducting meaningful consultations with PAPs and other stakeholders. GRM is a component of RIPs in the Mahaweli Systems and other irrigation programs. EA and IAs have used social preparation phase in their projects. The capacity to implement this principle exist at the Program and project levels.
3. Improve or at least restore the livelihoods of all DPs. Land-for-land compensation when affected livelihoods are land-based where possible or cash-for-land compensation when land the loss of land does not undermine livelihoods;	Yes	The country safeguard system provides opportunity to identify persons, households severely affected in terms of their income and employment losses. Income restoration programs are to be developed in consultations with APs in order to re-establish themselves and improve their quality of life. Replacement land is	EA/IAs are aware of this key principle and have applied in several projects.

ADB Policy Principle	Triggered by the Program	Assessment	
		Assessment of Adequacy of the Program IR Safeguard Regime to Meet SPS IR Safeguard Requirements Actions	Assessment of Implementation Capacity
prompt replacement of assets, prompt compensation at replacement cost for assets that cannot be restored.Provide additional revenue and services through benefit-sharing schemes.		an option for compensation in the case of land loss; in the absence of replacement land cash compensation is an option for all APs. See NIRP Payment of full replacement cost of lost assets to PAPs is a key principle of NIRP. LA Regulations 2008 provide a comprehensive compensation package including the market value of property acquired. The total package amounts to replacement cost of lost assets.	
4. Provide all APs needed assistance: if relocated, secured tenure to resettlement land, better housing, access to employment and production opportunities, integration of resettlers with host communities, extension of project benefits to host communities, transitional support and civic infrastructure and community services, as required.	Yes	The CSS recognizes the special needs of physically relocated PAPs. PAPs involve in the selection of resettlement sites, livelihood compensation and development options at the earliest opportunity. Gender equality and equity are to be ensured and adhered to in resettlement programs. The CSS provides for assisting PAPs to be economically and socially integrated into the host communities. Participatory measures are to be designed and implemented by the resettlement planners and implementers.	Our field visits to current resettlement sites of projects (Moragahakanda Reservoir project) indicate that EA/IAs have sufficient understanding of this principle and have applied in several other projects.
5. Improve the standards of living of the displaced poor and vulnerable groups	Yes	CSS, especially NIRP and LA Regulations 2008, emphasize the importance of improving standard of living of the affected vulnerable and poor groups.	EA/IAs in their previous RIPs have paid sufficient attention to this key principle. Entitlement Matrices indicate this practice which is satisfactory.
6.Develop procedures in a transparent, consistent and equitable manner if land acquisition through negotiated settlement to ensure that APs maintain the same or better income and livelihood status	Yes	Although negotiated acquisition is recognized as a method of land acquisition by CSS, it is subject to LAA procedures of land acquisition which could cause delays. However, the NIRP and LA Regulations 2008 provide a legal framework for ensuring that PAPs maintain the same or better income and livelihood status	The application of LA Regulations 2008 and NIRP by EA/IAs in several other projects is satisfactory. They have the capacity to apply this principle.
7.Ensure that APs without titles to land or	Yes	Compensation for non-land assets of non-titled persons is a well-	EA/IAs have planned and implemented several RIPs

ADB Policy Principle	Triggered by the Program	Assessment	
		Assessment of Adequacy of the Program IR Safeguard Regime to Meet SPS IR Safeguard Requirements Actions	Assessment of Implementation Capacity
recognizable legal rights to land are eligible for resettlement assistance and compensation for loss of nonland assets.		established principle in CSS. Often such non-titled persons are provided with land at resettlement sites to ensure that they will have better socio-economic status during post-displacement.	which include this key principle. EA/IA possess sufficient capacity.
8.Prepare a resettlement plan with APs' entitlements, income and livelihood strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule	Yes	CSS, especially NIRP and LA Regulations 2008 require RIP for any project which is likely to have resettlement impacts. Necessary guidance is also published by MLLD on how to prepare RIP.	EA/IAs have vast experience in RIP formulation and implementation
9.Disclose resettlement plan including documentation of the consultation process in a timely manner, before project appraisal in an accessible place and a form and language understandable to APs and other stakeholders. Disclose final resettlement plan and its updates to APs and other stakeholders.	Yes	CSS, especially NIRP and LA Regulations 2008 require disclosure of RIP. LAA discloses the lands which have been identified to acquire for a public purpose and calls for views, opinions and objections.	EA/IAs possess sufficient experience and capacity in RIP disclosure and consultations on resettlement information with PAPs. This has been done in several projects.
10. Conceive and execute involuntary resettlement as a part of development project or program. Include the full cost of resettlement in the project costs and benefits. If significant resettlement impacts are found, consider implementing the IR component of the project as a stand-alone operation.	Yes	IR is considered as a key component of any development project in Sri Lanka and in this regard, NIRP and LA Regulations 2008 provide sufficient guidance.	EA/IAs have sufficient experience in calculating resettlement cost as part of project cost and in obtaining sufficient funds from the Treasury to pay compensation and implement resettlement programs including income restoration programs for the benefit of PAPs.

ADB Policy Principle	Triggered by the Program	Assessment	
		Assessment of Adequacy of the Program IR Safeguard Regime to Meet SPS IR Safeguard Requirements Actions	Assessment of Implementation Capacity
11. Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement RP under close supervision throughout project implementation	Yes	CSS focuses on this key safeguard principle. Payment of compensation before displacement is the law except in case of urgency clause 38(a) of LAA.	EA/IAs are cognizant of the importance of paying compensation prior to displacement. Delays do occurbecause of lack of sufficient funds and litigation over land ownership. EA/IAs have sufficient experience and capacity to apply this principle
12. Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the RP have been achieved based on baseline conditions and the results of resettlement monitoring.	Yes	Monitoring and assessing resettlement outcomes are not well developed in the IR regulatory framework. Special arrangements are to be introduced to overcome this deficiency in CSS	Project-based internal and external monitoring of IR impacts are part of donor-funded projects which EA/IA have planned and implemented. They have gained sufficient capacity in this regards which could be applied to the Program.

Annex 4: INVOLUNTARY RESETTLEMENT IMPACT CATEGORIZATION CHECKLIST

Probable Involuntary Resettlement Effects	Yes	No	Not Known	Remarks
Involuntary Acquisition of Land				
1. Will there be land acquisition?				.
2. Is the site for land acquisition known?				
3. Is the ownership status and current usage of land to be acquired known?				
4. Will easement be utilized within an existing Right of Way (ROW)?				
5. Will there be loss of shelter and residential land due to land acquisition?				
6. Will there be loss of agricultural and other productive assets due to land acquisition?				
7. Will there be losses of crops, trees, and fixed assets due to land acquisition?				
8. Will there be loss of businesses or enterprises due to land acquisition?				
9. Will there be loss of income sources and means of livelihoods due to land acquisition?				
Involuntary restrictions on land use or on access to legally designated parks and protected areas				
10. Will people lose access to natural resources, communal facilities and services?				
11. If land use is changed, will it have an adverse impact on social and economic activities?				
12. Will access to land and resources owned communally or by the state be restricted?				
Information on Displaced Persons:				
Any estimate of the likely number of persons that will be displaced by the Project? If yes, approximately how many?				[ ] No [ ] Yes
Are any of them poor, female-heads of households, or vulnerable to poverty risks?				[ ] No [ ] Yes
Are any displaced persons from indigenous or ethnic minority groups?				[ ] No [ ] Yes

Note: The project team may include additional questions to get more information on the project, as necessary.

Sri Lanka

Project Number: 47381
December 2014

Sri Lanka: Water Resources Development Investment Programme

North Western Province Canal Project

Resettlement Implementation Plan (draft)

Ministry of Irrigation and Water Resources Management
Democratic Socialist Republic of Sri Lanka

Contents

ABBREVIATIONS

DOI	Department of Irrigation
DRC	Depreciated recovery cost
DSD	Divisional Secretary Division
EA	Executive Agency
EIA	Environment impact assessment
GNO	*Grama Niladhari* Officer
GND	*Grama Niladhari* Division
GRC	Grievance redress committee
GRM	Grievance redress mechanism
HH	Household
IA	Implementing agency
IR	Involuntary resettlement
ISEWP	improving system efficiencies and water productivity
KMTC	Kaluganga-Moragahakanda Transfer Canal
LAA	Land Acquisition Act 1950
MASL	Mahaweli Authority of Sri Lanka
MCB	Mahaweli Consultancy Bureau (Pvt) Limited
MFF	Multi-tranche Financing Facility
MLLD	Ministry of Land and Land Development
MDP	Mahaweli Development Programme
MRB	Mahaweli River Basin
MIWRM	Ministry of Irrigation and Water Resources Management
MLBCR	Minipe Left Bank Canal Rehabilitation
MFF	Multi tranche financing facility
NCPCP	North Central Province Canal Programme
NWPC	North Western Province Canal
PAP	Project-affected person
PIU	Project implementation unit
PMDC	programme management and design consultant
PMU	Project management unit
PPTA	project preparatory technical assistance
RDA	Road Development Authority
RIP	Resettlement Implementation Plan
SIWRM	Strengthening integrated water resources management
SLR	Sri Lanka rupees (US $ = SLR 128)
SPS	Safeguard Policy Statement

GLOSSARY

Cut-off-date: For land to be acquired from titled landowners, the date of notification for acquisition under the Land Acquisition Act (LAA) will be treated as the cut-off date. For non-titleholders such as squatters, encroachers, the starting date of the project census or a designated date declared by EA in consultation with Divisional Secretaries will be considered as the cut-off date**.**

Disturbance**:** Disturbances caused to normal living of a person arising from compulsory acquisition of private land.

Encroacher: A Person who has illegally occupied state land. Any legal title holder to a piece of land becomes an encroacher if he/she establishes boundaries of the holding to include adjacent state land without prior approval.

Entitlement: A variety of measures including compensation, income restoration and interim support, transfer assistance, relocation and other benefits given to project-affected-persons (PAPs) to restore and improve their post-displacement socioeconomic conditions.

Entitlement matrix: It identifies categories of eligible persons and their specific entitlements under the project, and what agency/department is responsible to deliver them on time.

Host population: Persons, households and communities who reside in resettlement areas where PAPs are relocated.

Income restoration: Re-establishing income sources and livelihoods of project-affected persons to pre-project level in real terms.

Injurious affection**:** Adverse impact on the value of the remaining land due to acquisition of a part of a land.

Inventory of losses: Complete and accurate count of houses, land, business structures, trees and crops and other assets on land that will be affected by the project.

Involuntary Resettlement: The unavoidable physical or economic displacement of persons arising from a development project. In case of physical displacement, PAPs need assistance to rebuilding their livelihood, income and asset bases and social and cultural systems. If economically displaced, PAPs still need assistance to restore their livelihood and assets.

Project-affected persons (PAPs): Any person, who as a result of the implementation of a project, losses the right to own, use, or otherwise benefit from a built structure, land (residential, agricultural or pasture), annual or perennial crops and trees, or any other fixed or moveable asset, either in full or in part, permanently or temporarily.

Rehabilitation: Re-establishing and improving incomes, livelihoods and social systems of PAPs.

Relocation: Moving PAPs and their moveable assets, rebuilding their houses, developing new land, and providing public infrastructure at the relocation site.

Replacement cost: The method of valuation of assets that helps determine the amount sufficient to replace lost assets and cover transaction costs. In applying this method of valuation, depreciation of structures and assets are not to be taken into account. For losses that cannot easily be valued or compensated in monetary terms such as access to public services, customers and suppliers; to fishing, grazing or forest areas, the project will establish access to equivalent and culturally acceptable resources and earning opportunities.

Resettlement: Involuntary physical or economic displacement of persons caused by a project that covers compensation, relocation and rehabilitation measures to mitigate the effects of such displacement.

Resettlement *Budget:* A detailed breakdown of all costs of a resettlement implementation plan (RIP). This is a part of project costs.

Resettlement effects: Loss of physical and non-physical assets, including homes, communities, productive land, income earning assets and sources, resources, cultural sites, social structures, networks and ties, cultural identity and mutual help mechanisms.

Resettlement Implementation Plan (RIP): Time bound action plan with a budget setting out resettlement strategy, objectives, entitlement, actions, responsibilities, monitoring, evaluation and reporting.

Severance**:** Dividing a landholding into two or several parts due to acquisition of the middle portion for a public purpose.

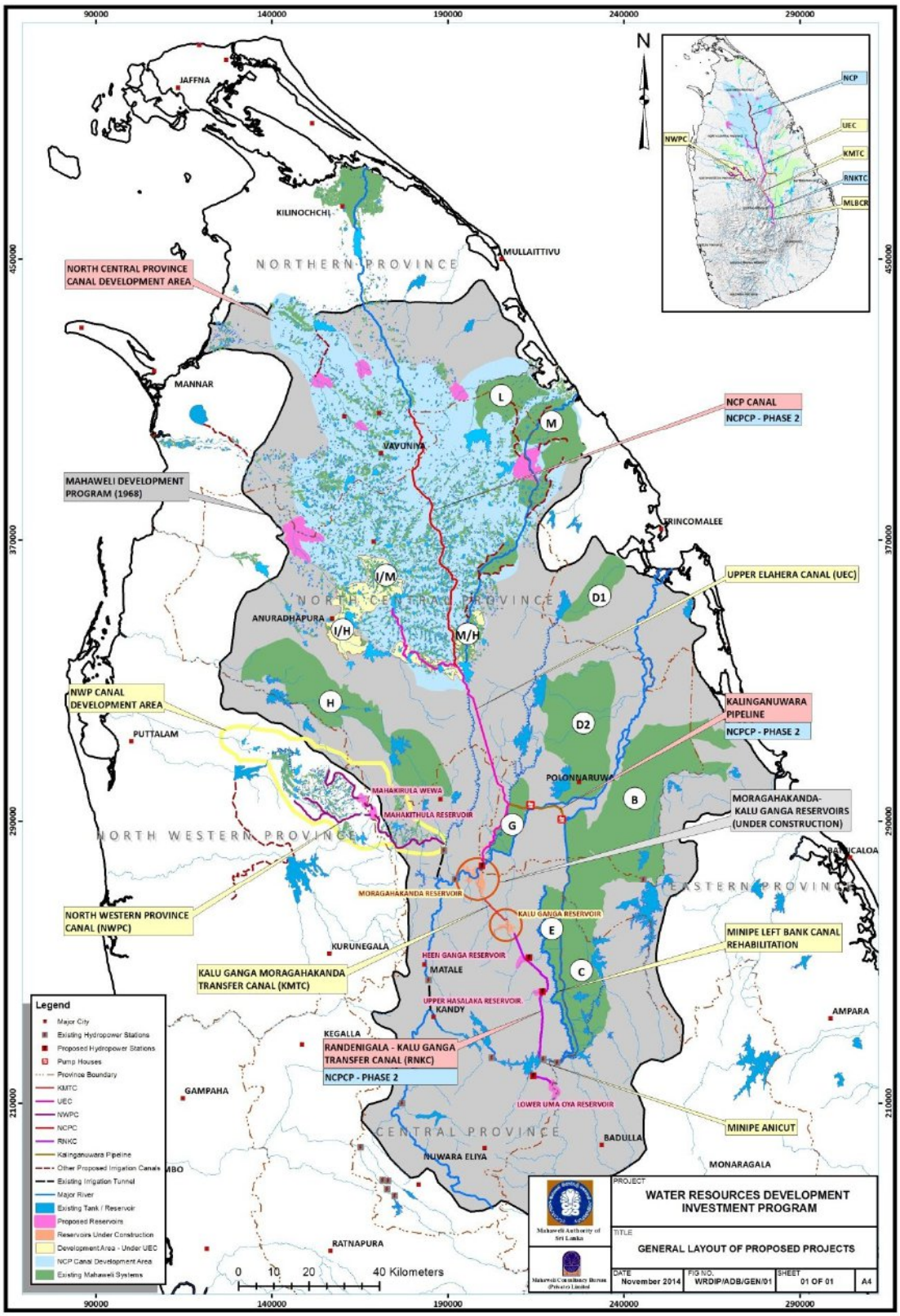
Social preparation: a process of consultations with PAPs conducted before key involuntary resettlement decisions are decided

Squatter**:** A person who occupies a piece of land without a title or any recognizable legal rights to that land.

Sub project: North western province canal project

Value to owner**:** Valuation based on actual cost to the landowner.

Vulnerable groups: Distinct groups of poor people who might suffer disproportionately from resettlement effects. Among them are the old, the young, the handicapped, the poor, isolated groups and female-headed of households.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NCP
UEC
NWPC
KMTC
RNKTC
MLBCR
JAFFNA
KILINOCHCHI
MULLAITTIVU
NORTHERN PROVINCE
NORTH CENTRAL PROVINCE CANAL DEVELOPMENT AREA
MANNAR
VAVUNIYA
NCP CANAL
NCPCP - PHASE 2
MAHAWELI DEVELOPMENT PROGRAM (1968)
TRINCOMALEE
UPPER ELAHERA CANAL (UEC)
NORTH CENTRAL PROVINCE
ANURADHAPURA
NWP CANAL DEVELOPMENT AREA
PUTTALAM
KALINGANUWARA PIPELINE
NCPCP - PHASE 2
POLONNARUWA
MAHAKIRULA WEWA
MAHAKITHULA RESERVOIR
MORAGAHAKANDA-KALU GANGA RESERVOIRS (UNDER CONSTRUCTION)
NORTH WESTERN PROVINCE
EASTERN PROVINCE
MORAGAHAKANDA RESERVOIR
KALU GANGA RESERVOIR
NORTH WESTERN PROVINCE CANAL (NWPC)
MINIPE LEFT BANK CANAL REHABILITATION
KURUNEGALA
HEEN GANGA RESERVOIR
MATALE
KALU GANGA MORAGAHAKANDA TRANSFER CANAL (KMTC)
UPPER HASALAKA RESERVOIR
KANDY
AMPARA
KEGALLA
RANDENIGALA - KALU GANGA TRANSFER CANAL (RNKC)
NCPCP - PHASE 2
GAMPAHA
LOWER UMA OYA RESERVOIR
MINIPE ANICUT
CENTRAL PROVINCE
BADULLA
NUWARA ELIYA
MONARAGALA
RATNAPURA
0 10 20 40 Kilometers
Legend
Major City
Existing Hydropower Stations
Proposed Hydropower Stations
Pump Houses
Province Boundary
KMTC
UEC
NWPC
NCPC
RNKC
Kalinganuwara Pipeline
Other Proposed Irrigation Canals
Existing Irrigation Tunnel
Major River
Existing Tank / Reservoir
Proposed Reservoirs
Reservoirs Under Construction
Development Area - Under UEC
NCP Canal Development Area
Existing Mahaweli Systems
Mahaweli Authority of Sri Lanka
Mahaweli Consultancy Bureau (Private) Limited
PROJECT
WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM
TITLE
GENERAL LAYOUT OF PROPOSED PROJECTS
DATE
November 2014
FIG NO.
WRDIP/ADB/GEN/01
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Water Resources Development Investment Programme

North Western Province Canal Project

Resettlement Implementation Plan

1. Introduction

1. This Resettlement Implementation Plan (RIP)addresses land acquisition, compensation, resettlement assistance, income restoration and improvement, and physical relocation requirements of the North Western Province Canal Project (the Project) which is a constituent part of the SRI: Water Resources Investment Development Programme (WRIDP) (See Table 1 below).

2. ADB supports the Government of Sri Lanka to plan and implement WRIDP through the Ministry of Irrigation and Water Resources Management (MIWRM) by financing the following three investment projects that constitute the planned North Central Province Canal Program (NCPCP).The WRIDP is a multitranche financing facility (MFF) of $675 million. The MFF will comprise three tranches financing three loan “Projects”. The Projects will comprise the following individual investment projects:

   (i) The Kaluganga-Moragahakanda Transfer Canal Project (KMTCP) will convey about 771 million cubic meters (MCM) of water annually between the Kaluganga and Moragahakanda Reservoirs which are under construction. They will retain local runoff and the Mahaweli River flow diversion, before augmenting downstream irrigation and water supply schemes. The length of the canal is 9 kilometers (km) and comprises about 8-km of tunneling.

   The Upper Elahera Canal Project (UECP) will annually convey about 974 MCM northwards from the Moragahakanda Reservoir along a 65.5-km canal to the Huruluwewa and Manankattiya Reservoirs which, in turn, feed existing irrigation and water supply schemes.

   (ii) The North Western Province Canal Project (NWPCP) will annually withdraw 130 MCM from the Dambulu Oya River and the Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located in North Western Province via 80-km of new and upgraded canals including a new 700 meter (m) tunnel.

   (iii) Minipe Left Bank Canal Rehabilitation Project (MLBCRP), located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork’s weir by 3.5 meters to regulate generation inflows, and (b) rehabilitate the 76-km Minipe Left Bank Canal to improve conveyance and reliability of service to farmers.

3. The Investment Programme will be implemented over ten year period, and its proposed structure is shown in Table 1. It will also include three consulting packages comprising:

(i) 'improving system efficiencies and water productivity' (ISEWP); (ii) 'strengthening of integrated water resources management' (SIWRM); and (iii) the 'The Program Management, Design, and Supervision Consultant' (PMDSC) which will support MIWRM in managing WRIDP and preparing packages under the investment programme.

Table 1: Tentative Investment Program Structure and Implementation Schedule

Project	Value ($, millions)	Project	Schedule
Construction Works			
Project-1	189	UEC Stage 1 NWPC Stage 1 MLBCR	Q1 2015 – Q4 2019
Project-2	287	UEC Stage 2 and KMTC	Q1 2016 – Q4 2024
Project-3	199	UEC Stage 3 NWPC Stage 2	Q1 2018 – Q2 2024
TOTAL	**675**		

KMTC = Kaluganga – Moragahakanda Transfer Canal; MLBCR = Minipe Left Bank Canal Rehabilitation; NWPC = North Western Province Canal;UEC = Upper Elahera Canal; Q = quarter of a year.
Source: Asian Development Bank

Rationale of the Project

4. Water is the principal medium in the dry zone of Sri Lanka through which climate change exhibits its environmental, economic and social impacts. Many regions, particularly poorer communities, are vulnerable to droughts and water-related disasters such as floods that destroy lives, assets and incomes. Moreover, widespread kidney diseases caused by bad drinking water threaten the lives of rural populations of the northern dry zone. The risks associated with climate uncertainty and change can be mitigated to some extent by storing and distributing water wisely when it is scarce, and by planning ahead to protect communities from droughts and floods. Coping with water-related risks requires a collective involvement and broad planning perspective. The WRDIP takes this key development issues as one of its objectives (see Table 2).

5. No new lands are identified to irrigate by the NWPCP. The main benefit of the Project will be increased cropping intensity of existing cultivated lands under major and minor irrigation schemes. In addition, the Project will provide safe drinking water to a large population who suffers now from drought and lack of safe drinking water.

6. Providing safe water services and managing water resources wisely will improve health, and open opportunities for all to improve their life chances through education and capacity-building. In many poor communities, fetching water from distant sources and queuing for water are physically-demanding and time-consuming responsibilities borne primarily by women and girls. Women, as a result, have less time to engage in productive economic activities and this lack of involvement leads to increased poverty. In

case of young girls, school attendance is often considered a lesser priority: a gender bias that creates an imbalance in school enrolment ratios has been noted in the project areas, although the imbalance has been progressively declining. Disparities in women's education and involvement in decision-making can place them at a significant disadvantage in earning an income or voicing their views on affairs of their communities (Table 2).

Table 2: WRDIP and Millennium Goals

Millennium Development Goal	Applicability to WRDIP	How It could help achieve the goal	Comments
1. Eradicate Extreme Poverty	Yes	Having a sustainable, safe water supply, and benefiting from its economic opportunities such as better and secure irrigated agriculture help break the vicious circle of poverty	Key objective of WRDIP
2. Achieve Universal Primary Education	Yes	A safe and secure water supply helps all children – boys and girls – to stay at school, and enables women to participate more actively in income generating activities and in their community activities	One of WRDIP's broad development goals
3. Promote gender equality and empower women	Yes	See above.	See above
4. Reduce child mortality	Yes	Safe drinking water, nutritious food and improved sanitation are central to health and well-being of children and their parents.	See above
5. Improve maternal health	Yes	See above	See above
6. Combat HIV/AIDS, malaria & other diseases	Yes	See above	See above
7. Ensure environmental Sustainability	Yes	Better management of water resources lessens pollution and improves water conservation towards ensuring sustainable, life-supporting ecosystems.	Key development goals of WRDIP
8. Develop a global partnership for development	Yes	Water has no political or ethnic boundaries and is especially vulnerable to human impacts. WRDIP works with people and agencies to use this irreplaceable resource wisely	Contribute to deal with vulnerability of communities regardless of their ethnicity and class.

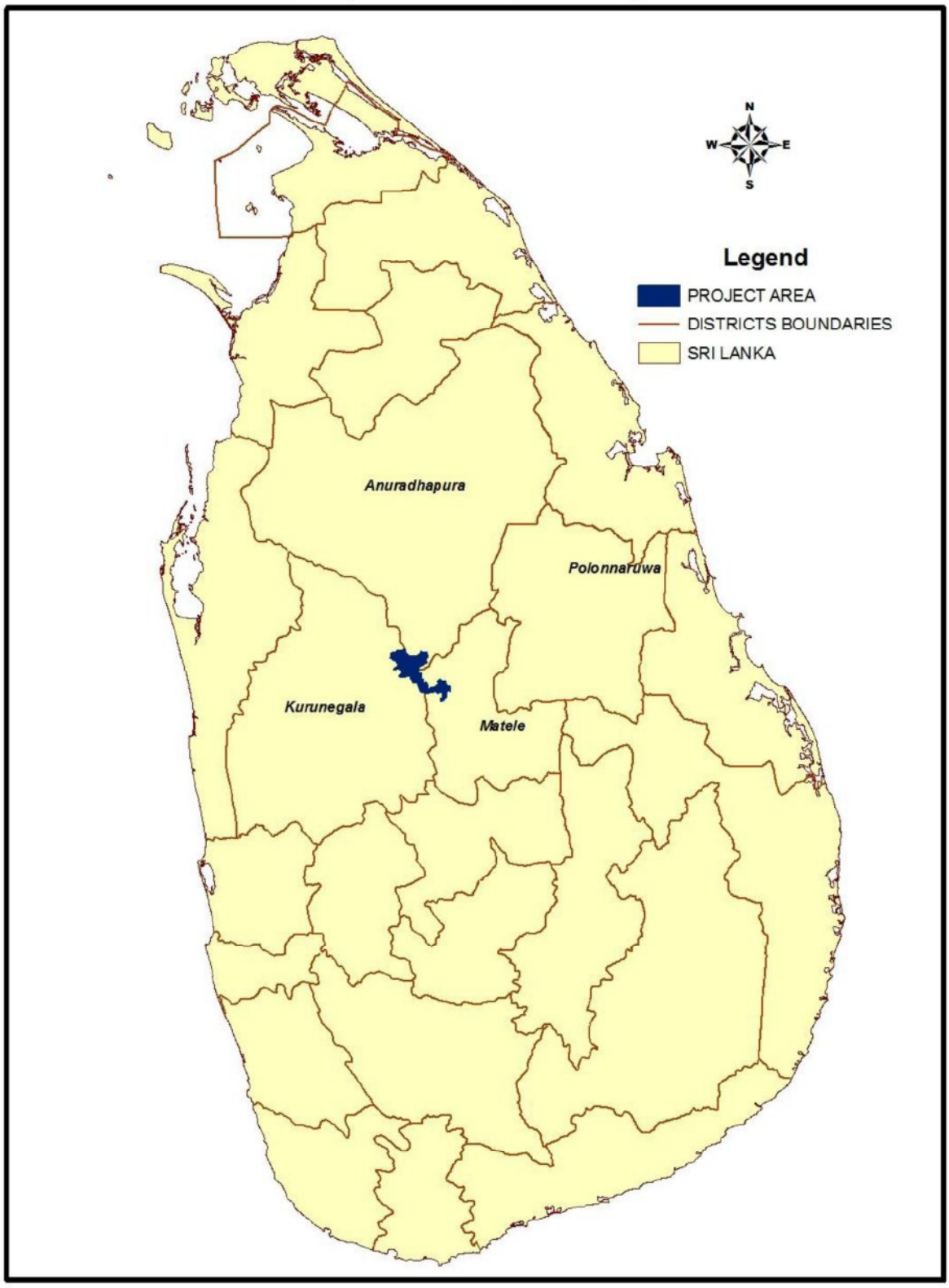
2. North Western Province Canal Project

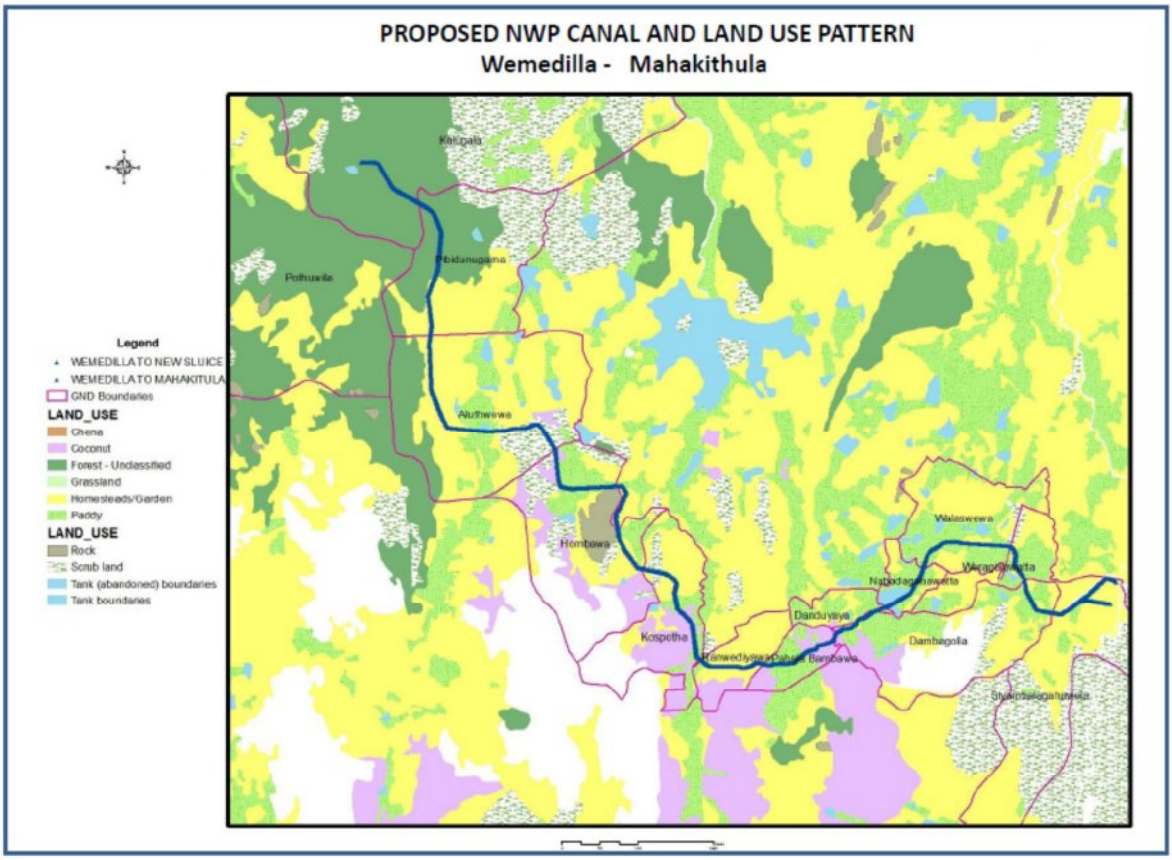
7. The Project will have limited resettlement impacts as only 22 households with 02 sub-families will be physically displaced. In addition, 473 households will lose some land to the Project; but no household will lose more than 10 percent of their land or other livelihood sources. Five physically displaced households fall into the category of poor whose monthly income is below the official poverty line. The resettlement impacts of the Project, therefore, are categorised as 'B'.

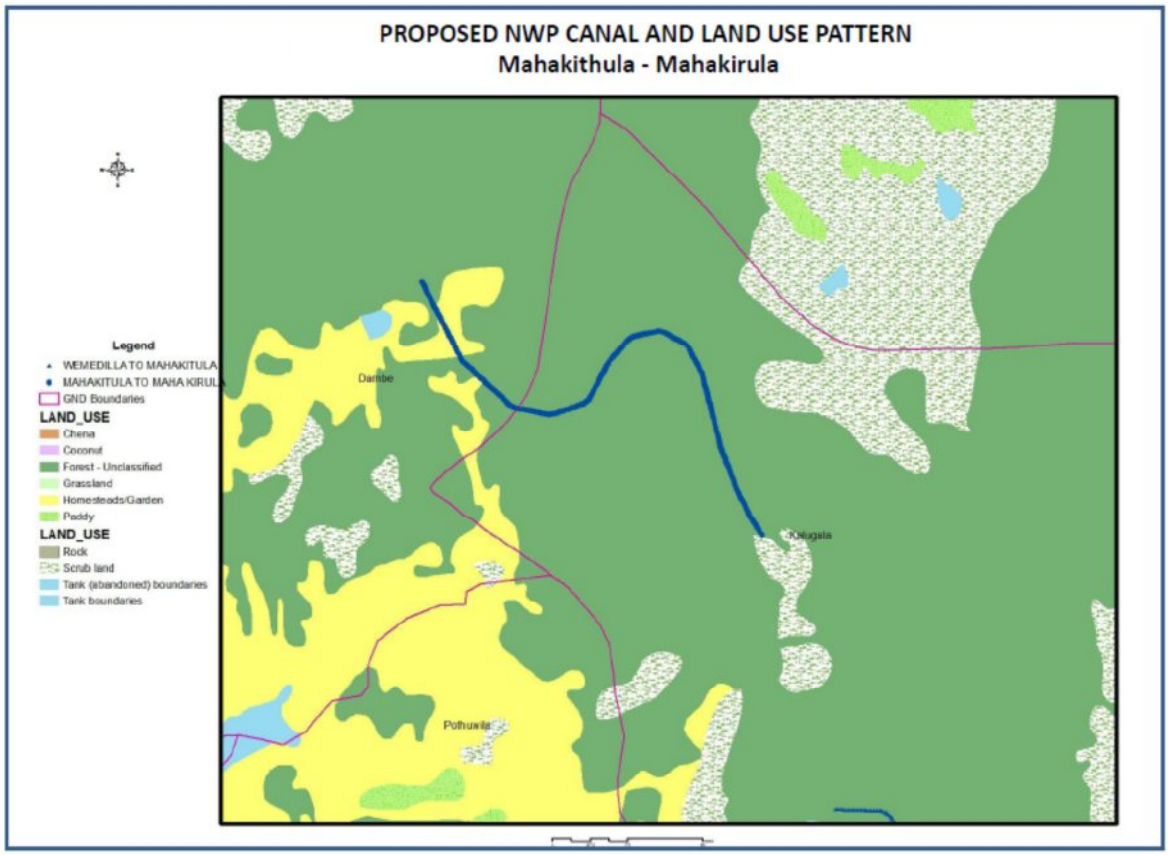
8. The Project will be located in the following administrative areas:

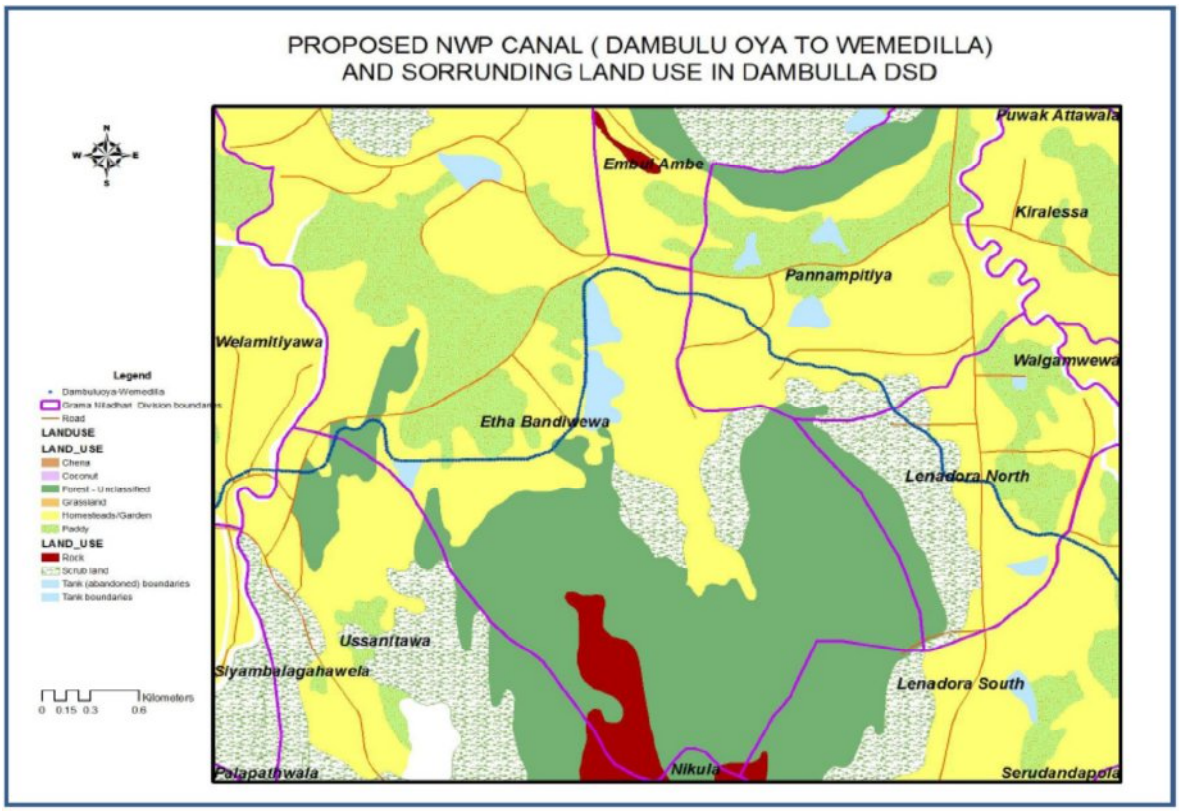
- Lenadora-Wemedilla section of the canal (00-26km) traverses through Naula and Dambulla DSDs where 10 households will physically be displaced and 96 households will economically affected.
- Dewahuwa Feeder Canal (00-05km) a part of the canal starts at Wemedilla in Dambulla DSD and ends at Nabadagaswewa in Galewela DSD. A few private highland allotments will be affected by the canal.
- 05-30km canal section starts at Nabadagawewa and ends at the Mahakitula Reservoir. 09 households with 02 sub-families will be affected by this section of the canal.
- 30-33km section starts at Mahakithula Reservoir and ends at Mahakirula Reservoir. This section of the canal will traverse through the wildlife reserve.
- 00-1.500km section of the canal starts at Mahakithula Reservoir and ends at Pothuwila village. In this section, there are no houses or cultivated land except for a few chena (slash-and-burn) plots.
- 1.500-6.500km of the canal section starts at Mediyawa and ends at Edandukote. No household will be physically displaced. A few households will marginally be affected as less than 10 percent of their highlands will be acquired.
- 6.500-19.500km section of the canal will traverse through several villages in Polpithigama and Mahawa DSDs. Three households will be physically displaced in this section by the canal in addition to highland allotments.

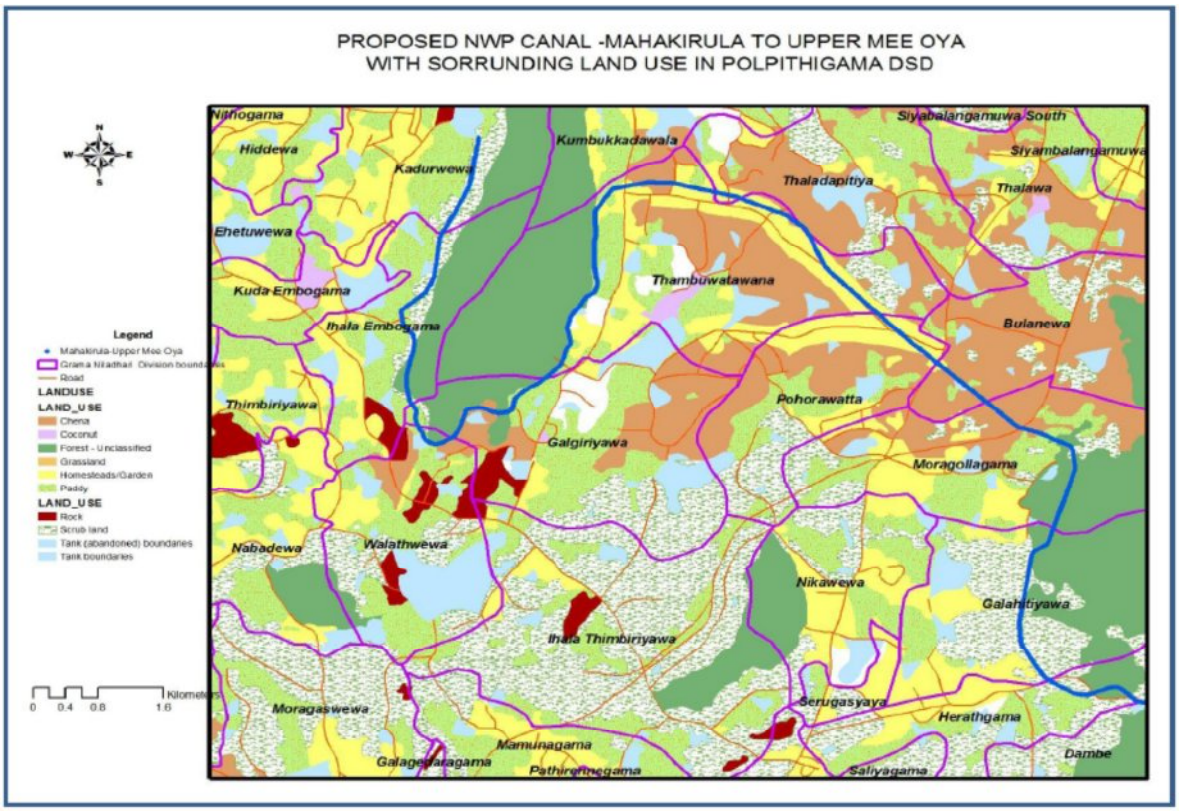
LOCATION MAP OF PROJECT AREA
(Proposed NWP Canal)




PROPOSED NWP CANAL AND LAND USE PATTERN
Wemedilla - Mahakithula
Legend
WEMEDILLA TO NEW SLUICE
WEMEDILLA TO MAHAKITULA
GND Boundaries
LAND_USE
Chena
Coconut
Forest - Unclassified
Grassland
Homesteads/Garden
Paddy
LAND_USE
Rock
Scrub land
Tank (abandoned) boundaries
Tank boundaries
Kalupala
Pothuwila
Aluthwewa
Hombawa
Kospetha
Danduwaya
Dambagolla
Walaswewa


PROPOSED NWP CANAL AND LAND USE PATTERN
Mahakithula - Mahakirula
Legend
WEMEDILLA TO MAHAKITULA
MAHAKITULA TO MAHA KIRULA
GND Boundaries
LAND_USE
Chena
Coconut
Forest - Unclassified
Grassland
Homesteads/Garden
Paddy
LAND_USE
Rock
Scrub land
Tank (abandoned) boundaries
Tank boundaries
Dambe
Kotagala
Pothuwila


PROPOSED NWP CANAL (DAMBULU OYA TO WEMEDILLA)
AND SORRUNDING LAND USE IN DAMBULLA DSD
Legend
Dambuluoya-Wemedilla
Grama Niladhari Division boundaries
Road
LANDUSE
LAND_USE
Chena
Coconut
Forest - Unclassified
Grassland
Homesteads/Garden
Paddy
LAND_USE
Rock
Scrub land
Tank (abandoned) boundaries
Tank boundaries
Kilometers
0 0.15 0.3 0.6
Puwak Attawala
Kiralessa
Pannampitiya
Welamitiyawa
Walgamwewa
Etha Bandiwewa
Lenadora North
Ussanitawa
Siyambalagahawela
Lenadora South
Palapathwala
Nikula
Serudandapola

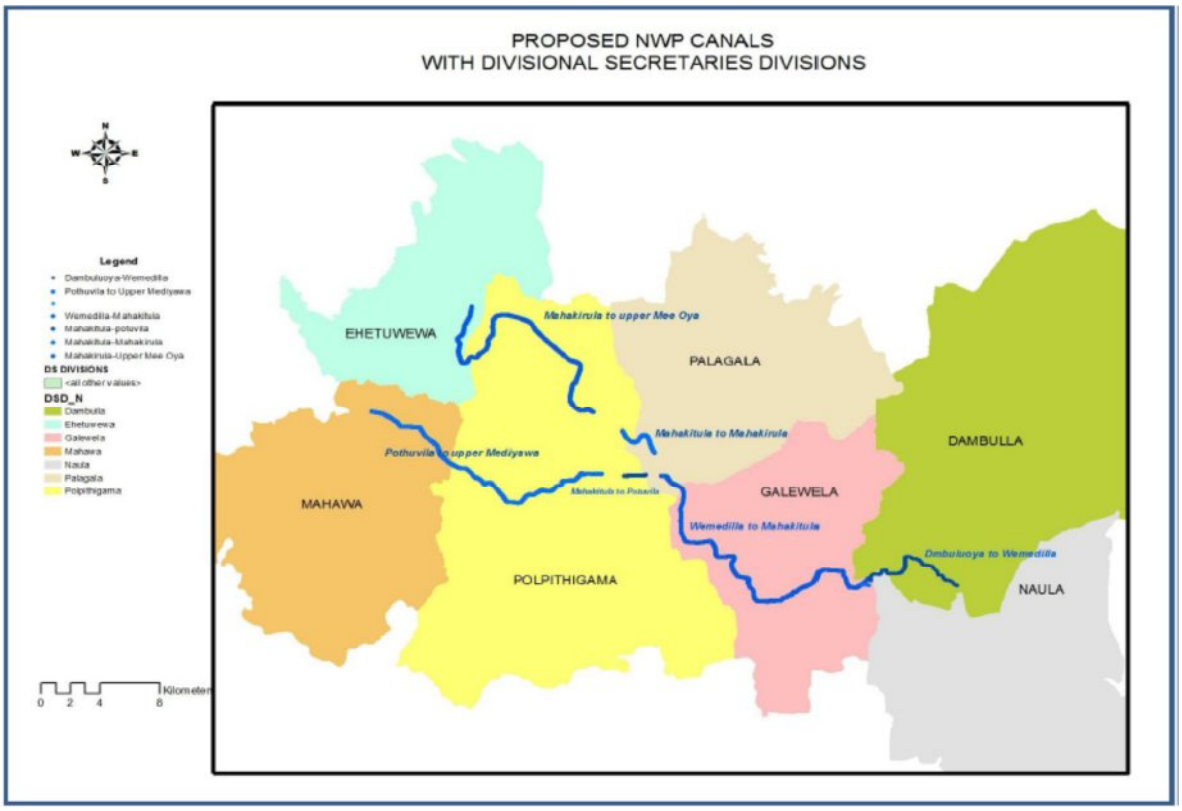


Avoidance of Resettlement Impacts

09. During the canal trace design, every attempt has been taken to avoid homesteads and dwellings. The canal trace has been revised several times to reduce its environmental and social impacts. Because of these adjustments to the canal trace, the land area and number of households affected by the Project have been substantially reduced. The socio-economic survey of 2013 identified 70 households as physically-displaced households. But by the time the resettlement census of 2014 conducted, the total number of physically displaced households reduced to 24 (22 households and 02 sub-families. Added to them are the 473 households whose land will be marginally affected as only a strip of land will be acquired from each affected land allotment. On the original canal trace, there were 04 houses between 15.800 and 15.900-km, and between 18.100 and 18.340, which are identified as property to be acquired. The discussions between the social safeguard team and design engineers of the Programme resulted in the change of the canal trace to avoid the acquisition of the 04 houses.

3. Socio-economic Profile of Project-affected Households

10. A comprehensive field information survey (socio-economic survey) was conducted in 2013 as a part of environmental assessment of the Project to identify the scope and significance of potential project impacts on project-affected households (PAHs). The survey team interviewed more than 90 percent of identified PAHs in order to develop a comprehensive socio-economic profile of the project area and its people. The survey identified 70 households as potentially affected households who reside in the GNDs of Lenadora north, Ethabendiwewa and Welamitiyawa in Dambulla DSD, Danduyaya, Ranwediyawa, Pahalabambawa Kospotha GNDs in Galewela DSD, and Konwewa GND of Mahawa DSD. This section outlines the key findings of the socio-economic assessment in the project area highlighting its impacts on human settlements and populations.



Population

11. 70 potentially affected households with 248 persons live in 05 DSDs, where the NWP Canal will be constructed (Table 3).

Table 3:Project-affected Population by Location and Gender

DS Division	No. of Displaced Households	Population		
		Male	Female	Total
Galewela	39	63	73	136
Dambulla	08	10	15	25
Naula	00	00	00	00
Polpithigama	11	24	24	48
Mahava	12	17	22	39
Total	**70**	**134**	**114**	**248**

Source: EIA Field Information Survey, NWCP, October 2013

12. Infant population constitute 10 percent of the project-affected population. 21 percent of the population is at the school going age. Half of the population (48 percent) constitutes the labour force in the Project area. Although the old population is as high as 17 percent, only a small percentage of it is in fact retired, as farmers do not retire till they become disabled. Male-female ratio is 40:60 (Table 4).

Table 4:Physically Displaced Population by Age

Age (years)	No. of Person	Percentage
05 and below	25	10
06 – 18	51	21
19 – 35	74	30
36 – 50	45	18
Older than 50	44	17
Data not provided	09	04
Total	**248**	**100**

Source: EIA Field Information Survey, NWCP, October 2013

Occupations

13. Agriculture is a source of income and livelihood. Small irrigation tanks and irrigation systems, and monsoons rains are the principal water sources of agriculture. Almost every village in the Project Area has an irrigation tank to collect rainwater, and a canal system to convey water to cultivated lands. The cultivable area in a given season depends on the size and capacity of the irrigation system and rain water availability. Farmers distribute water collectively using well established traditions and rules.

14. Only 25 percent of households are engaged in agriculture as their main source of income in the Project area because of high risks associated with farming. In good rainy seasons, villagers store water in irrigation reservoirs and collectively manage water carefully for irrigation and domestic purposes. If a drought sets in during a cultivation season, they could lose the entire crop. Another risk is wild animals harming the crops. As a result, the majority (75 percent) are engaged in different occupations such as

government employment (14 percent), private sector employment (25 percent), self-employment (17 percent), wage labour (14 percent), and agricultural labour (Table 5). Despite the risks associated with agriculture, uneducated and poor villagers engage in agriculture by finding their own solutions within their limited capacities for the difficulties encountered a season after another.

Table 5: Occupations of PAPs in the Project Area

Sector	No. of People Engaged	Percentage
Government	15	14
Private	27	25
Self employed	18	17
Daily wage labour	15	14
Agriculture labour	05	05
Farming	27	25
Total	**107**	**100**

Source: EIA Field Study, NWP Canal Project 2013 October

15. There are 16 households in the Project area identified by the Government as low-income households. Many of them are headed by widows. Each household receives a monthly grant from the Government under the *Samurdhi* Relief Programme (Table 6). They work as daily wage workers in agriculture and non-agricultural activities to supplement the grant, as it is not sufficient to cover their household expenditure.

Table 6: Samurdhi Recipients in the Project Area

Monthly Grant in Rs	No.of Households
350 and less	02
351 – 700	05
701 – 1000	08
More than 1001	01
Total	**16**

Source: EIA Field Information Survey, NWPCP, October 2013

Infrastructure Facilities in the Project Area

16. The Project area includes urban, semi-urban and rural settlements. Although the settlement patterns are widespread over a large area, they are well connected through transport facilities.

17. **Roads**: Main towns in the Project area are Galewela, Dambulla, Ambanpola and Galgamuwa. The affected villages are directly connected with major road network of the country. Mahawa, Polpithigama and Ahatuweva also can be easily accessed through a secondary road network. Rural areas can be reached through motorable road network

although some roads have not been repaired for many years. Gravel roads connect hamlets within villages.

18. **Transport Facilities**: The road networks connecting towns have excellent transport facilities operated by both the Government and private sector. In rural areas, transport facilities are satisfactory. Many villagers own bicycles, two-wheeled tractors, motor bicycles, and three-wheelers. Rural villages are also served by private buses, trucks and tractors operated on daily basis by town-based transport providers. They transport people as well as local produce to the market centres.

19. **Health Facilities**: In the Project area, there are two base hospitals, three 'A' grade district hospitals, one 'B' grade district hospital and one 'C' grade district hospital, administered by the Department of Health. In addition, depending on the population size, each DSD has a rural hospital and central dispensaries to provide health services to rural village communities. In addition, there is a community Health service reaching to the remotest areas functioning under a Regional Director of Health Services. Several communities in the Project area are affected by chronic kidney disease (CKDu). Polpithigama and Mahawa DSDs are the areas where increased incidence of CKDuhas been reported. For example, thePolpithigama Divisional Secretariat in 2013 had records of 228 kidney patients.

20. **Marketing Facilities**: Dambulla Town is the key commercial centre in the Project area. It is connected with Galewela, Kurunagala and Colombo. Many farmers of project-affected villages use private transport facilities to transport vegetables, fruit and grains from their villages to Dambulla commercial Centre for sale. Another market network is Galgamuva and Ambanpolatowns and their environs. Farmers buy their agricultural inputs and sell their produce through these market networks. Market centres also provide computer services and skill training programmes for the youth.

Land Use Patterns

21. Several sections of the canal traverse through the land owned by the Forest and Wildlife Departments. In the project-affected villages, farmers cultivate paddy, other field crops (OFCs), vegetable, and fruit trees. Valuable timber such as teak, satin (burutha), and halmilla are also cultivated in homesteads and highland allotments as an investment. Households depend on the monsoons rains to cultivate their crops mainly in the Maha (main) season. In the Yala (minor) season, as discussed earlier, rains often fail destroying their crops. As a result, many farmers cultivate only a portion of their holdings during the Yala season to avert disaster arising from prolonged droughts. The Yala season of 2013 in the Project area was a failure.

Highland Cultivation

22. During the dry (Yala) season, farmers cultivate root-crops such as beet, radish, leafy vegetables, maize and chilli using micro irrigation systems such as drip irrigation and sprinklers on highland allotments. As the dry season progresses, the water level in shallow dug wells drops and the streams and village reservoirs dry out causing threats to crops. This often results in reducing crop yield and yield quality. With assured water supply especially in the Yala season farmers can cultivate their land and improve cropping intensity by using irrigation methods such as drip and sprinkler irrigation.

Homestead Development

23. As in other areas of the dry zone, villagers in the Project area have neglected their homesteads mainly because of the difficulty in maintaining them during the dry season. Traditionally, homesteads in the dry and intermediate zones were located closer to the village reservoir. Homesteads are mostly cultivated with coconut, mango, cashew, tamarind, jack, kohomba (Margosa) which provide an income and shade to the house. In addition, they cultivate fruit trees such as banana, orange and lime on their homesteads. Growth and the yield of these trees are affected during Yala season due to scarcity of water. The Project is expected to create a high ground water table throughout the year by augmenting water level in village reservoirs enabling the cultivation of crops in both Maha and Yala seasons.

Chena Cultivation

24. Chena (slash-and-burn) cultivation of government forests is an avenue of earning a living for dry zone villagers. Depending on the man-power available at a household or the resources available to mobilize labourers, a slash-and-burn cultivation plot could be as big as five acres or more. Both poor and non-poor engage in slash-and-burn cultivation of crops such as maize, sesame, millet and vegetable.

Land ownership

25. The canal will traverse through a land over which both the government and individuals have a variety of land tenure interests and rights. Part of the canal traverses through government land most of which belongs to the Wildlife Department. Over the years, some of these lands have been distributed among landless poor in surrounding areas on ‘government permits’ which range from one year to 30 years of tenure, enabling them to earn their living by cultivating the land and in some cases, to construct their dwellings.

26. Main land tenure types in the Project area are:

- **Private Titled Deeds:** The private deeds are registered at the Land Registry under the Act of Registration of Documents. A deed can be transferred to any person

through sale or lease, or rent on agreed terms between parties in the presence of a Notary Public.

- ***Jayabhoomi* Deeds:** These deeds are issued under the Land Development Ordinance for agricultural and residential purposes with certain conditions. A *Jayabhoomi* land can be transferred to a specified person described in the Schedule of the Land Development Ordinance. A *Jayabhoomi* holder is the owner of the allotment.
- **Land Development Ordinance (LDO) Permits:** They are issued under the Land Development Ordinance for a specified period of time. An allotment can be transferred to another person following the rules given in the Schedule of the Land Development Ordinance.
- **Long-term Leases:** These leases are issued under the Land Ordinance [LDO] for commercial, residential and other purposes described in the Act. Leased period is 30 years with certain conditions. A long-term lease can be transferred to another person with the approval of the concerned authority. Some of the leases are upgraded to freehold ownership after paying the valuation for the land particularly housing allotments under the provision of LDO.
- **Annual Permits:** The permit is a legal document that allows the permit holder to cultivate a piece of state land for a period of 12 months. A levy is charged from the permit holder. He cannot claim any right or interest over the land allotment.
- **Encroached Land:** Use of state land without permission for various purposes, mainly to cultivate highland crops is prohibited. However, an encroachment could continue over several years with the connivance of state officials. Periodically, the State 'regularizes' some encroachments mainly as a part of the strategy to alleviate rural poverty.
- **Temple Land:** Several old Buddhist temples have been given large extent of land by the kings. These lands have been recognized by the government as temples lands. The incumbent priests of the temples use the land to obtain services and rituals from people of different castes. These people have become tenants or leaseholders of the temples and pay annual dues to the temple to accept the fact that the temple owns the land. They also perform some traditional services such as painting the temple in lieu of land rights to cultivate temple land. Temple lands come under the purview of Temple Land Ordinance of 1944. Several households of PahalaBambava GND located close to Galewela town, and Kanadana village in Ranvadiyava GND live on the lands owned by Bambava Purana Raja MahaViharaya (Buddhist temple). Several affected households in Valamitiyawa village in Dambulla DSD live on the land that belongs to the Dambulla Buddhist Temple on long-term lease basis. They do not have any legal rights over the land that they cultivate although they have built permanent houses and have developed land as if they were their own.

27. In the Project area, dominant land tenure type is titled land in various forms: private ancestral land (30 percent), *jayabhoom*i grants (26 percent), *swarnabhoomi* grants (08

percent) and freehold licensed land allotments (05 percent). The next largest tenure type is temple land (20 percent) (Table 7).

Table 7: Distribution of Different Types Land Tenure in Project Area

Type of Tenure	Number of Households	Percentage
Private titled	19	30
Freehold	03	05
Swarnabhoomi	05	08
Jayabhoomi	17	26
Ranbhoomi	00	00
Government permit	02	03
Encroachment	05	08
Temple land	13	20
Total	**64**	**100**

Source: EIA Field Information Survey, NWPCP, November 2013

4. Socioeconomic Conditions of Physically-displaced Households

28. A resettlement census was conducted in July 2014 in the Project area. It covered PAHs' assets and main sources of livelihood affected and their socioeconomic status. The gender-disaggregated socioeconomic data have been used to determine if special actions are needed by poor and vulnerable households, especially female-headed households, to overcome their socioeconomic marginality and disarticulation. As the detailed project designs are being completed parallel to the census of project-affected households and persons, the data presented in this RIP could be taken as final for the Project area.

29. The Project will physically displace 22 households with 02 sub-families (table 08).

Table 08: Physically Displaced Households in the Project Area

DS Division	GND	Village	No. of Physically Displaced Households
Dambulla	Lenadora north	Lenadora	02
	Ethabendiwewa	Ethabendiwewa	04
	Welamitiyawa	Welamitiyawa	04
Galewela	Danduyaya	Danduyaya	01
	Ranwediyawa	Ranwediyawa	02*
	Kospotha	Kospotha	02
	Pahalabambawa	Pahalabambawa	04
Mahawa	Konwewa	Konwewa	03
		Total	**22**

Source: MCB Resettlement Census, 2014 * with 02 sub-families.

30. The canal will traverse through their land affecting their dwellings and homesteads. These 22 dwelling houses need to be rebuilt either on the remaining homesteads after land acquisition or at a place where households select to live. The two sub-families of two households too need to be resettled separately from their mother households. Therefore, for the purposes of this RIP, there are 24 households to be relocated.

Population

31. The physically displaced 22 households are not 'native' to the Project area. All of them in different time phases arrived in their current settlements, when the dry zone land development programmes opened up more land for the landless and poor households. Table 09 shows that 84 percent of households arrived in the Project area after 1970. By holding land permits from the government over a period of time, the majority of households have become eligible to receive *swarnabhoomi* and *jayabhoomi* land titles for the land that they have been cultivated over several decades (see table 09).

Table 09: Arrival Phases of Physically-displaced Household in the Project Area

Arrival Phase	Number of Households	Percentage
1960 – 1970	03	16
1970 – 1980	02	10
1980 - 1990	09	45
1990 - 2000	04	17
2000- 2010	04	17
After 2010	00	00
Total	**22**	**100**

Source: MCB Resettlement Census, June 2014

32. 66 persons live in the 22 physically displaced households. The number of dependents is 17. The dependency ratio is about 26:74. The average household size is 03. The population is largely a young population. They are all Sinhala Buddhists. There are no female-headed households among the physically displaced households (table 10). All PAPs are in good health, and the census found no disabled PAP. Also, the census did not find a household with divorced or separated parents.

Table 10: Key Characteristics of Physically-displaced

DSD	Type of Household		Impact on Residence		Health Condition of households	
	Male – headed	Female – headed	Relocation	Isolation	Good Health	Disabled
Naula	00	-	00	-	00	-
Dambulla	10	-	10	-	10	-
Galewela	09*	-	09*	-	09*	-
Polpithigama	00	---	00	-	00	-
Mahawa	03		03		03	
Total	**22**	**-**	**22**	**-**	**22**	**-**

Source: MCB Resettlement Census, July 2014 * + 02 sub-families

33. Physically displaced households live in Dambulla, Galewela and Mahawa DS divisions. All of them are male-headed households. Only 05 households fall below the poverty line. They will be considered as vulnerable households and will receive special attention from the Project to restore and improve their sources of income and livelihood.

34. The physically displaced households are well connected with nearby townships such as Dambulla, Galewela, Galgamuwa and the provincial capitals of Matale, Anuradhapura, and Kurunegala. Regular bus service connects PAPs with Kurunegala, Dambulla and Anuradhapura cities, and also with markets.

Demography of Physically-displaced Households

35. 26 percent of the population is below 18 years and 11 percent is above 60 years. Of the labour force (19 -60 years) ratio of men and women is 50-50. This is also a reason for low engagement in agriculture (table 11).

Table 11: Population, Sex, Marital Status and Age Distribution of Affected households

DSD	Below 18 years				19 – 59 years						Over 60 years					
	Male		Female		Male			Female			Male			Female		
	Married	Unmarried	Married	Unmarried	Married	Unmarried	Widow	Married	Unmarried	Widow	Married	Unmarried	Widow	Married	Unmarried	Widow
Naula	-	-			-		-	-	-	-	-		-	-	-	-
Dambulla	00	01	-	06	07	05	00	08	01	00	02	00	00	01	00	00
Galewela	00	04	00	02	06	00	00	08	01	00	03	00	00	01	00	00
Polpithigama	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Mahawa	00	00		04	03	00	00	03	00	00	00	00	00	00	00	00
Total	**00**	**05**	**00**	**12**	**16**	**05**	**00**	**19**	**02**	**00**	**05**	**00**	**00**	**02**	**00**	**00**

Source: MCB Resettlement Census, July 2014

Affected Homesteads

36. The total area of homesteads to be acquired by the Project is about 02 acres 03 roods 15 perches. Most of the homesteads are titled land – outright, *Swarnaboomi* and *Jayaboomi* titles. 06 households live on temple lands as long-term leaseholders and tenants, and 02 households on LDO allotments (table 12).

Table 12: Land Tenure Patterns of Acquired Homesteads

Homesteads (acquired portion)																		
DSD	Outright			*Swarnaboomi*			*Jayaboomi*			LDO			Temple land			Encroached Land		
	A	R	P	A	R	P	A	R	P	A	R	P	A	R	P	A	R	P
Danbulla		00	00	00	03	0	0	02	-		01	-		-		-	-	-
Galewela		01	35	-	-	-	-	-	-	-	01	-	-	01	-	-	-	-
Mahawa	-	01	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	- -	- -	- -
Total	**0**	**02**	**35**	**01**	**03**	**0**	**0**	**02**	**20**	**-**	**02**	**-**		**01**		-	-	-

Source: MCB Resettlement Census, July 2014

Affected Cultivated Land

37. The Project will acquire about 102 acres of highland and 23 acres of paddy land. Ninety percent of highland holdings are private land including titled land, *Suwarnaboomi* and *Jayaboomi* land grants. All paddy lands are either titled land or *Jayabhoomi/ Swarnabhoomi* land grants. Seven percent of highland to be acquired are encroachments (Table13).

Table 13: Type of land Tenure of Acquired Highland for the Project

Type of Land	**High land**			**Paddy Land**		
	Area of land affected			**Area of Land Affected**		
	A	**R**	**P**	**A**	**R**	**P**
Outright deeds	21	03	11	15	00	00
Jayabhoomi deeds	37	00	00	03	01	00
Swarnabhoomi deeds	31	00	00	02	02	00
Encroachment	07	01	16	-		
Government lease land	04	03	00	-		
Temple land	00	00	00	02	00	00
Total	**101**	**03**	**27**	**22**	**03**	**00**

Source: MCB Resettlement Census, July 2014

38. Most of the landholdings identified for acquisition are dry highland cultivated only during the Maha (main) season in each year under rain-fed conditions. Highland cultivators do not have sufficient resources to dig deep wells or to pump water from a nearby water source to their allotments. The main crops cultivated on these lands are maize, sorghum, chillies, lime, groundnuts, vegetable, and few perennial trees such as jack, breadfruit and mango.

39. 22.75 acres of paddy land in the Project area will be acquired for the construction of the canal. Paddy land holdings too are mostly cultivated only during the Maha season under rain fed conditions. In the Yala season, some farmers cultivate paddy in a portion of their paddy land with a high risk of crop failure due to drought. During the past two Yala seasons paddy crops failed owing to drought.

Income and Livelihood Sources

40. Among the physically-displaced households, agriculture is not the main source of household income. Only 41 percent of households are engaged in farming. About one-third of households are engaged in private sector employment as security guards, sale assistants, and vehicle drivers (table 14). Both men and women work together in land cultivation. A few women are engaged in private sector employment.

Table 14: Income and Livelihood Sources

DSD	Farming	Government	Private Sector	Self-employment	Business	Hired labour
Dambulla	06	01	01	00	01	01
Galewela	02	00	05	01	00	01
Mahawa	01	01	00	01	00	00
Total	**09**	**02**	**06**	**02**	**01**	**02**

Source: MCB Resettlement Census, July 2014

41. Poor educational and skill levels among the affected population keep them in agriculture or in low level private sector work. Only two out of 22 heads of households have passed GCE (O/L) examination. No household has a member who has gained some formal skill training (table 15).

Table 15: Educational Level of Head of Households

DSD	Up to 5 Std		6 to 10 Std		GCE (O/L)		GCE (A/L)		Degree	
	M	F	M	F	M	F	M	F	M	F
Dambulla	06	-	04	-	-	-	-	-	-	-
Galewela	03	-	04	-	02	-	-	-	-	-
Mahawa	01	-	02	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total	**10**	**-**	**10**		**02**					

Source: MCB Resettlement Census, July 2014

5. Scope of Land Acquisition and Resettlement

42. As discussed above, 22 households and 02 sub-families will be physically displaced and 473 households will lose some of their land as a result of the acquisition of land for the canal. The need for the Project's finding relocation sites for the physically displaced will not arise, as they prefer to self-relocate in the vicinity of their present settlements or to rebuild houses on their remaining homesteads after the acquisition. 15 out of 22 physically displaced households fall into this category.

43. It is estimated that 283.25 acres of land will be acquired from 495 households (including the 22 physically displaced households). 22.75 acres (18 percent) are paddy lands; 94.5 acres (74 percent) are highland allotments; 02.75 acres (02 percent) are homesteads (table 16) and 7.5 acres are chena lands (06 percent).

Table 16: Project-affected Households by the Type of Land Owned/Cultivated

Type of land	No of Households	A. R. P.	Percentage
Paddy	53	22 03 00	18
Homesteads	22	02 03 15	02
Highland	418	94 02 11	74
Chena (Slash and Burn)	02	07 01 16	06
Total	**495**	**127 02 02**	**100**

Source: MCB Resettlement Census, June 2014

Condition of the Buildings and Structures

Affected Dwelling Houses

44. 20 permanent and 02 semi-permanent houses will be displaced. Only 02 houses will be fully affected (table 17). The 20 partially affected houses will be considered as fully affected in compensation calculations. No household will be separated by the canal from other households in an affected village. Remaining portions of homestead could be used for rebuilding new houses or for cultivation Partly-affected houses will not be used as dwellings. Moreover, most of secondary structures which are located close to the affected houses will also be affected by the canal. If a household relocates, compensation will be paid for secondary structures such as wells and small sheds as well.

Table 17: Number of Houses Affected by the Project

DSD	Houses Affected		
	Fully	Partially	Isolated
Dambulla	00	10	-
Galewela	02	07	-
Mahawa	00	03	-
Total	**02**	**20**	-

Source: MCB Resettlement Census, June 2014

45. Seven out of 20 houses are roomy and well-furnished houses. 20 out of 22 houses have cemented floors, brick walls and roof tiles. Two are semi-permanent small houses with a few pieces of furniture. Each house has electricity and 06 of them (25 percent) are connected to pipe borne water supply (Table 18).

Table 18: Type of houses Affected: Basic Information

DSD	Tile/Cement/ Bricks			Asbestos/ Cement/Bricks			Tile/Floor tile/ Bricks			Semi-permanent			Temporary			Electricity		Pipe-Bourne water	
	<750 sq.ft	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	Yes	No	Yes	No
Dambulla	07	02	01	-	-	-	-	-	-	-	-	-	-	-	-	01	0	0	1
Galewela	03	03	01	-	-	-			-	02	-	-	-	-	-	03	0	01	0
Mahawa	03	---	-	-	-	-	-	-	-	-	-	-	-	-	-	03	0	03	2
										-						02	0		
	13	**05**	**02**	**-**	**-**	**-**	**-**	**-**	**-**	**02**	**-**	**-**	**-**	**-**	**-**	**22**	**00**	**06**	**16**

Source: MCB Resettlement Census, July 2014

Affected Trees

46. The resettlement census identified 7,782 perennial trees and 768 non-perennial trees which will be uprooted for the canal (tables 19, 20 and 21). Most perennial trees are valuable trees which brought periodic income to households. Other trees provide food and a surplus to sell in the market.

Table 19: Number of Trees Affected on Homesteads

DSD	Coconut	Teak	Areca nuts	Jake	Mango	Ketakela	Bread Fruit
Dambulla	179	40	20	23	12	00	01
Galewela	41	33	14	09	15	02	01
Mahawa	10	00	00	03	06	00	00
			-				
Total	**230**	**73**	**34**	**35**	**33**	**02**	**02**
	Halmilla	**Neem**	**cashew**	**Lunumidella**	**Orange**	**Lime**	**Banana Guava**
Dabulla	03	00	08	02	06	02	85 00
Galewela	00	00	00	00	00	02	45 04
Mahawa	10	10	02	00	00	00	50
Total	**13**	**10**	**10**	**02**	**06**	**04**	**180 4**

Source: MCB Resettlement Census, June 2014

Table 20: Number of Affected Perennial Trees on Highland Allotments

DSD	Coconut	Cashew	Teak	Jack	Mango	Neem	Halmilla	Burutha	Lunumidella	Aricanut
Naula	51	04	61	04	04	04	00	00	00	00
Dambulla	493	213	337	37	70	08	42	06	10	00
Galewela	1598	175	985	52	124	39	41	02	00	52
Polpithigama	1463	281	430	40	106	74	82	02	00	00
Mahawa	238	41	70	15	37	32	15	00	00	00
Total	3843	714	18 83	148	341	157	180	10	10	52
Grand Total = 7338										

Source: MCB Resettlement Census, June 2014

Table 21: Number of Affected Medium-term Crops on Highland Allotments

DSD	Banana	Bread fruit	Orange	Lime
Naula	14	00	00	00
Dambulla	242	04	40	08
Galewela	171	01	00	00
Polpithigama	106	00	02	00
Mahawa	00	00	00	00-
Total	533	05	42	08
Grand total 588		-		

Source: MCB Resettlement Census, June 2014

Acquisition of Special Properties

47. As discussed ealier, during the Project design stage, the canal trace has been changed several times to minimize project impacts on houses and other property. During the resettlement census, it was noticed that the canal trace would traverse through the play ground of the Keppetiya Muslim Collage in Galewela DSD. There was no other alternative trace to take the canal through the area. It was also noticed that during the construction phase of the canal, children's sport activities and class programmes would be disrupted. The discussions among design engineers, local people and census team on how to avoid such temporary and permanent disruption to the school resulted in the decision the canal section will be built during school holidays. The canal section will be a covered canal section. They also agreed to restore the playground to its original status, minimizing hardships to school children and the school staff.

48. The resettlement census identified 05 acres of land belonging to the Beligamuwa Farm of National Livestock Development Board which will be acquired for the canal. The canal will affect a coconut plantation of about 300 coconut trees.

49. During consultations with potential PAPs of Umbawa village, several PAPs pointed out that the public well at Umbawa should be spared as it provides year-round clean water

to the village community. A slight change in the canal trace is required to meet this request. Project engineers will decide on the feasibility of the proposal and inform villagers and EA.

50. The Project will affect 05 land allotments of the Bambawa Temple and 02 land allotments of Dambulla Temple. The total area of the allotments is about 02 acres and 40 perches of two temples. During consultations, the chief incumbent priests expressed their concerns on the manner in which land values are determined when acquired for a public purpose. They pointed out that the cash compensation paid for land acquired is not sufficient to buy replacement land. Therefore, he requested that replacement land instead of cash compensation should be provided by the Project in the vicinity of the temples. The final arrangement is to give 05 acres of irrigated land and one acre of highland at the Mahaweli resettlement site in Madirigiriya in Polonnaruwa District for Bambawa Temple.

Land values

51. The value of the acquired land is specified as 'market value' by LAA. This is the price that the owner would receive if sold in the open market on the date of publication of the section 2 Notice under LAA. However, the valuation officer has the discretion to specify what the 'market value' should be for a particular parcel of land.

52. Land value varies from place to place, and according to the type of land. In the Poject areas, land prices range varied from SLR 50,000 to 60,000 per perch. These prices were confirmed by the Divisional Secretaries of Galewela and Dambulla DSDs and will be used in determining the market value of acquired land. Land prices in Mahawa DSD area are lower than that of the other two DSDs.

Resettlement options

53. During the resettlement census, 15 households opted to resettle on the remaining portions of the acquired land. The remaining 07 households and 02 sub-families requested the EA to purchase land in the vicinity as replacement land, where they will build their new houses with compensation and the special grant. However, at the stakeholder workshop held in August 2014, these 07 households and 02 sub-families indicated that they would self-relocate in the vicinity of their communities.

54. No land will be acquired under the 'urgency section' of 38 A of the Land Acquisition Act. In acquiring land and other property, the proposed procedures of this RIP will be applied to expedite the land acquisition process.

6. Policy and Legal and Framework for Land Acquisition

55. Land acquisition, compensation, relocation and income and livelihood restoration of the Project will be guided by the Land Acquisition Act (LAA), 1950 and its amendments, National Involuntary Resettlement Policy (NIRP), 2001, National Policy for the Payment of Compensation, 2008, the Land Acquisition Regulations of 2009 (LA Regulations 2009), National Environmental Act of 1980 and amendments, and ADB's SPS (2009).

Land Acquisition Act (LAA)

56. The LAA provides a legal framework for acquisition of land for a 'public purpose'. It provides detailed procedures for land acquisition, consultations, calculation of compensation for land, structures, and crops at 'market value' and assistance packages. It guarantees that no person is deprived of his land except under the provisions of LAA, and provides a compensation package for acquired land, structures, damaged crops and disturbances caused by the project. The normal procedure for land acquisition begins with a request from a government agency made to the Minister of Land and Land Development (MLLD) to acquire a piece of land for a public purpose. Once acquired, the land is vested in the government agency.

57. Provisions of the LAA are inadequate to address all adverse impacts associated with land acquisition and involuntary relocation. The LAA is indifferent to land losers' socio-economic conditions and long-term adverse impacts on their incomes and livelihoods. The LAA prescribes that market value of land should be paid as compensation which amounts the price a property owner could expect if sold in the open market, whereas the SPS (2009) stipulates that 'replacement cost' should be paid as compensation which includes market value and other resettlement assistance packages. Post-acquisition monitoring of IR impacts is not part of LAA.

National Involuntary Resettlement Policy (NIRP*)*

58. The Government adopted NIRP in 2001 to ensure that (i) PAPs are fairly and adequately compensated, relocated, and rehabilitated; (ii) delays in project implementation and cost overruns are reduced; and (iii) better community relations are restored among PAPs and host communities.

59. The NIRP is based on LAA and it amendments, National Environmental Act of 1980 and amendments, and several other applicable laws such as Urban Development Authority Act and Coastal Conservation Act, Regulations of the Acts, and also on legal opinions of courts on land acquisition, compensation, consultation and income restoration.

60. Principles of the Policy are:

(i) IR should be avoided as much as possible by reviewing alternatives to the project as well as alternatives within the project.

(ii) Where IR is unavoidable, PAPs should be assisted to re-establish themselves and improve their quality of life.

(iii) Gender equality and equity should be ensured and adhered to throughout.

(iv) PAPs should be fully involved in the selection of relocation sites, livelihood compensation and development options at the earliest opportunity.

(v) Replacement land should be an option for compensation in the case of loss of land; and in the absence of replacement land cash compensation should be an option for all PAPs.

(vi) Compensation for loss of land, structures, other assets and income and livelihood losses should be based on full replacement cost and should be paid promptly. This should include transaction costs.

(vii) Resettlement should be planned and implemented with full participation of the provincial and local authorities.

(viii) Participatory measures should be designed and implemented to assist those economically and socially affected to be integrated into their host communities.

(ix) Common property resources and community and public services should be provided to resettlers.

(x) Resettlement should be planned as a development activity for PAPs.

(xi) PAPs who do not have title deeds to land should receive fair and just treatment.

(xii) Vulnerable groups should be identified and given appropriate assistance to improve their living standards.

(xiii) Project Executing Agencies should bear the full costs of compensation and resettlement.

61. The Policy applies to:

- All development-induced land acquisition or recovery of possession by the State
- All projects regardless of the source of funding
- All projects in the planning phase on the date the policy came into effect and all future projects

62. The MLLD is responsible for implementing of NIRP. This is done in collaboration with a wide network of public agencies including CEA, Survey Department, Valuation Department, Ministries concerned, and Divisional Secretariats.

63. NIRP ensures that PAPs are treated in a fair and equitable manner, and that they are not impoverished in the process of land acquisition and resettlement. The Policy also enables establishing a framework for project planning and implementation that would meet international best practices in involuntary resettlement including involuntary resettlement safeguard policy principles and requirements of ADB.

National Policy on Payment of Compensation (2008) and LA Regulations (2009)

64. The Cabinet of Ministers approved the National Policy on Payment of Compensation (NPPC) in November 2008 in order to establish a uniform system of adequate compensation payment, based on LAA, NIRP and several other laws applicable to land acquisition and resettlement, and also to supersede all other *ad hoc* and special compensation packages used by government agencies such as Road Development Authority (RDA). The LA Regulations 2009, ratified by the Parliament of Sri Lanka in 2009 as Regulations of LAA gave effect to both NIRP and NPPC. The LA Regulations 2008 incorporated NIRP and NPPC principles into Sri Lanka's legal framework thereby improving the congruence between local regulatory framework for land acquisition and resettlement, and international best practices for involuntary resettlement.

National Environmental Act (NEA) 1980 and 1988

65. The National Environmental Act (NEA), No.47 of 1980, amended by Act No.56 of 1988 has some provisions relevant to involuntary settlement. The Gazette notification No.859/14 of 23 February 1995 determined the projects and undertakings for which Central Environmental Authority (CEA) approval is needed in terms of Part IV – C of the NEA. Item 12 in the Schedule requires the formulation of RIP to address involuntary resettlement of 100 or more households.

Safeguard Policy Statement of ADB, 2009 (SPS)

66. The objectives of the involuntary resettlement safeguards policy of ADB are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

67. IR safeguards covers physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. IR safeguards apply whether such losses and involuntary restrictions are full or partial, permanent or temporary.

68. The IR policy principles are:

- Screen the project early on to identify past, present, and future involuntary resettlement impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons, including a gender analysis, specifically related to resettlement impacts and risks.

- Carry out meaningful consultations with affected persons, host communities, and concerned non-government organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programmes. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations.

- Establish a grievance redress mechanism to receive and facilitate resolution of the affected persons' concerns. Support the social and cultural institutions of displaced persons and their host population. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.

- Improve, or at least restore, the livelihoods of all displaced persons through (i) land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement value for land when the loss of land does not undermine livelihoods, (ii) prompt replacement of assets with access to assets of equal or higher value, (iii) prompt compensation at full replacement cost for assets that cannot be restored, and (iv) additional revenues and services through benefit sharing schemes where possible.

- Provide physically and economically displaced persons with needed assistance, including the following: (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities; (ii) transitional support and development assistance such as land development, credit facilities, training or employment opportunities, and (iii) civic infrastructure and community services, as required.

- Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.

- Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status.

- Ensure that displaced persons without titles to land or any recognisable legal rights to land are eligible for resettlement assistance and compensation for loss of non-land assets.

- Prepare a resettlement plan elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule.

- Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to affected persons and other stakeholders. Disclose the final resettlement plan and its updates to affected persons and other stakeholders.

- Conceive and execute involuntary resettlement as part of a development project or program. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.

- Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation.

- Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports.

Gap Analysis: Resettlement Regulatory Framework of the Programme and IR Safeguard Policy of ADB

69. LAA is the legal framework for compensation for acquired land and structures and land development. The NRP and LA Regulations 2009 together with LAA provide a comprehensive resettlement regulatory framework which broadly matches IR safeguard policy objectives and principles. A Gap analysis matrix is given in annex 1.

70. The key gaps between LAA and IR policy principles of SPS were (i) the entitlements of non-titled PAPs, (ii) compensation at replacement cost, (iii) income restoration and improvement, (iv) consulting PAPs and their host communities on relocation options; (v) special assistance to vulnerable PAPs, (vi) monitoring and assessment of resettlement outcome and impacts, and (vii) the formulation of RIP to address these issues.

71. The issue of non-titled PAPs' entitlements is addressed in LAA and elaborated in NIRP and LA Regulations 2009. Under the LAA any person having a 'right, title or interest in or over the land which is to be acquired or over which a servitude is to be acquired' (section 10(1) is entitled to compensation. A person who has 'interest' in land' apart from owner and co-owners area mortgagee, a lessee, or an occupier absolutely for himself or in trust for another person or for any charitable, religious or other purpose, or a person having a

servitude over the land (section 65 as amended in 1964). The Court of Appeal in 2001 added tenants to this list. The court also held that the occupier 'could not, in any event, be evicted without being compensated in respect of his improvement (if, in fact, he is the owner of such improvements'. The court distinguished between 'ownership of the property' and 'ownership of land improvement'. This matches with ADB's IR safeguard policy principle 7 that those who do not hold title to land are eligible for resettlement assistance and compensation for loss of non-land assets.

72. NIRP takes replacement cost as the norm for cash compensation.LA Regulations 2008 detail how the total compensation package amounts to replacement cost of acquired land and other properties such as dwelling and business structures. MLLD's 'A Guide for Public Officials on Good Practices' (MLLD 2013) guides that in preparing the entitlement matrix 'to determine replacement cost for land and structures which will be acquired to the project'.

73. Restoration and improvement of income sources and livelihood of PAP is a key resettlement principle of NIRP. MLLD (2013) states that in preparing a RIP it is necessary to identify persons and households severely affected in terms of their income and employment losses; conduct consultations to develop an income restoration program for all PAPs; and develop a special income improvement program for vulnerable PAPs.

74. Consulting PAPs and their host communities on relocation issues is also a key resettlement principle of NIRP. Special assistance to vulnerable PAPs constitutes a core resettlement principle of NIRP and is elaborated further in LA Regulations 2009.

75. Monitoring and assessment of resettlement outcome and impacts which is an IR safeguard policy principle is not addressed in the resettlement regulatory framework.

76. NIRP and LA Regulations 2009 require the formulation of a RIP to address IR safeguard requirement. LA Regulations 2009 states that 'formulation of an RP and its implementation is the responsibility of the project executing agency and project management unit (PMU) of a development project.

IR Principles Applied to the Project

77. Based on the comparative review of various resettlement policies, laws, regulations and guidelines of Sri Lanka and the ADB Involuntary Resettlement Policy, the following broad resettlement principles are distilled for this Programme to apply to its projects:

- Screen each project of the Programme to determine whether it triggers the following involuntary resettlement principles and to determine the scope of resettlement planning required.

- Take every effort to avoid physical displacement and/or any other adverse impacts on livelihood and income sources and community resources and infrastructure. If physical displacement and economic displacement are unavoidable, the following actions will be taken to ensure that they improve or at least restore their income and livelihoods and rebuild their socio-cultural systems.
- Consult and inform all PAPs on land acquisition, compensation, and rehabilitation, and their entitlements and grievance redress mechanism.
- Provide special project assistance to meet the needs of affected vulnerable people such as poor, landless, elderly, woman-headed households, informal settlers and squatters.
- Improve or at least restore livelihoods of all affected households through cash-for-land compensation at replacement cost for acquired or damaged non-land property, and cash-for-land or land-for-land for land acquired.
- Provide well-planned and budgeted income restoration and improvement programmes for the benefit of PAPs, especially for the poor and vulnerable groups.
- All common property resources lost due to the project will be replaced or compensated by the project;
- If land acquisition is through negotiated acquisition, the project will ensure that PAPs who enter into negotiated acquisition will maintain the same or better income and livelihood status.
- PAPs without title to land are eligible for resettlement assistance.
- Disclose resettlement information and RIPs including consultation documentation before the project appraisal in a form, manner and language(s) accessible to PAPs and other stakeholders. The final RIPs and their updates, if any, will also be disclosed to PAPs and other stakeholders in the same manner.
- The full costs of resettlement will be included in project costs.
- Pay compensation and provide other entitlements to each eligible displaced person before physical displacement and any construction work starts.
- Monitor and assess the progress of RIP implementation and prepare monitoring reports to share with ADB, PAPs and other stakeholders.

78. In accordance with IR principles outlined above, all PAPs are entitled to a combination of compensation packages and resettlement assistance according to the nature of ownership/user/occupier rights and interests on lost assets and the degree of project impacts on socio-economic conditions and vulnerability of PAPs. Please refer to the Entitlements Matrix given below. It summarises the entitlements of PAPs/PAHs against different losses. The full description and budget allocations are given in sections 8 and 9.

Figure 1: Entitlement Matrix

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of Agricultural Land	Land acquired for the canal and related facilities such as service roads	Owner of titled land	a) Compensation for land at replacement cost b) Market value for trees and crops.	EA/PIU	1. Compensation rates are determined based on NIRP, and LA Regulation, 2009 2. Replacement land: PAHs will purchase replacement land in same locality using the statutory compensation and special grant provided regardless of the tenure type of the acquired land. The formula is given below: (a) homestead – Rs 5,000,000 per acre; (b) Highland allotment – Rs 2,000,000 per acre (c) Paddy land – Rs 450,000 per acre; and (d) Chena land – Rs 200,000 3. Other assistance outlined in RIP will also be provided by PIU
Loss of Agricultural Land	-do-	Leasehol-der of state land	a) Compensation for loss of lease-hold land right; b) Market value for trees and crops	-do-	
Loss of Agricultural Land	-do-	Owner of State grant land	a) Compensation for land at replacement cost, and trees and crops at market value	-do-	
Loss of access to agricultural land	-do-	Owner of titled land	a)Compensation for land on replacement cost b) Compensation for crops and trees at market value	-do-	
Loss of access to agricultural land	-do-	*Ande* Farmer (Share cropper)	a) Compensation for loss of *Ande* right b) compensation for crops destroyed/damaged	-do-	
Loss of access to agricultural land	-do-	Non-titled user or squatter on State land	a) Compensation for land development b) Replacement cost of structures built c) Compensation for trees and crops at market value	-do-	
Residential Land and Structures					
Loss of Residential land and structures	Land acquired for canal, related facilities such as service roads	Owner of titled land (Main HH)	a) Compensation for structures and land at replacement cost b) Trees/crops at market value. c) Salvage materials from structures and trees without cost. c) Cash grant for purchase of housing allotment. d) Transport cost and other transaction cost e) Cash grant for temporary shed (Rs 50,000)	EA /PIU	1. Compensation rates are determined based on NIRP, and LA Regulation 2009 2. Replacement homestead will be purchased by each physically displaced household for relocation in the same locality with the cash grant provided by PIU

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of Residential land and structures	-do-	Owner with State grant land (Main HH)	a) Compensation for structures and land at replacement cost, b)Trees and crops at market value. c) Salvage materials of structures and trees without cost. d) Cash grant to purchase of housing allotment. e) Transport cost and other transaction cost f) Cash grant for temporary shed (Rs 50,000)	-do-	The cash grant will enable PAH to: a) purchase 20 perches of land, if lost up to 20 perches of land. b) purchase 40 perches of land, if lost between 21 and 40 perches of land. c) purchase 60 perches of land, if lost between 41 60 perches of land d) purchase of 80 perches of land, if lost between 61and 80 perches of land 3. other assistance outlined in RIP will also be provided by PIU
Loss of Residential land and structures	-do-	Leasehol der of state land	a) Compensation for structures at replacement cost b) trees and crops at market value, compensation for leasehold right for land c)Salvage materials of structures and trees without cost. d) Cash grant for purchase of housing allotment. e) Transport cost and other transaction cost. f) Cash grant for temporary shed.	-do-	
Other Private Properties or Secondary Structure					
Partial or complete loss of other property or secondary structure (i.e. shed, outdoor latrine, rice store, animal pen etc.)	Land acquired for canals, related facilities such as service road	Owners of structures regardles sof whether the land is owned or not)	a) Compensation for structure and land at replacement cost b)trees at market value c)cash grant for purchase of housing allotment d) Salvage materials without cost e) Cash grant for temporary shed (Rs 50,000)	EA /PIU	1. Compensation rates are determined based on NIRP, and LA Regulation, 2009 2. other assistance outlined in RIP will also be provided by PIU

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of tombs or graves	-do-	All owners	a) In case of a family cemetery, compensation will be paid for the lost land and structure b) If it is a public facility run by a local authority, compensation will be paid to the local authority	-do-	
Livelihood Restoration and Rehabilitation Assistance					
Materials Transport Allowance					
i) Loss of house and other structures		PAHs rebuilding house and other structures on same plot	a) Shifting allowance	EA/ PIU	
ii) Loss of house and other structures		PAH rebuilding house and other structures at a relocation site.	a) Shifting allowance b) Transport allowance	EA/PIU	
Transition Subsistence Allowance					
Loss of house		Each member of severely affected household	As per LA 2009 Regulations.	EA / PIU	
Livelihood Restoration (Grant and Training)					
Loss of source of income or livelihood		PAPs/ household	a) Vocational & skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Permanent loss of income or livelihood sources		One member per household	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	

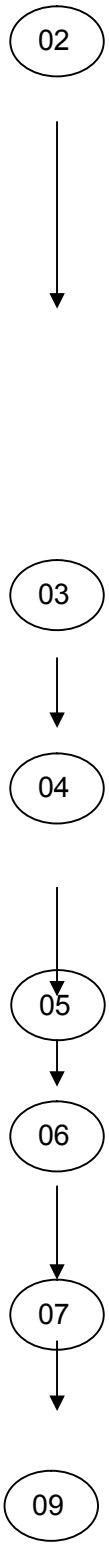
Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Permanent loss of income or livelihood sources		Severely affected household remaining on the affected land	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Special Assistance					
Loss of income or livelihood sources		Vulnerable PAHs including the poor and woman-headed household	a) Rs.25,000/= cash grant b) Priority in membership in Income restoration and improvement programmes c) assistance in official document search and registration.		
Community Assets					
Loss of local roads, footpaths, bridges, irrigation, water ways .		Divisional Secretary's Division, Local Authority and local community	a) All lost infrastructure facilities will be rehabilitated to their original conditions. b) If such affected infrastructure facilities cannot be provided, alternative infrastructure facilities will be provided	EA / PIU	- do-

HH = household; PIU = Project Implementing Unit, EA = Executive Agency, R = Rood, P= Perch,

Land Acquisition Procedure

79. Land for the Project will be acquired under the regulations and guidelines of the Land Acquisition Act as elaborated in Section 06 above.

Figure 2: Land Acquisition Procedure



Action

EA requests MLLD to acquire land for the public purpose described in the application. The application is submitted to the Land and Land Development Ministry through line ministry. Land Minister authorizes the issuance of Section 2 order.

MLLD publishes Section 2 order and soon after that the Divisional Secretary publishes the section 2 notice on identified land for acquisition at relevant public places and informed the affected PAPs. The DS issues a survey requisition to the Survey Superintendent [SS] of the district to survey land. SS surveys the land through his field surveyors. The surveyors prepare advance tracing and send to SS. SS sends them to the Acquiring Officer / Secretary to MLLD.

If the survey damaged the property, the land owners can make claims against the damages. The payment should be made to the owners under section 03 of LAA

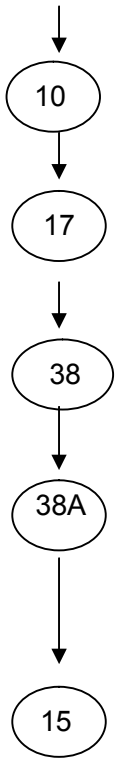
Objections from land owners against the acquisition of land are sent to the Secretary of the subject Ministry or his representative. The Secretary of the subject ministry informs the claimant of the land the result of the objection inquiry after informing the MLLD his recommendation.

Approval is given by the Minister of Land & Land Development for the acquisition of such land.

After publication of Section 05 Gazette Notification issues a survey requisition by DS of the area to survey the land and preparation of preliminary plan by the Survey Department.

Publication of Gazette Notification on calling the Claim for ownership status and compensation amount from the owners of the land and interested parties.

Acquiring Officer is holding a inquiry for the Determine the ownership status.



Decision of the ownership and informed to the claimants and Valuation Department for making valuation for the land to be acquired.

Award and payment of compensation is implementing.

Possession will be taken over of land after payment of compensation.

If necessary possession can be taken under 38 A after publication of Section 02 notice. But interest should be paid until such time compensation will be made.

There are no claimants.

80. The above flow chart indicates that the time frame is 71 weeks for the completion of land acquisition and compensation payment under LAA. However, delays can occur due to poor coordination among the agencies such as DS Office, Valuation Department, Survey Department and Land Registry. Therefore, a Land Acquisition and Resettlement Unit will be established at the Project Management Unit (PMU). The EA will appoint a well experienced 02 Acquiring Officer to conduct the process and liaise with the Divisional Secretariat, Valuation Department, Survey Department and Land Registry to expedite the acquisition tasks. These two officers can conduct the acquisition inquiries under the supervision by the divisional secretary as volume of work is limited. With efficient administration of the process, it is possible to complete the entire acquisition and compensation program in 25 to 40 weeks.

81. Under the provision of Part IV C of the National Environmental Act No.72/22 of 24th June 1993 and No.859/14 of 23rd February 1995 the Central Environmental Authority (CEA) approval is require for a resettlement implementation plan for project causing involuntary resettlement exceeding 100 families other than resettlement affected under emergency situation.

7. Consultation, Participation, and Information Disclosure

Objectives of Consultation

82. The main objectives of consultations with PAPs and other stakeholders are:

- To provide PAPs with information on their entitlements including compensation package and resettlement assistance schemes.
- To obtain comments from PAPs on how to improve the resettlement process and comments on draft RIP.
- To create goodwill among PAPs and the project personnel.
- To describe project benefits to PAPs.

83. The EA contacted PAPs and other stakeholders through MCB and DSs to discuss the scope of the Project, its benefits and potential adverse impacts and proposed mitigation measures. The EA actively engaged in examining project alternatives, scope of land acquisition, potential direct and indirect impacts on economic activities, and social and cultural identity and networks of the affected persons, and resettlement planning, implementation, and monitoring needs. In these key activities ADB assisted the EA.

84. EA conducted several project awareness programs to meet PAPs, especially those who are likely to be physically displaced, vulnerable households, religious and community leaders, local elite, and community-based organizations (CBOs) such as farmer organisations. In such meetings, their views, opinions and recommendations on compensation packages, relocation programs and the regarding the final trace of the canal were obtained. In these discussions, representatives of relevant government agencies (GNs, representative of the Divisional Secretary of the area) and local business community also participated.

85. In December 2013, a series of project awareness creation workshops were held at the Galgamuwa Irrigation Training Institute for Divisional Secretaries, Chairmen of *Pradeshiya Sabhas* and officials of the Agrarian Development Department, Irrigation Department, Department of Wildlife Conservation, Forest Department, Mahaweli Authority of Sri Lanka at Dambulla, Gelewela and Polpithigama Divisional Secretariats.

86. Several grassroots level awareness meetings were organized by GNs with the support of Divisional Secretaries of Dambulla, Galewela, Polpithigama and Mahawa DSD. Officers of Irrigation Department, Economic Development Officers and GNs and officers of the Mahaweli Consultancy Bureau attended these meetings. Representatives of ADB participated in the small group discussions held in Pannampitiya and Lenadora South GNDs

87. The table 22 indicates the dates and location of grassroots level project awareness meetings.

Table 22: Grassroots Level Awareness Meetings

DS Division	GN Division	Date of meeting	Venue of meeting	No of stakeholders present	No of officers attended
Galewela	Pahala Bambawa and Ranwediyawa	24th March 2014 (Morning Session)	Pahala Bambawa Temple	27	9
Galewela	Danduyaya, Dambagolla and Nebadagahawatta	24th Evening	Danduyaya Temple	22	10
Polpithigama	Polpithigama, Bogolla	25th March 2014 (Morning)	DS Office	25	13
Polpithigama	Amunukole, Hathigamuwa	25th March 2014 (Evening)	Amunukole temple	50	9
Polpithigama	Bulnewa, Moragllagama	26th March 2014 (Morning)	Bulnewa temple	28	9
Polpithigama	Kattambuwawa	26th March 2014 (Evening)	Private house	38	8
Galewela	Nilagama, Aluthwewa, Pibidunugama	27th March 2014 (Morning)	Aluthwewa temple	42	9
Galewela	Hombawa	27th March 2014 PM	Andagala temple	26	7
Galewela	Koapotha	28th March 2014 AM	Danduwagolla temple	27	6
Polpithigama	Pallekele	28th March 2014 (Evening)	SANANSA meeting hall	37	5
Dambulla	Pannampitiya	1st April 2014 (Morning)	Parakum Community hall	29	12
Dambulla	Lenadora north	1st April 2014 (Evening)	Lenadora Community hall	31	13
Dambulla	Ethabendiwewa	2nd April 2014 (Morning)	Menikdena Community hall	37	9
Dambulla	Welamitiyawa	2nd April 2014 (morning)	Welamitiyawa temple	14	7
Mahawa	Mahawa	3rd April 2014 (Evening)	Konwewa Community hall	47	13

Source: Minutes of the meetings kept by DS Secretariats of Dambulla, Mahawa, Galewala, and Polpithigama.

88. Several key issues were highlighted at the meetings which are summarised below:

- Potential PAPs emphasised that they have no objection to the Project and its implementation, and they are willing to give their utmost support in the Project activities. However, they highlighted their past bitter experience associated with other development projects, and pleaded not create similar situation under the Project.

- All Project activities connected with communities should be done with transparency, and the true scope of the Project should not be concealed from Project beneficiaries. Decision making on behalf of the community should be done in their presence of the representatives.

- A strategy should be formed to listen, discuss and provide solutions to community problems at the GND level.

- Displacement of households should be done minimally, and where unavoidable. Resettlement of such households should be done in an area where basic infrastructure facilities similar to what they enjoy at present are present, and also in close to their original community.

- Cash compensation should be paid as a single payment after a fair assessment based on market prices.

- Relocation should be done only after the payment of compensation. Compensation should be paid to the owner of the land and property. However other than statutory payment should be paid to the displaced household.

- If livelihood is lost, a comprehensive income restoration programme should be introduced before the Project activities start.

- Implementation of the Project should be done with minimum damage to houses and other private property.

- There should be a mechanism to uplift the displaced persons who are vulnerable - suffering with chronic illnesses, disabled people and widows, and to provide housing facilities for them.

- The Project should engage PAPs in construction work and inform them of time schedule of such activities well in advance.

- The PAPs who live on temple and *devala* lands on long term leases need special attention of the project and should be treated fairly and justly in paying compensation.

- The formulation of a detailed Resettlement Implementation Plan should be done by competent and experienced Resettlement Consultants.

89. A stakeholder consultation workshop on resettlement issues was held on 28 August at the Galewela Divisional Secretariat. 66 PAPs and 28 government officials participated in the workshop. The key issues discussed at the meeting were the comprehensive cash compensation packages and income restoration and improvement programmes under the Project. Among the participants were the representatives of the 09 households and 02 subfamilies who will lose their dwellings and land, and those who will lose land only to the Project. All of them supported the Project and wanted to be its beneficiaries.

90. The consultations were held in an atmosphere conducive to free exchange of views and recommendations without any intimidation from the government officials or project

officials who attended the workshop. In fact, they supported the EA in understanding the resettlement issues better and PAPs who need special attention and the issues that need urgent attention such as finding replacement land in the locality.

91. The physically displaced households who earlier wanted the Project to find replacement land for homesteads and highland allotments indicated that they would prefer to purchase replacement land by themselves using the cash that they will receive in the form of compensation and special grant. (See appendix 2.)

Public Opinion on Resettlement and Related Issues

92. During the socioeconomic survey, EIA and resettlement census PAPs supported the Project. They, however, were interested to know about their compensation packages and the relocation options. They were of the view that their present livelihood pattern would be affected if they were to move out of their villages and resettle in far away settlement sites. Their key worry is that they might not get a reasonable compensation package prior to the commencement of Project activities.

93. Most of the participants at consultations indicated that they possess a good knowledge of the Project and of how it would affect them adversely and positively. Each household which will lose its house to the Project indicated its compensation and resettlement preferences. Those who lose dwellings but will have sufficient land left after land acquisition prefer to reconstruct their houses on the same landholdings without moving out to a resettlement site. Those who will lose dwellings and land to the project, and will not have sufficient remaining land to rebuild households want to remain in their current village/community. They plan to buy land in the same area to rebuild houses, so that they could continue with their current livelihoods and maintain socioeconomic networks.

94. Consultations with PAPs and other stakeholders will continue during RIP implementation to inform PAPs and other stakeholders about the Project activities and their progress and to learn any corrective actions that the Project should take. During the implementation of income restoration programme, project officers will be responsible for assisting and facilitating PAPs on development programmes designed for them.

Disclosure of Resettlement Information

95. Resettlement information - measurement of losses, detailed asset valuations, entitlements and special provisions, grievance redress procedures, timetable for cash compensation payment, physical displacement schedule and project construction schedule will be disseminated by EA through brochures, leaflets, or booklets written in Sinhala. For non-literate people, other communication methods such as small group discussions and posters will be used.

96. The RIP will be implemented in close consultation with the stakeholders, particularly with

PAPs through focus group discussions and stakeholder consultation meetings. Women's participation will be ensured by involving them in public consultations at various stages of project preparation and implementation, and by arrangements which would enhance their ability to attend such meetings.

97. The EA will submit the following planning documents to ADB for disclosure on ADB's website:

(i) RIP before project appraisal;
(ii) a new RIP or an updated RIP, and a Corrective Action Plan (CAP), if any, prepared during project implementation; and
(iii) resettlement monitoring reports

98. Public Consultation and Disclosure Plan will be prepared by PMU and format is given below

Figure 3: Consultation and Disclosure Plan

Activity	Task	Timing (Date/ Period)	No. of Persons Attended (if applicable)	Agencies Attended (if applicable)	Feedback / Issues/ Concerns	Remarks
Stakeholder/PAP Identification	Mapping of the project area					
Project information Dissemination	Distribution of information leaflets to PAPs					
Consultative meetings with PAPs during scoping phase	Discuss potential resettlement impacts of the project					
Public Notification	Publish list of affected lands/sites at Divisional Secretariat/GNOs; Publish eligibility cut-off date					
Socio-economic survey	Collect socioeconomic information and PAPs' perception on resettlement impacts					
Consultative meetings on resettlement mitigation measures	Discuss entitlements, compensation rates, grievance redress mechanisms					
Publicize RIP or at least its entitlement matrix	Distribute leaflets or booklets in local language					
Full disclosure of the RIP to PAPs	Distribute RIP in local language to PAPs					
Internet disclosure of the RIP	RP posted on ADB And EA website					
Consultative meetings during detailed measurement survey(DMS)	Face- to-face meetings with PAPs					

Disclosure after DMS	Disclose updated RIP to PAPs					
Internet disclosure of the updated RP	Updated RP posted on ADB and EA website					

Gender Impacts and Vulnerabilities, and Mitigation Measures

99. In the Project areas, most of private lands are owned by heads of households who are men. There are several built in inheritance or sale barriers, and as a result, many transactions take place under the table, and in such exchanges invariably only men are involved. In order to avoid fragmentation of a land holding which would make the holding economically unviable, it is the general practice in the area to pass on the landholding to one child. If there is a son, he will get the holding. Rarely a daughter gets a holding from her father. No women hold land as the owner or renter or tenant among the households affected by the Project.

100. Although women are not the owners of land, they play a significant role in land cultivation, irrigation decisions, local organizations, agricultural production and marketing activities. An example is that 35 percent of attendees at the stakeholder workshop were women.

101. The communication strategy of the Project will include women group discussions that focus on possible displacement and relocation, potential impacts on their socio-cultural systems, any potential threats regarding their safety during construction owing to the presence of labourers from outside, potential opportunities for women to engage in project activities to earn an income, and on special care to be taken by contractors during project construction activities, if women are recruited as workers.

Cut-off-Date

102. 1st of July 2014 is the Project's cut-off date for compensation. The resettlement census of the project-affected households was completed on this date. This applies to non-titleholders such as squatters and informal settlers, encroachers, tenants and leaseholders. The Divisional Secretaries will disseminate this vital piece of information in the Project areas**.** The relevant local authorities will request through GNOs to refrain from granting approvals for new constructions within the Project area after the cut-off-date. EA/IA will disseminate information regarding the cut-off date throughout the project area through GNOs and DSs. Persons who occupy land in the project area after the cut-off-date are not eligible for compensation or resettlement assistance. Structures such as houses, crops, fruits, trees and wood lots established after this date are also not eligible for compensation.

8. Compensation, Income Restoration and Relocation

Valuation of Lost and Affected Assets

103. The LAA, NIRP and LA Regulations 2009, outlined in section -- above, constitute the resettlement regulatory framework for determining the replacement cost. Replacement cost comprises fair market value of the property and other compensation packages that are elaborated in NIRP and LA Regulations 2009 (see below).The valuation of acquired property will be done by the Valuation Department on the request of by the Divisional Secretary of the area where land is located. DS is the land acquiring officer. The compensation package has two components: compensation package under the LAA, and special assistance scheme under the LA Regulations 2009. The latter is given regardless of the type of land tenure of the affected households. Both packages together amount to the replacement cost of a property acquired; and in some cases, such as annual permit holders, exceeding the replacement cost. The entitlement matrix reflects these compensation packages and who is responsible for distributing these packages to PAPs.

Assessment of 'Replacement Cost'

104. LAA provides for determining compensation based on 'market value'. It defines market value as 'the amount which the land might be expected to have realized if sold by a willing seller in the open market as a separate entity on the date of publication of that notice in the Gazette … [Section 46(1)]. The NIRP states that compensation will be based on 'replacement cost' of acquired land and structures. 'Compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly. This should include transaction costs [Principle 6].

105. The LA Regulations of 2009 under section 63(2) (f) of the LAA did not adopt 'replacement cost' as the basis for compensation as LAA does not use the concept; instead it used 'market value' as defined in LAA together with several safeguard provisions to eliminate inequities arising from methods of valuation and determining 'market value' thereby upgrading compensation to the level pf replacement cost.

106. The current IR regulatory framework ensures that persons affected by land acquisition receives replacement cost, so that they could maintain the same socio-economic status that they enjoyed prior to land acquisition, or that their living standards are raised to a higher level compared with the pre-acquisition level particularly in case of the poor. As outlined above, LA Regulations of 2009 under 'Disturbances' make the necessary provisions for compensating every possible cost incurred by a PAP during the acquisition of their properties. Section 3.11 of the LA Regulations 2009 provides a range of compensation for 'disturbances' that are caused by land acquisition. The total package of compensation and other payments would bring compensation to the level of 'replacement cost' which is also a best international practice in involuntary resettlement.

The LA Regulations 2009 provides the following compensation packages to those who lost land to a public project.

- Where part of a land is acquired and when its value as a separate entity deems to realize a value proportionately lower than the market value of the main land, the compensation will be proportionate to the value of the main land.
- A building used for occupation or for business purpose, or was intended to be used for occupation or business purpose on the date the intention to acquire was published, the difference between the cost of re-construction and the value of building based for determination of market value will be paid as additional compensation.
- Value based on 'development potential' is considered in determining the value of land when a paddy land plot is acquired if the Agrarian Services Commissioner General's approval has already been obtained to convert it into a non-agricultural land.
- Where an acquired building is occupied by a tenant/statutory tenant protected under the provision of the Rent Act No 7 of 1972 (as amended thereafter) compensation will be ascertained in proportion having regard to the provisions of Rent (amendment) Act No 26 of 2006.

107. Damages caused by injurious affection and severance should be allowed fully. Compensation for disturbance is based on the "value to owner" will be paid based on written claims:

- Expenses incurred during appearing under LAA section 9 Inquiry: maximum payment is Rs 10,000.
- Expense of finding an alternative accommodation: maximum rental of Rs 10,000 per month for properties located in urban council areas, and Rs 5000 per month for properties located in *pradeshiya sabha* areas. If the anticipated physical displacement is temporary, maximum of three months rental; if the anticipated physical displacement is permanent, a maximum of 6 months rental of Rs 10,000 per month is payable for a house where floor area is less than 1000 square feet.
- Cost incurred in change of residence: Rs 10,000 for houses where floor area is less than 1000 square feet and Rs 15,000 for houses where floor area is between 1000 and 2000 square feet. Rs 25,000 for houses where floor area is more than 2000 square feet. If sub families live in a house, the payment should be divided proportionately. For other properties, maximum of Rs 25,000 is paid based on the nature of the occupation.
- Cost of advertising: permanent displacement of informal business establishment will get Rs 2,500 and a formal business establishment, Rs 15,000.
- Re-fixing cost of fixtures and fittings; transport expenses: Rs 5,000 for a house/ residence. In case of a business premises or any other structure of specific nature,

the amount should be based on actual expenses

- Loss of earnings from business: Rs 15,000 a month for informal businesses. For formal businesses compensation amount is based on accounts and tax returns pertaining to preceding three years.
- Increased overhead expenses: will be paid according to the circumstances.
- Double payments, for example, rent or rates: This is to be calculated based on actual expenditure; all other expenses incurred by the owner in relation to the acquisition: losses sustained because of the compulsory sale of the business due to the acquisition, for example, sale of livestock.
- Other additional expenses for disturbance or compensation not considered under any other compensation item above: disturbance experienced by tenants fall into this category. A payment in respect of vulnerable persons such as old and disabled people who are dependent on affected persons. Another category is self-employment. The maximum payment for any of these disturbances is Rs 15,000.
- When an owner of a house or of an investment property is displaced, additional 10% of the market value is paid as compensation. This is conditional upon leaving the acquired property on the stipulated date.
- When a value of a piece of land acquired is based on its agricultural potential, the displacement cost and loss of income will be taken into consideration in determining its value.

108. Having considered the above regulatory framework and the desire of the Cabinet of Ministers to provide adequate assistance to all PAPs of the Project, the following compensations package area approved for the Project.

Compensation Package for Land and Resettlement

109. Community Consultative Groups (CCGs) will be established in each affected GND to assist affected households and PAPs in compensation determination, payment, appeals, housing and income restoration programmes. CCGs will also help affected households in finding alternative lands and in re-investment of cash compensation in productive activities especially in income-generating programmes. CCGs consist of the members of under mentioned organisations.

(i) Priests of affected temples.
(ii) Chairmen of community organisations such as farmer organisations, rural development societies.
(iii) Community leaders.
(iv) GN should act as the convener of the Committee who will liaise with the project

110. The 22 households (including two sub-families) who will be losing their houses partially or fully will be considered as severely affected households. These households are entitled to a compensation package under Land Acquisition Act as well as under the special grant scheme at least to restore their livelihood at pre-project status. These entitlements will be given to them on a priority basis prior to the acquisition of land and other property.

111. 15 out of 22 physically displaced households have opted to rebuild their new houses on the remaining portions of the acquired residential allotments. Each of the other 07 households wants Project authorities to purchase a piece of suitable land in same locality where they now reside. During stakeholder consultation workshop, these 07 households changed their request and agreed to find suitable lands to construct their new houses and requested sufficient compensation for this purpose.

Allocation of Special Grant for Purchasing Residential Land Plots (Homesteads)

112. The following formula has been approved by the EA in consultation with MLLD and the Divisional Secretary for the provision of **a special grant** in addition to statutory compensation.

113**.** The special grant is applicable to each of the 22 physically displaced households and 02 sub-families regardless of whether it has sufficient left-over land after the acquisition to rebuild the house lost. Two special grant payments schemes will be apply to capture different land values in different DSDs. Land prices in Dambulla and Galewela DSDs are more or less the same. Therefore one scheme applies to these two DSDs, and the second scheme applies to Mahawa DSD:

114. **Scheme 01**: For Dambulla and Galewela DSDs

- ✓ A household who loses 20 perches (1/8 acre) of land or less is entitled to receive Rs 750,000 as cash compensation enabling it to purchase a plot of land of similar quality and size in the locality.
- ✓ A household who loses between 21 and 40 perches (1/4 acre) of land is entitled to receive Rs 1,250,000 as cash compensation enabling it to buy a land plot of similar quality and size in the locality.
- ✓ A household who loses between 41 and 60 perches of land is entitled to receive Rs 1,750,000 as cash compensation enabling it to buy a land plot of similar quality and size in the locality.
- ✓ A household who loses between 61 and 80 perches (1/2 acre) of land is entitled to receive Rs 2,000,000 as cash compensation enabling it to buy a plot of land of similar quality and size in the locality.

115. **Scheme 02**: For Mahawa DSD

- ✓ A household who loses 20 perches or less of land is entitled to receive Rs.300, 000 as cash compensation enabling it to buy a land plot of similar quality and size in the locality.
- ✓ A household who loses between 21 and 40 perches of land is entitled to receive Rs. 600,000 as cash compensation enabling it to buy a land plot of similar quality and size in the locality.
- ✓ A household who loses between 41 and 60 perches of land is entitled to receive Rs. 900,000 as cash compensation enabling it to buy a land plot of similar quality and size in the locality.
- ✓ A household who loses between 61 and 80 perches of land is entitled to receive Rs. 1200,000 as cash compensation enabling it to buy a plot of land of similar quality and size in the locality.

Allocation of Special Grant for Acquired Agricultural Land

116. Each affected household who cultivates highland, paddy land and *chena* (slash-and-burn) land and occupies a homestead is entitled to receive compensation as follows:

- Housing allotment (homestead): SLR 5,000,000 per acre of land in Dambulla and Galewela DSDs
- Housing allotment (homestead): SLR 2,000,000 per acre of land in Mahawa DSD.
- Highland allotment:
    - SLR 2,000,000 per acre in Naula, Dambulla and Galewela DSDs
    - SLR 750,000 per acre in Polpithigama and Mahawa DSDs.
- Paddy land: SLR 450,000 per acre
- Chena land: SLR 200,000 per acre

Special Assistance to a Household who Live on Temple Land

117. The resettlement census identified 04 household living on the Bambawa Temple land on lease. They are not eligible to receive compensation according to the land laws. But under the Project, each household will be given a cash grant to purchase land under the special grant scheme. The 04 heads of household will also be entitled to compensation on leasehold rights.

Special Assistance to the Dambulla and Bambawa Temples

118. During the resettlement census, 05 land parcels that belong to the Bambawa Temple were identified as affected land. The total area of the 05 land parcels is 40 perches. It was also identified that 02 acres of paddy land belong to Dambulla Rajamaha Temple

will be affected by the canal. Several discussions with the chief incumbents of the temples have been held on the scope of land acquisition, compensation rates, resettlement policy and strategies. He requested the EA to find replacement paddy land in the area. But EA cannot find replacement paddy land in Dambulla and Galewela area as requested. Therefore, the EA agreed to allocate 05 acres of paddy land and one acre of highland to the Bambawa Temple. The EA also agreed to allocate 7.5 acres of paddy land and 01 acre of high land to the Dambulla RajamahaTemple in system D of the Mahaweli system in Medirigiriya as replacement lands.

Technical Assistance for House Construction

119. The 22 physically displaced households and 02 sub-families are expected to self-relocate or to stay on their current premises. The above calculation of land replacement values has taken into consideration the availability of infrastructure facilities such as electricity, water, and access roads at new sites. Therefore those who relocate will have to pay for such facilities when rebuild their houses.

120. The EA will provide technical assistance in house planning and construction to each physically displaced household. A Technical Officer will assist in planning and construction households and in obtaining necessary permits and raw materials. He will ensure that displaced households will get salvage articles from acquired buildings free of cost. Each relocated household will be allowed sufficient time to rebuild its new house, so that it does not have to move out of its existing house until the replacement house is ready.

Compensation, Assistance and Land Entitlements of Other Affected Households

121. Each *ande* (sharecropper) will be compensated for all permanent land losses according to the sharecropper arrangement with land owners. Generally the arrangement is 75 percent of the crop is retained by the sharecropper and 25 percent is given to the land owner. A sharecropper whose acquired portion is more than ½ acre of paddy land will be entitled to a homestead and farmstead in the Mahaweli resettlement sites in Medirigiriya. Short term sharecroppers and leaseholders will be entitled to cash compensation for loss income, as determined by the Chief Valuer. The ande cultivator who is cultivating below ½ acre is not eligible to obtain alternative agricultural land in Medirigiriya settlement. However, the EA will respond positively to applications from such PAPs for land in the Mahaweli resettlement sites in Madirigiriya in the Polonnaruwa District, based on his current income and land ownership.

122. The Project authorities will assist PAPs to assess and their skills and assets and in reinvesting their compensation in income-generating scheme

123. The Project authorities with the assistance of the Department of Agriculture and Department of Agrarian Services will help PAPs in improving land productivity of the remaining land or newly acquired land through agricultural extension programme.

124. An encroacher who has been cultivating state land before the cut-off date, but it cannot be regularised because the land is reserved for other purpose will be entitled to the following:
- Compensation for trees and crops at market value.
- Compensation for any improvement (structures) on the land at full replacement cost.

125. Transport facilities will be provided free of charge for transportation of households goods. Maximum 02 trips will be given to each household.

126. Community Consultative Groups (CCGs) will be established in each affected GND to assist PAPS through facilitation and consultation on special assistance schemes, income restoration programmes, and land alienation programmes.

Compensation for Trees and Crop Losses

127. Farmers will be allowed to harvest their crops before construction work starts. Where crops cannot be harvested or the destruction of crops is unavoidable, cash compensation will be paid based on the market value of affected crops. All other structures and trees remain in the property such as privately owned trees (timber, fuel wood) would remain in the property. PAPs are entitled to sale of trees after determination of compensation.

128. Compensation for crops in land under tenancy and lease agreements will be based on the tenancy/ lease agreement. Final compensation rates for such crops will be determined by the Chief Valuer.

129. The losses of trees that belong to the State will be replenished through re-forestation schemes undertaken by the Project in consultation with the Forest Department.

130. Each PAP will be entitled to receive assistance under the Project's Home Garden Development Programme. They will receive planting material and extension assistance from the Project (table 23).

Table 23: Cost of Planting Materials

Type of Plants	No. of plants per person	Number of PAPs (Both highland and paddy land)	Unit Cost (SLR)	Total cost (SLR)
Fruit plants	10	495	200	990,000
Forestry plants	25	495	50	618,750
Perennial plants	10	495	50	247,500
			Total	**1,856,250**

Compensation for Loss of Houses and Other Structures

135. Owners of acquired houses and other structures such as sheds, wells, water tanks, retaining walls and fences will be compensated for full or partial losses at full replacement cost. This entitlement applies title holders, lease holders, tenants and encroachers occupying state land at the time of the cut-off date. Furthermore structures that are partly affected will be entitled to compensation at full replacement cost.

136. Owners of the property will have the right to take salvage materials of the affected structures. The value of salvaged materials will not be deducted from the final compensation amount.

137. In case of partial loss, in order to recognize its injurious effect, the remaining land and other property, if renders useless or uneconomical, they too will be acquired applying the relevant compensation package to other land and property.

138. Re-locating households will be entitled to remove trees on their lands without cost if vacated the premises at the stipulated time. All entitlements will be paid before a household is required to move out from the affected area.

Displacement Assistance

139. In addition to paying cash compensation for lost property, each physically displaced household is qualified for the following assistance. Each physically displaced household is entitled to:

- A relocating household will be entitled to a shifting allowance as determined by Chief Value according to the 2009 regulation.
- Transport facilities will be provided free of charge for transportation of households goods. 02 free trips will be provided to each relocated household.
- An allowance Rs 50,000 to build a temporary shed at the new location (Total cost is Rs. 1,200,000 for 24 households including the 03 sub-families). The PIU will assist each household to choose the type of the shed.
- A limited accommodation allowance until the house is rebuilt and ready for occupancy. The allowance will be determined according to the rates prevailing in the area. Temporary relocation will be avoided where possible as it would cause hardship to the household.

Damages Caused During Construction

140. Project Contractors will avoid damaging public and private property during the construction phase of the Project. If any such damaged is caused, the Project authorities/Contractor will pay compensation promptly to the affected household,

community or government agency. The Contractors will restore such damages to land, structures and infrastructures immediately.

Temporarily Loss of Private Land

141. Two options are offered to affected households

OPTION 1:

Borrow pits will be established on state land whenever possible. If borrowed materials are to be obtained from land occupied, regardless of the tenure type, the land user is expected to sign a formal agreement with Project authorities or the contractor indicating the following in the contract:

- Period of occupancy
- Terms and compensation amount determination by the Chief Valuer.
- Compensation for other disturbances and damages caused to property.
- The frequency of compensation payment
- Guarantee that the land will be returned to the user at the end of the lease after restoring it to its original condition or better condition, as agreed with the APS.

Option 2:

142. The project contractor obtain borrow areas at his own cost. Under this option, the Contractor could contract with private land owners/users and obtains permits to extract borrow materials. The Contractors under the agreement will pay the owner/user:

- compensation for material losses during temporary occupation,
- Compensation for other disturbances and damages caused to the property.
- the Contractor will rehabilitate/restore the land to it original condition, and
- Returns the land to the owner at the end of lease period.

Special Assistance to Vulnerable Households

143. 10 PAHs are identified as vulnerable households. Other PAPS requiring special assistance could also be identified during resettlement implementation with the assistance of Community Consultative Groups (CCGs). During the resettlement census it was identified 05 households below poverty line and another 05 households who are age of above 60 years.

144. A vulnerable household will be entitled to Rs. 25,000 as an income restoration grant and a replacement land plot at same village where its relatives live. This household will also be entitled to receive the assistance scheme under economic rehabilitation and income restoration programme.

145. A vulnerable household will receive preferential access to project construction employment opportunities. At least one member of a vulnerable household will receive priority assistance in skill and vocational training programmes organized the EA.

Damages Caused During Construction

146. Contractors are expected to be vigilant to avoid damages to public and private property during construction work. If any damage does occur to public and private property as a result of construction work, the contractor will pay adequate compensation immediately to the affected households, communities or government agencies. Once the complaint received on such damages, PIU (PD) should taken step to appoint a committee to investigate it and the committee make the suitable recommendations on payment of compensation. However it is better to have a permanent committee at PIU. Damaged land, structures, and infrastructures shall be restored immediately to their former conditions. Temporarily affected land and community infrastructures and property will be restored to pre-project level.

9. Income Restoration and Improvement

147. In the Project area, the majority of PAPs are engaged in non-agricultural employment. This is partly because of their proximity to towns and cities, and partly because of low economic viability of their allotments of paddy and highland to earn a living. Such land cultivation does not provide them sufficient income to live above the poverty threshold. As a result, they engage themselves in various other supplementary employments to augment their household incomes. In the Project area, the affected households are mostly nuclear households and only two households have sub-families living with them.

150. Land acquisition and physical displacement will adversely impact on their fragile income sources. Land acquisition for the project will cause the following losses to households:

(i) They lose a part of household income because of the acquisition of agricultural land

(ii) They will lose income because of their engagement in house reconstruction and movement

(iii) They lose day-to-day income as they will have to find time to attend to administrative requirements such as filling applications, searching for legal documents, and meeting officials and bank managers to collect their compensation packages

(iv) Temporary disturbances to their environment, dust and heavy vehicle movement in the vicinity and the need to use alternative routes affect their living during the construction period of the canal.

Table 24: Annual Average Household Income of Physically-displaced households

Below Rs.60,000	Rs.60,000 to Rs.120,000	Rs.120,000 to Rs.500,000	Above Rs.500,000
05	07	12	00

Source: MCB Resettlement Census – July 2014

151. Table 24 indicates that 05 (21 percent) households earn less than Rs 5,000 a month and are *Samurdhi* recipients. In case of 07 households (29 percent), monthly household income is between Rs. 5,000 to Rs.10,000. These 12 households will receive special income restoration *and* improvement programme under the Project. Those 12 households who earn between Rs 10,000 to Rs 42,000 a month (50 percent) each will also receive the assistance from the Project to restore their household incomes.

152. In formulating an income restoration and improvement program, several observations of PAHs were taken into consideration. Among them are:

- Lack of institutional support
- Lack of entrepreneurship attitude
- Lack of working capital
- Lack of marketing support and
- Lack of opportunity for skill development

153. To overcome these constraints the Project has designed a income restoration and improvement programme which multi-dimensional and flexible. The main features of the programme are:

i. Provision of capacity building training programmes;
ii. Development of entrepreneurship skills,
iii. Development of managerial skills among the selected APs,
iv. Formation of societies among women, youth and low income groups,
v. Provision of skill training facilities for youth.
vi. Provision of employment opportunities.

Income Restoration Programmes

Skill Development Programme for Unemployed Youth

154. The unemployed youth will receive skill development training such as carpentry, masonry, plumbing, and electrical work, focusing on the job market in the area, particularly in construction activities. The project personnel will identify such opportunities. Moreover, at least one person per household will receive training in one of the following skills. 50 percent of trainees will be women. Priority will be given in selecting for training to those households which are physically displaced and vulnerable households. Both physically displaced and economically displaced households will be eligible to receive employment training under the project.

155. The training fields are:

- Computer literacy and computer-based programmes
- TV and radio repairing programmes
- Motor mechanism
- Vehicle driving
- Heavy machine operation
- Masonry and carpentry
- Sewing clothes, and
- Any other fields identified by the PIU.

156. The young men and women from the Project area will be selected based on their educational qualification and abilities. There will be a Community Development Officer attached to the Project Office who will prepare the training curricula and liaise with vocational training institutions. Training period will range from 2 weeks to 6 months depending on nature of the training. A trainees will be entitled Rs.6,000 as an allowance per month during the training.

Institutional Arrangement for Training

157. There are few training institutions available in the country. Among them are the Vocational Training Authority and Department of Technical and Education Training are prominent. There are several non-governmental organizations who conduct various vocational training programmes. These sources will be contacted by the project personnel before the Project finalizes its income restoration and improvement programme.

158. Training budget is given below:

- 2 weeks training programme Rs.5,000 per person
- 1 month training programme Rs. 10,000 per person
- 2 month training programme Rs. 15,000 per person
- 3 months training programme Rs. 25,000 per person

Special Programmes for Women

159. **Cottage industries** will be introduced for benefit of unemployed women PAPs. A sewing machine programme will also be started for the benefit of women. Each PAP will receive Rs.15, 000 to Rs. 30, 000 as a grant in addition to 06 months training. 24 PAPs will be selected for this grant (table 25).

Table 25: Cost Estimate of Training Programme for Women and Youth

Area of training	No. of Trainers	No. of months	Cost of Training (Rs)	Allowances for Trainees (Rs)
Dress making for women	24	06	1,200,000	864,000
Motor machine operation	05	03	125,000	90.000
Driving of motor vehicles	05	03	125,000	90,000
TV and Radio Repairing	02	06	100,000	72,000
Computer literacy for school children	12	06	600,000	432,000
Carpentry	05	06	250,000	180,000
Masonry	05	06	250,000	180,000
Total			2650,000	1,908,000
Grand total				**4,558,000**

160. The Project will provide cash assistance to encourage physically displaced households to recover from their resettlement experience and trauma as early as possible. For this purpose, special income generating programme has been formulated. It will help them to restart their animal husbandry and skill development (Table 26).

Table 26: Cost Estimates of the Project's Income Generation Programme

Description	No of Houses	Unit Cost Rs.	Total Cost Rs.
Livestock development	15	50,000	750,000
Poultry	09	25,000	225,000
Grant for sewing machine or any other equipment that is relevant to their training field.	24	30,000	720,000
		Total	**1695,000**

Rehabilitation Assistance

161. Apart from the provision of displacement support, the severely affected and vulnerable households will be supported through the following measures:

- Counselling on project impacts, preparation of compensation claims and bank investment assistance.
- Counselling on savings scheme and cash management.
- Assessment of current economic activities and potentials for improvement of these activities as well as advice on alternative income-earning opportunities
- Assessment and establishment of small-scale income generating schemes for severely affected households.
- Assistance to gain access to National and Local Poverty Alleviation and Credit programmes.
- One person in each severely-affected household will be entitled to skills and vocational training that would help in obtaining employment.
- Establish self-employment programmes through skill development assistance. Cost of training, accommodation, and subsistence during the training period will be borne by the Project. CCGs will determine who the severely-affected households are and select them on priority basis.
- Provide general information construction schedules, acquisition data, valuation, compensation, grievance resolution mechanism and employment opportunities at project sites and development initiatives and opportunities.
- Establishment Community Consultative Groups (CCGs) to assist severely-affected and vulnerable people in particular and the other PAPs in general and to monitor the progress of physical and economic rehabilitation programs and to recommend corrective measures, where necessary.

10. Grievance Redress Mechanism

162. The grievance redress mechanism of the Project will address PAPs' complaints and grievances promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of PAPs at no costs and without retribution.

Types of Grievances

163. **Legal issues**:

(i) Application of LAA and its limitations to arrive at the replacement cost of acquired property
(ii) Difficulties in obtaining abstracts of deeds from the Land Registry
(iii) Rules and regulations determining the ownership of land and amount of compensation

164. **Practical issues:**

(i) Lack of knowledge on the acquisition process and how to present claims.
(ii) Delays in the payment of compensation
(iii) Delays in the payment of resettlement assistance and provision of benefits.
(iv) Most contacts on leased land are verbal. Difficulty in transforming into written contracts.
(v) Inability to find land for building new houses
(vi) Inability to construct new houses in a short period of time.
(vii) During the construction period temporary disruptions

165. During the socio-economic survey and resettlement census, several CBOs were identified who actively participate in people's affairs in the Project area. It was also observed that almost all PAPs are members of CBOs. Farmer organizations and Death Donation Associations are popular among PAPs. The chairmen of these organizations can be included into CCGs to deal with grievances of PAPs as a 'primary level redress forum' regarding land acquisition and resettlement issues. Gramaniladari of the respective GN division can coordinate with CCGs and PAPs on the issues.

Legal Frame work of Grievance Redress

166. Under the Land Acquisition Act, an Appeal Board has been constituted to deal with appeals against compensation offers. This process will minimize the grievances. However, a person who does not agree with the decision of the Board of Appeal can go before the Supreme Court claiming higher amount of compensation. But such an action is rare as it would consume money and time. Appeal Board and the Supreme Court are located in Colombo and as a result, most PAPs are reluctant to go that far.

167. PAPs will need to obtain abstracts of land title deeds from the Land Registry which is located in Polonnaruwa city which is about 50km from their villages.

Grievance Redress Committee

168. A grievance redress Committee (GRC) will be established at the Project level to resolve disputes and grievances relating to land acquisition, relocation and implementation of the RIP, and environment-related grievance and complaints. The GRC will be an ex-gratia, legal, semi-structured body empowered to make decisions on disputes resolution during the implementation of RIP. The fundamental objective of formation of a GRC is to resolve disputes at the grass-roots level in order to avoid lengthy and costly judicial process. The GRC will not deal with matters pending in the court of law. Also it has no jurisdiction over the rate of compensation.

169. As the project will not anticipate environmental grievances from the Project, the GRC will deal with social and environmental grievances.

170. The GRC will meet according to a well-advertised timetable. This information will be disseminated among all PAPs. It will call public meetings to arbitrate grievances. Each session/meeting will be held at a place which is convenient to PAPs to attend. GRC procedures will be publicized through notices and community meetings. PAPs will be made aware of the presence of GRM, its powers and benefits during consultations and group discussions. At such gatherings, PAPs will be encouraged to discuss their views on the structure and functions of GRM.

Composition of the Grievance Redress Committee

GRC at the EA level

171. This GRC consists of senior officer of the Executive Agency, Divisional Secretary in the area, Project Director of the Upper Elahera link Canal Project. The Chairman of GRC will be a senior officer of the Executive Agency appointed by the Secretary of MI&WRD. GRC meetings will be held once a month at the Project Office. Project Director will be the Convenor of GRC. The Committee will inform the grieved parties of its decision, through the Convenor, after recording the grievance, supporting documents and evidence. The total period of arbitration will not exceed six weeks.

GRC at the Project Level

172. The project level GRC will have as ex-officio members the Project Director (PD) as the Chairman of the Committee, officers who handle land acquisition and resettlement, Divisional Secretary and 04 representatives of the community consultative groups including women PAPs. Dispute resolution process will be quick, impartial and legitimate. Any PAP could present its case or evidence without any fear of harassment or intimidation.

173. If the Committee cannot resolve the issue, the Project Director as the convenor of the higher committee should submit the complaint or grievances to the Higher Committee. When PD submits the complaint to the Higher Committee, PD will make his observations on the issue. Once the Committee makes its decision on the issue, it will inform to the complainants in writing the decision. Every attempt will be taken to resolve the issue by the Committee within 04 weeks.

GRC Process

174. A PAP can make their complaint either in writing or verbally to the GN of the division or directly to a project officer. If the complaint is made verbally, the GN or the project officer will record it and forward the complaint to the Project Director who will record observations of project on the compliant.

175. Project Director will submit complaints and the observations that he received from PAPs to the Committee at the project level at the monthly meeting of the Committee. If necessary, it will call relevant parties to obtain their evidence and views. If there is a legal barrier to resolve the issues, Committee will inform the complainants how they should resolve the issue through legal institutions.

176. The GRC will attend to grievances and complaints on land acquisition cases, compensation payments, resettlement issues, ownership disputes, delays of payment of compensation issues and rehabilitation assistance programs.

177. Information about the GRC and its procedures will be published as a leaflet and widely disseminated. Notices and timetable of community meetings will also be widely disseminated among PAPs.

11. Institutional Arrangements for Resettlement Administration

Project Management Unit (PMU)

178. The Programme will have a project Management Unit (PMU) established at MIWRM. It will oversee social safeguard compliance during social impact assessments, formulation of RIPs, their implementation and monitoring of implementation progress. The PMU will have Resettlement Unit or Cell with a full time specialist (s) who will assist the formulation of RIPs, resettlement due diligence reports and resettlement monitoring reports. PMU will develop the specialist(s) TOR(s) and forward them to ADB for review. The specialist(s) key activities include: (i) screening of proposed projects for potential resettlement impacts and risks;(ii) reviewing of project alternatives to avoid or minimize resettlement impacts; (iii) assessing social impacts of the project; (iii) formulating an appropriate strategy for public consultations and resettlement information disclosure; (iv) formulating RIPs with resettlement consultants; and (v) establishing GRM and monitoring of their effectiveness.

Resettlement Staff and Consultants

179. While EA will be responsible for overall coordination, planning, and financing of resettlement programme, the implementation of RIP is the responsibility of PMU. Before commencing socioeconomic surveys and the formulation of RIP, EA will recruit a social development specialist(s)as a staff member of PMU who is familiar with land and resettlement regulatory framework and ADB involuntary resettlement policy and procedures. The specialist(s) conduct surveys and formulates RIPs of the project. The specialist(s) through EA/IA could hire resettlement consultants to assist resettlement planning and implementation.

180. Involuntary resettlement is a sensitive process and officials who are engaged in resettlement programme need field experience in resettlement and rehabilitation and community development. In order to facilitate good rapport with affected communities and oversee resettlement implementation, experienced and well-qualified civil society organizations could be hired in project areas to assist PMU/PIU in RIP implementation especially in case of category ‘A’ project. Such organizations could play the role of facilitator and will work as a link between PMU and affected communities. They will assist PAPs in income restoration through training in skill development and getting access to various government development schemes and to agencies that provide financial assistance and loans for small enterprises

Project Implementation Unit

181. The PMU will be supported by project implementing units (PIUs) in the field. Each project will have a PIU working under the supervision of PMU of the Programme. If required, resettlement officers will be hired to assist PIU/field offices for social impact assessment, formulation of RIP and their implementation and monitoring.

182. The roles and responsibilities of various agencies to be involved in resettlement planning process and implementation of resettlement activities are summarized below.

Figure 4: Roles and Responsibilities of Resettlement Agencies

Roles and Responsibilities of Agencies in Resettlement Planning and Implementation	
Activity	**Agency Responsible**
Establishment of Resettlement Unit at EA and appointment of a Resettlement Specialist (RS)	EA
Hiring of resettlement consultants (RC), external monitors (EM)	EA
Organizing resettlement training workshop (optional)	EA, RC
Screen project affected area for resettlement effects	RS, RC
Determine the scope of RIP	EA in consultation with ADB
Social Assessment and preparation of land acquisition plan, Census, Socioeconomic Surveys, RIP	EA/PMU and RS and RC
Hiring of Civil Society Organizations (NGOs)	EA
Public consultation and disclosure of RIP	RS,RC, NGO/CBO
Co-ordination with divisional administration for land acquisition	IA, PMU/PIU, RS and RC
Declaration of cut-off date	EA, Divisional Secretary (DS), RS
Review and obtaining of approval of RIP from ADB	EA
Appointment of GRC	EA/ PMU/PIU
Submission of land acquisition proposals to Divisional Secretary (DS)	PIU
Compensation award and payment of compensation	DS, PMU/PIU, RS
Payment of replacement cost and allowance	DS, PIU
Taking possession of acquired land and structures	DS
Handing over the acquired land to contractors for construction	DS
Notify the date of commencement of construction to PAPs	RS, RC, PMU/PIU, NGO
Assistance in relocation, particularly for vulnerable groups	RS, PMU/PIU, NGO, DS
Internal monitoring of overall RP Implementation	PIU, RS, RC,NGO
External Monitoring and Evaluation (M&E)	EM

12. Monitoring and Reporting

183. The PMU together with PIU of the Project will monitor the implementation of RIP to determine whether resettlement goals have been achieved and livelihood and living standards have been restored, and also to recommend on how to further improve RIP implementation.[1] The PIU will prepare half-yearly monitoring reports to submit to EA/PMU and ADB. The reports will focus on whether resettlement activities have complied with involuntary resettlement safeguard principles and loan covenants of the project. The report will also document consultations conducted with PAPs and summaries of issues identified and actions taken to resolve them. It will also provide a summary of grievances or complaints lodged by PAPs and actions taken to redress them and the specific activities conducted to restore and improve income sources and livelihoods of PAPs. The grievances include social and environmental issues and grievances.

184. Resettlement monitoring will involve (i) administrative monitoring to ensure that implementation is on schedule and problems are dealt with on a timely basis; (ii) socio-economic monitoring including income restoration and improvement during and after any resettlement impacts, utilizing baseline information established during socio-economic surveys; and (iii) overall monitoring to assess the socioeconomic status of PAHs. If any deviations from resettlement loan covenants or safeguard principles are reported in monitoring reports, EA/IA will prepare a Corrective Action Plan (CAP) and will submit to ADB for review and approval. The monitoring reports and CAP will be posted on ADB website.

185. The Project is categorized as “A” for involuntary resettlement impacts. EA will engage a qualified and experienced internal (IM) who is not associated with the project planning and implementation to monitor the resettlement implementation process and to suggest how to address if any weakness is detected.

186. In addition, IM will document good practices as well as difficulties encountered in implementing RIP. This document will provide guidance for subsequent projects. A monitoring format is given below which needs to be elaborated during the RIP implementation stage.

187. As involuntary resettlement impacts envisaged in the Project is limited and the number of households involved is only 495 who are categorised as 22 physically displaced households, 02 sub families and 471 economically displaced households. EA expects to complete land acquisition, compensation and special grant payment and income restoration and improvement in 12 to 18 months. EA will hire qualified professionals as skill trainers and organizers of income-generating programmes in the Project area. They will liaise with the income restoration groups of other Projects of the Project and work out

[1] Please see (http://www.adb.org/documents/involuntary-resettlement-safeguards-planning-and-implementation-good-practice-sourcebook-d) for sample internal and external monitoring indicators.

a comprehensive programme for the benefit of PAPs. A separate and committed budget for this purpose is established as shown in the Section 13 of RIP.

Figure 5: Monitoring Framework

Activity	Progress	Remarks
Assessment of IR impacts of changes in project design, if any.		
Updating of RIP based on changes in project design, if any.		
Approval of updated RIP by ADB		
Appointment NGO, if required		
Disclosure of updated RIP		
Establishment of GRM/Committee		
Capacity building of EA/IA, if required		
Verification of Census; assessment on compensation and assistance, and readjustment		
Land Acquisition		
Payment of compensation at replacement cost of land & assets		
Disbursement of resettlement assistance to title holder PAPs		
Disbursement of assistance to non-title holder PAPs		
Disbursement of special assistance to vulnerable groups		
Number of vocational training provided to PAPs		
Linking PAPs with local, provincial development schemes		
Planning for resettlement sites as per RIP		
Shifting PAPs to resettlement sites as per RIP		
Replacement/ shifting of community property resources		
Reinstallation of public utilities		
Preparation/ updating of Indigenous Peoples Development Plan based on changes in project design		

13. Resettlement Budget

Preparation of Budget Estimates

188. Cost estimates for lands, structures and trees acquired or affected were prepared based on the prevailing rates in the project area. This information and data were gathered from the Divisional Secretary, GNs and from informal sale agreements signed between land buyers and sellers in the area. In preparing the cost estimates, the memo of 19.01.2010 issued by the Chief Valuer on the determination of valuation of land, structures and trees were taken into consideration. The costs of land acquired, structures, crops and trees will be determined by the Valuation Department at the time of receiving 10.1.A Notice from the Acquiring Officer. Therefore, costs could be increased at that stage due to increase of land and building prices. In order to meet this risk, 20 percent contingency costs are added to cost estimates. Transport cost and other cost under LA 2009 Regulation can be met under the contingency estimate.

189. Cost of income restoration programmes has been prepared based on the prevailing costs of each item. Cost of planting materials was prepared on the basis that each PAH will request planting materials.

190. Cost estimate for institutional development covers office accommodation, vehicles and other infrastructure facilities and staff salaries.

191. The full budget will be provided by the Government through the EA. The cost estimates are given in the RIP covers the special assistance schemes limited to the project. Statutory compensation based on LAA will also be paid to PAHs. The estimates will become available only after the Survey Department and Chief Valuer determine the value of land, houses, crops and trees affected.

192. Sufficient funds will be available at the beginning of the Project to pay compensation, resettlement assistance and implement income restoration and improvement programme. All land acquisition, compensation, and rehabilitation, administrative, monitoring and consultant cost, income and livelihood restoration cost will be considered as an integral component of project costs and will be borne by EA. The EA will ensure timely disbursement of sufficient funds for RIP implementation. The EA, through its IA of the Project and in consultation with PAPs and appropriate divisional and provincial officials will determine the cost of land acquisition, resettlement and rehabilitation. The approved cost will be allocated in advance in the annual budget of EA. All cash compensation and resettlement assistance packages will be paid to PAPs before any construction activity of the project commences. Income restoration and improvement programmes will start before the construction works of the Project start and will continue during the project implementation phase.

Investment Budget

193. The total investment budget for land acquisition and resettlement has been developed into under five components.

1. Cost of compensation for land, structure and trees
2. Cost of relocation (purchase of land)
3. Cost of income restoration programme
4. Cost of monitoring and evaluation
5. Cost of institutional development

Total investment Budget

194. The total investment budget is **Rs. 447,567,510**.

Table 27: Cost Estimates of Cash Compensation for Land, Structures and Trees Affected

Land	Extent			Unit Cost (Per acre) Rs	Total Cost (Rs)
Naula,Dambulla and Galewela DSDs.	**A**.	**R.**	**P**		
Homesteads	02	01	35	5,000,000	12,300,000
Highland allotments	78	00	11	2,000,000	156,000,000
Polpithigama and Mahawa DSDs.					
Homesteads	00	01	20	2,400,000	900,000
High land allotments	16	02	00	750,000	12,375,000
Paddy lands	22	03	00	450,000	10,237,500
Chena lands	07	01	16	200,000	1470,000
				Sub Total	**Rs.193,282,500**

Structures	No and Sq.ft	Total Area Square Ft.	Rs. per sq.ft.	
Permanent buildings	13x750sqft	9750	3000	29,250,000
	05x1500sqft	7500	3000	22,500,000
	02x2000sqft	4000	3000	12,000,000
Semi-permanent buildings.	02x750sqft	1500	1,750	2,625,000
			Sub Total	**Rs 66,375,000**
Trees				
No. of perennial trees.	7782 x 10,000/-			77,820,000
No. of non perennial trees.	768 x 1000/-			768,000
			Sub Total	**78,588,000**
			Grand Total	**336,428,500**

Table 29: Cost of Buying Land for Relocation

Loss of Land	No. of Households	Unit Cost Rs.	Total Cost Rs.
Homesteads less than 20 perches (scheme 1)	21	750,000	15,750,000
Do (scheme 2)	03	300,000	900,000
Temporary sheds	24	50,000	1,200,000
		Total	**17,850,000**

Table 30: Cost of Income Restoration Programme

Cost Item	Cost Rs.
Cost of planting materials	1,856,250
Cost of training programmes	4,558,000
Cost of special assistance to vulnerable HHs	250,000
Cost of income generation programme	1,695,000
Total	**8,359,250**

Table 31: Total Cost of Resettlement Implementation and Monitoring

Description	Amount Rs.
Cost of compensation for land, structure and trees	336,428,500
Cost of relocation (purchase of land)	17,850,000
Cost of income restoration programme	8,359,250
Sub Total	3,62,637,750
Monitoring and Evaluation 2 percent	7,252,755
Sub Total	369,890,505
Cost estimate for institutional development 10%	36,989,050
Sub Total	406,879,555
Contingencies 10%	40,687,955
Grand Total	**447,567,510**

195. The disbursement of cash compensation to PAPs for land and other property losses and damages will be done by the Division Secretariats in the project areas. The approved amount will be deposited by EA/ IA in the Divisional Secretariat accounts and the disbursement will be done by the divisional administration.

196. EA will bear the total cost of land compensation, housing, relocation, and income restoration and improvement programmes. The payments will be made in cheques which will be deposited in PAPs accounts by the Divisional Secretariat of the area.

14. Implementation Schedule

197. The key involuntary resettlement-related activities such as census and socio-economic survey, cut-off-date publication, resettlement planning, public consultation have already been completed. Disclosure of information on land acquisition, compensation payment, relocation, income restoration and improvement, monitoring and evaluation of resettlement implementation are be detailed in the implementation schedule.

198. The EA/IA will ensure that no physical/or economic displacement of affected households will occur until: (i) compensation at full replacement cost has been paid to each displaced person for project components or sections that are ready to be constructed; (ii) other entitlements listed in the resettlement plan are provided to PAPs; and (iii) a comprehensive income and livelihood rehabilitation programme, supported by adequate budget, is in place to help displaced persons, improve, or at least restore, their incomes and livelihoods.

Figure 6: Implementation Schedule

Resettlement Activity	Time Schedule	Progress
Screen project areas to identify potential resettlement impacts	2014 June – August	
Determine the scope of resettlement planning and resources required	2014 August-September	
Socioeconomic Survey	2014 May and June	
Census	2014 June and July	
Declaration of cut-off date	2014 July 01	
Determine land acquisition plan (by segment or as a whole)	2014 August	
Preparation of RIP	2014 September	
Hiring of Civil Society Organizations (NGOs), if required	2014 October	
Public consultation and disclosure of RIP	2014 September	
Co-ordination with divisional administration on land acquisition	2014 August-2015 December	
Approval of RIP by ADB	2014 November	
Submission of land acquisition proposals to ministry of land and land development	2014 September	
Compensation award and payment of compensation	2014 June and July	
Payment of replacement cost and other IR allowances	2015 June and July	
Taking possession of acquired land and structures	2015 July – August	
Handing over of acquired land to contractors	2015 August – September	

Notify the date of commencement of construction to PAPs	2015 August	
Assistance to PAPs, especially to vulnerable groups	2015 June-August	
Internal monitoring of RP Implementation	2014 September-2016 December	
External Monitoring and Evaluation (M&E), if applicable		
Project Completion Report		

Annex 1: Gap Analysis - Programme's Involuntary Resettlement Safeguards and ADB Involuntary Safeguard Policy Principles, and Program's Safeguard Implementation Capacity

ADB Policy Principle	Triggered by the Program	Assessment	
		Assessment of Adequacy of the Program IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
1. Screen the project to identify involuntary resettlement (IR) impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons and a gender analysis	Yes	IR country safeguard system provides for screening IR and risks as part of resettlement planning. NIRP requires that a RIP is prepared for projects where 20 or more households are affected. If less than 20 households are affected a RIP is to be prepared at a 'lesser level of detail'. Part of resettlement planning is identifying key stakeholders and exploration of viable project alternatives to minimize social impacts especially involuntary displacement, and assess whether resettlement and social impacts are significant or not. See 2008 LAA Regulations	MLLD is responsible for implementing of NIRP in collaboration with network of public and CSOs including CEA, PEA, the Ministries concerned and Divisional Secretaries. These agencies and EA have sufficient experience in applying this principle in formulating RIPs for projects.
2. Conduct meaningful consultations with affected persons (APs), host communities, and NGOs. Inform APs of their entitlements and resettlement options. Ensure APs, especially vulnerable household participation in project planning, implementation and monitoring. Establish a grievance redress mechanism. Support socio-cultural institutions of APs. If IR impacts are complex and sensitive, provide social preparation phase	Yes	The country safeguard system (CSS) has specific guidelines on consultations with PAPs, vulnerable groups and other stakeholders and NGOs; establishment of a GRM; recording of decisions at consultative meetings; and social preparation phase of RIP planning.	EA and IAs of the program have excellent experience in conducting meaningful consultations with PAPs and other stakeholders. GRM is a component of RIPs in the Mahaweli Systems and other irrigation programs. EA and IAs have used social preparation phase in their projects. The capacity to implement this principle exist at the Program and project levels.

3. Improve or at least restore the livelihoods of all DPs. Land-for-land compensation when affected livelihoods are land-based where possible or cash-for-land compensation when land the loss of land does not undermine livelihoods; prompt replacement of assets, prompt compensation at replacement cost for assets that cannot be restored. Provide additional revenue and services through benefit-sharing schemes.	Yes	The country safeguard system provides opportunity to identify persons, households severely affected in terms of their income and employment losses. Income restoration programs are to be developed in consultations with APs in order to re-establish themselves and improve their quality of life. Replacement land is It is an option for compensation in the case of land loss; in the absence of replacement land cash compensation is an option for all APs. See NIRP Payment of full replacement cost of lost assets to PAPs is a key principle of NIRP. LA Regulations 2008 provide a comprehensive compensation package including the market value of property acquired. The total package amounts to replacement cost of lost assets.	EA/IAs are aware of this key principle and have applied in several projects.
4. Provide all APs needed assistance: if relocated, secured tenure to resettlement land, better housing, access to employment and production opportunities, and integration of resettlers with host communities, extension of project benefits to host communities, transitional support and civic infrastructure and community services, as required.	Yes	The CSS recognizes the special needs of physically relocated PAPs. PAPs involve in the selection of resettlement sites, livelihood compensation and development options at the earliest opportunity. Gender equality and equity are to be ensured and adhered to in resettlement programs. The CSS provides for assisting PAPs to be economically and socially integrated into the host communities. Participatory measures are to be designed and implemented by the resettlement planners and implementers.	Our field visits to current resettlement sites of projects (Moragahakanda Reservoir project) indicate that EA/IAs have sufficient understanding of this principle and have applied in several other projects.
5. Improve the standards of living of the displaced poor and vulnerable groups	Yes	CSS, especially NIRP and LA Regulations 2008, emphasize the importance of improving standard of living of the affected vulnerable and poor groups.	EA/IAs in their previous RIPs have paid sufficient attention to this key principle. Entitlement Matrices indicate this practice which is satisfactory.

6. Develop procedures in a transparent, consistent and equitable manner if land acquisition through negotiated settlement to ensure that APs maintain the same or better income and livelihood status	Yes	Although negotiated acquisition is recognized as a method of land acquisition by CSS, it is subject to LAA procedures of land acquisition which could cause delays. However, the NIRP and LA Regulations 2008 provide a legal framework for ensuring that PAPs maintain the same or better income and livelihood status	The application of LA Regulations 2008 and NIRP by EA/IAs in several other projects is satisfactory. They have the capacity to apply this principle.
7. Ensure that APs without titles to land or recognizable legal rights. The non titled households are eligible for resettlement assistance and compensation for loss of non land assets.	Yes	Compensation for non-land assets of non-titled persons is a well established principle in CSS. Often such non-titled persons are provided with land at resettlement sites to ensure that they will have better socioeconomic status during post-displacement.	EA/IAs have planned and implemented several RIPs which include this key principle. EA/IA possess sufficient capacity.
8. Prepare a resettlement plan with APs' entitlements, income and livelihood strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule	Yes	CSS, especially NIRP and LA Regulations 2008 require RIP for any project which is likely to have resettlement impacts. Necessary guidance is also published by MLLD on how to prepare RIP.	EA/IAs have vast experience in RIP formulation and implementation
9. Disclose resettlement plan including documentation of the consultation process in a timely manner, before project appraisal in an accessible place and a form and language understandable to APs and other stakeholders. Disclose final resettlement plan and its updates to APs and other stakeholders.	Yes	CSS, especially NIRP and LA Regulations 2008 require disclosure of RIP. LAA discloses the land which have been identified to acquire for a public purpose and calls for views, opinions and objections.	EA/IAs possess sufficient experience and capacity in RIP disclosure and consultations on resettlement information with PAPs. This has been done in several projects.

10. Conceive and execute involuntary resettlement as a part of development project or program. Include the full cost of resettlement in the project costs and benefits. If significant resettlement impacts are found, consider implementing the IR component of the project as a stand-alone operation.	Yes	IR is considered as a key component of any development project in Sri Lanka and in this regard, NIRP and LA Regulations 2008 provide sufficient guidance.	EA/IAs have sufficient experience in calculating resettlement cost as part of project cost and in obtaining sufficient funds from the Treasury to pay compensation and implement resettlement programs including income restoration programs for the benefit of PAPs.
11. Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement RP under close supervision throughout project implementation	Yes	CSS focuses on this key safeguard principle. Payment of compensation before displacement is the law except in case of urgency clause 38(a) of LAA.	EA/IAs are cognizant of the importance of paying compensation prior to displacement. Delays do occur because of lack of sufficient funds and litigation over land ownership. EA/IAs have sufficient experience and capacity to apply this principle
12. Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the RP have been achieved based on baseline conditions and the results of resettlement monitoring.	Yes	Monitoring and assessing resettlement outcomes are not well developed in the IR regulatory framework. Special arrangements are to be introduced to overcome this deficiency in CSS	Project-based internal and external monitoring of IR impacts are part of donor-funded projects which EA/IA have planned and implemented. They have gained sufficient capacity in this regards which could be applied to the Program.

Annex 2

Minutes of the Meeting on Affected Persons and Stakeholders of NWP Canal Project-Galewela Divisional Secretary Division

Date : 28/08/2014
Time : 11.00 am
Venue : Meeting Hall, Divisional Secretariat, Galewela

Officers Attended;

1.	Ms. A.M.K.C.K.Atapattu	-	DS / Galewela
2.	Eng. G.M.R.A.Perera	-	DPD / NWPCP
3.	Eng. H.M.U.B.Herath	-	DIE / Dambulla
4.	Mr.Y.G.Wijeratne	-	Consultant / MCB
5.	Ms. R.M.Samanmalee Swarnalatha	-	Consultant-Communication / ADB
6.	Eng. W.M.D.Wijesinghe	-	IE / NWPCP
7.	Mr. Roy Nanayakkara	-	EA / DIE-Dambulla
8.	G.P.S.Sanjeewa	-	EA / NWPCP
9.	M.L.A.V.Omeshani	-	EA / NWPCP

Ms. A.M.K.C.K. Atapattu, Divisional Secretary, Galewela (DS, Galewela) who presided at the meeting, welcome all officers of NWPCP & Irrigation Department, Consultants and all the invitees. Starting the meeting, she explained the purpose of the meeting. She further expressed that the people of North Western Province face severe water shortage since the area receives water from no external sources. She urged the importance of NWP Canal and stated that people living in Galewela area have to do a commitment for the benefit of the people of North Western Province.

Next, Eng. G.M.R.A. Perera, Deputy Project Director, NWP Canal Project (DPD, NWPCP), briefed on the project and current status.

Mr. Y.G. Wijeratne, Consultant, MIWRM who is doing the resettlement planning activities, expressed his views on resettlement procedure & methodology suggested to be adapted in resettlement & compensation process. He further stated that they had carried out a field survey on land, property and house-affected persons and found that only 9 houses will be affected due to project in Galewela area. He mentioned that there is a possibility of providing financial support for purchasing desired land plots, for the affected persons, those who will be dispossessed of their houses. He further mentioned it was just a suggestion and invited the participants for their suggestions and concerns on resettlement. It was also explained that although 09 households and 02 sub families will be re located only 04 HH requested relocation sites. All other 07 HH are willing to relocate their houses at remaining portion of the acquired land. However these 04 HH also agreed to find relocation sites in the locality provided that PIA will give the funds for purchase of land plot.

Mr. W.A.G.G.S.C. Wickramasinge of Kanadana, Galewela in Rawediyawa GN Division questioned whether the compensation is received only for deeds of freehold lands. Mr. Wijeratne replied that not only the deeds of freehold lands, but also “Swarnabhoomi” and “Jayabhoomi” deed holders will duly receive compensation. Mr. Wickramasinghe then stated he has been informed that only a part of the building owned by him will be affected and he inquired whether the compensation is received for the entire building in such circumstances. Mr.

Wijeratne said that the compensation is usually paid for the entire building in such cases. He further stated the final decision on building, which has been accounted to be affected for the time being, will be taken only after the final survey by Survey Department.

Ms. A. Raifa of Keppitiya, Galewela in Ranwediyawa GN Division expressed they had not received letters informing on the meeting. DPD, NWPCP replied that invitation letters were sent to all the land and house affected persons as per the list, sent by Mr. Wijeratne / Consultant , MIWRM ,by whom the persons were identified from the survey on resettlement.

After that, DS, Galewela read the list of names of the house affected persons and mentioned no government owned land available in the Galewela Town for resettlement and stressed the need of finding out desired land outside the town limits.

Ms. W.D. Krishanthi Biyatris, Welgama, GN, Pahala Bambawa subsequently, questioned why the name of Mr. Anura Jayarathne is not available in the list, though his house is situated in between two affected houses owned by Mr. H.A. Lucas Singno and Mr. H.A. Asoka Titus. Mr. Wijeratne replied that only the details of those who were available in the houses during the survey had been recorded and there can be some names missing.

Mrs. G.L.A.C.D. Rajapakse, who claimed to be a widow, mentioned that a land of hers in Dambagolla Road, Galewela in Danduyaya GN Division will be affected and she had not yet been informed the exact affected extent. She stated that she has rented the house built in the land to other person and while living in a small house in Galewela town. She claimed that the rent from this house is one of her major incomes but there is a risk of loosing her income since those who live in the house are going to leave the house due to the risk of being affected.

DS, Galewela requested to inform GNN of relevant areas before proceeding with any survey work related to project.

GN of Nebadagahawatte Division then, complained that no one from his division has been called upon the meeting though the canal trace lies within his division. In reply Mr. Wijeratne mentioned that as only the existing canal is improved and therefore, all persons living in that area will not be affected and not invited for the meeting He further stated that for the persons who need more clarifications for their issues on canal trace, to contact PD's Office, Kurunegala.

Mr. P.M. Nimal Karunathilake, GN of Ranwediyawa and Hombawa Divisions stated that some persons in his division had not received the letters while some others had received. He further complained the official for not informing GNN in the relevant divisions before the works related to the project. He requested to inform them at least a week in advance before the task.

In reply ,DPD, NWPC stated that the project is at the initial phase and this meeting was also convened through Divisional Secretary and informed to respective GNN only as per the necessity and for future works also will be also informed to GNN through DS/Galewela before any future work related to the project within their divisions.

The meeting adjourned at around 12.45 pm.

Minutes taken by : Eng. W.M.D.Wijesinghe-Irrigation Engineer

Eng. G.M.R.A.Perera – Deputy Project Director/NWPC

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ගලේවෙල ප්‍රාදේශීය ලේකම් කොට්ඨාශය 2014-08-28

Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation (නිලධාරීන්)

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
Y.M.W.B. [illegible]	[illegible]	[illegible]	
W.D. [illegible]	[illegible]	[illegible]	
A.G.K. [illegible]	[illegible]	[illegible]	
L.S.K. [illegible]	[illegible]	[illegible]	
P.W. [illegible]	[illegible]	[illegible]	
M.D. [illegible]	[illegible]	[illegible]	
R.M.M.L. [illegible]	[illegible]	[illegible]	
M.S.F. [illegible]	250. [illegible]	[illegible]	
M.H.F. RISMINA	200. [illegible]	[illegible]	
K.N. [illegible]	[illegible]	[illegible]	
W.M.S. [illegible]	[illegible]	"	
M.G. [illegible]	[illegible]	" " "	
[illegible]	[illegible]	" "	
PA. [illegible]	[illegible]	[illegible]	
P.M. [illegible]	[illegible]	[illegible]	
P.M. [illegible]	[illegible]	" "	
N.D.S. [illegible]	[illegible]	[illegible]	
A.S. [illegible]	[illegible]	[illegible]	
R.D.N. [illegible]	[illegible]	" " " - "	
N.D.T. [illegible]	[illegible]	[illegible]	
M.I.M. [illegible]	[illegible]	[illegible]	
G.M.R.A. [illegible]	[illegible]	[illegible]	
R.M. Samanmalee Swarnalath	[illegible] ADA	47/1 Kadawala, Dunag.	
H.M.G.B. [illegible]	[illegible]	[illegible]	
W.M.D. Wijesinghe	16	PD's office	
R.M. Nanayakkara	E-A	D.E's office Dambulla	
M.L.A.V. Omeshani	EA	NWP canal project	
G.P.S. Sanjeewa	EA	" "	

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ගලේවෙල ප්‍රාදේශිය ලේකම් කොට්ඨාශය 2014-08-28

Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
W.A. G.S.C [illegible]	[illegible]	618 [illegible]	[illegible]
A. Raifa	—	59 Keppitiya Galewela	[illegible]
S. FaREERa	—	588 Keppitiya Galewela	[illegible]
M.G. [illegible]	[illegible]	[illegible]	[illegible]
H.M. [illegible]	[illegible]	" "	[illegible]
G.H. [illegible]	"	" "	[illegible]
K.A. [illegible]	—	[illegible] 3 [illegible]	[illegible]
S.R. [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
H.M. [illegible]	[illegible]	[illegible]	[illegible]
K.A. D [illegible]	—	608 A. [illegible]	[illegible]
[illegible]	[illegible]	448 B. [illegible]	[illegible]
S.A.M. [illegible]	[illegible]	[illegible]	[illegible]
W.A. [illegible]	[illegible]	[illegible]	[illegible]
L.A. [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
M.W. [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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P.G. [illegible]	[illegible]	[illegible]	[illegible]
G.H.G. [illegible]	[illegible]	[illegible]	[illegible]
G.L.A.C.D. [illegible]	[illegible]	249/3. [illegible]	[illegible]
P.H. [illegible]	—	249/3, [illegible]	[illegible]
I.B. [illegible]	—	263, [illegible]	[illegible]
P.D. [illegible]	— [illegible]	[illegible]	[illegible]
G.L.A. [illegible]	—	[illegible]	[illegible]
G.L.A. [illegible]	[illegible]	[illegible] 249/1, [illegible]	[illegible]

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Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
H.M. [illegible]	ගොවිතැන්	[illegible], [illegible]	[signature]
G L A [illegible]	යුධ හමුදා	249, [illegible], ගලේවෙල	Ahuttage
M.D. [illegible]	[illegible]	[illegible]	[signature]
H. [illegible]	පුස්තකාල සහායක	[illegible], ගලේවෙල	[signature]
D.G. ඉන්ද්‍රා ශ්‍යාමලී	[illegible]	[illegible], ගලේවෙල	[signature]
H.A. අනුර ජයරත්න	මෝටර් කාර්මික	89/1B, මාතලේ පාර, [illegible] ගලේවෙල	Anura
H.A. උපුල් ශාන්ත	ගොවිතැන	පහළ බම්බාව, ගලේවෙල	උපුල්
H.A. අශෝක [illegible]	කම්කරු	පහළ බම්බාව, ගලේවෙල	[signature]
H.A. [illegible]	නැත	" " "	[signature]
T.A. [illegible]	නැත	[illegible], ගලේවෙල	[signature]
T.A. විජේරත්න බණ්ඩාර	[illegible]	[illegible], ගලේවෙල	බණ්ඩාර
D.M. [illegible]	ගොවිතැන	[illegible]	[signature]
M.A. [illegible]	ගොවිතැන	[illegible]	[signature]
R.H.A. [illegible]	[illegible]	[illegible]	[signature]
R.H.A. [illegible]	ගොවිතැන	[illegible]	[signature]
T.M. [illegible]	[illegible]	[illegible]	[signature]
D.G. [illegible]	[illegible]	[illegible]	[signature]
A.M.U.C. [illegible]	[illegible]	90/1, මාතලේ පාර, ගලේවෙල	[signature]
M.A.C.P. [illegible]	[illegible]	10/[illegible] [illegible], ගලේවෙල	[signature]
H.A. [illegible]	[illegible]	[illegible], ගලේවෙල	[signature]
K.W. [illegible]	[illegible] / ගොවිතැන	[illegible] - ගලේවෙල	[signature]
R.M. [illegible]	නැත	[illegible], ගලේවෙල	[signature]
R.P.D. [illegible]	[illegible]	[illegible]	[signature]
[illegible]	යුධ හමුදා	[illegible]	[signature] H/[illegible]
HM [illegible]	ගොවිතැන	[illegible]	
D.M. [illegible]	ගොවිතැන	[illegible]	[signature]

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Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
G.L.A. [illegible] හේමලතා	—	249 / [illegible]	[signature]
[illegible]	ගොවිතැන	දඹකොල්ල	[signature]
[illegible]	[illegible]	[illegible]	[signature]
[illegible]	ගොවිතැන	[illegible]	[signature]
I.G. [illegible]	ගොවිතැන	[illegible]	[signature]
S.P.M. [illegible]	ගොවිතැන	[illegible]	[signature]
M.S.M. MASOOD	—	[illegible] ගලේවෙල	[signature]
[illegible]	"	[illegible] - ගලේවෙල	[signature]
G.L.A. හේමචන්ද්‍ර	[illegible]	දඹකොල්ල - [illegible]	Hemachandra
G.L.A. [illegible]	—	දඹකොල්ල - [illegible]	[signature]

Purpose of the meeting is explained by Divisional Secretary Galewela

Discussion with the affected persons

Sri Lanka
Project Number: 47381
December 2014

Sri Lanka: Water Resources Development Investment Programme

North Western Province Canal

Tranche 1

Resettlement Implementation Plan (draft)

Ministry of Irrigation and Water Resources Management
Democratic Socialist Republic of Sri Lanka

Contents

ABBREVIATIONS

DOI	Department of Irrigation
DRC	Depreciated recovery cost
DSD	Divisional Secretary Division
EA	Executive Agency
EIA	Environment impact assessment
GNO	*GramaNiladhari* Officer
GND	*GramaNiladhari* Division
GRC	Grievance redress committee
GRM	Grievance redress mechanism
HH	Household
IA	Implementing agency
IR	Involuntary resettlement
ISEWP	improving system efficiencies and water productivity
KMTC	Kaluganga-Moragahakanda Transfer Canal
LAA	Land Acquisition Act 1950
MASL	Mahaweli Authority of Sri Lanka
MCB	Mahaweli Consultancy Bureau (Pvt) Limited
MFF	Multi-tranche Financing Facility
MLLD	Ministry of Land and Land Development
MDP	Mahaweli Development Programme
MRB	Mahaweli River Basin
MIWRM	Ministry of Irrigation and Water Resources Management
MLBCR	Minipe Left Bank Canal Rehabilitation
MFF	multitranche financing facility
NCPCP	North Central Province Canal Programme
NWPC	North Western Province Canal
PAP	Project-affected person
PIU	Project implementation unit
PMDC	programme management and design consultant
PMU	Project management unit
PPTA	project preparatory technical assistance
RDA	Road Development Authority
RIP	Resettlement Implementation Plan
SIWRM	Strengthening integrated water resources management
Rs	Sri Lanka rupees (US $ = Rs 128)
SPS	Safeguard Policy Statement

GLOSSARY

Cut-off-date: For land to be acquired from titled landowners, the date of notification for acquisition under the Land Acquisition Act (LAA) will be treated as the cut-off date. For non-titleholders such as squatters, encroachers, the starting date of the project census or a designated date declared by EA in consultation with Divisional Secretaries will be considered as the cut-off date**.**

Disturbance**:** Disturbances caused to normal living of a person arising from compulsory acquisition of private land.

Encroacher: A Person who has illegally occupied state land. Any legal title holder to a piece of land becomes an encroacher if he/she establishes boundaries of the holding to include adjacent state land without prior approval.

Entitlement: A variety of measures including compensation, income restoration and interim support, transfer assistance, relocation and other benefits given to project-affected-persons (PAPs) to restore and improve their post-displacement socio-economic conditions.

Entitlement matrix: It identifies categories of eligible persons and their specific entitlements under the project, and what agency/department is responsible to deliver them on time.

Host population: Persons, households and communities who reside in resettlement areas where PAPs are relocated.

Income restoration: Re-establishing income sources and livelihoods of project-affected persons to pre-project level in real terms.

Injurious affection**:** Adverse impact on the value of the remaining land due to acquisition of a part of a land.

Inventory of losses: Complete and accurate count of houses, land, business structures, trees and crops and other assets on land that will be affected by the project.

Involuntary Resettlement: The unavoidable physical or economic displacement of persons arising from a development project. In case of physical displacement, PAPs need assistance to rebuilding their livelihood, income and asset bases and social and cultural systems. If economically displaced, PAPs still need assistance to restore their livelihood and assets.

Project-affected persons (PAPs): Any person, who as a result of the implementation of a project, losses the right to own, use, or otherwise benefit from a built structure, land (residential, agricultural or pasture), annual or perennial crops and trees, or any other fixed or moveable asset, either in full or in part, permanently or temporarily.

Rehabilitation: Re-establishing and improving incomes, livelihoods and social systems of PAPs.

Relocation: Moving PAPs and their moveable assets, rebuilding their houses, developing new land, and providing public infrastructure at the relocation site.

Replacement cost: The method of valuation of assets that helps determine the amount sufficient to replace lost assets and cover transaction costs. In applying this method of valuation, depreciation of structures and assets are not to be taken into account. For losses that cannot easily be valued or compensated in monetary terms such as access to public services, customers and suppliers; to fishing, grazing or forest areas, the project will establish access to equivalent and culturally acceptable resources and earning opportunities.

Resettlement: Involuntary physical or economic displacement of persons caused by a project that covers compensation, relocation and rehabilitation measures to mitigate the effects of such displacement.

Resettlement Budget: A detailed breakdown of all costs of a resettlement implementation plan (RIP). This is a part of project costs.

Resettlement effects: Loss of physical and non-physical assets, including homes, communities, productive land, income earning assets and sources, resources, cultural sites, social structures, networks and ties, cultural identity and mutual help mechanisms.

Resettlement Implementation Plan (RIP): Time bound action plan with a budget setting out resettlement strategy, objectives, entitlement, actions, responsibilities, monitoring, evaluation and reporting.

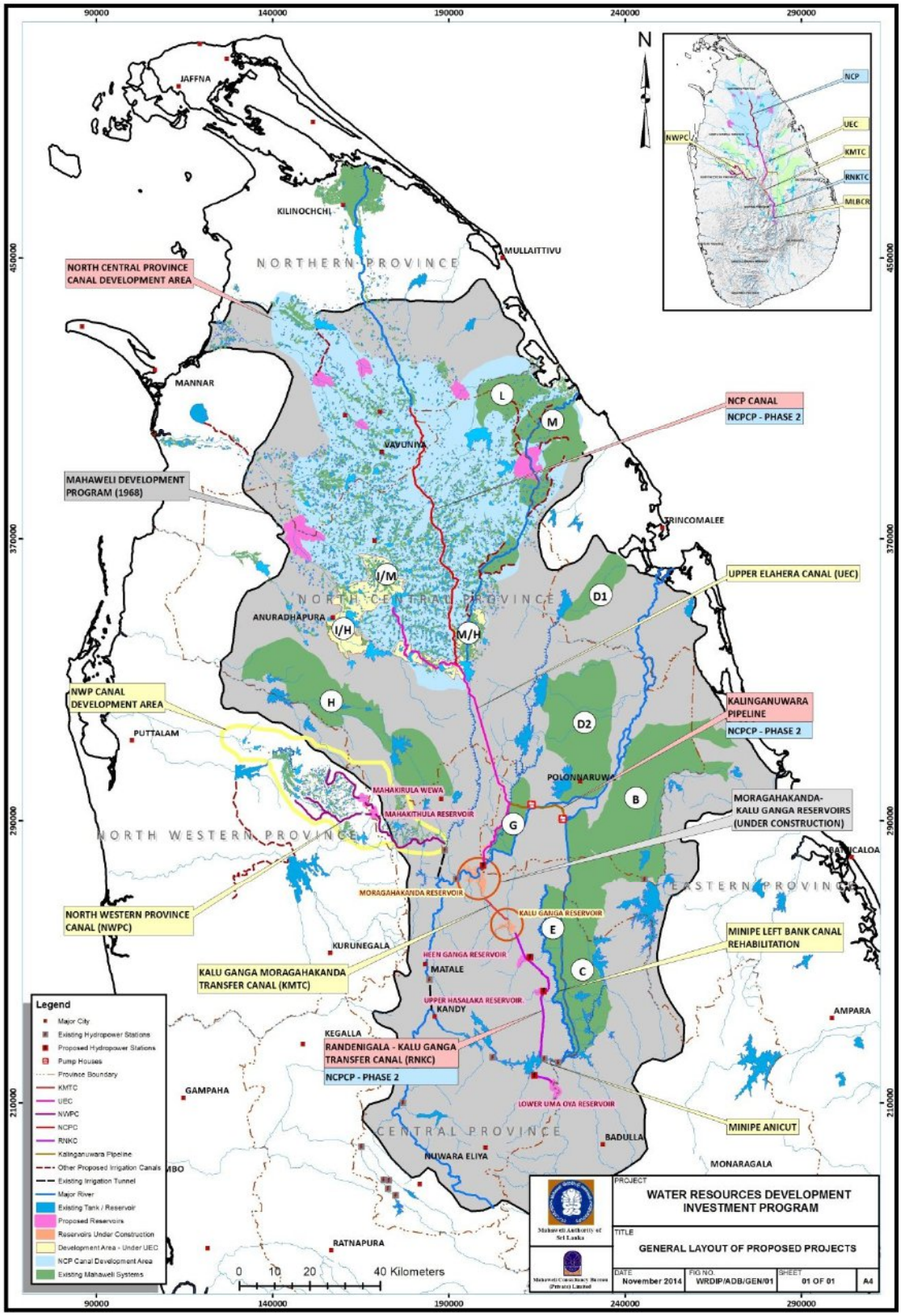
Severance**:** Dividing a landholding into two or several parts due to acquisition of the middle portion for a public purpose.

Social preparation: A process of consultations with PAPs conducted before key involuntary resettlement decisions are decided

Squatter**:** A person who occupies a piece of land without a title or any recognizable legal rights to that land.

Value to owner**:** Valuation based on actual cost to the landowner.

Vulnerable groups: Distinct groups of poor people who might suffer disproportionately from resettlement effects. Among them are the old, the young, the handicapped, the poor, isolated groups and female-headed of households.


N
NCP
UEC
NWPC
KMTC
RNKTC
MLBCR
JAFFNA
KILINOCHCHI
MULLAITTIVU
NORTHERN PROVINCE
NORTH CENTRAL PROVINCE CANAL DEVELOPMENT AREA
MANNAR
VAVUNIYA
NCP CANAL
NCPCP - PHASE 2
MAHAWELI DEVELOPMENT PROGRAM (1968)
TRINCOMALEE
UPPER ELAHERA CANAL (UEC)
NORTH CENTRAL PROVINCE
ANURADHAPURA
NWP CANAL DEVELOPMENT AREA
PUTTALAM
KALINGANUWARA PIPELINE
NCPCP - PHASE 2
POLONNARUWA
MAHAKIRULA WEWA
MAHAKITHULA RESERVOIR
MORAGAHAKANDA-KALU GANGA RESERVOIRS (UNDER CONSTRUCTION)
NORTH WESTERN PROVINCE
BATTICALOA
EASTERN PROVINCE
MORAGAHAKANDA RESERVOIR
KALU GANGA RESERVOIR
NORTH WESTERN PROVINCE CANAL (NWPC)
KURUNEGALA
HEEN GANGA RESERVOIR
MINIPE LEFT BANK CANAL REHABILITATION
KALU GANGA MORAGAHAKANDA TRANSFER CANAL (KMTC)
MATALE
UPPER HASALAKA RESERVOIR
KANDY
AMPARA
KEGALLA
RANDENIGALA - KALU GANGA TRANSFER CANAL (RNKC)
NCPCP - PHASE 2
GAMPAHA
LOWER UMA OYA RESERVOIR
MINIPE ANICUT
CENTRAL PROVINCE
BADULLA
NUWARA ELIYA
MONARAGALA
RATNAPURA
Legend
Major City
Existing Hydropower Stations
Proposed Hydropower Stations
Pump Houses
Province Boundary
KMTC
UEC
NWPC
NCPC
RNKC
Kalinganuwara Pipeline
Other Proposed Irrigation Canals
Existing Irrigation Tunnel
Major River
Existing Tank / Reservoir
Proposed Reservoirs
Reservoirs Under Construction
Development Area - Under UEC
NCP Canal Development Area
Existing Mahaweli Systems
0 10 20 40 Kilometers
PROJECT
WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM
TITLE
GENERAL LAYOUT OF PROPOSED PROJECTS
DATE
November 2014
FIG NO.
WRDIP/ADB/GEN/01
SHEET
01 OF 01
A4

Water Resources Development Investment Programme

North Western Province Canal Project – Tranche 1

Resettlement Implementation Plan

1. Introduction

1. This Resettlement Implementation Plan (RIP)addresses land acquisition, compensation, resettlement assistance, income restoration and improvement, and physical relocation requirements of the North Western Province Canal (NWPC) Stage 1 subproject (the Subproject) of the North Western Province Canal Project (the Project) which is a constituent part of the SRI: Water Resources Investment Development Programme (WRIDP) (See Table 1 below).

2. ADB supports the Government of Sri Lanka to plan and implement WRIDP through the Ministry of Irrigation and Water Resources Management (MIWRM) by financing the following three investment projects that constitute the planned North Central Province Canal Program (NCPCP). The WRIDP is a multitranche financing facility (MFF) of $675 million. The MFF will comprise three tranches financing three loan "Projects". The Projects will comprise the following individual investment projects:

   (i) The Kaluganga-Moragahakanda Transfer Canal Project (KMTCP) will convey about 771 million cubic meters (MCM) of water annually between the Kaluganga and Moragahakanda Reservoirs which are under construction. They will retain local runoff and the Mahaweli River flow diversion, before augmenting downstream irrigation and water supply schemes. The length of the canal is 9 kilometers (km) and comprises about 8-km of tunneling.

   The Upper Elahera Canal Project (UECP) will annually convey about 974 MCM northwards from the Moragahakanda Reservoir along a 65.5-km canal to the Huruluwewa and Manankattiya Reservoirs which, in turn, feed existing irrigation and water supply schemes.

   (ii) The North Western Province Canal Project (NWPCP) will annually withdraw 130 MCM from the Dambulu Oya River and the Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located in North Western Province via 96-km of new and upgraded canals including a new 940 meter (m) tunnel.

   (iii) Minipe Left Bank Canal Rehabilitation Project (MLBCRP), located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork's weir by 3.5 meters to regulate generation inflows, and (b) rehabilitate the 76-km Minipe Left Bank Canal to improve conveyance and reliability of service to farmers.

3. The Investment Programme will be implemented over ten year period, and its proposed structure is shown in Table 1. It will also include three consulting packages comprising: (i) 'improving system efficiencies and water productivity' (ISEWP); (ii) 'strengthening of integrated water resources management' (SIWRM); and (iii) the 'The Program Management, Design, and Supervision Consultant' (PMDSC) which will support MIWRM in managing WRIDP and preparing packages under the investment programme.

Table 1: Tentative Investment Program Structure and Implementation Schedule

Project	Value ($, millions)	Subproject	Schedule
Construction Works			
Project-1	189	UEC Stage 1 NWPC Stage 1 MLBCR	Q1 2015 – Q4 2019
Project-2	287	UEC Stage 2 and KMTC	Q1 2016 – Q4 2024
Project-3	199	UEC Stage 3 NWPC Stage 2	Q1 2018 – Q2 2024
TOTAL	**675**		

KMTC = Kaluganga – Moragahakanda Transfer Canal; MLBCR = Minipe Left Bank Canal Rehabilitation; NWPC = North Western Province Canal; UEC = Upper Elahera Canal; Q = quarter of a year.
Source: Asian Development Bank

Rationale of the Project

4. Water is the principal medium in the dry zone of Sri Lanka through which climate change exhibits its environmental, economic and social impacts. Many regions, particularly poorer communities are vulnerable to droughts and water-related disasters such as floods that destroy lives, assets and incomes. Moreover, widespread kidney diseases caused by bad drinking water threaten the lives of rural populations of the northern dry zone. The risks associated with climate uncertainty and change can be mitigated to some extent by storing and distributing water wisely when it is scarce, and by planning ahead to protect communities from droughts and floods. Coping with water-related risks requires a collective involvement and broad planning perspective. The WRDIP takes this key development issues as one of its objectives (see Table 2).

5. No new lands are identified to irrigate by the NWPCP. The main benefit of the Project will be increased cropping intensity of existing cultivated lands under major and minor irrigation schemes. In addition, the Project will provide safe drinking water to a large population who suffers now from drought and lack of safe drinking water.

6. Providing safe water services and managing water resources wisely will improve health, and open opportunities for all to improve their life chances through education and capacity-building. In many poor communities, fetching water from distant sources and queuing for water are physically-demanding and time-consuming responsibilities borne

primarily by women and girls. Women, as a result, have less time to engage in productive economic activities and this lack of involvement leads to increased poverty. In case of young girls, school attendance is often considered a lesser priority: a gender bias that creates an imbalance in school enrolment ratios has been noted in the project areas, although the imbalance has been progressively declining. Disparities in women's education and involvement in decision-making can place them at a significant disadvantage in earning an income or voicing their views on affairs of their communities (Table 2).

Table 2: WRDIP and Millennium Goals

Millennium Development Goal	Applicability to WRDIP	How It could help achieve the goal	Comments
1. Eradicate Extreme Poverty	Yes	Having a sustainable, safe water supply, and benefiting from its economic opportunities such as better and secure irrigated agriculture help break the vicious circle of poverty	Key objective of WRDIP
2. Achieve Universal Primary Education	Yes	A safe and secure water supply helps all children – boys and girls – to stay at school, and enables women to participate more actively in income generating activities and in their community activities	One of WRDIP's broad development goals
3. Promote gender equality and empower women	Yes	See above.	See above
4. Reduce child mortality	Yes	Safe drinking water nutritious food and improved sanitation are central to health and well-being of children and their parents.	See above
5. Improve maternal health	Yes	See above	See above
6. Combat HIV/AIDS, malaria & other diseases	Yes	See above	See above
7. Ensure environmental Sustainability	Yes	Better management of water resources lessens pollution and improves water conservation towards ensuring sustainable, life-supporting ecosystems.	Key development goals of WRDIP
8. Develop a global partnership for development	Yes	Water has no political or ethnic boundaries and is especially vulnerable to human impacts. WRDIP works with people and agencies to use this irreplaceable resource wisely	Contribute to deal with vulnerability of communities regardless of their ethnicity and class.

2. North Western Province Canal Project – Tranche I

7. The NWPCP will have limited resettlement impacts as only 09 households with 02 sub-families will be physically displaced. In addition, 119 households will have minor economic impacts, as each of them will lose al, less than 10 percent of its land because of the subproject. One physically displaced household falls into the category of poor whose monthly income is below the official poverty line of Rs 3,981. The resettlement impacts of the subproject, therefore, are categorised as 'B'.

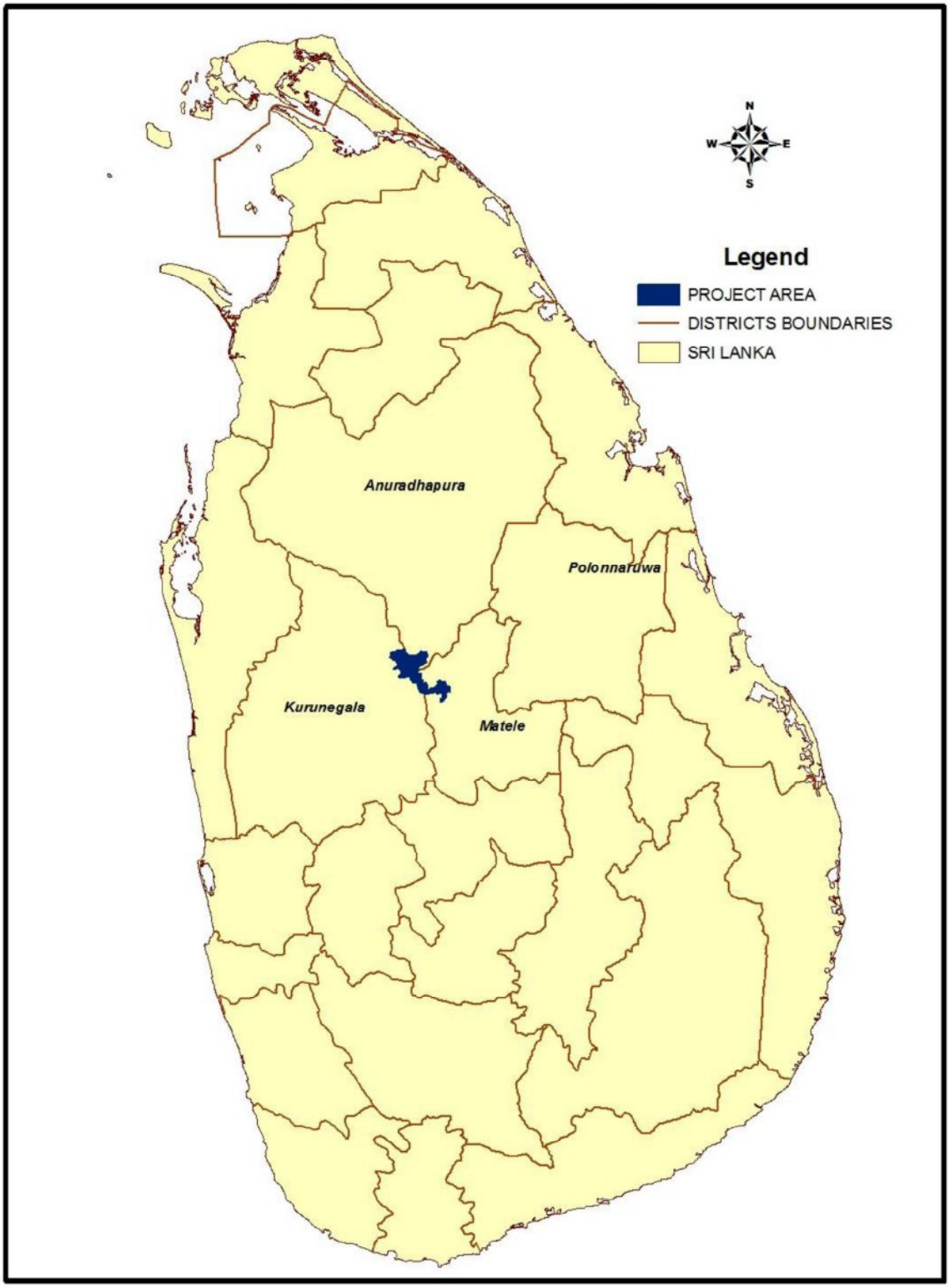
8. The 30-metre wide Tranche 1 section of the NWPC will start at the Welamitiyawa GND in Dambulla DSD. It will flow 33km through jungles and a few human settlements before reaching the Mahakirula Reservoir in Palagala DSD in Anuradapura District. It locational information is given below.

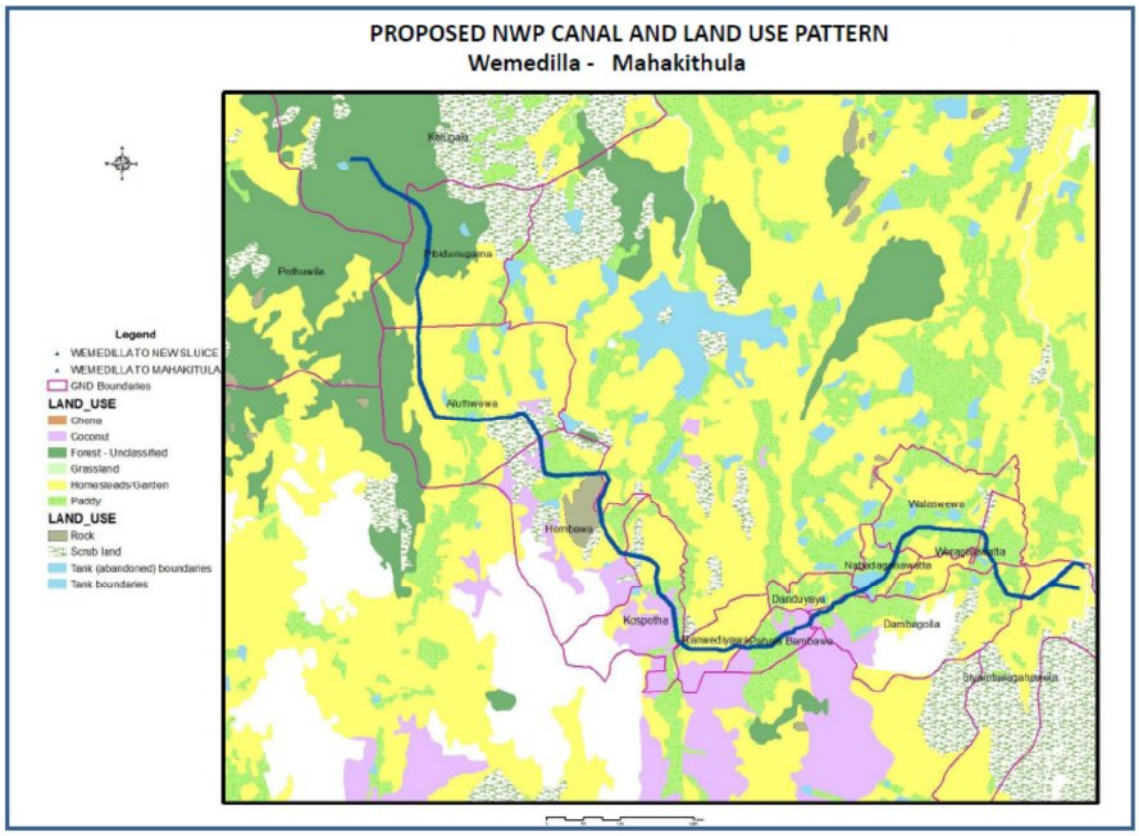
9. 0 to 05 km is the Dewahuwa Feeder Canal that starts at Wemedilla in Dambulla DSD and ends at the Nabadagaswewa in Galewela DSD. A few private land allotments will be affected by the canal.

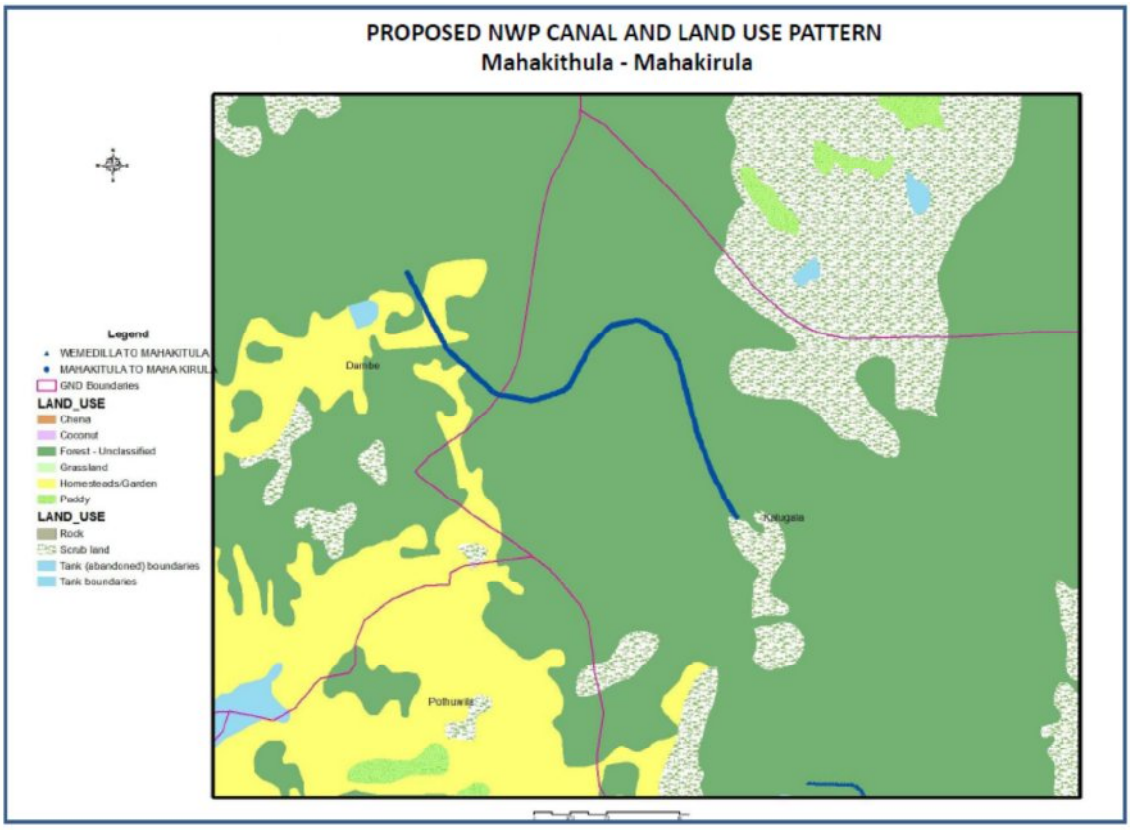
10. 05-30-kmcanal section starts at Nabadagawewa and ends at the Mahakitula Reservoir. 09 households with 02 sub-families will be affected by this section of the canal.

11. 30-33-kmsection starts at the Mahakithula Reservoir and ends at the Mahakirula Reservoir. This section of the canal will traverse through the wildlife reserve and there are no human settlements.

LOCATION MAP OF PROJECT AREA
(Proposed NWP Canal)




PROPOSED NWP CANAL AND LAND USE PATTERN
Wemedilla - Mahakithula
Legend
WEMEDILLATO NEW SLUICE
WEMEDILLATO MAHAKITULA
GND Boundaries
LAND_USE
Chena
Coconut
Forest - Unclassified
Grassland
Homesteads/Garden
Paddy
LAND_USE
Rock
Scrub land
Tank (abandoned) boundaries
Tank boundaries
Kalupala
Pothuwila
Aluthwewa
Hombewa
Walawewa
Kospotha
Danduyaya
Dambagolla



Avoidance of Resettlement Impacts

12. During the canal trace design, every attempt was taken to avoid homesteads. The canal trace has been revised several times to reduce environmental and social impacts of the canal. Because of these adjustments to the canal trace, the land area and number of households affected by the Project have been substantially reduced. The Subproject 1 will physically displace 09 households and 02 sub-families in Danduyaya, Ranwediyawa, Hombawa, Pahala Bambawa, Nilagama, Aluthwewa, Pibidunugama, Pahalabambawa and Kospotha of Galewela DSDs. In addition, 119 households will be economically displaced. Their economic displacement is partial, as only a strip of land will be taken from each affected land allotment. On the canal trace, there were 04 houses between 15.800 km and 15.900 km, and between 18.100 km and 18.340 km, which were identified as property to be acquired. The discussions between the social safeguard team and design engineers of the Programme resulted in the change of the canal trace to avoid the acquisition of the four houses.

3. Socio-economic Profile of Project-affected Households

13. A comprehensive field information survey (socio-economic survey)was conducted in 2013 as a part of environmental assessment of the Project to identify the scope and significance of potential project impacts on project-affected households (PAHs). As the Project is a linear development project, the survey team interviewed more than 90 percent of identified PAHs in order to develop a comprehensive socio-economic profile. The survey identified 70 households in 26 villages as potentially affected households and interviewed 64 households. This section outlines the key findings of the socio-economic assessment highlighting the impacts of the proposed Project on human settlements.

Population

14. According to the survey, there are 70 households with 248 persons who will be affected by the Project. They live in 25 village communities located in 22 GNDs of 05 DSDs (Table 3).

Table 3:Project-affected Population by Location and Gender

DS Division	No. of Displaced Households	Population		
		Male	Female	Total
Galewela	39	63	73	136
Dambulla	08	10	15	25
Naula	00	00	00	00
Polpithigama	11	24	24	48
Mahava	12	17	22	39
Total	**70**	**134**	**114**	**248**

Source: EIA Field Information Survey, NWCP, October 2013

15. Infant population constitute 10 percent of the affected population. 21 percent of the population is at the school going age. Half of the population (48 percent) constitutes the labour force in the Project area. Although the old population is as high as 17 percent, only a small percentage of it is in fact retired, as farmers do not retire till they become disabled. Male-female ratio is 40:60 (Table 4).

Table 4:Physically Displaced Population - Disaggregated by age and Gender

Age (years)	No. of Person	Percentage
05 and below	25	10
06 – 18	51	21
19 – 35	74	30
36 – 50	45	18
Older than 50	44	17
Data not provided	09	04
Total	**248**	**100**

Source: EIA Field Information Survey, NWCP, October 2013

Occupations

16. Agriculture is a source of income and livelihood. Small irrigation tanks and irrigation systems, and monsoons rains are the principal water sources for agriculture. Almost every village in the Project Area has an irrigation tank to collect rainwater, and a canal system to convey water to cultivated lands. The cultivable area in a given season depends on the size and capacity of the irrigation system and rain water availability. Farmers distribute water collectively using well established traditions and rules.

17. Only 25 percent of households are engaged in agriculture as their main source of income in the Project area because of high risks associated with farming. In good rainy seasons, villagers store water in irrigation reservoirs and collectively manage water carefully for irrigation and domestic purposes. If a drought sets in during a cultivation season, they could lose the entire crop. Another risk is wild animals harming the crops. As a result, the majority (75 percent) are engaged in different occupations such as government employment (14 percent), private sector employment (25 percent), self-employment (17 percent), wage labour (14 percent), and agricultural labour (Table 5). Despite the risks associated with agriculture, uneducated and poor villagers engage in agriculture by finding their own solutions within their limited capacities for the difficulties encountered a season after another.

Table 5: Occupations of PAPs in the Project Area

Sector	No. of People Engaged	Percentage
Government	15	14
Private	27	25
Self employed	18	17
Daily wage labour	15	14
Agriculture labour	05	05
Farming	27	25
Total	**107**	**100**

Source: EIA Field Study, NWP Canal Project 2013 October

18. There are 16 households in the Project area identified by the Government as low-income households. Many of them are headed by widows. Each household receives a monthly grant from the Government under the *Samurdhi* Relief Programme (Table 6). They work as daily wage workers in agriculture and non-agricultural activities to supplement the grant, as it is not sufficient to cover their household expenditure.

Table 6:Samurdhi Recipients in the Project Area

Monthly Grant in Rs	No. of Households
350 and less	02
351 – 700	05
701 – 1000	08
More than 1001	01
Total	**16**

Source: EIA Field Information Survey, NWPCP, October 2013

Infrastructure Facilities in the Project Area

19. The Project area includes urban, semi-urban and rural settlements. Although the settlement patterns are widespread over a large area, they are well connected through transport facilities.

20. **Roads**: Main towns in the Project area are Galewela, Dambulla, Ambanpola and Galgamuwa. The affected villages are directly connected with major road network of the country. Mahawa, Polpithigama and Ahatuweva also can be easily accessed through a secondary road network. Rural areas can be reached through motorable road network although some roads have not been repaired for many years. Gravel roads connect hamlets within villages.

21. **Transport Facilities**: The road networks connecting towns have excellent transport facilities operated by both the Government and private sector. In rural areas, transport facilities are satisfactory. Many villagers own bicycles, two-wheeled tractors, motor bicycles, and three-wheelers. Rural villages are also served by private buses, trucks and tractors operated on daily basis by town-based transport providers. They transport people as well as local produce to the market centres.

22. **Health Facilities**: In the Project area, there are two base hospitals, three 'A' grade district hospitals, one 'B' grade district hospital and one 'C' grade district hospital, administered by the Department of Health. In addition, depending on the population size, each DSD has a rural hospital and central dispensaries to provide health services to rural village communities. In addition, there is a community Health service reaching to the remotest areas functioning under a Regional Director of Health Services. Several communities in the Project area are affected by chronic kidney disease (CKDu). Polpithigama and Mahawa DSDs are the areas where increased incidence of CKDu has been reported. For example, the Polpithigama Divisional Secretariat in 2013 had records of 228 kidney patients.

23. **Marketing Facilities**: Dambulla Town is the key commercial centre in the Project area. It is connected with Galewela, Kurunagala and Colombo. Many farmers of project-affected villages use private transport facilities to transport vegetables, fruit and grains from their

villages to Dambulla commercial Centre for sale. Another market network is Galgamuva and Ambanpola towns and their environs. Farmers buy their agricultural inputs and sell their produce through these market networks. Market centres also provide computer services and skill training programmes for the youth.

Land Use Patterns

24. Several sections of the canal traverse through land owned by the Forest and Wildlife Departments. In the project-affected villages, farmers cultivate paddy, other field crops (OFCs), vegetable, and fruit trees. Valuable timber such as Teak, Burutha, and Halmilla are also cultivated in homesteads and highland allotments as an investment. Households depend on the monsoons rains to cultivate their crops mainly in the Maha (main) season. In the Yala (minor) season, as discussed earlier, rains often fail destroying their crops. As a result, many farmers cultivate only a portion of their holdings during the Yala season to avert disaster arising from prolonged droughts. The Yala season of 2013 in the Project area was a failure.

Highland Cultivation

25. During the dry (Yala) season, farmers cultivate root-crops such as beet, radish, leafy vegetables, maize and chilli using micro irrigation systems such as drip irrigation and sprinklers on highland allotments. As the dry season progresses the water level in shallow dug wells drops and the streams and village reservoirs dry out causing threats to crops. This often results in reducing crop yield and yield quality. With assured water supply especially in the Yala season farmers can cultivate their land and improve cropping intensity by using irrigation methods such as drip and sprinkler irrigation.

Homestead Development

26. As in other areas of the dry zone, villagers in the Project area have neglected their homesteads mainly because of the difficulty in maintaining them during the dry season. Traditionally, homesteads in the dry and intermediate zones were located closer to the village reservoir. Homesteads are mostly cultivated with coconut, mango, cashew, tamarind, jack, kohomba (Margosa) which provide an income and shade to the homestead. In addition, they cultivated fruit trees such as banana, orange and lime. Growth and the yield of these trees are affected during Yala season due to scarcity of water. The Project is expected to create a high ground water table throughout the year by augmenting water level in village reservoirs enabling the cultivation of crops in both Maha and Yala seasons.

Chena Cultivation

27. Chena (slash-and-burn) cultivation of government forests is an avenue of earning a living for dry zone villagers. Depending on the man-power available at a household or the resources available to mobilize labourers, a slash-and-burn cultivation plot could be as big as five acres or more. Both poor and non-poor engage in slash-and-burn cultivation of crops such as maize, sesame, millet and vegetable.

Land ownership

28. The canal will traverse through a land over which both the government and individuals have a variety of land tenure interests and rights. Part of the canal traverses through government land most of which belongs to the Wildlife Department. Over the years, some of these lands have been distributed among landless poor in surrounding areas on 'government permits' which range from one year to 30 years of tenure, enabling them to earn their living by cultivating the land and in some cases to construct their dwellings.

29. Main land tenure types in the Subproject area are:

- **Private Titled Deeds**: The private deeds are registered at the Land Registry under the Act of Registration of Documents. A deed can be transferred to any person through sale or lease, or rent on agreed terms between parties in the presence of a Notary Public.
- ***Jayabhoomi* Deeds**: These deeds are issued under the Land Development Ordinance for agricultural and residential purposes with certain conditions. A *Jayabhoomi* land can be transferred to a specified person described in the Schedule of the Land Development Ordinance. A *Jayabhoomi* holder is the owner of the allotment.
- **Land Development Ordinance (LDO) Permits**: They are issued under the Land Development Ordinance for a specified period of time. An allotment can be transferred to another person following the rules given in the Schedule of the Land Development Ordinance.
- **Long-term Leases**: These leases are issued under the State Land Ordinance[SLO] for commercial, residential and other purposes described in the Act. Leased period is 30 years with certain conditions. A long-term lease can be transferred to another person with the approval of the concerned authority. Some of the leases are upgraded to freehold ownership after paying the valuation for the land particularly housing allotments under the provision of SLO.
- **Annual Permits:** The permit is a legal document that allows the permit holder to cultivate a piece of state land for a period of 12 months. A levy is charged from the permit holder. He cannot claim any right or interest over the land allotment.

- **Encroached Land**: Use of state land without permission for various purposes, mainly to cultivate highland crops is prohibited. However, an encroachment could continue over several years with the connivance of state officials. Periodically, the State 'regularizes' some encroachments mainly as a part of the strategy to alleviate rural poverty.
- **Temple Land**: Several old Buddhist temples have been given large extent of land by the kings. These lands have been recognized by the government as temples lands. The incumbent priests of the temples use the land to obtain services and rituals from people of different castes. These people have become tenants or leaseholders of the temples and pay annual dues to the temple to accept the fact that the temple owns the land. They also perform some traditional services such as painting the temple in lieu of land rights to cultivate temple land. Temple lands come under the purview of Temple Land Ordinance of 1944. Several households of Pahala Bambava GND located close to Galewela town, and Kanadana village in Ranvadiyava GND live on the lands owned by Bambava Purana Raja Maha Viharaya (Buddhist temple). Several affected households in Valamitiyawa village in Dambulla DSD live on the land that belongs to the Dambulla Buddhist Temple on long-term lease basis. They do not have any legal rights over the land that they cultivate although they have built permanent houses and have developed land as if they were their own.

30. In the Project area, dominant land tenure type is titled land in various forms: private ancestral land (30 percent), *jayabhoomi* grants (26 percent), *swarnabhoomi* grants (08 percent) and freehold licensed land allotments (05 percent). The next largest tenure type is temple land (20 percent) (Table 7).

Table 7: Distribution of Different Types Land Tenure in Project Area

Type of Tenure	Number of Households	Percentage
Private titled	19	30
Freehold	03	05
Swarnabhoomi	05	08
Jayabhoomi	17	26
Ranbhoomi	00	00
Government permit	02	03
Encroachment	05	08
Temple land	13	20
Total	**64**	**100**

Source: EIA Field Information Survey, NWPCP, November 2013

4. Socio-economic Conditions of Physically Displaced Households

31. A resettlement census was conducted in May and June 2014 in the Subproject area. It covered PAHs' assets and main sources of livelihood affected and their socio-economic status. The gender-disaggregated socio-economic data have been used to determine if special actions are needed by poor and vulnerable households, especially female-headed households, to overcome their socio-economic marginality and disarticulation. As the detailed project designs are being completed parallel to the census of project-affected households and persons, the data presented in this RIP could be taken as final for the Subproject area.

32. The Subproject area is located in Aluthwewa, Pibidunugama, Hombawa, Ranwediyawa, Nilagama, Danduyaya, Pahalabambawa and Kospotha GNDs. The Subproject will affect 128 households. They include 09 households with 02 sub-families who will be physically displaced. The PAH distribution among the GNDs and villages is given in Table 8.

Table 8: Subproject Affected Households

Division	GND	Village	No. of Households Affected
Galnawa	Aluthwewa	Aluthwewa	22
	Pibidunugama	Pibidunugama	13
	Hombawa	Hombawa	23
	Ranwediyawa	Kanadana	13
	Nilagama	Nilgama	14
	Danduyaya	Danduyaya	05
	Pahalabambawa	Pahalabambawa Bogaswewa	04
	Kospotha	Kosptha	34
	Total		**128**

Source: MCB Resettlement Census, 2014

33. Of the 128 Subproject-affected households, 09 households with 02 sub-families will be physically displaced. The canal will traverse through their land affecting their dwellings and homesteads. These 09 dwelling houses need to be rebuilt either on the remaining homesteads after land acquisition or at a place where households select to live. The two sub-families of two households too need to be resettled separately from their current households.

Population

34. The physically displaced 09 households are not 'native' to the Subproject area. All of them in different time phases arrived in their current settlements, when the dry zone land development programmes opened up more land for the landless and poor households. Table 9 shows that 78 percent of households arrived in the subproject area after 1970 (Table 9). By holding land permits from the government over a period of time, the majority of households have become eligible to receive *swarnabhoomi* and *jayabhoomi* land titles for the land that they have been cultivated over several decades (see Table 9).

Table 9: Arrival Phases of Displaced Household in the Subproject Area

Arrival Phase	Number of Households	Percentage
1960-1970	02	14
1970-1980	03	14
1980-1990	02	22
1990-2000	00	36
2000-2010	02	07
After 2010	00	07
Total	**09**	**100**

Source: MCB Resettlement Census, June 2014

35. Only 27 persons live in the 09 physically displaced households. The number of dependents is 08. The dependency ratio is about 30:70. The average household size is 04. The population is largely a young population. They are all Sinhala Buddhists. There are no female-headed households among the physically displaced households (Table 10). All PAPs are in good health, and the census found no disabled PAP. Also, the census did not find a household with divorced or separated parents.

Table10: No. of Affected Households

DSD	GSD	Type of HH		Impact on Residence		Condition of HH		
		Male – headed	Female - headed	Relocation	Isolation	Good Health	Disabled	Vulnerable
Galewela	Danduyaya	01	-	01	-	01	-	-
	Ranwediyawa	03	-	03	-	03	-	-
	Pahalabambawa	03	-	03	-	03	-	-
	Kospotha	02	-	02	-	02	-	-
Total		**09**	**-**	**09**	**-**	**09**	**-**	**-**

Source: MCB Resettlement Census, July 2014

36. Physically displaced households live in Ranwediyawa, Danduyaya, Pahalabambawa, and Kospotha GNDs. All of them are male-headed households. Only one household falls below the poverty line. It will be considered as a vulnerable household and will receive special attention from the Subproject to restore and improve its livelihood.

37. The physically displaced households are well connected with nearby townships such as Galewela and the provincial capital of Matale. Regular bus service connects PAPs with Kurunegala, Dambulla and Anuradhapura cities, and also with markets.

Demography of Affected Households

38. 22 percent of the population is below 18 years and 15 percent is above 60 years. Of the labour force (19-60 years), 35 percent are men and 65 percent are women. This is also a reason for low engagement in agriculture (Table 11).

Table 11: Population, Sex, Marital Status and Age Distribution of Affected Households

GND	Below 18 years				19 – 59 years						Over 60 years					
	Male		Female		Male			Female			Male			Female		
	Married	Unmarried	Married	Unmarried	Married	Unmarried	Widow	Married	Unmarried	Widow	Married	Unmarried	Widow	Married	Unmarried	Widow
Danduyaya	- -	02	-	-	01		-	01	-	-	-		-	-	-	-
Ranwediyawa	-	01	-	-	02		-	03	-	-	-	- -	-	-	-	-
Pahalabambawa	-	-	-	01	02	-	-	04	01	-	02	-	-	01	-	-
Kospotha		01	-	01	01	-	-	02	-		01	-	-	-	-	-
Total	**-**	**04**		**02**	**06**	**-**	**-**	**10**	**01**		**03**			**01**		
Total population = 27																

Source: MCB Resettlement Census, July 2014

Affected Homesteads

39. The total area of homesteads affected by the Subproject is 01 acre and 15 perches. These are either outright titled land or temple lands (Table 12).

Table 12: Land Ownership Patterns of Acquired Homesteads

Residence Land (Affected Portion)																		
GND	Outright			Swarnaboomi			Jayaboomi			LDO			Temple Land			Encroached		
	A	R	P	A	R	P	A	R	P	A	R	P	A	R	P	A	R	P
Danduyawa	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranwediyawaa	-	01	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pahalabambawa	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kospotha	-	-	25	-	-	-	-	-	-	-	-	-	-	01	-	- -	- -	- -
Total		**03**	**15**											**01**				

Source: MCB Resettlement Census, July 2014

40. 75 percent land to be acquired is titled land including outright, *jayabhoomi* and *swarnabhoomi* land allotments.12 percent of acquired land allotments are government land belonging to the Wildlife Reserve (Table 13). A few encroachments on state highland were noted during the resettlement census.

Table 13: Type of Land Tenure of Acquired Highland for the Subproject

Type of Land	High land			Paddy Land		
	Area of land affected			Area of Land Affected		
	A	R	P	A	R	P
Outright deeds	10	00	00	01	03	20
Jayabhoomi deeds	06	00	00	00	01	20
Swarnabhoomi deeds	02	00	00	02	00	00
Encroachment	01	02	15		-	
Government land	02	03	18		-	
Temple land	01	03	00		-	
Total	**24**	**00**	**33**	**04**	**01**	**00**

Source: MCB Resettlement Census, July 2014

41. Most of the landholdings identified for acquisition are dry highland cultivated only during the Maha (main) season in each year under rain-fed conditions. Highland cultivators do not have sufficient resources to dig deep wells or to pump water from a nearby water source to their allotments. The main crops cultivated on these lands are maize, sorghum, chillies, lime, groundnuts, vegetable, and few perennial trees such as jack, breadfruit and mango.

42. Only 1.2 acres of paddy land in the Subproject area will be affected by the construction of the canal. Paddy land holdings too are cultivated only during the Maha season under rain fed conditions. In the Yala season, some farmers cultivate paddy in a portion of their paddy land with a high risk of crop failure due to drought. During the past two Yala seasons paddy crops failed owing to drought.

Income and Livelihood Sources

43. As in case of other areas of the Project, in the Subproject area, agriculture is not the main source of income of more than 75 percent of households. Most of households are engaged in private sector employment (55 percent) as security guards, sale assistants and vehicle drivers (Table 14).

Table 14:Income and Livelihood Sources

GND	Farming	Government	Private Sector	Self-Employment	Business	Hired Labor
Danduyaya						01
Ranwediyawa			01	01		
Pahalabambawa	01	-	03			
Kospota	01	-	01			
Total	**02**	**-**	**05**	**01**		**01**

Source: MCB Resettlement Census, July 2014

44. No household is engaged in business or in government service. This indicates the poor educational and skill level among the affected population (Table 14). Only one out of 10 has passed GCE (O/L) examination. No household has a member who has gained some formal skill training (Table 15).

Table 15: Educational Level of Head of Households

GND	Up to 5Std		6 to 10Std		GCE (O/L)		GCE (A/L)		Degree	
	M	F	M	F	M	F	M	F	M	F
Danduyaya	-	-	-	-	01	-	-	-	-	-
Ranwediyawa	-	-	02	-	-	-	-	-	-	-
Phalabambawa	02	-	02	-	-	-	-	-	-	-
Kospota	01	-	02	-	-	-	-	-	-	-
Total	**03**		**06**		**01**					

Source: MCB Resettlement Census, July 2014

Affected Dwelling Houses

45. Each homestead and house will only be partially affected by the canal. Remaining portions of homestead could be used for rebuilding new houses or for cultivation. Partly affected houses will not be used as dwellings. Therefore, compensation will be paid for whole structures regardless of the extent of damage in case of affected houses. Moreover, most of secondary structures which are located close to the affected houses will also be affected by the canal. If a household relocates, compensation will be paid for secondary structures such as wells and small sheds as well.

46. No household will be separated by the canal from other households in an affected village. Each affected household has electricity, and 04 houses have pipe-borne water supply (Table 16).

Table16: Affected Dwelling Houses and Homesteads

GND	Houses Affected			Homesteads Affected	
	Fully	Partly	Isolated	Fully	Partly
Danduyawa	-	01	-	-	01
Ranwediyawa	-	03	-	-	03
Pahalabambawa	- -	03 02	- -	- -	03 02
Kospotha			-	-	
Total		**09**			**09**

Source: MCB Resettlement Census, July 2014

5. Scope of Land Acquisition and Resettlement

47. As discussed above, 128 households will lose some of their land as a result of the canal. Of them, 09 households will be physically displaced. The need for finding relocation sites will not arise, as all displaced households prefer to self-relocate in the vicinity of their settlements or to rebuild houses on their remaining homesteads after the acquisition. 07 out of 11 physically displaced households fall into this category. It is estimated that 29 acres and 16 perches of land (11.78 ha) will be acquired from 128 households. 4.1 acres (14 percent) are paddy lands; 23.76 acres (82 percent) are highland allotments; and 1.1 acres (4 percent) are homesteads (Table 17).

Table 17: Sub-Project-affected Land

Type of land	Acreage	Percentage
Paddy	4.10	14
Homesteads	1.25	04
Highland	23.76	82
Chena (Slash and Burn)	0.00	00
Total	**29.11**	**100**

Source: MCB Resettlement Census, June2014

Condition of the Building Structures

48. The 07 permanent and 02 semi-permanent houses will be affected. Only 02 houses will be fully affected (table 18). The 09 partially affected houses will be considered as fully affected in paying compensation.

Table 18: Project-affected Structures (Dwellings)

GND	Houses Affected		
	Fully	Partially	Isolated
Danduyawa	00	01	
Ranwediyawa	00	03	
Pahalabambawa	00	03	
Kospotha	00	02	
Total	**00**	**09**	

Source: MCB Resettlement Census, June 2014

49. Seven out of 09 houses are roomy and well-furnished houses. 7 out of 09 houses have cemented floors, brick walls and roof tiles. Two are semi-permanent small houses with a few pieces of furniture. Each house has electricity and 04 of them (45 percent) are connected to pipe borne water supply (Table 19).

Table 19: Type of houses Affected: Basic Information

GND	Tile/Cement/ Bricks			Asbestos/ Cement/Bricks			Tile/Floortile/ Bricks			Semi-permanent			Temporary			Electricity		Pipe-Bourne water	
	<750 sq.ft	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	Yes	No	Yes	No
1.Danduyawa	-	01-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	0	0	1
2.Ranwediyawa	01	01	01	-	-	-			-	-	-	-	-	-	-	03	0	01	0
3.Pahalabambawa	01	-- 01	-	-	-	-	-	-	-	- 01	-	-	-	-	-	03	0	03	2
4.Kospotha	01									01						02	0		
Total	**03**	**03**	**01**	**-**	**-**	**-**	**-**	**-**	**-**	**02**	**-**	**-**	**-**	**-**	**-**	**09**	**00**	**0405**	

Affected Trees

50. The resettlement census identified 3,136 perennial trees and non-perennial trees which will be uprooted for the canal (Tables 20, 21 and 22).Most perennial trees are valuable trees which brought periodic income to households. Other trees provide food and a surplus to sell in the market.

Access to the Land and Properties

51. In a meeting held with affected people at Galewela, some of them complained that they will lose access to their lands and properties as a result of canal construction. Alternate access is to be provided to enable them to access their land and properties.

Table 20: Number of Trees Affected on Homesteads

GND	Coconut	Teak	Areca nuts	Jak	Mango	Ketakela	Bread Fruit
1	08	03	-	-	01	-	01
2	09	-	08	-	04	-	-
3	16	28	06	07	07	02	-
4	08	02	-	02	03	02	01
Total	**41**	**33**	**14**	**09**	**15**	**04**	**02**
GND	**Banana**	**Kaluwara**	**Murunga**	**Papaw**	**Orange**	**Lime**	**Guava**
1			1	6			
2	17	1		2	1	29	4
3					2	1	1
4							
Total	**17**	**1**	**1**	**8**	**3**	**30**	**5**

Source: MCB Resettlement Census, June 20141=Danduyawa 2=.Ranwediyawa; 3= Pahalabambawa; 4 = Kospotha

Table 21: Number of Affected Perennial Trees on Highland Allotments

GND	Coconut	Cashew	Teak	Jack	Mango	Neem	Halmilla	Burutha	Bread Fruit	Aricanut
Aluthwewa	225	45	105	05	25	08	06	-	-	30
Pibidunugama	82	38	92	02	-	08	--	-	-	-
Hombawa	438	36	238	15	32	01	-	-	-	02
Ranwediyawa	120	03	04	-	03	01	-	-	01	-
Nilagama	125	-	228	03	17	05	10	-	-	20
Danduyaya	99	01	26	12	15	04	15	02	-	-
Pahala Bambawa	310	02	31	05	05	01	01	-	-	-
Kospotha	441	50	96	10	27	11	09	-	-	-
Total	1840	175	810	52	124	39	41	02	01	52
Grand Total =3136										

Source: MCB Resettlement Census, June 2014

Table 22: Number of Affected Medium Term Crops on Highland Allotments

GND	Banana	Guava	Mandarin
Aluthwewa	40	02	-
Pibidunugama	-	-	-
Hombawa	32	-	-
Ranwediyawa	46	-	01
Nilagama	-	-	-
Danduyaya	-		05
Pahala Bambawa	27	01	-
Kospotha	26	-	01
Total	**171**	**03**	**07**

Source: MCB Resettlement Census, June 2014

Acquisition of Special Properties

52. As mentioned earlier, during the Project design stage, the canal trace was changed several times to minimize project impacts on houses and other property. During the resettlement census, it was noticed that the canal trace would traverse through the playground of the Keppetiya Muslim Collage in Galewela DSD. It was also noticed that during the construction phase of the canal, children's sport activities and class programmes would be disrupted. The discussions among design engineers, local people and census team on how to avoid such temporary and permanent disruption to the school resulted in the decision the canal section will be built during school holidays. The canal section will be a covered canal section. They also agreed to restore the playground to its original status, minimizing hardships to school children and the school staff.

53. The resettlement census identified 05 acres of land belonging to the Beligamuwa Farm of National Livestock Development Board which will be acquired for the canal. The canal will affect a coconut plantation of about 300 coconut trees.

54. During consultations with potential PAPs of Umbawa village, several PAPs pointed out that the public well at Umbawa should be spared as it provides year-round clean water to the village community. A slight change in the canal trace is required to meet this request. Project engineers will decide on the feasibility of the proposal and inform villagers and the EA.

55. The Subproject will affect 05 land allotments of the Bambawa Temple. The total area of the allotment is about 40 perches (1/4 acre). During consultations, the chief incumbent priest expressed his concerns on the manner in which land values are determined when acquired for a public purpose. He pointed out that the cash compensation paid for land acquired is not sufficient to buy replacement land. Therefore, he requested that replacement land instead of cash compensation should be provided by the Subproject in the vicinity of the temple. The final arrangement is to give 05 acres of irrigated land and 1acre of highland at the Mahaweli resettlement site in Madirigiriya in Polonnaruwa District.

Land Values

56. The value of the acquired land is specified as 'market value' by LAA. This is the price that the owner would receive if sold in the open market on the date of publication of the section 2 Notice under LAA. However, the valuation officer has the discretion to specify what the 'market value' should be for a particular parcel of land.

57. Land value varies from place to place and according to the type of land. In the Subproject areas, land prices varied from Rs. 50,000 to 60,000 per perch. These prices were confirmed by the Divisional Secretary of Galewela DSD and will be used in determining the market value of acquired land.

Resettlement options

58. During the resettlement census, 07 households opted to resettle on the remaining portions of the acquired land. The remaining 04 households requested the EA to purchase land in the vicinity as replacement land, where they will build their new houses with compensation and the special grant. However at the stakeholder workshop held in August 2014, these 04 households indicated that they could find land for relocation in the vicinity of their existing communities. DS Galawela informed that no government land available in Galewela and Project should motivate them to find private land to buy.

59. No land will be acquired under the 'urgency section' of 38 A of the Land Acquisition Act. In acquiring land and other property, the proposed actions of this RIP will be applied to expedite the land acquisition process.

6. Policy and Legal and Frame Work and Procedure of Land Acquisition

60. Land acquisition, compensation, relocation and income and livelihood restoration of the subproject will be guided by the Land Acquisition Act (LAA), 1950 and its amendments, National Involuntary Resettlement Policy (NIRP), 2001, National Policy for the Payment of Compensation, 2008,the Land Acquisition Regulations of 2009 (LA Regulations 2009), National Environmental Act of 1980 and amendments, and ADB's SPS(2009).

Land Acquisition Act (LAA)

61. The LAA provides a legal framework for acquisition of land for a 'public purpose'. It provides detailed procedures for land acquisition, consultations, calculation of compensation for land, structures, and crops at 'market value' and assistance packages. It guarantees that no person is deprived of his land except under the provisions of LAA, and provides a compensation package for acquired land, structures, damaged crops and disturbances caused by the project. The normal procedure for land acquisition begins with a request from a government agency made to the Minister of Land and Land Development (MLLD) to acquire a piece of land for a public purpose. Once acquired, the land is vested in the government agency.

62. Provisions of the LAA are inadequate to address all adverse impacts associated with land acquisition and involuntary relocation. The LAA is indifferent to land losers' socio-economic conditions and long-term adverse impacts on their incomes and livelihoods. The LAA prescribes that market value of land should be paid as compensation which amounts the price a property owner could expect if sold in the open market, whereas the SPS (2009) stipulates that 'replacement cost' should be paid as compensation which includes market value and other resettlement assistance packages. Post-acquisition monitoring of IR impacts is not part of LAA.

National Involuntary Resettlement Policy (NIRP*)*

63. The Government adopted NIRP in 2001 to ensure that (i) PAPs are fairly and adequately compensated, relocated, and rehabilitated; (ii) delays in project implementation and cost overruns are reduced; and (iii) better community relations are restored among PAPs and host communities.

64. The NIRP is based on LAA and it amendments, National Environmental Act of 1980 and amendments, and several other applicable laws such as Urban Development Authority Act and Coastal Conservation Act, Regulations of the Acts, and also on legal opinions of courts on land acquisition, compensation, consultation and income restoration.

65. Principles of the Policy are:

(i) IR should be avoided as much as possible by reviewing alternatives to the project as well as alternatives within the project.

(ii) Where IR is unavoidable, PAPs should be assisted to re-establish themselves and improve their quality of life.

(iii) Gender equality and equity should be ensured and adhered to throughout.

(iv) PAPs should be fully involved in the selection of relocation sites, livelihood compensation and development options at the earliest opportunity.

(v) Replacement land should be an option for compensation in the case of loss of land; and in the absence of replacement land cash compensation should be an option for all PAPs.

(vi) Compensation for loss of land, structures, other assets and income and livelihood losses should be based on full replacement cost and should be paid promptly. This should include transaction costs.

(vii) Resettlement should be planned and implemented with full participation of the provincial and local authorities.

(viii) Participatory measures should be designed and implemented to assist those economically and socially affected to be integrated into their host communities.

(ix) Common property resources and community and public services should be provided to resettlers.

(x) Resettlement should be planned as a development activity for PAPs.

(xi) PAPs who do not have title deeds to land should receive fair and just treatment.

(xii) Vulnerable groups should be identified and given appropriate assistance to improve their living standards.

(xiii) Project Executing Agencies should bear the full costs of compensation and resettlement.

66. The Policy applies to:

- All development-induced land acquisition or recovery of possession by the State
- All projects regardless of the source of funding
- All projects in the planning phase on the date the policy came into effect and all future projects

67. The MLLD is responsible for implementing of NIRP. This is done in collaboration with a wide network of public agencies including the CEA, Survey Department, Valuation Department, Ministries concerned, and Divisional Secretariats.

68. NIRP ensures that PAPs are treated in a fair and equitable manner, and that they are not impoverished in the process of land acquisition and resettlement. The Policy also enables establishing a framework for project planning and implementation that would meet international best practices in involuntary resettlement including involuntary resettlement safeguard policy principles and requirements of ADB.

National Policy on Payment of Compensation (2008) and LA Regulations (2008)

69. The Cabinet of Ministers approved the National Policy on Payment of Compensation (NPPC) in November 2008 in order to establish a uniform system of adequate compensation payment, based on LAA, NIRP and several other laws applicable to land acquisition and resettlement, and also to supersede all other *ad hoc* and special compensation packages used by government agencies such as Road Development Authority (RDA). The LA Regulations 2008, ratified by the Parliament of Sri Lanka in 2009 as Regulations of LAA gave effect to both NIRP and NPPC. The LA Regulations 2008 incorporated NIRP and NPPC principles into Sri Lanka's legal framework thereby improving the congruence between local regulatory framework for land acquisition and resettlement, and international best practices for involuntary resettlement.

National Environmental Act (NEA) 1980 and 1988

70. The National Environmental Act (NEA), No.47 of 1980, amended by Act No.56 of 1988 has some provisions relevant to involuntary settlement. The Gazette notification No.859/14 of 23 February 1995 determined the projects and undertakings for which Central Environmental Authority (CEA) approval is needed in terms of Part IV – C of the NEA. Item 12 in the Schedule requires the formulation of RIP to address involuntary resettlement of 100 or more households.

Safeguard Policy Statement of ADB, 2009 (SPS)

71. The objectives of the involuntary resettlement safeguards policy of ADB are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

72. IR safeguards covers physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. IR safeguards apply whether such losses and involuntary restrictions are full or partial, permanent or temporary.

73. The IR policy principles are:

- Screen the project early on to identify past, present, and future involuntary resettlement impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons, including a gender analysis, specifically related to resettlement impacts and risks.
- Carry out meaningful consultations with affected persons, host communities, and concerned non-government organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programmes. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations. Establish a grievance redress mechanism to receive and facilitate resolution of the affected persons' concerns. Support the social and cultural institutions of displaced persons and their host population. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.
- Improve, or at least restore, the livelihoods of all displaced persons through (i) land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement value for land when the loss of land does not undermine livelihoods, (ii) prompt replacement of assets with access to assets of equal or higher value, (iii) prompt compensation at full replacement cost for assets that cannot be restored, and (iv) additional revenues and services through benefit sharing schemes where possible.
- Provide physically and economically displaced persons with needed assistance, including the following: (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities; (ii) transitional support and development assistance such as land development, credit facilities, training or employment opportunities, and (iii) civic infrastructure and community services, as required.
- Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.
- Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status.
- Ensure that displaced persons without titles to land or any recognisable legal rights to land are eligible for resettlement assistance and compensation for loss of non-land assets.

- Prepare a resettlement plan elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule.
- Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to affected persons and other stakeholders. Disclose the final resettlement plan and its updates to affected persons and other stakeholders.
- Conceive and execute involuntary resettlement as part of a development project or programmes. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.
- Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation.
- Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports.

Gap Analysis: Resettlement Regulatory Framework of the Programme and IR Safeguard Policy of ADB

74. LAA is the legal framework for compensation for acquired land and structures and land development. The NRP and LA Regulations 2008 together with LAA provide a comprehensive resettlement regulatory framework which broadly matches IR safeguard policy objectives and principles. A Gap Analysis Matrix is given in Annex 1.

75. The key gaps between LAA and IR policy principles of SPS were (i) the entitlements of non-titled PAPs, (ii) compensation at replacement cost, (iii) income restoration and improvement, (iv) consulting PAPs and their host communities on relocation options; (v) special assistance to vulnerable PAPs, (vi) monitoring and assessment of resettlement outcome and impacts, and (vii) the formulation of RIP to address these issues.

76. The issue of non-titled PAPs' entitlements is addressed in LAA and elaborated in NIRP and LA Regulations 2009. Under the LAA any person having a 'right, title or interest in or over the land which is to be acquired or over which a servitude is to be acquired' (section 10(1) is entitled to compensation. A person who has 'interest' in land' apart from owner and co-owners area mortgagee, a lessee, or an occupier absolutely for himself or in trust for another person or for any charitable, religious or other purpose, or a person having a servitude over the land (section 65 as amended in 1964). The Court of Appeal in 2001 added tenants to this list. The court also held that the occupier 'could not, in any event,

be evicted without being compensated in respect of his improvement (if, in fact, he is the owner of such improvements'. The court distinguished between 'ownership of the property' and 'ownership of land improvement'. This matches with ADB's IR safeguard Policy Principle 7 that those who do not hold title to land are eligible for resettlement assistance and compensation for loss of non-land assets.

77. NIRP takes replacement cost as the norm for cash compensation. The LA Regulations 2008 detail how the total compensation package amounts to replacement cost of acquired land and other properties such as dwelling and business structures. MLLD's 'A Guide for Public Officials on Good Practices' (MLLD 2013) guides that in preparing the entitlement matrix 'to determine replacement cost for land and structures which will be acquired to the project'.

78. Restoration and improvement of income sources and livelihood of PAP is a key resettlement principle of NIRP. MLLD (2013) states that in preparing a RIP it is necessary to identify persons and households severely affected in terms of their income and employment losses; conduct consultations to develop an income restoration programme for all PAPs; and develop a special income improvement programme for vulnerable PAPs.

79. Consulting PAPs and their host communities on relocation issues is also a key resettlement principle of NIRP. Special assistance to vulnerable PAPs constitutes a core resettlement principle of NIRP and is elaborated further in LA Regulations 2009.

80. Monitoring and assessment of resettlement outcome and impacts which is an IR safeguard policy principle is not addressed in the resettlement regulatory framework.

81. NIRP and LA Regulations 2009 require the formulation of a RIP to address IR safeguard requirement. LA Regulations 2009 states that 'formulation of an RP and its implementation is the responsibility of the project executing agency and project management unit (PMU) of a development project.

IR Principles Applied to the Subproject

82. Based on the comparative review of various resettlement policies, laws, regulations and guidelines of Sri Lanka and the ADB Involuntary Resettlement Policy, the following broad resettlement principles are distilled for this Programme to apply to its projects:

- Screen each project of the Programme to determine whether it triggers the following IR principles and to determine the scope of resettlement planning required.
- Take every effort to avoid physical displacement and/or any other adverse impacts on livelihood and income sources and community resources and infrastructure. If physical displacement and economic displacement are unavoidable, the following actions will be taken to ensure that they improve or at least restore their income and livelihoods and rebuild their socio-cultural systems.

- Consult and inform all PAPs on land acquisition, compensation, and rehabilitation, and their entitlements and grievance redress mechanism.
- Provide special project assistance to meet the needs of affected vulnerable people such as poor, landless, elderly, woman-headed households, informal settlers and squatters.
- Improve or at least restore livelihoods of all affected households through cash-for-land compensation at replacement cost for acquired or damaged non-land property, and cash-for-land or land-for-land for land acquired.
- Provide well-planned and budgeted income restoration and improvement programmes for the benefit of PAPs, especially for the poor and vulnerable groups.
- All common property resources lost due to the project will be replaced or compensated by the project;
- If land acquisition is through negotiated acquisition, the project will ensure that PAPs who enter into negotiated acquisition will maintain the same or better income and livelihood status.
- PAPs without title to land are eligible for resettlement assistance.
- Disclose resettlement information and RIPs including consultation documentation before the project appraisal in a form, manner and language(s) accessible to PAPs and other stakeholders. The final RIPs and their updates, if any, will also be disclosed to PAPs and other stakeholders in the same manner.
- The full costs of resettlement will be included in project costs.
- Pay compensation and provide other entitlements to each eligible displaced person before physical displacement and any construction work starts.
- Monitor and assess the progress of RIP implementation and prepare monitoring reports to share with ADB, PAPs and other stakeholders.

83. In accordance with IR principles outlined above, all PAPs are entitled to a combination of compensation packages and resettlement assistance according to the nature of ownership/user/occupier rights and interests on lost assets and the degree of project impacts on socio-economic conditions and vulnerability of PAPs. Please refer to the Entitlements Matrix given below. It summarises the entitlements of PAPs/PAHs against different losses. The full description and budget allocations are given in sections 8 and 9.

Land Acquisition Procedure

84. Land for the Subproject will be acquired under the regulations and guidelines of the Land Acquisition Act as elaborated in Section 06 above.

Figure 1: Entitlement Matrix

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of Agricultural Land	Land acquired for the canal and related facilities such as service roads	Owner of titled land	a) Compensation for land at replacement cost b) Market value for trees and crops.	EA/PIU	1. Compensation rates are determined based on NIRP, and LA Regulation, 2009 2. Replacement land: PAHs will purchase replacement land in same locality using the statutory compensation and special grant provided regardless of the tenure type of the acquired land. The formula is given below: (a) homestead – Rs 5,000,000 per acre; (b) Highland allotment – Rs 2,000,000 per acre (c) Paddy land – Rs 450,000 per acre; and (d) Chena land – Rs 200,000 3. Other assistance outlined in RIP will also be provided by PIU
Loss of Agricultural Land	-do-	Leasehol-der of state land	a) Compensation for loss of lease-hold land right; b) Market value for trees and crops	-do-	
Loss of Agricultural Land	-do-	Owner of State grant land	a) Compensation for land at replacement cost, and trees and crops at market value	-do-	
Loss of access to agricultural land	-do-	Owner of titled land	a)Compensation for land on replacement cost b) Compensation for crops and trees at market value	-do-	
Loss of access to agricultural land	-do-	*Ande* Farmer (Share cropper)	a) Compensation for loss of *Ande* right b) compensation for crops destroyed/damaged	-do-	
Loss of access to agricultural land	-do-	Non-titled user or squatter on State land	a) Compensation for land development b) Replacement cost of structures built c) Compensation for trees and crops at market value	-do-	
Residential Land and Structures					
Loss of Residential land and structures	Land acquired for canal, related facilities such as service roads	Owner of titled land (Main HH)	a) Compensation for structures and land at replacement cost b) Trees/crops at market value. c) Salvage materials from structures and trees without cost. c) Cash grant for purchase of housing allotment. d) Transport cost and other transaction cost e) Cash grant for temporary shed (Rs 50,000)	EA /PIU	1. Compensation rates are determined based on NIRP, and LA Regulation 2009 2. Replacement homestead will be purchased by each physically displaced household for relocation in the same locality with the cash grant provided by PIU

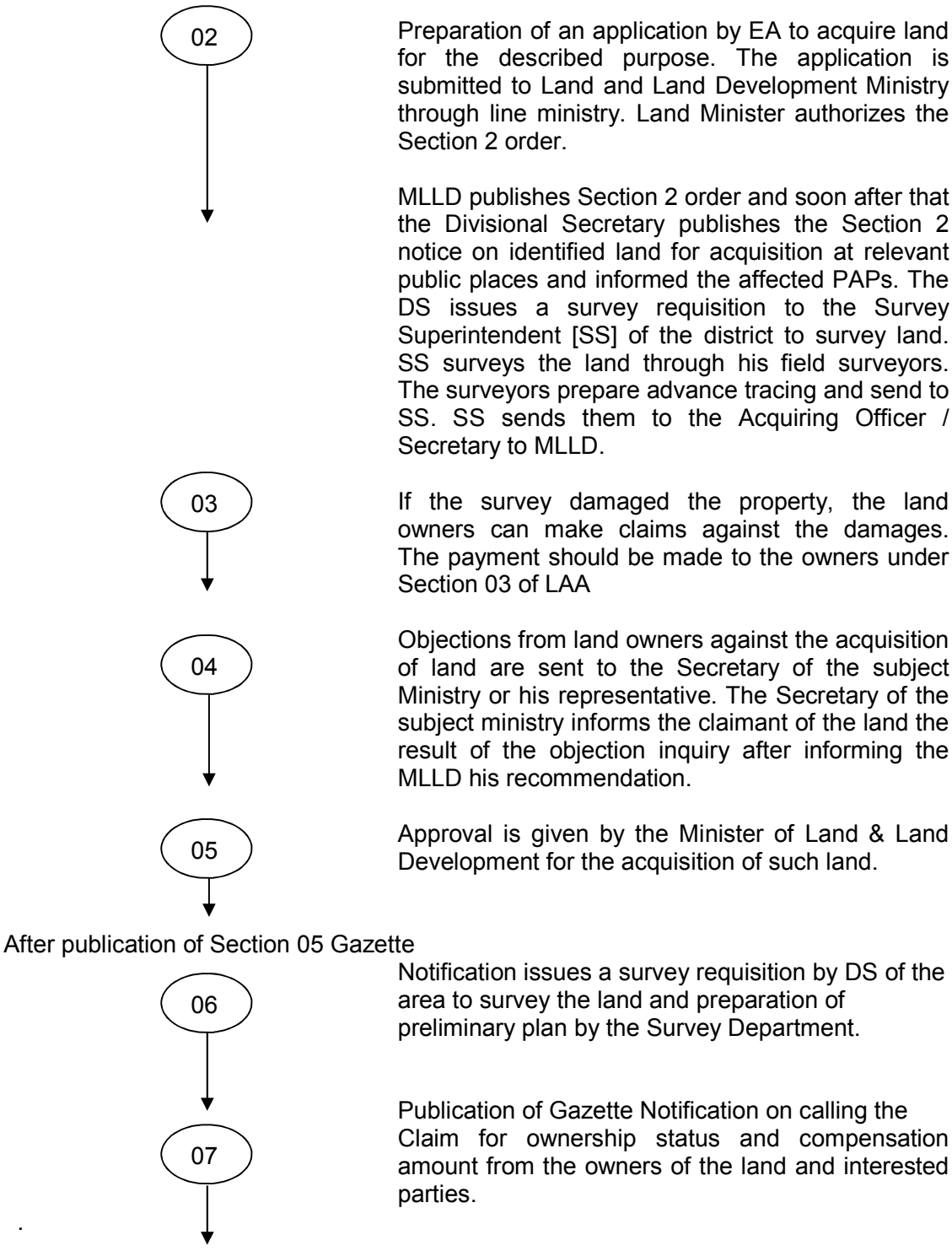
Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of Residential land and structures	-do-	Owner with State grant land (Main HH)	a) Compensation for structures and land at replacement cost, b)Trees and crops at market value. c) Salvage materials of structures and trees without cost. d) Cash grant to purchase of housing allotment. e) Transport cost and other transaction cost f) Cash grant for temporary shed (Rs 50,000)	-do-	The cash grant will enable PAH to: a) purchase 20 perches of land, if lost up to 20 perches of land. b) purchase 40 perches of land, if lost between 21 and 40 perches of land. c) purchase 60 perches of land, if lost between 41 and 60 perches of land d) purchase of 80 perches of land, if lost between 61 and 80 perches of land. The above special grant applies to the 02 sub-families who will be physically displaced with their main households. Each sub-family will receive the special grant as if it lost less than 40 perches of land to the Subproject. 3. Other assistance outlined in RIP will also be provided by PIU
Loss of Residential land and structures	-do-	Leasehol der of state land	a) Compensation for structures at replacement cost b) trees and crops at market value, compensation for leasehold right for land c)Salvage materials of structures and trees without cost. d) Cash grant for purchase of housing allotment. e) Transport cost and other transaction cost. f) Cash grant for temporary shed.	-do-	

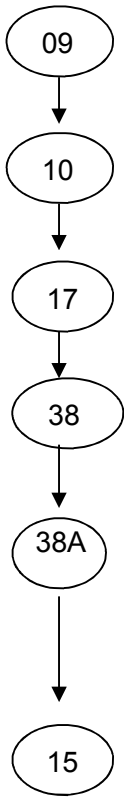
Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Other Private Properties or Secondary Structure					
Partial or complete loss of other property or secondary structure (i.e. shed, outdoor latrine, rice store, animal pen etc.)	Land acquired for canals, related facilities such as service road	Owners of structures regardless of whether the land is owned or not)	a) Compensation for structure and land at replacement cost b)trees at market value c)cash grant for purchase of housing allotment d) Salvage materials without cost e) Cash grant for temporary shed (Rs 50,000)	EA /PIU	1. Compensation rates are determined based on NIRP, and LA Regulation, 2009 2. Other assistance outlined in RIP will also be provided by PIU
Loss of tombs or graves	-do-	All owners	a) In case of a family cemetery, compensation will be paid for the lost land and structure b) If it is a public facility run by a local authority, compensation will be paid to the local authority	-do-	
Livelihood Restoration and Rehabilitation Assistance					
Materials Transport Allowance					
i) Loss of house and other structures		PAHs rebuilding house and other structures on same plot	a) Shifting allowance	EA/ PIU	
ii) Loss of house and other structures		PAH rebuilding house and other structures at a relocation site.	a) Shifting allowance b) Transport allowance	EA/PIU	
Transition Subsistence Allowance					
Loss of house		Each member of severely affected household	As per LA 2009 Regulations.	EA / PIU	

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Livelihood Restoration (Grant and Training)					
Loss of source of income or livelihood		PAPs/ household	a) Vocational & skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Permanent loss of income or livelihood sources		One member per household	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Permanent loss of income or livelihood sources		Severely affected household remaining on the affected land	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Special Assistance					
Loss of income or livelihood sources		Vulnerable PAHs including the poor and woman-headed household	a) Rs.25,000/= cash grant b) Priority in membership in Income restoration and improvement programmes c) assistance in official document search and registration.		
Community Assets					
Loss of local roads, footpaths, bridges, irrigation, water ways .		Divisional Secretary's Division, Local Authority and local community	a) All lost infrastructure facilities will be rehabilitated to their original conditions. b) If such affected infrastructure facilities cannot be provided, alternative infrastructure facilities will be provided	EA / PIU	- do-

HH = household; PIU = Project Implementing Unit, EA = Executive Agency, R = Rood, P= Perch,

Figure 2: Land Acquisition Procedure





Acquiring Officer is holding inquiry for the determination of ownership.

Decision of the ownership and informed to the claimants and Valuation Department for making valuation for the land to be acquired.

Award of compensation & payment.

Possession will be taken over of land after payment of compensation.

If necessary possession can be taken under 38A after publication of Section 02 notice. But interest should be paid until such time compensation will be made.

are no claimants.

85. The above flow chart indicates that the time frame is 71 weeks for the completion of land acquisition and compensation payment under LAA. However, delays can occur due to poor coordination among the agencies such as DS Office, Valuation Department, Survey Department and Land Registry. Therefore, a Land Acquisition and Resettlement Unit will be established at the Project Management Unit (PMU). The EA will appoint a well experienced Acquiring Officer to conduct the process and liaise with the Divisional Secretariat, Valuation Department, Survey Department and Land Registry to expedite the acquisition tasks. With efficient administration of the process, it is possible to complete the entire acquisition and compensation programme in 25 to 40 weeks.

86. Under the provision of Part IV C of the National Environmental Act No.72/22 of 24th June 1993 and No.859/14 of 23rd February 1995 the Central Environmental Authority (CEA) approval is require for a resettlement implementation plan for project causing involuntary resettlement exceeding 100 families other than resettlement affected under emergency situation.

7. Consultation, Participation, and Information Disclosure

Objectives of Consultation

87. The main objectives of consultations with PAPs and other stakeholders are:

- To provide PAPs with information on their entitlements including compensation package and resettlement assistance schemes.
- To obtain comments from PAPs on how to improve the resettlement process and comments on draft RIP.
- To create goodwill among PAPs and the project personnel.
- To describe project benefits to PAPs.
- To identify their issues and problems and find ways and means to resolve them.

88. The EA contacted PAPs and other stakeholders through MCB and DSs to discuss the scope of the Subproject, its benefits and potential adverse impacts and proposed mitigation measures. The EA actively engaged in examining project alternatives, scope of land acquisition, potential direct and indirect impacts on economic activities, and social and cultural identity and networks of the affected persons, and resettlement planning, implementation, and monitoring needs. In these key activities ADB assisted the EA.

89. EA conducted several project awareness programmes to meet PAPs, especially the potential physical displacees, vulnerable households, religious and community leaders, local elite, and community-based organizations (CBOs) such as farmer organisations. In such meetings, their views, opinions and recommendations on compensation packages, relocation programmes and the regarding the final trace of the canal were obtained. In these discussions, representatives of relevant government agencies (GNs, representative of the Divisional Secretary of the area) and local business community also participated.

90. In December 2013, a series of project awareness creation workshops were held at the Galgamuwa Irrigation Training Institute for Divisional Secretaries, Chairmen of Pradeshiya Sabhas and officials of the Agrarian Development Department, Irrigation Department, Department of Wildlife Conservation, Forest Department, Mahaweli Authority of Sri Lanka at Dambulla, Gelewela and Polpithigama Divisional Secretariats.

91. Several grassroots level awareness meetings were organized by GNs with the support of Divisional Secretaries of Dambulla, Galewela, Polpithigama and Mahawa DSD. Officers of Irrigation Department, Economic Development Officers and GNs and officers of the Mahaweli Consultancy Bureau attended these meetings. Representatives of ADB participated in the small group discussions held in Pannampitiya and Lenadora South GNDs.

92. Table 23 indicates the dates and location of grassroots level project awareness meetings.

Table 23: Grassroots Level Awareness Meetings

DS Division	GN Division	Date of Meeting	Venue of Meeting	No of Stakeholders Present	No of Officers Attended
Galewela	Pahala Bambawa and Ranwediyawa	24th March 2014 (Morning Session)	Pahala Bambawa Temple	27	9
Galewela	Danduyaya, Dambagolla and Nebadagahawatta	24th Evening	Danduyaya Temple	22	10
Polpithigama	Polpithigama, Bogolla	25th March 2014 (Morning)	DS Office	25	13
Polpithigama	Amunukole, Hathigamuwa	25th March 2014 (Evening)	Amunukole temple	50	9
Polpithigama	Bulnewa, Moragllagama	26th March 2014 (Morning)	Bulnewa temple	28	9
Polpithigama	Kattambuwawa	26th March 2014 (Evening)	Private house	38	8
Galewela	Nilagama, Aluthwewa, Pibidunugama	27th March 2014 (Morning)	Aluthwewa temple	42	9
Galewela	Hombawa	27th March 2014 (Evening)	Andagala temple	26	7
Galewela	Koapotha	28th March 2014(Morning)	Danduwagolla temple	27	6
Polpithigama	Pallekele	28th March 2014 (Evening)	SANANSA meeting hall	37	5
Dambulla	Pannampitiya	1st April 2014 (Morning)	Parakum Community hall	29	12
Dambulla	Lenadora north	1st April 2014 (Evening)	Lenadora Community hall	31	13
Dambulla	Ethabendiwewa	2nd April 2014 (Morning)	Menikdena Community hall	37	9
Dambulla	Welamitiyawa	2nd April 2014 (morning)	Welamitiyawa temple	14	7
Mahawa	Mahawa	3rd April 2014 (Evening)	Konwewa Community hall	47	13

93. Several key issues were highlighted at the meetings which are summarised below:

- Potential PAPs emphasised that they have no objection to the Project and its implementation, and they are willing to give their utmost support in the Project activities. However, they highlighted their past bitter experience associated with other development projects, and pleaded not create similar situation under the Project.
- PAP's, officers of line agencies and general public requested they be made aware of the Project activities, canal tracing and compensation process. All Project activities connected with communities should be done with transparency, and the true scope of the Project should not be concealed from Project beneficiaries. Decision making on behalf of the community should be done in their presence of the representatives.

- A strategy should be formed to listen, discuss and provide solutions to community problems at the GND level.
- Displacement of households should be done minimally, and where unavoidable. Resettlement of such households should be done in an area where basic infrastructure facilities similar to what they enjoy at present are present, and also in close to their original community.
- Cash compensation should be paid as a single payment after a fair assessment based on market prices.
- Relocation should be done only after the payment of compensation. Compensation should be paid to both husband and wife to avoid family disputes.
- If livelihood is lost, a comprehensive income restoration programme should be introduced before the Project activities start.
- Implementation of the Project should be done with minimum damage to houses and other private property.
- There should be a mechanism to uplift the displaced persons who are vulnerable - suffering with chronic illnesses, disabled people and widows, and to provide housing facilities for them.
- The Project should engage PAPs in construction work and inform them of time schedule of such activities well in advance.
- PAPs who live on temple and *devala* lands on long term leases need special attention of the project and should be treated fairly and justly in paying compensation. Good communication and coordination system should be established with head priest of temples and *devalas* to avoid issues in paying compensation.
- The formulation of a detailed Resettlement Implementation Plan should be done by competent and experienced Resettlement Consultants.

94. A stakeholder consultation workshop on resettlement issues was held on 28 August at the Galewela Divisional Secretariat. 66 PAPs and 28 government officials participated in the workshop. The key issues discussed at the meeting were the comprehensive cash compensation packages and income restoration and improvement programmes under the Subproject. Among the participants were the representatives of the 09 households who will lose their dwellings and land, and those who will lose land only to the Subproject. All of them supported the Project and wanted to be its beneficiaries.

95. The consultations were held in an atmosphere conducive to free exchange of views and recommendations without any intimidation from the government officials or project officials who attended the workshop. In fact, they supported the EA in understanding the resettlement issues better and PAPs who need special attention and the issues that need urgent attention such as finding replacement land in the locality.

96. The physically displaced households who earlier wanted the Subproject to find replacement land for homesteads and highland allotments indicated that they would prefer to purchase replacement land by themselves using the cash that they will receive in the form of compensation and special grant (See Annex 2).

Public Opinion on Resettlement and Related Issues

97. During the socio-economic survey, the EIA and resettlement census PAPs supported the Project. They, however, were interested to know about their compensation packages and the relocation options. They were of the view that their present livelihood pattern would be affected if they were to move out of their villages and resettle in faraway settlement sites. Their key worry is that they might not get a reasonable compensation package prior to the commencement of Subproject activities.

98. Most of the participants at consultations indicated that they possess a good knowledge of the Subproject and of how it would affect them adversely and positively. Each household which will lose its house to the Subproject indicated its compensation and resettlement preferences. Those who lose dwellings but will have sufficient land left after land acquisition prefer to reconstruct their houses on the same landholdings without moving out to a resettlement site. Those who will lose dwellings and land to the project, and will not have sufficient remaining land to rebuild households want to remain in their current village/community. They plan to buy land in the same area to rebuild houses, so that they could continue with their current livelihoods and maintain socio-economic networks.

99. Consultations with PAPs and other stakeholders will continue during RIP implementation to inform PAPs and other stakeholders about the Project activities and their progress and to learn any corrective actions that the Project should take. During the implementation of income restoration programme, project officers will be responsible for assisting and facilitating PAPs on development programmes designed for them.

Disclosure of Resettlement Information

100. Resettlement information - measurement of losses, detailed asset valuations, entitlements and special provisions, grievance redress procedures, timetable for cash compensation payment, physical displacement schedule and project construction schedule - will be disseminated by the EA through brochures, leaflets, or booklets written in Sinhala. For non-literate people, other communication methods such as small group discussions and posters will be used.

101. The RIP will be implemented in close consultation with the stakeholders, particularly with PAPs through focus group discussions and stakeholder consultation meetings. Women's participation will be ensured by involving them in public consultations at various stages of project preparation and implementation, and by arrangements which would enhance their ability to attend such meetings.

102. The EA will submit the following planning documents to ADB for disclosure on ADB's website:

(i) RIP before project appraisal;

(ii) A new RIP or an updated RIP, and a Corrective Action Plan (CAP), if any, prepared during project implementation; and

(iii) Resettlement monitoring reports

103. Public Consultation and Disclosure Plan will be prepared by PMU and format is shown in Figure 3:

Figure 3: Consultation and Disclosure Plan

Activity	Task	Timing (Date/ Period)	No. of Persons Attended (if applicable)	Agencies Attended (if applicable)	Feedback/ Issues/ Concerns	Remarks
Stakeholder/PAP Identification	Mapping of the project area					
Project information Dissemination	Distribution of information leaflets to PAPs					
Consultative meetings with PAPs during scoping phase	Discuss potential resettlement impacts of the project					
Public Notification	Publish list of affected lands/sites at Divisional Secretariat/GNOs; Publish eligibility cut-off date					
Socio-economic survey	Collect socio-economic information and PAPs' perception on resettlement impacts					
Consultative meetings on resettlement mitigation measures	Discuss entitlements, compensation rates, grievance redress mechanisms					
Publicize RIP or	Distribute leaflets					

Activity	Task	Timing (Date/ Period)	No. of Persons Attended (if applicable)	Agencies Attended (if applicable)	Feedback/ Issues/ Concerns	Remarks
at least its entitlement matrix	or booklets in local language					
Full disclosure of the RIP to PAPs	Distribute RIP in local language to PAPs					
Internet disclosure of the RIP	RP posted on ADB And EA website					
Consultative meetings during detailed measurement survey(DMS)	Face- to-face meetings with PAPs					
Disclosure after DMS	Disclose updated RIP to PAPs					
Internet disclosure of the updated RP	Updated RP posted on ADB and EA website					

Gender Impacts and Vulnerabilities, and Mitigation Measures

104. In the Subproject areas, most of private lands are owned by heads of households who are men. There are several built in inheritance or sale barriers, and as a result, many transactions take place under the table, and in such exchanges invariably only men are involved. In order to avoid fragmentation of a land holding which would make the holding economically unviable, it is the general practice in the area to pass on the land holding to one child. If there is a son, he will get the holding. Rarely a daughter gets a holding from her father. No women hold land as the owner or renter or tenant among the households affected by the Subproject.

105. Although women are not the owners of land, they play a significant role in land cultivation, irrigation decisions, local organizations, agricultural production and marketing activities. An example is that 35 percent of attendees at the stakeholder workshop were women.

106. The communication strategy of the Project will include women group discussions that focus on possible displacement and relocation, potential impacts on their socio-cultural systems, any potential threats regarding their safety during construction owing to the

presence of labourers from outside, potential opportunities for women to engage in project activities to earn an income, and on special care to be taken by contractors during project construction activities, if women are recruited as workers.

Cut-off-Date

107. 1st of July 2014 is the Subproject's cut-off date for compensation. The resettlement census of the subproject households was completed on this date. This applies to non-titleholders such as squatters and informal settlers, encroachers, tenants and leaseholders. The Divisional Secretaries will disseminate this vital piece of information in the subproject areas. The relevant local authorities will request through GNOs to refrain from granting approvals for new constructions within the subproject area after the cut-off-date. The EA/IA will disseminate information regarding the cut-off date throughout the project area through GNOs and DSs. Persons who occupy land in the project area after the cut-off-date are not eligible for compensation or resettlement assistance. Structures such as houses, crops, fruits, trees and wood lots established after this date are also not eligible for compensation.

8. Compensation, Income Restoration and Relocation

Valuation of Lost and Affected Assets

108. The LAA, NIRP and LA Regulations 2009, outlined in section -- above, constitute the resettlement regulatory framework for determining the replacement cost. Replacement cost comprises fair market value of the property and other compensation packages that are elaborated in NIRP and LA Regulations 2009 (see below).The valuation of acquired property will be done by the Valuation Department on the request of by the Divisional Secretary of the area where land is located. DS is the land acquiring officer. The compensation package has two components: compensation package under the LAA, and special assistance scheme under the LA Regulations 2009. The latter is given regardless of the type of land tenure of the affected households. Both packages together amount to the replacement cost of a property acquired; and in some cases, such as annual permit holders, exceeding the replacement cost. The entitlement matrix reflects these compensation packages and who is responsible for distributing these packages to PAPs.

Assessment of 'Replacement Cost'

109. LAA provides for determining compensation based on 'market value'. It defines market value as 'the amount which the land might be expected to have realized if sold by a willing seller in the open market as a separate entity on the date of publication of that notice in the Gazette … [Section 46(1)]. The NIRP states that compensation will be based on 'replacement cost' of acquired land and structures. 'Compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly. This should include transaction costs [Principle 6].

110. The LA Regulations of 2009 under section 63(2) (f) of the LAA did not adopt 'replacement cost' as the basis for compensation as LAA does not use the concept; instead it used 'market value' as defined in LAA together with several safeguard provisions to eliminate inequities arising from methods of valuation and determining 'market value' thereby upgrading compensation to the level pf replacement cost.

111. The current IR regulatory framework ensures that persons affected by land acquisition receives replacement cost, so that they could maintain the same socio-economic status that they enjoyed prior to land acquisition, or that their living standards are raised to a higher level compared with the pre-acquisition level particularly in case of the poor. As outlined above, LA Regulations of 2009 under 'Disturbances' make the necessary provisions for compensating every possible cost incurred by a PAP during the acquisition of their properties. Section 3.11 of the LA Regulations 2009providesa range of compensation for 'disturbances' that are caused by land acquisition. The total package of compensation and other payments would bring compensation to the level of 'replacement cost' which is also a best international practice in involuntary resettlement.

The LA Regulations 2009 provides the following compensation packages to those who lost land to a public project.

- Where part of a land is acquired and when its value as a separate entity deems to realize a value proportionately lower than the market value of the main land, the compensation will be proportionate to the value of the main land.
- A building used for occupation or for business purpose, or was intended to be used for occupation or business purpose on the date the intention to acquire was published, the difference between the cost of re-construction and the value of building based for determination of market value will be paid as additional compensation.
- Value based on 'development potential' is considered in determining the value of land when a paddy land plot is acquired if the Agrarian Services Commissioner General's approval has already been obtained to convert it into a non-agricultural land.
- Where an acquired building is occupied by a tenant/statutory tenant protected under the provision of the Rent Act No 7 of 1972 (as amended thereafter) compensation will be ascertained in proportion having regard to the provisions of Rent (amendment) Act No 26 of 2006.

112. Damages caused by injurious affection and severance should be allowed fully. Compensation for disturbance is based on the "value to owner" will be paid based on written claims:

- Expenses incurred during appearing under LAA section 9 Inquiry: maximum payment is Rs 10,000.
- Expense of finding an alternative accommodation: maximum rental of Rs 10,000 per month for properties located in urban council areas, and Rs 5000 per month for properties located in *pradeshiya sabha* areas. If the anticipated physical displacement is temporary, maximum of three months rental; if the anticipated physical displacement is permanent, a maximum of 6 months rental of Rs 10,000 per month is payable for a house where floor area is less than 1000 square feet.
- Cost incurred in change of residence: Rs 10,000 for houses where floor area is less than 1,000 square feet and Rs 15,000 for houses where floor area is between 1,000 and 2,000 square feet. Rs 25,000 for houses where floor area is more than 2,000 square feet. If sub families live in a house, the payment should be divided proportionately. For other properties, maximum of Rs 25,000 is paid based on the nature of the occupation.
- Cost of advertising: permanent displacement of informal business establishment will get Rs 2,500 and a formal business establishment, Rs 15,000.
- Re-fixing cost of fixtures and fittings; transport expenses: Rs 5,000 for a house/residence. In case of a business premises or any other structure of specific nature, the amount should be based on actual expenses.

- Loss of earnings from business: Rs 15,000 a month for informal businesses. For formal businesses compensation amount is based on accounts and tax returns pertaining to preceding three years.
- Increased overhead expenses: will be paid according to the circumstances.
- Double payments, for example, rent or rates: This is to be calculated based on actual expenditure; all other expenses incurred by the owner in relation to the acquisition: losses sustained because of the compulsory sale of the business due to the acquisition, for example, sale of livestock.
- Other additional expenses for disturbance or compensation not considered under any other compensation item above: disturbance experienced by tenants fall into this category. A payment in respect of vulnerable persons such as old and disabled people who are dependent on affected persons. Another category is self-employment. The maximum payment for any of these disturbances is Rs 15,000.
- When an owner of a house or of an investment property is displaced, additional 10% of the market value is paid as compensation. This is conditional upon leaving the acquired property on the stipulated date.
- When a value of a piece of land acquired is based on its agricultural potential, the displacement cost and loss of income will be taken into consideration in determining its value.

113. Having considered the above regulatory framework and the desire of the Cabinet of Ministers to provide adequate assistance to all PAPs of the subproject, the following compensations package area approved for the subproject.

Compensation Package for Land and Resettlement

114. Community Consultative Groups (CCGs) will be established in each affected GND to assist affected households and PAPs in compensation determination, payment, appeals, housing and income restoration programmes. CCGs will also help affected households in finding alternative lands and in re-investment of cash compensation in productive activities especially in income-generating programmes. (See Section 10 Grievance Redress Mechanism).

115. The 11 households (including 02 sub-families) who will be losing their houses partially or fully will be considered as severely affected households. These households are entitled to a compensation package under Land Acquisition Act as well as under the Special Assistance Scheme at least to restore their livelihood at pre-project status. These entitlements will be given to them on a priority basis prior to the acquisition of land and other property.

116. 07 out of 11 (including 02 sub-families) physically displaced households have opted to rebuild their new houses on the remaining portions of the acquired residential allotments.

During stakeholder consultation workshop, other 04 households agreed to find suitable lands to construct their new houses and requested replacement cost of the lost land for this purpose.

Allocation of Special Grant for Purchasing Residential Land Plots (Homesteads)

117. The following formula has been approved by the EA in consultation with MLLD and the Divisional Secretary for provision of **a special grant** in addition to statutory compensation. The two sub-families will get the special grant to buy land for constructing their own houses. They will be treated as those who lost less than 20 perches of land.

118. The special grant is applicable to each of the physically displaced households regardless of whether it has sufficient left-over land after the acquisition to rebuild the house lost.

- A household which loses 20 perches (1/8 acre) of land or less to the Subproject is entitled to receive Rs 750,000 to purchase a piece of land of similar quality and size in the locality.
- A household which loses between 21 and 40 perches (1/4 acre) of land to the Subproject is entitled to receive Rs 1,250,000 as cash compensation enabling it to buy a land plot of similar quality and size in the locality.
- A household which loses between 41 and 60 perches of land is entitled to receive Rs 1,750,000 to buy a land plot of similar quality and size in the locality.
- A household which loses between 61 and 80 perches (1/2 acre) of land is entitled to receive Rs 2,000,000 to buy a piece of land in the locality.

Allocation of Special Grant for Acquired Agricultural Land

119. Each affected PAP who cultivates highland, paddy land and chena (slash-and-burn) land and occupies a homestead is entitled to receive compensation as follows:

- Housing allotment (homestead): Rs5,000,000 per acre of land
- Highland allotment: Rs 2,000,000 per acre of land
- Paddy land: Rs 450,000 per acre
- Chena land: Rs 200,000

Special Assistance to a Household who live on Temple Land

120. The resettlement census identified one household living on the Bambawa Temple land on lease. He is not eligible to receive compensation according to the land law. But under the Subproject, the household will be given a cash grant to purchase land under the special grant scheme. The person will also be entitled to compensation on leasehold rights.

Special Assistance to the Bambawa Temple

121. During the resettlement census, 05 land parcels that belong to the Bambawa Temple were identified as affected land. The total area of the 05 land parcels is 40 perches. Several discussions with the chief incumbent of the temple have been held on the scope of land acquisition, compensation rates, resettlement policy and strategies. He requested the EA to find replacement paddy land in the area. But the EA cannot find replacement paddy land in Galewela area as requested. Therefore, the EA proposes that the temple be allocated 05 acres of paddy land and 01 acre of high land in System D of the Mahaweli system in Medirigiriya as replacement land.

Technical Assistance for House Construction

122. The 11 physically displaced households are expected to self-relocate or to stay on their current premises. The above calculation of land replacement values has taken into consideration the availability of infrastructure facilities such as electricity, water, and access roads. Therefore those who relocate will have to pay for such facilities when rebuild their houses.

123. EA will provide technical assistance in house planning and construction to each physically displaced household. A Technical Officer will assist in planning and construction households and in obtaining necessary permits and raw materials. He will ensure that displaced households will get salvage articles from acquired buildings free of cost. Each relocated household will be allowed sufficient time to rebuild its new house, so that it does not have to move out of its existing house until the replacement house is ready.

Compensation, Assistance and Land Entitlements of Other Affected Households

124. Each *ande* (sharecropper) will be compensated for all permanent land losses according to the sharecropper arrangement with land owners. Generally the arrangement is 75 percent of the crop is retained by the sharecropper and 25 percent is given to the land owner. A sharecropper who cultivates more than ½ acre of paddy land will be entitled to a homestead and farmstead in the Mahaweli resettlement sites in Medirigiriya. Short term sharecroppers and leaseholders will be entitled to cash compensation for loss income, as determined by the Chief Valuer.

125. The Subproject authorities will assist PAPs to assess and their skills and assets and in reinvesting their compensation in income-generating scheme.

126. The Subproject authorities with the assistance of the Department of Agriculture and Department of Agrarian Services will help PAPs in improving land productivity of the remaining land or newly acquired land through agricultural extension programme.

127. An encroacher who has been cultivating state land before the cut-off date, but it cannot be regularised because the land is reserved for other purpose will be entitled to the following:

- Compensation for trees and crops at market value.
- Compensation for any improvement (structures) on the land at full replacement cost.

128. Transport facilities will be provided free of charge for transportation of households goods. Maximum 02 trips will be given to each household.

129. Community Consultative Groups (CCGs) will be established in each affected GND to assist PAPS through facilitation and consultation on special assistance schemes, income restoration programmes, and land alienation programmes.

Compensation for Trees and Crop Losses

130. Farmers will be allowed to harvest their crops before construction work starts. Where crops cannot be harvested or the destruction of crops is unavoidable, cash compensation will be paid based on the market value of affected crops. All other structures and trees remain in the property such as privately owned trees (timber, fuel wood) would remain in the property. PAPs are entitled to sale of trees after determination of compensation.

131. Compensation for crops in land under tenancy and lease agreements will be based on the tenancy/lease agreement. Final compensation rates for such crops will be determined by the Chief Valuer.

132. The losses of trees that belong to the State will be replenished through re-forestation schemes undertaken by the subproject in consultation with the Forest Department.

133. Each PAP will be entitled to receive assistance under the Project's Home Garden Development Programme. They will receive planting material and extension assistance from the Project (Table 24).

Table 24: Cost of Planting Materials

Type of Plants	No. of plants per person	No. of PAPs including (highland and paddy land)	Unit Cost (Rs)	Total Cost (Rs)
Fruit plants	10	141	200	282,000
Forestry plants	25	141	50	176,250
Perennial plants	10	141	50	70,550
			Total	**528,800**

Compensation for Loss of Houses and Other Structures

134. Owners of acquired houses and other structures such as sheds, wells, water tanks, retaining walls and fences will be compensated for full or partial losses at full replacement cost. This entitlement applies title holders, lease holders, tenants and encroachers occupying state land at the time of the cut-off date. Furthermore structures that are partly affected will be entitled to compensation at full replacement cost.

135. Owners of the property will have the right to taken salvage materials of the affected structures. The value of salvaged materials will not be deducted from the final compensation amount.

136. In case of partial loss, in order to recognize its injurious effect, the remaining land and other property, if renders useless or uneconomical, they too will be acquired applying the relevant compensation package to other land and property.

137. Re-locating households will be entitled to remove trees on their lands without cost if vacated the premises at the stipulated time. All entitlement will be paid before a household is required to move out from the affected area.

Displacement Assistance

138. In addition to paying cash compensation for lost property, each physically displaced household is qualified for the following assistance. Each physically displaced household is entitled to:

- A shifting allowance which will be determined by the Department of the Chief Valuer according to the LA 2009 Regulation)
- Transport facilities will be provided free of charge for transportation of households goods. 02 free trips will be provided to each relocated household.
- An allowance of Rs 50,000 to build a temporary shed at the new location (Total cost is Rs. 550,000). Two sub-families will also get this allowance.
- A temporary accommodation allowance until the house is rebuilt and ready for occupancy. The allowance will be determined according to the rates prevail in the area. Temporary relocation should be avoided it would cause hardship to the household.

Damages Caused During Construction

139. Subproject Contractors will avoid damaging public and private property during the construction phase of the subproject. If any such damaged is caused, the subproject authorities/Contractor will pay compensation promptly to the affected household,

community or government agency. The Contractors will restore such damages to land, structures and infrastructures immediately.

Temporarily Loss of Private Land

140. Two options are offered to affected households

OPTION 1:

141. Borrow pits will be established on state land whenever possible. If borrowed materials are to be obtained from land occupied, regardless of the tenure type, the land user is expected to sign a formal agreement with subproject authorities or the contractor indicating the following in the contract:

- Period of occupancy
- Terms and compensation amount determination by the Chief Valuer.
- Compensation for other disturbances and damages caused to property.
- The frequency of compensation payment
- Guarantee that the land will be returned to the user at the end of the lease after restoring it to its original condition or better condition, as agreed with the APS.

Option 2:

142. The project contractor obtain borrow areas at his own cost. Under this option, the Contractor could contract with private land owners/users and obtains permits to extract borrow materials. The Contractors under the agreement will pay the owner/user:

- Compensation for material losses during temporary occupation
- Compensation for other disturbances and damages caused to the property
- The Contractor will rehabilitate/restore the land to its original condition
- Returns the land to the owner at the end of lease period

Special Assistance to Vulnerable Households

143. One household is identified as a vulnerable household whose income is below the poverty line. Other PAPs requiring special assistance could also be identified during resettlement implementation with the assistance of Community Consultative Groups (CCGs).

144. A vulnerable household will be entitled to Rs 25,000 as an income restoration grant and a homestead at same village where its relatives live. This household will also be entitled

to receive the assistance scheme under economic rehabilitation and income restoration programme.

145. A vulnerable household will receive preferential access project construction employment opportunities. At least one member of a vulnerable household will receive priority assistance in skill and vocational training programmes organized the EA.

Displacement Support

146. In addition to compensation for lost property, affected households are entitled to receive the following assistance and support from EA.

i) A relocating household will be entitled to a shifting allowance as determined by Chief Value according to the 2009 regulation. It will get Rs 50,000 as an allowance to build a temporary shed at the new house. Total cost would be Rs 550,000 for 11 households including the 02 sub-families who will move to their own houses.

ii) A household that cannot find a suitable plot of land to rebuild its house or fail to complete the construction of the house before the subproject activities starts is entitled to a temporary accommodation allowance until the resettlement sites are ready for occupancy. The allowance will be determined according to the rates prevailing in the area.

Damages Caused During Construction

147. Contractors are expected to be vigilant to avoid damages to public and private property during construction work. If any damage does occur to public and private property as a result of construction work, the contractor will pay adequate compensation immediately to the affected households, communities or government agencies. Damaged land, structures, and infrastructures shall be restored immediately to their former conditions. Temporarily affected land and community infrastructures and property will be restored to pre-project level.

9. Income Restoration and Improvement

148. In the Subproject area, the majority of PAPs are engaged in non-agricultural employment. This is partly because of their proximity to towns and cities, and partly because of low economic viability of their allotments of paddy and highland to earn a living. Such land cultivation does not provide them sufficient income to live above the poverty threshold. As a result, they engage themselves in various other supplementary employments to augment their household incomes. In the Subproject area, the affected households are mostly nuclear households and only two households have sub-families living with them.

149. Land acquisition and physical displacement will adversely impact on their fragile income sources. Land acquisition for the project will cause the following losses to households:

(i) They lose a part of household income because of the acquisition of agricultural land

(ii) They will lose income because of their engagement in house reconstruction and movement

(iii) They lose day-to-day income as they will have to find time to attend to administrative requirements such as filling applications, searching for legal documents, and meeting officials and bank managers to collect their compensation packages

(iv) Temporary disturbances to their environment, dust and heavy vehicle movement in the vicinity and the need to use alternative routes affect their living during the construction period of the canal.

Table 25: Annual Average Household Income of Physically Displaced households

Below Rs.60,000	Rs.60,000 to Rs.120,000	Rs.120,000 to Rs.500,000	Above Rs.500,000
01	02	08	00

Source: MCB Resettlement Census – July 2014

150. Table 25indicates that 01(09 percent) household earns less than Rs 5,000 a month and is a *Samurdhi* recipient. In case of 02 households, monthly household income is between Rs 5,000 to Rs 10,000. These 03 households deserve special income restoration *and* improvement programme. Those 08 households who earn between Rs 10,000 to Rs 42,000 a month will need the assistance of an income restoration programme to restore their household incomes.

151. Income restoration program should be prepared considering the skills, expertise, experience and specific abilities of PAP's and market avenues. In formulating an income restoration and improvement programme for their benefit, several findings among the affected households are relevant. Among them are:

- Lack of institutional support
- Lack of entrepreneurship attitude
- Lack of working capital
- Lack of marketing support and
- Lack of opportunity for skill development

152. To overcome these constraints the programme designed under RIP is expected to be multi-dimensional and flexible. It is also aimed to broader socio-economic benefits of the target group of people who will be provided with training, working capital and institutional support. The main features of these programmes are:

(i) Provision of capacity building training programmes;
(ii) Development of entrepreneurship skills,
(iii) Development of managerial skills among the selected APs,
(iv) Formation of societies among women, youth and low income groups,
(v) Provision of skill training facilities for youth.
(vi) Provision of employment opportunities.

Income Restoration Programmes

Skill Development Programme for Unemployed Youth

153. The unemployed youth will receive skill development training such as carpentry, masonry, plumbing, and electrical work, focusing on the job market in the area, particularly in construction activities. The project personnel will identify such opportunities. Moreover, at least one person per household will receive training in one of the following skills. 50 percent of trainees will be women. Priority will be given in selecting for training to those households which are physically displaced and vulnerable households. Both physically displaced and economically displaced households will be eligible to receive employment training under the project.

154. The training fields are:

(i) Computer literacy and computer-based programmes
(ii) TV and radio repairing programmes
(iii) Motor mechanism
(iv) Vehicle driving
(v) Heavy machine operation
(vi) Sawing machine training

155. The young men and women from the subproject area will be selected based on their educational qualification and abilities. There will be a Community Development Officer attached to the Project Office who will prepare the training curricula and liaise with vocational training institutions. Training period will be 2 weeks to 6 months depending on nature and quality of the training. A trainee will get Rs6,000 as an allowance per month.

Institutional Arrangement for Training

156. There are few training institutions available in the country. Among them are the Vocational Training Authority, Department of Technical and Education Training, Territory and Educational Commission are prominent. There are several non-governmental organizations conducting various vocational training programmes. These sources will be contacted by the project personnel before the subproject work starts.

157. Training budget is given below:

(i) 2 weeks training programme Rs.5,000/- per person,
(ii) 1 month training programme Rs.10,000/- per person
(iii) 2 month training programme Rs.15,000/- per person
(iv) 3 month training programme Rs.25,000/- per person

Special Programmes for Women

158. Cottage industries will be introduced for benefit of unemployed women PAPs. A sewing programme will be started for the benefit of women. Each PAP will receive Rs15, 000 to Rs 30, 000 as a grant over period of 06 months. 11 PAPs will be selected for this grant (Table 26).

Table 26: Cost Estimate of Training Programme for Women

Area of Training	No. of Trainers	No. of Months	Cost per Trainee (Rs)	Allowance for Trainee (Rs)
Dress making	11	06	Rs 550,000	Rs 396,000

159. The Subproject will provide cash assistance to encourage physically displaced households to recover from their resettlement experience and trauma as early as possible. For this purpose, special income generating programme has been formulated. It will help them to restart their animal husbandry and skill development (Table 27).

Table 27: Cost of Income Generation Programme

Description	No. of Houses	Unit Cost (Rs)	Total Cost (Rs)
Livestock development	06	50,000	300,000
Poultry	05	25,000	125,000
Grant for sewing machine	11	30,000	330,000
		Total	**755,000**

Rehabilitation Assistance

160. Apart from the provision of displacement support, the severely affected and vulnerable households will be supported through the following measures:

- Counselling on project impacts, preparation of compensation claims and bank investment assistance
- Counselling on savings scheme and cash management
- Assessment of current economic activities and potentials for improvement of these activities as well as advice on alternative income-earning opportunities
- Assessment and establishment of small-scale income generating schemes for severely affected households
- Assistance to gain access to National and Local Poverty Alleviation and Credit programmes
- One person in each severely-affected household will be entitled to skills and vocational training that would help in obtaining employment.
- Establish self-employment programmes through skill development assistance. Cost of training, accommodation, and subsistence during the training period will be borne by the Project. CCGs will determine who the severely-affected households are and select them on priority basis.
- Provide general information construction schedules, acquisition data, valuation, compensation, grievance resolution mechanism and employment opportunities at project sites and development initiatives and opportunities.
- Establishment Community Consultative Groups (CCGs) to assist severely-affected and vulnerable people in particular and the other PAPs in general and to monitor the progress of physical and economic rehabilitation programmes and to recommend corrective measures, where necessary.

10. Grievance Redress Mechanism

161. The grievance redress mechanism of the Subproject will address PAPs' complaints and grievances promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of PAPs at no costs and without retribution.

Types of Grievances

162. Legal issues:

(i) Application of LAA and its limitations to arrive at the replacement cost of acquired property

(ii) Difficulties in obtaining abstracts of deeds from the Land Registry

(iii) Rules and regulations determining the ownership of land and amount of compensation

163. Practical Issues

(i) Lack of knowledge on the acquisition process and how to present claims. Delays in the payment of compensation.

(ii) Delays in the payment of resettlement assistance and provision of benefits

(iii) Most contacts on leased land are verbal. Difficulty in transforming into written contracts.

(iv) Inability to find land for building new houses

(v) Inability to construct new houses in a short period of time

(vi) During the construction period temporary disruptions

164. During the socio-economic survey and resettlement census, several CBOs were identified who actively participate in people's affairs in the Project area. It was also observed that almost all PAPs are members of CBOs. Farmer organizations and Death Donation Associations are popular among PAPs. These organizations can be enlisted to deal with grievances of PAPs as a 'primary level redress forum' regarding land acquisition and resettlement issues.

Legal Frame work of Grievance Redress

165. Under the Land Acquisition Act, an Appeal Board has been constituted to deal with appeals against compensation offers. This process will minimize the grievances. However, a person who does not agree with the decision of the Board of Appeal can go before the Supreme Court claiming higher amount of compensation. But such an action

is rare as it would consume money and time. Appeal Board and the Supreme Court are located in Colombo and as a result, most PAPs are reluctant to go that far.

166. PAPs will need to obtain abstracts of land title deeds from the Land Registry which is located in Polonnaruwa which is about 50km from their villages.

Grievance Redress Committee

167. A grievance redress Committee (GRC) will be established at the Subproject level to resolve disputes and grievances relating to land acquisition, relocation and implementation of the RIP, and environment-related grievance and complaints. The GRC will be an ex-gratia, legal, semi-structured body empowered to make decisions on disputes resolution during the implementation of RIP. The fundamental objective of formation of a GRC is to resolve disputes at the grass-roots level in order to avoid lengthy and costly judicial process. The GRC will not deal with matters pending in the court of law. Also it has no jurisdiction over the rate of compensation. Project should take necessary action to create awareness of the PAP's on GRC to make it as an easy and trustful mechanism.

168. As the project will not anticipate environmental grievances from the subproject, the GRC will deal with social and environmental grievances.

169. The GRC will meet according to a well-advertised timetable. This information will be disseminated among all PAPs. It will call public meetings to arbitrate grievances. Each session/meeting will be held at a place which is convenient to PAPs to attend. GRC procedures will be publicized through notices and community meetings. PAPs will be made aware of the presence of GRM, its powers and benefits during consultations and group discussions. At such gatherings, PAPs will be encouraged to discuss their views on the structure and functions of GRM.

Composition of the Grievance Redress Committee

GRC at the EA level

170. This GRC consists of senior officer of the EA, Divisional Secretary in the area, Project Director of the NWPC Project. The Chairman of GRC will be a senior officer of the EA appointed by the Secretary of MIWRM. GRC meetings will be held once a month at the Project Office. Project Director will be the Convenor of GRC. The Committee will inform the grieved parties of its decision, through the Convenor, after recording the grievance, supporting documents and evidence. The total period of arbitration will not exceed six weeks.

GRC at the Project Level

171. The project level GRC will have as ex-officio members the Project Director as the Chairman of the Committee, officers who handle land acquisition and resettlement, Divisional Secretary and 04 representatives of the community consultative groups including women PAPs. Dispute resolution process will be quick, impartial and legitimate. Any PAP could present its case or evidence without any fear of harassment or intimidation.

172. If the Committee cannot resolve the issue, the Project Director as the convenor of the higher committee should submit the complaint or grievances to the Higher Committee. When PD submits the complaint to the Higher Committee, PD will make his observations on the issue. Once the Committee makes its decision on the issue, it will inform to the complainants in writing the decision. Every attempt will be taken to resolve the issue by the Committee within 04 weeks.

GRC Process

173. A PAP can make their complaint either in writing or verbally to the GN of the division or directly to a project officer. If the complaint is made verbally, the GN or the project officer will record it and forward the complaint to the Project Director who will record observations of project on the compliant.

174. Project Director will submit complaints and the observations that he received from PAPs to the Committee at the project level at the monthly meeting of the Committee. If necessary, it will call relevant parties to obtain their evidence and views. If there is a legal barrier to resolve the issues, Committee will inform the complainants how they should resolve the issue through legal institutions.

175. The GRC will attend to grievances and complaints on land acquisition cases, compensation payments, resettlement issues, ownership disputes, delays of payment of compensation issues and rehabilitation assistance programmes.

176. Information about the GRC and its procedures will be published as a leaflet and widely disseminated. Notices and timetable of community meetings will also be widely disseminated among PAPs.

11. Institutional Arrangements for Resettlement Administration

Project Management Unit (PMU)

177. The Programme will have a project Management Unit (PMU) established at MIWRM. It will oversee social safeguard compliance during social impact assessments, formulation of RIPs, their implementation and monitoring of implementation progress. The PMU will have Resettlement Unit or Cell with a full time specialist (s) who will assist the formulation of RIPs, resettlement due diligence reports and resettlement monitoring reports. PMU will develop the specialist(s) TOR(s) and forward them to ADB for review. The specialist(s) key activities include: (i) screening of proposed projects for potential resettlement impacts and risks;(ii) reviewing of project alternatives to avoid or minimize resettlement impacts; (iii) assessing social impacts of the project; (iii) formulating an appropriate strategy for public consultations and resettlement information disclosure; (iv) formulating RIPs with resettlement consultants; and (v) establishing GRM and monitoring of their effectiveness.

Resettlement Staff and Consultants

178. While EA will be responsible for overall coordination, planning, and financing of resettlement programme, the implementation of RIP is the responsibility of PMU. Before commencing socio-economic surveys and the formulation of RIP, EA will recruit a social development specialist(s) as a staff member of PMU who is familiar with land and resettlement regulatory framework and ADB involuntary resettlement policy and procedures. The specialist(s) conduct surveys and formulates RIPs of the project. The specialist(s) through EA/IA could hire resettlement consultants to assist resettlement planning and implementation.

179. Involuntary resettlement is a sensitive process and officials who are engaged in resettlement programme need field experience in resettlement and rehabilitation and community development. In order to facilitate good rapport with affected communities and oversee resettlement implementation, experienced and well-qualified civil society organizations could be hired in project areas to assist PMU/PIU in RIP implementation especially in case of category ‘A’ project. Such organizations could play the role of facilitator and will work as a link between PMU and affected communities. They will assist PAPs in income restoration through training in skill development and getting access to various government development schemes and to agencies that provide financial assistance and loans for small enterprises

Project Implementation Unit

180. The PMU will be supported by project implementing units (PIUs) in the field. Each project will have a PIU working under the supervision of PMU of the Programme. If required, resettlement officers will be hired to assist PIU/field offices for social impact assessment, formulation of RIP and their implementation and monitoring.

181. The roles and responsibilities of various agencies to be involved in resettlement planning process and implementation of resettlement activities are summarized below.

Figure 4: Roles and Responsibilities of Resettlement Agencies

Roles and Responsibilities of Agencies in Resettlement Planning and Implementation	
Activity	**Agency Responsible**
Establishment of Resettlement Unit at EA and appointment of a Resettlement Specialist (RS)	EA
Hiring of resettlement consultants (RC), external monitors (EM)	EA
Organizing resettlement training workshop (optional)	EA, RC
Screen project affected area for resettlement effects	RS, RC
Determine the scope of RIP	EA in consultation with ADB
Social Assessment and preparation of land acquisition plan, Census, Socio-economic Surveys, RIP	EA/PMU and RS and RC
Hiring of Civil Society Organizations (NGOs)	EA
Public consultation and disclosure of RIP	RS,RC, NGO/CBO
Co-ordination with divisional administration for land acquisition	IA, PMU/PIU, RS and RC
Declaration of cut-off date	EA, Divisional Secretary (DS), RS
Review and obtaining of approval of RIP from ADB	EA
Appointment of GRC	EA/ PMU/PIU
Submission of land acquisition proposals to Divisional Secretary (DS)	PIU
Compensation award and payment of compensation	DS, PMU/PIU, RS
Payment of replacement cost and allowance	DS, PIU
Taking possession of acquired land and structures	DS
Handing over the acquired land to contractors for construction	DS
Notify the date of commencement of construction to PAPs	RS, RC, PMU/PIU, NGO
Assistance in relocation, particularly for vulnerable groups	RS, PMU/PIU, NGO, DS
Internal monitoring of overall RP Implementation	PIU, RS, RC,NGO
External Monitoring and Evaluation (M&E)	EM

12. Monitoring and Reporting

182. The PMU together with PIU of the subproject will monitor the implementation of RIP to determine whether resettlement goals have been achieved and livelihood and living standards have been restored, and also to recommend on how to further improve RIP implementation.[1] The PIU will prepare half-yearly monitoring reports to submit to the EA/PMU and ADB. The reports will focus on whether resettlement activities have complied with involuntary resettlement safeguard principles and loan covenants of the project. The report will also document consultations conducted with PAPs and summaries of issues identified and actions taken to resolve them. It will also provide a summary of grievances or complaints lodged by PAPs and actions taken to redress them and the specific activities conducted to restore and improve income sources and livelihoods of PAPs. The grievances include social and environmental issues and grievances.

183. Resettlement monitoring will involve (i) administrative monitoring to ensure that implementation is on schedule and problems are dealt with on a timely basis; (ii) socio-economic monitoring including income restoration and improvement during and after any resettlement impacts, utilizing baseline information established during socio-economic surveys; and (iii) overall monitoring to assess the socio-economic status of PAHs. If any deviations from resettlement loan covenants or safeguard principles are reported in monitoring reports, the EA/IA will prepare a Corrective Action Plan (CAP) and will submit to ADB for review and approval. The monitoring reports and CAP will be posted on ADB website.

184. The subproject is categorized as “A” for involuntary resettlement impacts. The EA will engage a qualified and experienced internal monitor (IM) who is not associated with the project planning and implementation to monitor the resettlement implementation process and to suggest how to address if any weakness is detected.

185. In addition, the IM will document good practices as well as difficulties encountered in implementing RIP. This document will provide guidance for subsequent projects. A monitoring format is given below which needs to be elaborated during the RIP implementation stage.

186. As involuntary resettlement impacts envisaged in the subproject is limited and the number of households involved is only 58, the EA expects to complete land acquisition, compensation and special grant payment and income restoration and improvement in 12 to 18 months. The EA will hire qualified professionals as skill trainers and organizers of income-generating programmes in the subproject area. They will liaise with the income restoration groups of other subprojects of the Project and work out a comprehensive programme for the benefit of PAPs. A separate and committed budget for this purpose is established as shown in the Section 13 of RIP.

[1] Please see (http://www.adb.org/documents/involuntary-resettlement-safeguards-planning-and-implementation-good-practice-sourcebook-d) for sample internal and external monitoring indicators.

Figure 5: Monitoring Framework

Activity	Progress	Remarks
Assessment of IR impacts of changes in project design, if any,		
Updating of RIP based on changes in project design, if any.		
Approval of updated RIP by ADB		
Appointment NGO, if required		
Disclosure of updated RIP		
Establishment of GRM/Committee		
Capacity building of EA/IA, if required		
Verification of Census; assessment on compensation and assistance, and readjustment		
Land Acquisition		
Payment of compensation at replacement cost of land & assets		
Disbursement of resettlement assistance to title holder PAPs		
Disbursement of assistance to non-title holder PAPs		
Disbursement of special assistance to vulnerable groups		
Number of vocational training provided to PAPs		
Linking PAPs with local, provincial development schemes		
Planning for resettlement sites as per RIP		
Shifting PAPs to resettlement sites as per RIP		
Replacement/ shifting of community property resources		
Reinstallation of public utilities		
Preparation/ updating of Indigenous Peoples Development Plan based on changes in project design		

13. Resettlement Budget

Preparation of Budget Estimates

187. Cost estimates for lands, structures and trees acquired or affected were prepared based on the prevailing rates in the project area. This information and data were gathered from the Divisional Secretary, GNs and from informal sale agreements signed between land buyers and sellers in the area. In preparing the cost estimates, the memo of 19.01.2010 issued by the Chief Valuer on the determination of valuation of land, structures and trees were taken into consideration. The costs of land acquired, structures, crops and trees will be determined by the Valuation Department at the time of receiving 10.1.A Notice from the Acquiring Officer. Therefore, costs could be increased at that stage due to increase of land and building prices. In order to meet this risk, 20 percent contingency costs are added to cost estimates. Transport cost and other cost under LA 2009 Regulation can be met under the contingency estimate.

188. Cost of income restoration programmes has been prepared based on the prevailing costs of each item. Cost of planting materials was prepared on the basis that each PAH will request planting materials.

189. Cost estimate for institutional development covers office accommodation, vehicles and other infrastructure facilities and staff salaries.

190. The full budget will be provided by the Government through the EA. The cost estimates are given in the RIP covers the special assistance schemes limited to the project. Statutory compensation based on LAA will also be paid to PAHs. The estimates will become available only after the Survey Department and Chief Value determine the value of land, houses, crops and trees affected.

191. Sufficient funds will be available at the beginning of the subproject to defray. All land acquisition, compensation, and rehabilitation, administrative, monitoring and consultant cost, income and livelihood restoration cost will be considered as an integral component of project costs and will be borne by the EA. The EA will ensure timely disbursement of sufficient funds for RIP implementation. The EA, through its IA and in consultation with PAPs and appropriate divisional and provincial officials will determine the cost of land acquisition, resettlement and rehabilitation. The approved cost will be allocated in advance in the annual budget of the EA. All cash compensation packages will be paid to PAPs before any construction activity of the project commences. Resettlement assistance programmes will start before construction works start and may continue during the project implementation phase. To avoid unnecessary delays and issues early action to be taken to allocate sufficient funds and timely approvals from the relevant authorities.

Investment Budget

192. The total investment budget for land acquisition and resettlement has been developed into under five components.

1. Cost of compensation for land, structure and trees
2. Cost of relocation (purchase of land)
3. Cost of income restoration programme
4. Cost of monitoring and evaluation
5. Cost of institutional development

Total Investment Budget

193. The total investment budget is Rs **171,798,331**.

Table 28: Cost of Compensation for Land, Structures and Trees(Rs)

Land	**Extent**		**Unit Cost Per Acre**	**Total Cost**
	A. R. P.			
Housing allotments	01 00 15		5,000,000.00	5,500,000
Highland allotments	23 03 01		2,000,000.00	47,500,000
Paddy lands	04 01 01		450,000.00	1,900,000
Chena lands	00 00 00		200,000.00	-
			Sub Total	54,900,000
Structures	Type	Sq.ft.	Rs. Per sq.ft.	
Permanent houses	07	8750	3,000	26,250,000
Semi-permanent houses	02	1500	1,750	2,625,000
			Sub Total	**28,875,000**
Trees				
No. of trees – perennial	3254 x 10,000/-			32,540,000
No. of trees – non perennial	229 x 1000/-			229,000
			Sub Total	**32,769,000**
			Grand Total	**116,544,000**

Table 29: Cost of Buying Land for Relocation and Building Sheds

Loss of Land	No. of Households	Unit Cost Rs.	Total Cost (Rs)
Households losing up to 1/4 acre of land	11*	750,000	8,250,000
Temporary sheds	11	50,000	550.000
		Total	**8,800,000**

- * including the 02 sub-families

Table 30: Cost of Income Restoration Programme

Cost Item	Cost (Rs)
Cost of planting materials	528,800
Cost of training programmes	946,000
Cost of special assistance to vulnerable HHs	25,000
Cost of income generation programme	755,000
Total	**2,254,800**

Table 31: Total Cost of Resettlement Implementation and Monitoring

Description	Amount (Rs)
Cost of compensation for land, structure and trees	116,544,000
Cost of relocation (purchase of land)	8,800,000
Cost of income restoration programme	2,254,800
Sub Total	127,598,800
Monitoring and Evaluation (2%)	2,551,976
Sub Total	130,150,176
Cost estimate for institutional development 10%	13,015,017
Sub Total	143,165,193
Contingencies 20%	28,633,138
Grand Total	**171,798,331**

194. The disbursement of cash compensation to PAPs for land and other property losses and damages will be done by the Division Secretariats in the project areas. The approved amount will be deposited by the EA/IA in the Divisional Secretariat accounts and the disbursement will be done by the divisional administration.

195. EA will bear the total cost of land compensation, housing, relocation, and income restoration and improvement programmes. The payments will be made in cheques which will be deposited in PAPs accounts by the Divisional Secretariat of the area.

14. Implementation Schedule

196. The key IR-related activities such as census and socio-economic survey, cut-off-date publication, resettlement planning, public consultation have already been completed. Disclosure of information on land acquisition, compensation payment, relocation, income restoration and improvement, monitoring and evaluation of resettlement implementation are be detailed in the implementation schedule.

197. The EA/IA will ensure that no physical/or economic displacement of affected households will occur until: (i) compensation at full replacement cost has been paid to each displaced person for project components or sections that are ready to be constructed; (ii) other entitlements listed in the resettlement plan are provided to PAPs; and (iii) a comprehensive income and livelihood rehabilitation programme, supported by adequate budget, is in place to help displaced persons, improve, or at least restore, their incomes and livelihoods.

Figure 6:Implementation Schedule

Resettlement Activity	Time Schedule	Progress
Screen project areas to identify potential resettlement impacts	2014 June – August	
Determine the scope of resettlement planning and resources required	2014 August-September	
Socio-economic Survey	2014 May and June	
Census	2014 June and July	
Declaration of cut-off date	2014 June 01	
Determine land acquisition plan (by segment or as a whole)	2014 August	
Preparation of RIP	2014 September	
Hiring of Civil Society Organizations (NGOs), if required	2014 October	
Public consultation and disclosure of RIP	2014 September	
Co-ordination with divisional administration on land acquisition	2014 August-2015 December	
Approval of RIP by ADB	2014 November	
Submission of land acquisition proposals to ministry of land and land development	2014 September	
Compensation award and payment of compensation	2014 June and July	
Payment of replacement cost and other IR allowances	2015 June and July	
Taking possession of acquired land and structures	2015 July – August	
Handing over of acquired land to contractors	2015August – September	
Notify the date of commencement of construction to PAPs	2015 August	
Assistance to PAPs, especially to vulnerable groups	2015 June-August	
Internal monitoring of RP Implementation	2014 September-2016 December	
External Monitoring and Evaluation (M&E), if applicable		
Project Completion Report		

Annex 1: Gap Analysis - Programme's Involuntary Resettlement Safeguards and ADB Involuntary Safeguard Policy Principles, and Programme's Safeguard Implementation Capacity

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
1. Screen the project to identify involuntary resettlement (IR) impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons and a gender analysis	Yes	IR country safeguard system provides for screening IR and risks as part of resettlement planning. NIRP requires that a RIP is prepared for projects where 20 or more households are affected. If less than 20 households are affected a RIP is to be prepared at a 'lesser level of detail'. Part of resettlement planning is identifying key stakeholders and exploration of viable project alternatives to minimize social impacts especially involuntary displacement, and assess whether resettlement and social impacts are significant or not. See 2008 LAA Regulations	MLLD is responsible for implementing of NIRP in collaboration with network of public and CSOs including CEA, PEA, the Ministries concerned and Divisional Secretaries. These agencies and EA have sufficient experience in applying this principle in formulating RIPs for projects.
2. Conduct meaningful consultations with affected persons (APs), host communities, and NGOs. Inform APs of their entitlements and resettlement options. Ensure APs, especially vulnerable household participation in project planning, implementation and monitoring. Establish a grievance redress mechanism. Support socio-cultural institutions of APs. If IR impacts are complex	Yes	The country safeguard system (CSS) has specific guidelines on consultations with PAPs, vulnerable groups and other stakeholders and NGOs; establishment of a GRM; recording of decisions at consultative meetings; and social preparation phase of RIP planning.	EA and IAs of the programme have excellent experience in conducting meaningful consultations with PAPs and other stakeholders. GRM is a component of RIPs in the Mahaweli Systems and other irrigation programmes. EA and IAs have used social preparation phase in their projects. The capacity to

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
and sensitive, provide social preparation phase			implement this principle exist at the Programme and project levels.
3. Improve or at least restore the livelihoods of all DPs. Land-for-land compensation when affected livelihoods are land-based where possible or cash-for-land compensation when land the loss of land does not undermine livelihoods; prompt replacement of assets, prompt compensation at replacement cost for assets that cannot be restored. Provide additional revenue and services through benefit-sharing schemes.	Yes	The country safeguard system provides opportunity to identify persons, households severely affected in terms of their income and employment losses. Income restoration programmes are to be developed in consultations with APs in order to re-establish themselves and improve their quality of life. Replacement land is It is an option for compensation in the case of land loss; in the absence of replacement land cash compensation is an option for all APs. See NIRP Payment of full replacement cost of lost assets to PAPs is a key principle of NIRP. LA Regulations 2008 provide a comprehensive compensation package including the market value of property acquired. The total package amounts to replacement cost of lost assets.	EA/IAs are aware of this key principle and have applied in several projects.
4. Provide all APs needed assistance: if relocated, secured tenure to resettlement land, better housing, access to employment and production opportunities, integration of resettlers with host communities, extension of project benefits to host communities, transitional support and	Yes	The CSS recognizes the special needs of physically relocated PAPs. PAPs involve in the selection of resettlement sites, livelihood compensation and development options at the earliest opportunity. Gender equality and equity are to be ensured and adhered to in resettlement programmes. The CSS provides for assisting PAPs to be economically and socially integrated into the host communities. Participatory measures are to be designed and implemented by the resettlement planners and implementers.	Our field visits to current resettlement sites of projects (Moragahakanda Reservoir project) indicate that EA/IAs have sufficient understanding of this principle and have applied in several other projects.

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
civic infrastructure and community services, as required.			
5. Improve the standards of living of the displaced poor and vulnerable groups	Yes	CSS, especially NIRP and LA Regulations 2008, emphasize the importance of improving standard of living of the affected vulnerable and poor groups.	EA/IAs in their previous RIPs have paid sufficient attention to this key principle. Entitlement Matrices indicate this practice which is satisfactory.
6. Develop procedures in a transparent, consistent and equitable manner if land acquisition through negotiated settlement to ensure that APs maintain the same or better income and livelihood status	Yes	Although negotiated acquisition is recognized as a method of land acquisition by CSS, it is subject to LAA procedures of land acquisition which could cause delays. However, the NIRP and LA Regulations 2008 provide a legal framework for ensuring that PAPs maintain the same or better income and livelihood status	The application of LA Regulations 2008 and NIRP by EA/IAs in several other projects is satisfactory. They have the capacity to apply this principle.
7. Ensure that APs without titles to land or recognizable legal rights. Non titled households are eligible for resettlement assistance and compensation for loss of non-land assets.	Yes	Compensation for non-land assets of non-titled persons is a well-established principle in CSS. Often such non-titled persons are provided with land at resettlement sites to ensure that they will have better socio-economic status during post-displacement.	EA/IAs have planned and implemented several RIPs which include this key principle. EA/IA possess sufficient capacity.
8. Prepare a resettlement plan with APs' entitlements, income and livelihood strategy, institutional arrangements, monitoring and reporting framework,	Yes	CSS, especially NIRP and LA Regulations 2008 require RIP for any project which is likely to have resettlement impacts. Necessary guidance is also published by MLLD on how to prepare RIP.	EA/IAs have vast experience in RIP formulation and implementation

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
budget, and time-bound implementation schedule			
9. Disclose resettlement plan including documentation of the consultation process in a timely manner, before project appraisal in an accessible place and a form and language under stable to APs and other stakeholders. Disclose final resettlement plan and its updates to APs and other stakeholders.	Yes	CSS, especially NIRP and LA Regulations 2008 require disclosure of RIP. LAA discloses the land which have been identified to acquire for a public purpose and calls for views, opinions and objections.	EA/IAs possess sufficient experience and capacity in RIP disclosure and consultations on resettlement information with PAPs. This has been done in several projects.
10. Conceive and execute involuntary resettlement as a part of development project or programmes. Include the full cost of resettlement in the project costs and benefits. If significant resettlement impacts are found, consider implementing the IR component of the project as a stand-alone operation.	Yes	IR is considered as a key component of any development project in Sri Lanka and in this regard, NIRP and LA Regulations 2008 provide sufficient guidance.	EA/IAs have sufficient experience in calculating resettlement cost as part of project cost and in obtaining sufficient funds from the Treasury to pay compensation and implement resettlement programmes including income restoration programmes for the benefit of PAPs.

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
11. Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement RP under close supervision throughout project implementation	Yes	CSS focuses on this key safeguard principle. Payment of compensation before displacement is the law except in case of urgency clause 38(a) of LAA.	EA/IAs are cognizant of the importance of paying compensation prior to displacement. Delays do occur because of lack of sufficient funds and litigation over land ownership. EA/IAs have sufficient experience and capacity to apply this principle
12. Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the RP have been achieved based on baseline conditions and the results of resettlement monitoring.	Yes	Monitoring and assessing resettlement outcomes are not well developed in the IR regulatory framework. Special arrangements are to be introduced to overcome this deficiency in CSS	Project-based internal and external monitoring of IR impacts are part of donor-funded projects which EA/IA have planned and implemented. They possess expertise in this regards which could be applied to the Programme.

Annex 2

Minutes of the Meeting on Affected Persons and Stakeholders of NWP Canal Project-Galewela Divisional Secretary Division

Date : 28/08/2014
Time : 11.00 am – 1.00 pm
Venue : Meeting Hall, Divisional Secretariat, Galewela

Officers Attended;

1.	Ms. A.M.K.C.K. Atapattu	-	DS / Galewela
2.	Eng. G.M.R.A. Perera	-	DPD / NWPCP
3.	Eng. H.M.U.B. Herath	-	DIE / Dambulla
4.	Mr. Y.G. Wijeratne	-	Consultant / MCB
5.	Ms. R.M. Samanmalee Swarnalatha	-	Consultant-Communication / ADB
6.	Eng. W.M.D. Wijesinghe	-	IE / NWPCP
7.	Mr. Roy Nanayakkara	-	EA / DIE-Dambulla
8.	G.P.S. Sanjeewa	-	EA / NWPCP
9.	M.L.A.V. Omeshani	-	EA / NWPCP

Ms. A.M.K.C.K. Atapattu, Divisional Secretary, Galewela (DS, Galewela) who presided at the meeting, welcome all officers of NWPCP & Irrigation Department, Consultants and all the invitees. Starting the meeting, she explained the purpose of the meeting. She further expressed that the people of North Western Province face severe water shortage since the area receives water from no external sources. She urged the importance of NWP Canal and stated that people living in Galewela area have to do a commitment for the benefit of the people of North Western Province.

Eng. G.M.R.A. Perera, Deputy Project Director, NWP Canal Project (DPD, NWPCP), briefed on the Project and its current status.

Mr. Y.G. Wijeratne, Resettlement Consultant, MIWRM, explained the resettlement procedures and methodology, compensation packages and income restoration and improvement programmes. He further explained the resettlement census and its key findings on land, property and house-affected persons. He pointed out that only 9 houses will be affected due to project in Galewela area. He mentioned that there is a possibility of providing financial support for purchasing desired land plots, for the affected persons, those who will be dispossessed of their houses. He further mentioned it was just a suggestion and invited the participants for their suggestions and concerns on resettlement. He also explained that although 09 households and 02 sub families will be relocated, only 04 households requested relocation sites. All other 07 households are willing to relocate their houses on the remaining portion of the acquired land. However these 04 households agreed to find relocation sites in the locality provided that PIA will give the funds for purchase of land plots.

Mr. W.A.G.G.S.C. Wickramasinge of Kanadana, Galewela in Rawediyawa GN Division questioned whether the compensation is received only for deeds of freehold lands. Mr. Wijeratne replied that not only the deeds of freehold lands, but also “Swarnabhoomi” and “Jayabhoomi” deed holders will duly receive compensation. Mr. Wickramasinghe then stated he has been informed that only a part of the building owned by him will be affected and he inquired

whether the compensation is received for the entire building in such circumstances. Mr. Wijeratne said that the compensation is usually paid for the entire building in such cases. He further stated the final decision on building, which has been accounted to be affected for the time being, will be taken only after the final survey by Survey Department.

Ms. A. Raifa of Keppitiya, Galewela in Ranwediyawa GN Division expressed they had not received letters informing on the meeting. DPD, NWPCP replied that invitation letters were sent to all the land and house affected persons as per the list, sent by Mr. Wijeratne / Consultant , MIWRM ,by whom the persons were identified from the survey on resettlement.

After that, DS, Galewela read the list of names of the house affected persons and mentioned no government owned land available in the Galewela Town for resettlement and stressed the need of finding out desired land outside the town limits.

Ms. W.D. Krishanthi Biyatris, Welgama, GN, Pahala Bambawa subsequently, questioned why the name of Mr. Anura Jayarathne is not available in the list, though his house is situated in between two affected houses owned by Mr. H.A. Lucas Singno and Mr. H.A. Asoka Titus. Mr. Wijeratne replied that only the details of those who were available in the houses during the survey had been recorded and there can be some names missing.

Mrs. G.L.A.C.D. Rajapakse, who claimed to be a widow, mentioned that a land of hers in Dambagolla Road, Galewela in Danduyaya GN Division will be affected and she had not yet been informed the exact affected extent. She stated that she has rented the house built in the land to other person and while living in a small house in Galewela town. She claimed that the rent from this house is one of her major incomes but there is a risk of losing her income since those who live in the house are going to leave the house due to the risk of being affected.

DS, Galewela requested to inform GNs of relevant areas before proceeding with any survey work related to project.

GN of Nebadagahawatte Division then, complained that no one from his division has been called upon the meeting though the canal trace lies within his division. In reply Mr. Wijeratne mentioned that as only the existing canal is improved and therefore, all persons living in that area will not be affected and not invited for the meeting He further stated that for the persons who need more clarifications for their issues on canal trace, to contact PD's Office, Kurunegala.

Mr. P.M. Nimal Karunathilake, GN of Ranwediyawa and Hombawa Divisions stated that some persons in his division had not received the letters while some others had received. He further complained the official for not informing GNN in the relevant divisions before the works related to the project. He requested to inform them at least a week in advance before the task.

In reply ,DPD, NWPC stated that the project is at the initial phase and this meeting was also convened through Divisional Secretary and informed to respective GNN only as per the necessity and for future works also will be also informed to GNN through DS/Galewela before any future work related to the project within their divisions.

The meeting adjourned at around 1.00 pm.

Minutes taken by: Eng. W.M.D. Wijesinghe – Irrigation Engineer

Eng. G.M.R.A. Perera – Deputy Project Director/NWPC

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Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation (නිලධාරීන්)

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
Y.M.W.B. [illegible]	[illegible]	[illegible]	[illegible]
W.D. [illegible]	[illegible]	[illegible]	[illegible]
A.G.K. [illegible]	ග්‍රාම නිලධාරී [illegible]	[illegible]	[illegible]
L.S.K. [illegible]	ග්‍රාම නිලධාරී	[illegible]	[illegible]
P.W. [illegible]	ග්‍රා.නි.	[illegible]	[illegible]
M.D. [illegible]	[illegible]	[illegible]	[illegible]
R.M.M.L. [illegible]	[illegible]	[illegible], ගලේවෙල	[illegible]
M.S.F. [illegible]	සං. නි (ආර්ථික සංවර්ධන)	[illegible], ගලේවෙල	[illegible]
M.H.F. RISMINA	සං. නි	[illegible]	[illegible]
K.N. [illegible]	[illegible]	ප්‍රා. ලේ. කා. ගලේවෙල	[illegible]
W.M.S. [illegible]	[illegible]	"	Sug
M.G. නිල්මිණි ද සිල්වා	සං. නි (ආර්ථික සං)	" " "	[illegible]
[illegible]	[illegible]	" "	[illegible]
P.A. [illegible]	[illegible]	[illegible]	[illegible]
P.M. [illegible]	[illegible]	[illegible]	[illegible]
P.M. [illegible]	[illegible]	" "	[illegible]
N.D.S. [illegible]	[illegible]	[illegible]	[illegible]
A.S. [illegible]	[illegible]	[illegible]	Anoma
R.D.N. [illegible]	[illegible]	" " " "	[illegible]
N.D.T. [illegible]	[illegible]	ප්‍රා.ලේ. ගලේවෙල	[illegible]
M.H.M. [illegible]	[illegible]	[illegible] - ගලේවෙල	[illegible]
G.M.R.A. [illegible]	[illegible]	[illegible]	[illegible]
R.M. Samanmalee Swarnalath	[illegible]	47/1 Kadawala, Dunag.	[illegible]
H.M.A.B. [illegible]	[illegible]	[illegible]	[illegible]
W.M.D. Wijesinghe	IE	PD's office	[illegible]
R.M. Nanayakkara	E-A	R.E's office Dambulla	[illegible]
M.L.A.V. Omeshani	EA	NWP canal project	[illegible]
G.P.S. Sanjeewa	EA	" "	[illegible]

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Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
W.A. GGSC [illegible]	[illegible]	618 [illegible]	[illegible]
A. Raifa	—	59 Keppitiya Galawela	[illegible]
S. FAREERA	—	558 Keppitiya Galewela	[illegible]
M.G. [illegible]	[illegible]	[illegible]	[illegible]
H.M. [illegible]	[illegible]	" "	[illegible]
G.H. [illegible]	"	" "	[illegible]
K.A. [illegible]	—	[illegible] 3 [illegible]	[illegible]
S.R. [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
H.M. [illegible]	[illegible]	[illegible]	[illegible]
K.A. [illegible]	—	608 A. [illegible]	[illegible]
[illegible]	[illegible]	448-B [illegible]	[illegible]
S.A.M. [illegible]	[illegible]	[illegible]	[illegible]
W.A. [illegible]	[illegible]	[illegible]	[illegible]
L.A. [illegible]	[illegible]	[illegible]	[illegible]
G.G. [illegible]	[illegible]	[illegible]	[illegible]
M.W. [illegible]	[illegible]	[illegible]	[illegible]
Y.G. [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
P.G. [illegible]	[illegible]	[illegible]	[illegible]
G.H.G. [illegible]	[illegible]	[illegible]	[illegible]
G.L.A.C.D. [illegible]	[illegible]	549/3 [illegible]	[illegible]
P.H. [illegible]	—	549/3, [illegible]	[illegible]
I.B. [illegible]	—	263, [illegible]	[illegible]
P.D. [illegible]	— [illegible]	[illegible]	[illegible]
G.L.A. [illegible]	—	[illegible]	[illegible]
G.L.A. [illegible]	[illegible]	[illegible] 549/1, [illegible]	[illegible]

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Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
H. M. [illegible]	ගොවිතැන්	[illegible], [illegible]	[illegible]
G L A [illegible]	යුව නමු [illegible]	249, දඹගහය, ගලේවෙල	Allutthge
M. D. [illegible]	[illegible]	[illegible]	[illegible]
H [illegible]	[illegible]	[illegible], ගලේවෙල	[illegible]
D. G. [illegible]	[illegible]	[illegible], ගලේවෙල	Shyas
H. A. අනුර [illegible]	[illegible]	84/1B, [illegible], ගලේවෙල	Anura
H A [illegible]	ගොවිතැන	[illegible], ගලේවෙල	[illegible]
H. A [illegible]	කම්කරු	[illegible], ගලේවෙල	[illegible]
H. A. [illegible]	[illegible]	" " " "	[illegible]
T. A. [illegible]	නැත.	[illegible], ගලේවෙල	[illegible]
T. A. [illegible]	[illegible]	[illegible], ගලේවෙල	[illegible]
D. M. [illegible]	ගොවිතැන	[illegible]	[illegible]
M. [illegible]	ගොවිතැන	[illegible]	[illegible]
R. H. A. [illegible]	[illegible]	[illegible]	[illegible]
R. H. A. [illegible]	ගොවිතැන	[illegible]	[illegible]
T. M. [illegible]	[illegible]	[illegible]	[illegible]
D. G. [illegible]	[illegible]	[illegible]	[illegible]
A. M. U. C. [illegible]	[illegible]	90/1, [illegible]	[illegible]
M. A. C. P. [illegible]	[illegible]	[illegible] 10/8, [illegible]	[illegible]
H. A. [illegible]	[illegible]	[illegible]	[illegible]
K. W. [illegible]	[illegible] / ගොවිතැන	[illegible]	[illegible]
R. M. [illegible]	නැත	[illegible], ගලේවෙල	[illegible]
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Stakeholders meetings on affected persons and Stakeholders of NWP canal/ Galewela D.S. Division

සහභාගීත්වය / Participation

නම / Name	රැකියාව / Position	ලිපිනය / Address	අත්සන / Signature
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PAPs and Other Stakeholder Consultation Workshop on 28 August 2014, Divisional Secretary, Galewela, addressing the Workshop

Discussion on the Compensation and Special Grant Packages at the PAP and Other Stakeholders Consultation Workshop – 28 August 2014

Sri Lanka
Project Number: 47381
December 2014

Sri Lanka: Water Resources Development Investment Programme

Upper Elahera Canal Project

Resettlement Implementation Plan

Ministry of Irrigation and Water Resources Management
Democratic Socialist Republic of Sri Lanka

Contents

ABBREVIATIONS

DOI	Department of Irrigation
DRC	Depreciated recovery cost
DSD	Divisional Secretary Division
EA	Executive Agency
EIA	Environment impact assessment
GNO	*Grama Niladhari* Officer
GND	*Grama Niladhari* Division
GRC	Grievance redress committee
GRM	Grievance redress mechanism
IA	Implementing agency
IR	Involuntary resettlement
ISEWP	improving system efficiencies and water productivity
KMTC	Kaluganga-Moragahakanda Transfer Canal
LAA	Land Acquisition Act 1950
MASL	Mahaweli Authority of Sri Lanka
MCB	Mahaweli Consultancy Bureau (Pvt) Limited
MFF	Multi-tranche Financing Facility
MLLD	Ministry of Land and Land Development
MDP	Mahaweli Development Programme
MRB	Mahaweli River Basin
MIWRM	Ministry of Irrigation and Water Resources Management
MLBCR	Minipe Left Bank Canal Rehabilitation
MFF	multitranche financing facility
NCPCP	North Central Province Canal Programme
NWPC	North Western Province Canal
PAP	Project-affected person
PIU	Project implementation unit
PMDC	programme management and design consultant
PMU	Project management unit
PPTA	project preparatory technical assistance
RDA	Road Development Authority
RIP	Resettlement Implementation Plan
SIWRM	Strengthening integrated water resources management
SPS	Safeguard Policy Statement
UEC	Upper Elahera Canal

GLOSSARY

Cut-off-date: For land to be acquired from titled landowners, the date of Section 02 notification for acquisition under the Land Acquisition Act (LAA) will be treated as the cut-off date. For non-titleholders such as squatters, encroachers, the starting date of the project census or a designated date declared by EA in consultation with Divisional Secretaries will be considered as the cut-off date.

Disturbance: Disturbances caused to normal living of a person arising from compulsory acquisition of private land.

Encroacher: A Person who has illegally occupied state land. Any legal title holder to a piece of land becomes an encroacher if he/she establishes boundaries of the holding to include adjacent state land without prior approval.

Entitlement: A variety of measures including compensation, income restoration and interim support, transfer assistance, relocation and other benefits given to project-affected-persons (PAPs) to restore and improve their post-displacement socio-economic conditions.

Entitlement matrix: It identifies categories of eligible persons and their specific entitlements under the project, and what agency/department is responsible to deliver them on time.

Host population: Persons, households and communities who reside in resettlement areas where PAPs are relocated.

Income restoration: Re-establishing income sources and livelihoods of project-affected persons to pre-project level in real terms.

Injurious affection**:** Adverse impact on the value of the remaining land due to acquisition of a part of a land.

Inventory of losses: Complete and accurate count of houses, land, business premises, structures and other assets on land that will be affected by the project.

Involuntary Resettlement: The unavoidable physical or economic displacement of persons arising from a development project. In case of physical displacement, PAPs need assistance to rebuilding their livelihood, income and asset bases and social and cultural systems. If economically displaced, PAPs still need assistance to restore their livelihood and assets.

Project-affected persons (PAPs): Any person, who as a result of the implementation of a project, losses the right to own, use, or otherwise benefit from a built structure, land (residential, agricultural or pasture), annual or perennial crops and trees, or any other fixed or moveable assets, either in full or in part, permanently or temporarily.

Rehabilitation: Re-establishing and improving incomes, livelihoods and social systems of PAPs.

Relocation: Moving PAPs and their moveable assets, rebuilding their houses, developing new land, and providing public infrastructure at the relocation site.

Replacement cost: The method of valuation of assets that helps to determine the amount sufficient to replace lost assets and cover transaction costs. In applying this method of valuation, depreciation of structures and assets are not to be taken into account. For losses that cannot easily be valued or compensated in monetary terms such as access to public services, customers and suppliers; to fishing, grazing or forest areas, the project will establish access to equivalent and culturally acceptable resources and earning opportunities.

Resettlement: Involuntary physical or economic displacement of persons caused by a project that covers compensation, relocation and rehabilitation measures to mitigate the effects of such displacement.

Resettlement Budget: A detailed breakdown of all costs of a resettlement implementation plan (RIP). This is a part of project costs.

Resettlement effects: Loss of physical and non-physical assets, including homes, communities, productive land, income earning assets and sources, resources, cultural sites, social structures, networks and ties, cultural identity and mutual help mechanisms.

Resettlement Implementation Plan (RIP): Time bound action plan with a budget setting out resettlement strategy, objectives, entitlements, actions, responsibilities, monitoring, evaluation and reporting.

Severance**:** Dividing a landholding into two or several parts due to acquisition of the middle portion for a public purpose.

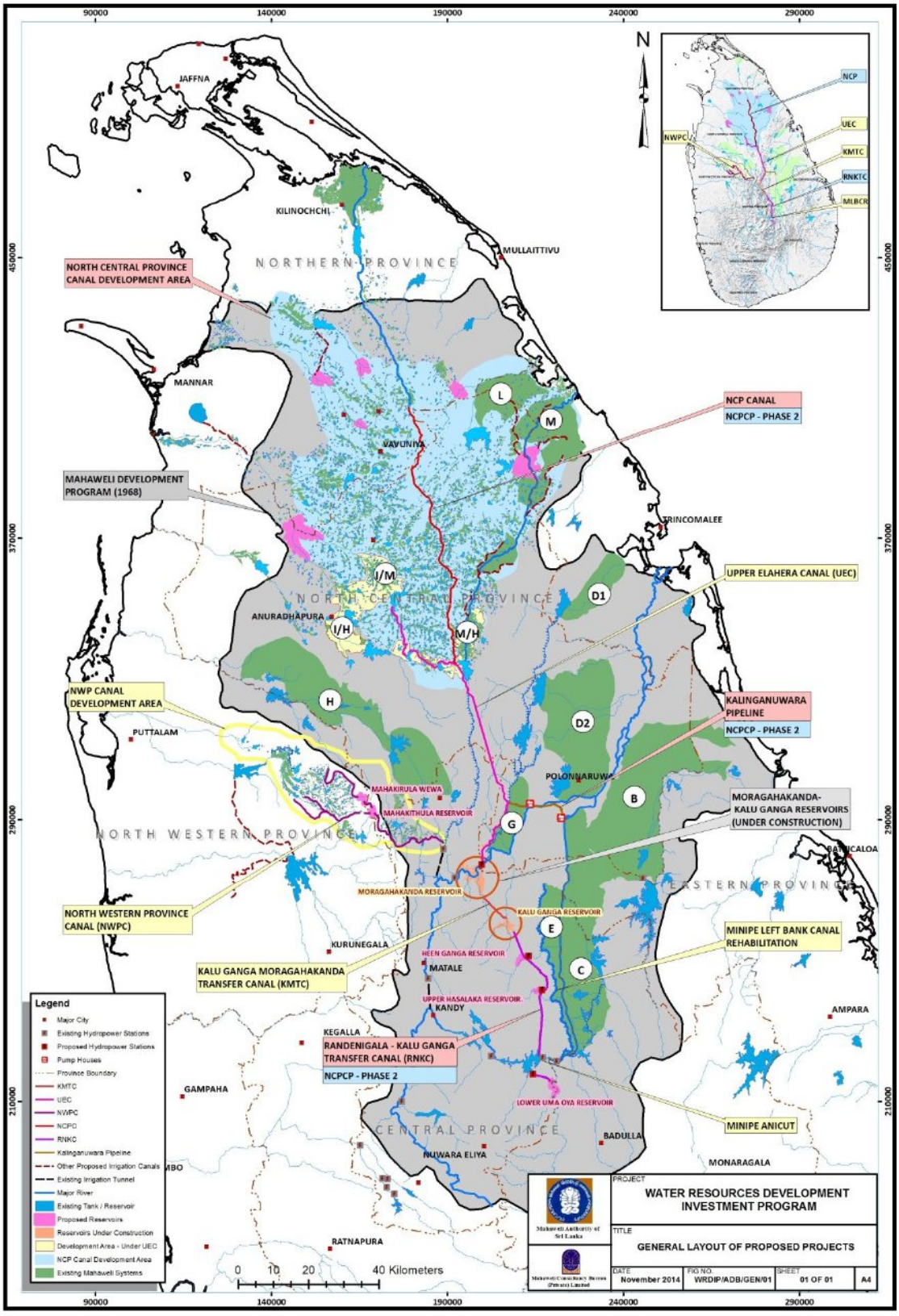
Social preparation: A process of consultations with PAPs that will be conducted before key involuntary resettlement decisions are made.

Squatter**:** A person who occupies a piece of land without a title or any recognizable legal rights to that land.

Sub Project**:** Upper Elahera Canal

Value to owner**:** Valuation based on actual cost to the landowner.

Vulnerable groups: Distinct groups of poor people who might suffer disproportionately from resettlement effects. Among them are the old, the young, the handicapped, the poor, isolated groups and female-headed households.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NORTH CENTRAL PROVINCE CANAL DEVELOPMENT AREA
MANNAR
VAVUNIYA
NCP CANAL
NCPCP - PHASE 2
MAHAWELI DEVELOPMENT PROGRAM (1968)
TRINCOMALEE
UPPER ELAHERA CANAL (UEC)
NORTH CENTRAL PROVINCE
ANURADHAPURA
NWP CANAL DEVELOPMENT AREA
KALINGANUWARA PIPELINE
NCPCP - PHASE 2
PUTTALAM
POLONNARUWA
MAHAKIRULA WEWA
MAHAKITHULA RESERVOIR
MORAGAHAKANDA-KALU GANGA RESERVOIRS (UNDER CONSTRUCTION)
NORTH WESTERN PROVINCE
BATTICALOA
EASTERN PROVINCE
MORAGAHAKANDA RESERVOIR
KALU GANGA RESERVOIR
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MINIPE LEFT BANK CANAL REHABILITATION
KURUNEGALA
HEEN GANGA RESERVOIR
MATALE
KALU GANGA MORAGAHAKANDA TRANSFER CANAL (KMTC)
UPPER HASALAKA RESERVOIR
KANDY
AMPARA
KEGALLA
RANDENIGALA - KALU GANGA TRANSFER CANAL (RNKC)
NCPCP - PHASE 2
GAMPAHA
LOWER UMA OYA RESERVOIR
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NUWARA ELIYA
MONARAGALA
RATNAPURA
Legend
Major City
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Proposed Hydropower Stations
Pump Houses
Province Boundary
KMTC
UEC
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NCPC
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Other Proposed Irrigation Canals
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Proposed Reservoirs
Reservoirs Under Construction
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Water Resources Development Investment Programme

Upper Elahera Canal Project

Resettlement Implementation Plan

1. Introduction

1. This Resettlement Implementation Plan (RIP) addresses land acquisition, compensation payment, resettlement assistance, income restoration and improvement of livelihood, and physical relocation requirements of the Upper Elahera Canal Project (the Project) which is a constituent part of the Sri Lanka: Water Resources Investment Development Programme (WRIDP).

2. ADB supports the Government of Sri Lanka to plan WRIDP through the Ministry of Irrigation and Water Resources Management (MIWRM) by financing the following three investment projects, which constitute components of the planned North Central Province Canal Programme. The WRIDP is a multitranche financing facility (MFF) of $675 million. The MFF will comprise three tranches financing three loan "Projects". The Projects will comprise the following individual investment projects:

   (i) The Kaluganga-Moragahakanda Transfer Canal Project (KMTCP) will convey about 771 million cubic meters (MCM) of water annually between Kaluganga and Moragahakanda Reservoirs which are under construction. They will retain local runoff and the Mahaweli River flow diversion before irrigating downstream areas and augmenting drinking water supply schemes. The length of the canal is 9 kilometers (km) and comprises about 8-km of tunneling.

   The Upper Elahera Canal Project (UECP) will annually convey about 974 MCM northwards from the Moragahakanda Reservoir along a 65.5-km canal (including about 27-km of tunnels), to the Huruluwewa and Mannakattiya Reservoirs which, in turn, feed existing irrigation and drinking water supply schemes.

   (ii) The North Western Province Canal Project (NWPCP) will annually withdraw 130 MCM from the Dambulu Oya River and the Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located throughout North Western Province via 96-km of new and upgraded canals including a new 940 meter (m) tunnel.

   (iii) The Minipe Left Bank Canal Rehabilitation Project (MLBCRP), located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River will: (a) add upstream storage by heightening the headwork's weir by 3.5 meters to regulate generation inflows, and (b) rehabilitate the 76-km Minipe Left Bank Canal to improve conveyance and reliability of service to farmers.

3. The Investment Programme will be implemented over ten years, and its proposed structure is shown in table 1. It will also include three consulting packages comprising: (i) 'improving system efficiency and water productivity' (ISEWP); (ii) 'strengthening of integrated water resources management' (SIWRM); and (iii) the 'Programme Management, Design and Supervision Consultant' (PMDC) that will support MIWRM in managing WRIDP and preparing packages under the investment programme.

Table 1: Tentative Investment Program Structure and Implementation Schedule

Project	Value ($, millions)	Subproject	Schedule
Construction Works			
Project-1	189	UEC Stage 1 NWPC Stage 1 MLBCR	Q1 2015 – Q4 2019
Project-2	287	UEC Stage 2 and KMTC	Q1 2016 – Q4 2024
Project-3	199	UEC Stage 3 NWPC Stage 2	Q1 2018 – Q2 2024
TOTAL	**675.0**		

KMTC = Kaluganga – Moragahakanda Transfer Canal; MLBCR = Minipe Left Bank Canal Rehabilitation; NWPC = North Western Province Canal; UEC = Upper Elahera Canal; Q = quarter of a year.
Source: Asian Development Bank

Rationale of the Project

4. Water is the principal medium in the dry zone of Sri Lanka through which climate change exhibits its environmental, economic and social impacts. Many regions, particularly, poorer communities, are vulnerable to droughts and floods which destroy lives, assets and income sources. Moreover, widespread kidney diseases, caused by polluted drinking water, threaten the lives of rural populations of the northern dry zone. The risks associated with climate uncertainty and change can be mitigated by storing and distributing water wisely, when it is scarce, and by planning ahead to protect communities from droughts and floods. Coping with water-related risks requires collective involvement of all stakeholders and broad long-term planning. The WRDIP takes this key development issues as one of its objectives (see Table 2).

5. No new lands are identified for land development under irrigation by UECP. Its main benefit will be increased cropping intensity of existing lands under major and minor irrigation schemes. This will increase farmer household incomes and food security. In addition, the Project will provide safe drinking water to a large population in the part of north central province who suffers now from the lack of safe drinking water.

6. As the Table 2 shows, WRDIP will address several millennium development goals. Among them are: poverty reduction, environment sustainability, combating diseases such as malaria. In fact some of them are key objectives of WRDIP as well.

Table 2: WRDIP and Millennium Goals

Millennium Development Goal	Applicability to WRDIP	How It could help achieve the goal	Comments
1. Eradicate Extreme Poverty	Yes	Having a sustainable, safe water supply and benefiting from its economic opportunities such as better and secure irrigated agriculture help break the vicious circle of poverty	Key objective of WRDIP
2. Achieve Universal Primary Education	Yes	A safe and secure water supply helps all children – boys and girls – to stay at school, and enables women to participate more actively in income generating activities and in their community activities	One of WRDIP's broad development goals
3. Promote gender equality and empower women	Yes	See above	See above
4. Reduce child mortality	Yes	Safe drinking water and improved sanitation are central to health and well-being of children and their parents.	See above
5. Improve maternal health	Yes	See above	See above
6. Combat HIV/AIDS, malaria and other diseases	Yes	See above	See above
7. Ensure environmental Sustainability	Yes	Better management of water resources lessens pollution and improves water conservation towards ensuring sustainable, life-supporting ecosystems.	Key development goals of WRDIP
8. Develop a global partnership for development	Yes	Water has no political or ethnic boundaries and is especially vulnerable to human impacts. WRDIP works with people and agencies to use this irreplaceable resource wisely	Contribute to deal with vulnerability of communities regardless of their ethnicity and class.

7. Providing safe drinking water services and managing water resources wisely will improve health and open opportunities for all to improve their life chances. In many poor communities, fetching water from distant sources and queuing for water are physically-demanding and time-consuming responsibilities borne primarily by women and young girls. Women, as a result, have less time to engage in productive activities, while in case of young girls, school attendance is often considered a lesser priority: a gender bias that creates an imbalance in school enrolment ratios has been noted in the project areas, although the imbalance has been progressively declining. Disparities in women's education and involvement in decision-making processes place them at a significant disadvantage in earning an income or voicing their views on household or community affairs. The Project takes these issues into consideration in formulating and implementing income restoration and livelihood improvement programmes.

2. Upper Elahera Canal Project

8. The proposed 66-65-km long Upper Elahera Canal starts at end of the KMTC Tunnel and end up in Yakalla Grama Niladhari Divsion (GND) of Galenbindunuwewa Divisional Secretary's Division (DSD). The canal will traverse through Naula and Dambulla DSDs of Matale District, Elahera and Hingurakgoda DSDs of Polonnaruwa Distrct, and Palugaswewa, Kekirawa and Galenbindunuwewa DSDs of Anuradhapura District. About 50-km of the canal will traverse through wild life and forest reserves. About 11-km of the canal will traverse through uncultivated highland allotments, home gardens, and paddy lands. The width of the acquisition boundary of the canal varies between 30 and 50 meters. The remaining 05-km stretch of the canal will traverse underground that starts at Yakalla and ends at the Manankattiya-Mahakanadarawa Reservoir Complex.

9. The potential resettlement impacts of the canal sections are given below.

- 00-10.600-km of the canal will go through the Minneriya–Girithala Wildlife Reserve. The canal starts at Moragahakanda reservoir outlet in the Thalagoda GND of the Naula DSD and ends in the Elahera GND of the Elahara DSD. There will be no resettlement impacts in this section of the canal.
- 10.600-10.700 km (100 meters) of the canal will traverse go through Samagipura village of Elahera GND in the Elahera DSD. One household will be physically displaced and 04 land allotments will be acquired for the canal.

- 10.700-13.500 km (2.8 km) of the canal will traverse through the Dampuragama and Damanayaya villages of the Damanayaya GND of the Elahera DSD. 12 households will be physically displaced and 31 highland and 11 paddy land allotments will be acquired for the canal. One household will be isolated due to cut-off from the road access.

- 13.540-14.340 km (800 meters) of the canal will go through the third stage of Kottapitiya village of Kottapitiya South GND of Elahera DSD. Three households will be physically displaced by the canal. Portions of 12 highland allotments will be acquired.

- 14.340-55.500 km (41.160-km) of the canal will traverse through the Minneriya-Giritale Wildlife Reserve in the Elahera, Hingurakgoda and Palugaswewa DSDs. There will be no resettlement impacts in this section.

- 55.500-57.00 Km (1.500Km) of the canal will traverse through a tunnel. The surface land area is predominantly *chena* land in Palugaswewa DSD.

- 57.00-61.000Km (4.000Km) of the canal will traverse through the Namalpura GND in the Plugaswewa DSD. No household will be physically displaced by the canal. Portions of 11 high land allotments and 24 paddy allotments will be acquired.

- 61.000-65.000Km (4.000-km) of the canal will traverse through the chena lands and scrubs in Yakalla and ulpotha GNDS of Galenbindunuwewa DS division where no affect to the households and thereby no resettlement impacts have been identified.

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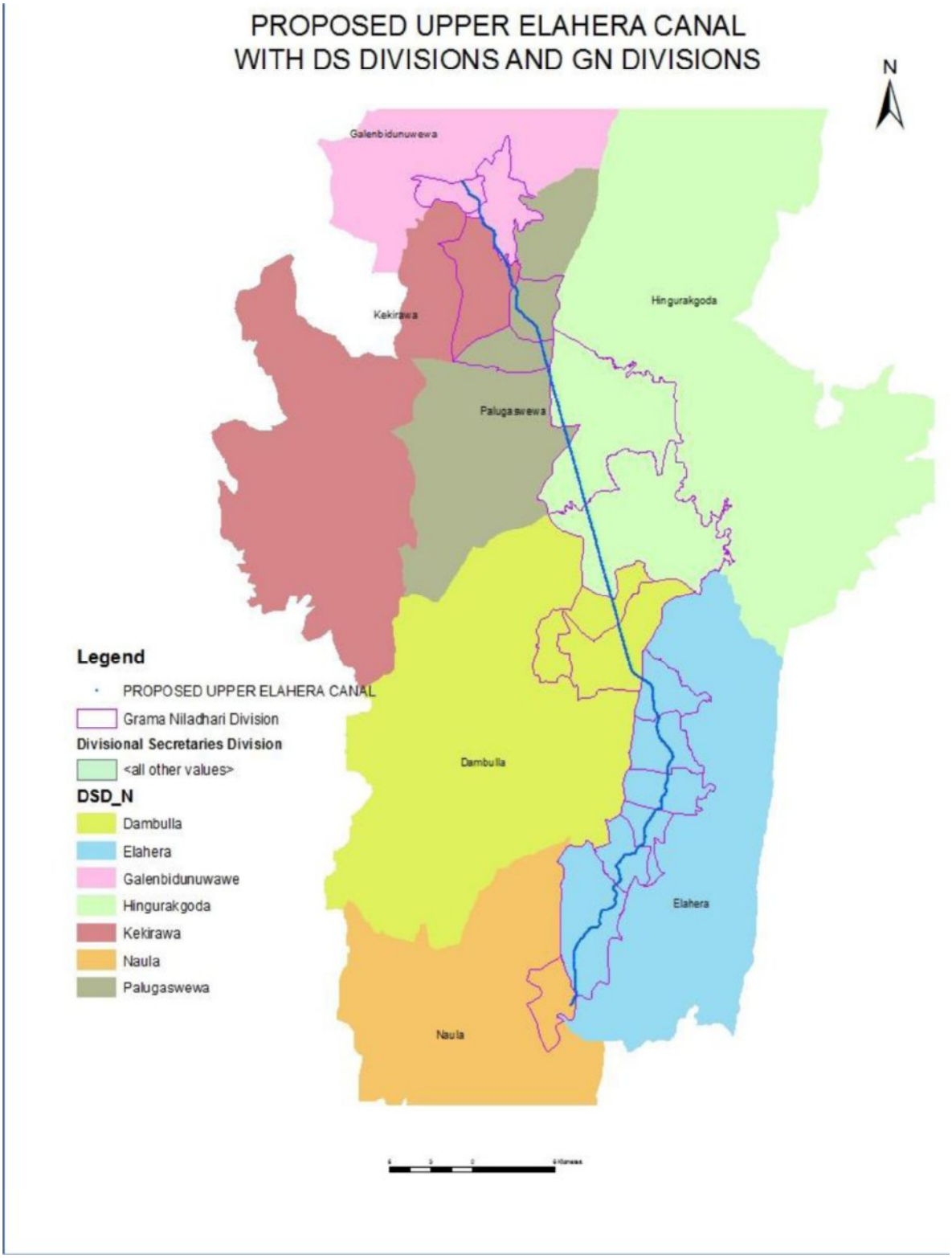
- 66.650-71.650 Km (05.00 Km) of the canal will traverse through the covered conduits until the Manankattiya Reservoir. The surface lands are found as scrubs and *chena* land.


PROPOSED UPPER ELAHERA CANAL
WITH DS DIVISIONS AND GN DIVISIONS
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Hingurakgoda
Kekirawa
Naula
Palugaswewa

3. Socio-economic Profile of the Project-affected Households

10. A comprehensive socioeconomic survey was conducted by MCB in 2014 to identify the nature and significance of potential project impacts on potential project-affected households (PAHs). As the Project is a linear canal project, the survey team interviewed 86 PAHs in the vicinity of the propose canal trace during the survey. This was supplemented by a rapid socioeconomic survey to identify those households affected by the new trace portion in the Yakkala and Ulpotha GNDS areas. The change of the canal trace in fact has reduced the number of PAHs identified earlier as the changed portion of the canal trace traverses through uncultivated scrub jungle area.

11. A resettlement census was conducted in May and June 2014 in the Project area to obtain a demographic overview of the total affected population. It covered PAHs' assets and main sources of livelihood affected, and their socio-economic status. The gender-disaggregated socio-economic data have been used to determine if special actions are needed by poor and vulnerable households, especially female-headed households, to overcome their socioeconomic marginality and disarticulation. As the detailed project design are been completed parallel to the census of project-affected households and persons, the data presented in this RIP could be taken as final for the Project area.

Population

12. The Project-affected GNDs are Damanayaya, Kottapitiya-south and Elahera in the Elahera DSD, Namalpura GND of Palugaswewa DSD and Yakalla and Ulpotha GNDs of Galenbindunuwewa DSD. The affected 86 households live in 08 villages. All of them are Sinhala Buddhists. The sample household distribution among the 05 GNDs and 08 villages is given in Table 3.

Table 3: Sample Project-affected Households

Division	GND	Village	Number of affected Households
Elahera	Damanayaya	Dampuragama	12
		Nuwaralagama	09
		Damanayaya	18
	Kottapitiya-south	Thunwana- Piyawara	12
	Elahera	Samagipura	07
Palugaswewa	Namalpura	Madawela	10
Galenbindunuwewa	Yakkala	Yakkala	14
	Ulpotha	Ulpotha	04
		Total	**86**

Source: Baseline Social Sample Survey -2014, MCB Consultants

13. Male-female ratio is 45:55. The main age categories are given in Table 04. About 60 percent of the population is in the age bracket of 15-59 years (Table 4) on which children (0-14 years) and old persons (over 60 years) categorised as dependants.

Table 4: Age Distribution of Sample Project-affected Households

DSD	GND	Age			Total Population
		0-14 years	15-59 Years	Over 60 Years	
Elahera	Damanayaya	35	102	14	151
	Kottapitiya-south	09	34	03	46
	Elahera	02	17	05	24
Palugaswewa	Namalpura	**10**	**17**	**08**	**35**
Galenbindunuwewa	Yakkala	**11**	**12**	**14**	**37**
	Ulpotha	**09**	**08**	**11**	**28**
Total		**76**	**190**	**55**	**321**

Source: Baseline Social Sample Survey -2014, MCB Consultants

14. 77 percent of households are identified as married families. 15 percent of households are widowed; 6 percent are divorced; and 2 percent of households are separated. No person with severe physical disabilities was identified in the villages. Average size of a household is 04.

Educational Levels of Households

15. The literacy rate in the Project area is as high as 89 percent. 35 percent of them have studied up to grade 09. Five percent passed GCE (A/L), and 13 percent passed GCE O/L. Only 02 percent of the population have studied at the degree level (Table 5).

Table 5: Educational Level of the Households in the Project Area

DSD	GND	Total Population	Education level								
			Below school age	Pre-school	Grade 1-5	Grade 6 - O/L	O/L passed	A/L passed	Graduate	Never school attend	Other
Elahera	Damanayaya	151	3	13	39	55	21	9	3	8	
	Kottapitiya-south	46	3	3	14	15	7	-	-	4	-
	Elahera	24	-	-	8	10	4	1	-	1	-
Palugaswewa	Namalpura	35	3	4	4	10	2	2	2	8	-
Galenbindunu wewaa	Yakkala	37	4	2	4	12	4	2	2	9	
	Ulpotha	28	2	2	6	10	3	2	0	3	
Total		**321**	**15**	**24**	**75**	**112**	**41**	**16**	**5**	**33**	**-**

Source: Baseline Social Sample Survey -2014, MCB Consultants

Occupations

16. About 42 percent of the employed persons earn their living primarily from the agricultural wage work. 28 percent of the employed are farmers. The remaining 30 percent of employed persons are engaged in government services including security services (14 percent), businesses (06 percent) and private work (06 percent). Five households (04 percent) reported that a member of each household is employed abroad (See Table 6).

Table 6: Employment Categories of Affected Persons

DSD	GND	Number of Persons of Employed										
		Administrative / Executive	Manager	Clerical	Agriculture	Fishery	Foreign employment	Security	Business	Self-employment	Wage labour	Total Employment
Elahera	Damanayaya	3	1	3	18	-	6	7	6	1	27	72
	Kottapitiya-south	-	-	-	6	-	-	5	-	-	12	23
	Elahera	-	-	-	8	-	-	-	1	-	4	13
Palugaswewa	Namalpura	1	1	2	7		2	1	1	2	16	33
Galenbindunuwewa	Yakkala		1		8	2		3	1	1	08	24
	Ulpotha		1	1	8	2		1	2		15	30
	Total	**4**	**4**	**6**	**55**	**4**	**8**	**17**	**11**	**4**	**82**	**195**

Source: Baseline Social Sample Survey -2014, MCB Consultants

17. 74 percent employed primarily within their villages. They will find it difficult to secure employment in the vicinity of their village after total or parts of their lands are acquired for the Project. This risk is high, especially if a displaced household selected to move out from their village to relocate elsewhere.

Household Incomes

17. In July 2014, the official poverty line[1] in Polonnaruwa District, where most of the Project-affected households live, was Rs 3,968. A household with 04 members would need about Rs 20,000 a month to subsist without falling into the category of 'poor'. About 17 percent of the households affected by the Project are poor which tallies with the district-level poverty level.

[1]Minimum expenditure per person per month to fulfil the basic needs

Table 7: Annual Income levels of Households in the Project Area

Income (Rs.)	No. of Households	%	Cumulative No of Households	Cumulative %
<10,000	05	06	5	5
10,001-20,000	10	11	15	17
20,001-30,000	32	38	47	55
30,001-50,000	24	28	71	83
50,001-100,000	09	10	80	93
100,000 <	06	07	86	100
Total	**86**	**100**		

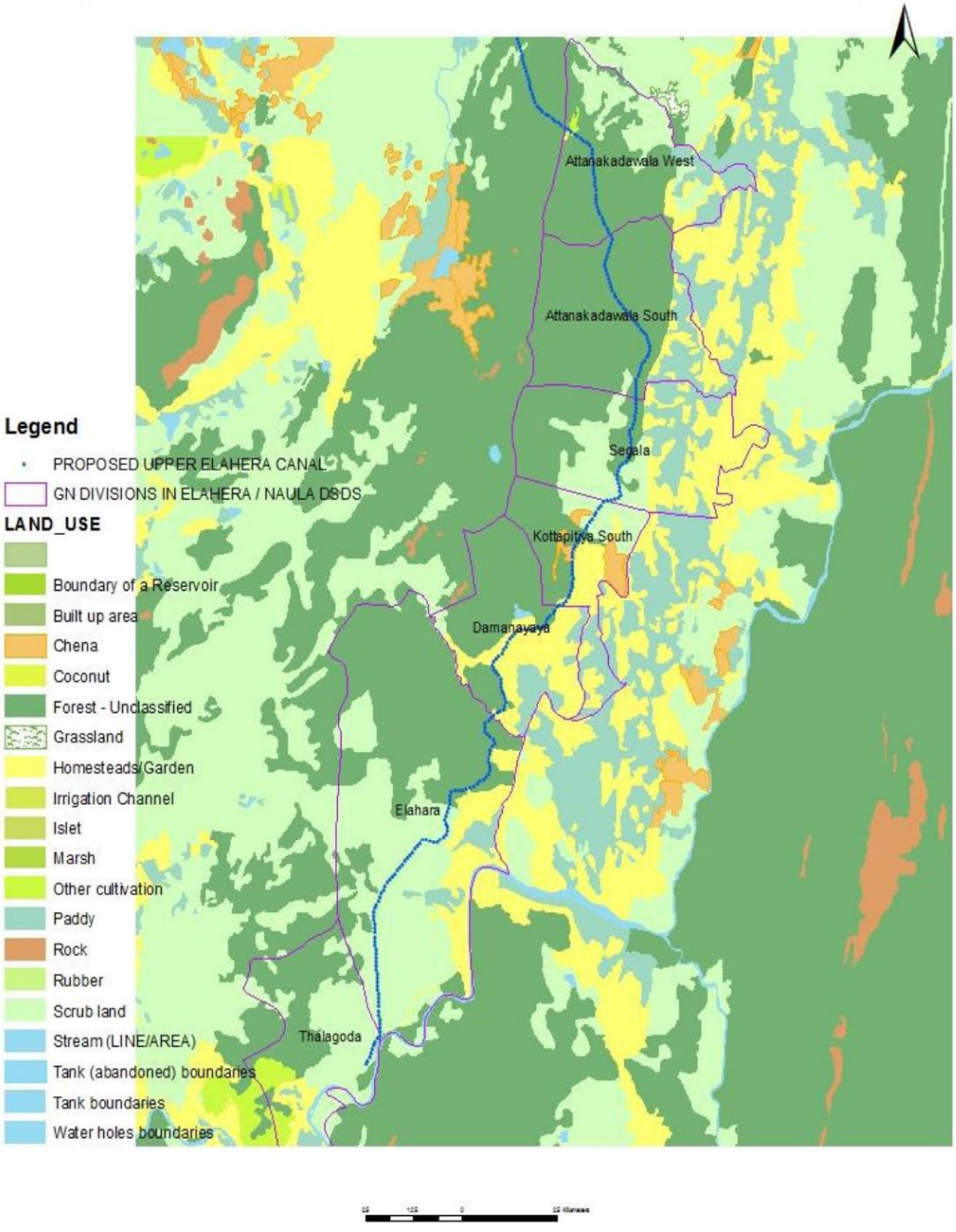
Source: Baseline Social Sample Survey -2014, MCB Consultants

Land Use Patterns

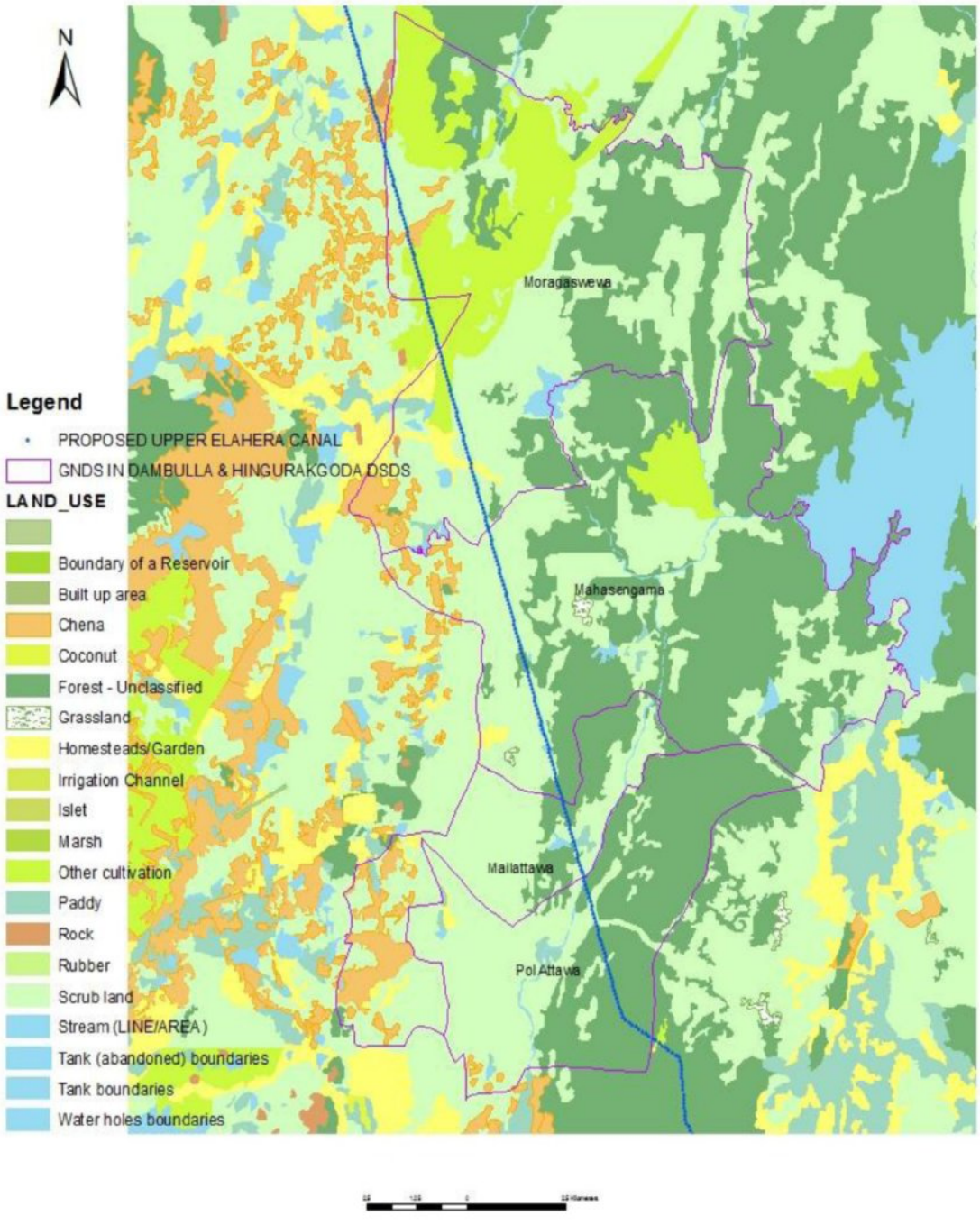
19. As land use patterns cover a broader area than the Project areas, this section and landownership section below are based on the pre-feasibility studies conducted in 2013 in the UECP area. After providing the general land use patterns in the Project area, a detailed description of land tenure and land use patterns will be presented about the physically-displaced households.

20. Most of the lands in the Project area is owned by the Forest and Wildlife Departments. Cultivation of land is the dominant pattern of land use in the affected villages. Cultivation of paddy, other field crops (OFCs), vegetable, fruits and coconuts are also significant. Valuable timber such as Teak, Burutha, and Halmilla are also discernible in homesteads and highland allotments. Households depend on monsoon rains to cultivate their crops mainly in the Maha(main) season. In the Yala (minor) season, often rains fail destroying their crops. As a result, many farmers cultivate only a portion of their lands during the Yala season to avert disaster arising from prolonged droughts. The Yala season of 2013 in the project area was a failure.

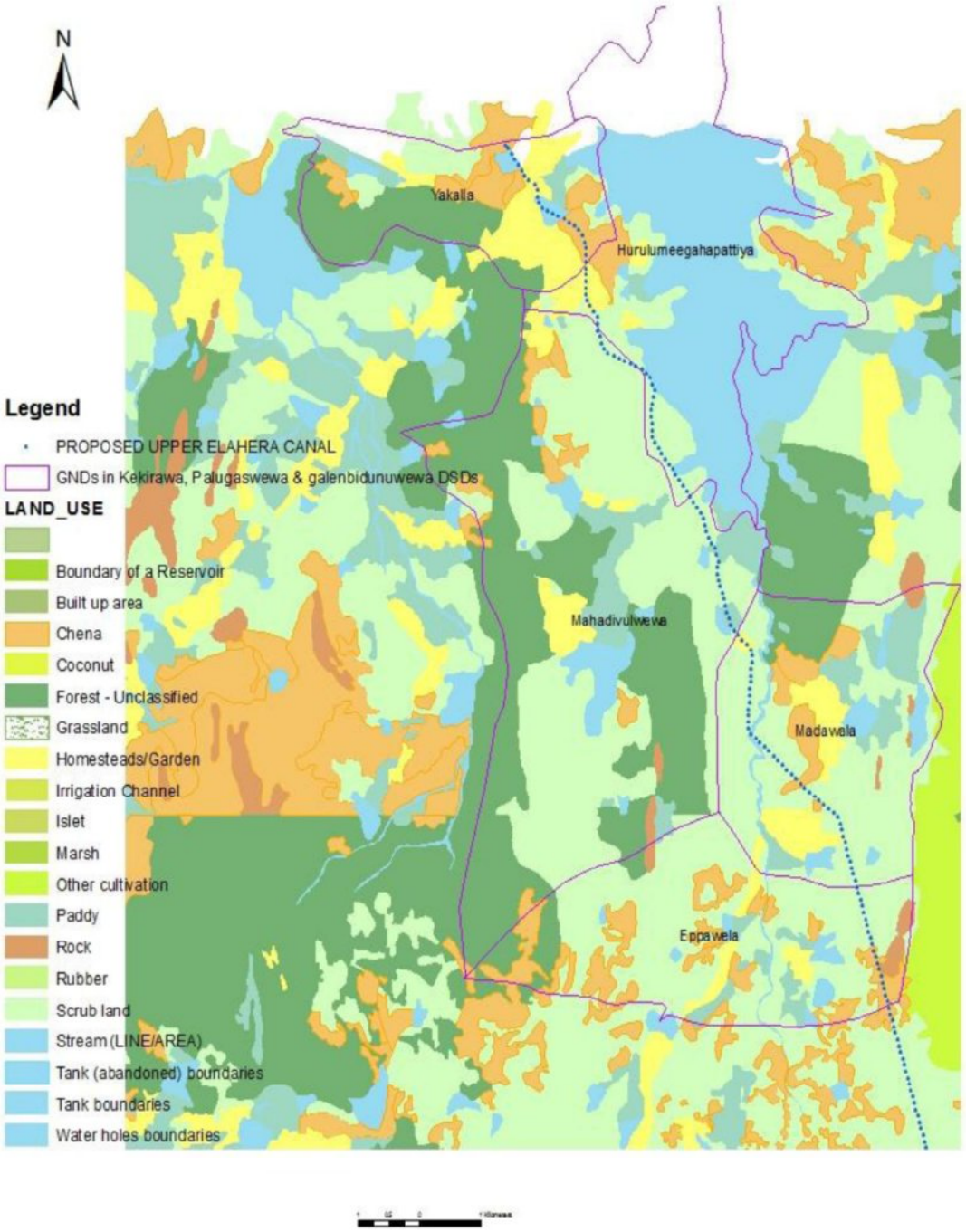
PROPOSED UPPER ELAHERA CANAL
SORRUNDING LAND USE IN ELAHERA / NAULA DS DIVISIONS



PROPOSED UPPER ELAHERA CANAL SORRUNDING LAND USE IN DAMBULLA / HINGURAKGODA DS DIVISIONS



PROPOSED UPPER ELAHERA CANAL SORRUNDING LAND USE
IN KEKIRAWA/ PALUGASWEWA /GALENBINDUNUWEWA DSDs



Land ownership

21. The entire stretch of the canal in the Project area traverses through government land most of which belonged to the Wildlife Department. Over the years, some of these lands have been distributed among landless poor who lived in surrounding areas on 'government permits' which range from one year to 30 years of tenure, enabling them to earn their living by cultivating the land and in some cases to construct their dwellings.

22. Main land tenure types in the Project area are:

- **Private titled deeds**: The private deeds are registered at the Land Registry under the Act of Registration of Documents. A deed can be transferred to any person through sale or lease or rent on agreed terms between the parties which should be attested by a Notary Public.
- ***Jayabhoomi* Deeds**: These deeds are issued under the Land Development Ordinance for agricultural and residential purposes on certain conditions. A land under *Jayabhoomi* deed can be transferred to a specified person described in the Schedule of the Land Development Ordinance. A *Jayabhoomi* holder is the owner of the allotment.
- **Land Development Ordinance (LDO) land Permits**: These permits are issued under Land Development Ordinance for a specified period of time. It can be transferred to a person described in the Schedule of the Land Development Ordinance.
- **Long-term Leases**: These leases are issued under the State Land Ordinance for commercial, residential or other purposes described under the Act. Leased period is 30 years on certain conditions. A long-term lease can be transferred to another person with the approval of the concerned authority.
- **Annual Permits:** The permit is a legal document that allows the permit holder to cultivate a piece of state land for a period of 12 months. A levy is charged from the permit holder. He cannot claim any right or interest over the land allotment.
- **Encroached Land:** Use of state land for various purposes by a person without proper authority, mainly to cultivate highland crops categorised as encroached land. An encroachment could continue over several years. Periodically, the State 'regularizes' some of encroachments mainly as a part of the strategy to alleviate rural poverty.

23. The baseline social sample survey of 2014 identified 183 acres of land as private property owned by the 86 affected households. It provides a general pattern of land ownership in the Project area. The PAHs cultivated 139 acres of highland and 43 acres of paddy lands. Out of 139 acres of highland, 125 acres (90 percent) are government land distributed on lease to poor households to cultivate or to construct a dwelling. 72 acres (5 percent) were given under Land Development Ordinance (LDO) grants. 37 acres (26 percent) were given by the Government on short-term LDO permits. These land allotments were given subject to the provisions of the Land Development Ordinance

as amended by the Act, No: 16, 1969, Act No: 27 of 1981 and the conditions set out in the schedule. As Table 8 shows, less than 11 percent of households are land owners. Others are LDO grant and permit holders with a small number of encroachers. About 80 percent of land allotments that are cultivated by households are LDO grants and permits. Only 11 households (13 percent) own paddy and highland allotments.

Table 8: Highland Ownership Patterns in the Project Area

Type of land Tenure	No. of Households	Percentage	Acres	Percentage
LDO grants	47	55	72.3	52.0
Annual Permits	20	23	37.0	26.9
Sole owner	9	10	14.8	10.7
Leased	5	6	4.5	3.2
Encroached	5	6	10.0	7.2
	86	100	139.0	100.0

Source: ***Baseline Social Sample Survey -2014, MCB Consultants***

24. As Table 9 shows, households on average cultivated small plots of land. 92 percent of highland holdings were less than 3 acres each in size. 82 percent of paddy land holdings were less than 3 acres each. 55 (63 percent) of households occupy less than 2 acres of homesteads each.

Table 9: Distribution of size of Landholdings

Size of plots (Acres)	Highland plots		Extent (Acres)		Paddy land plots		Homesteads	
	No.	%	No.	%	Acres	%	Acres	%
> 1	16	18	09.0	07	06	14	03.5	04
1 >2	39	45	45.5	33	21	52	26.7	36
2 >3	25	29	55.7	40	07	16	17.2	24
3 >4	05	06	18.8	13	03	08	09.0	12
4 >6	02	02	10.0	07	04	10	18.0	24
	87	100	139	100	40	100	74.5	100

Source: ***Baseline Social Sample Survey -2014, MCB Consultants***

Condition of Houses/Buildings

25. Three-fourths of houses were permanent buildings with cement floors and title/asbestos roofs. Each of them has good quality furniture and electricity. About 50 percent of these households own a tractor or a motor bicycle. Sixteen percent of houses are semi-permanent houses, while 09 percent of houses are temporary small sheds (Table 11). Most of agricultural labour households live in temporary huts. They barely have the basic household furniture.

Table 11: Condition of Dwellings

DSD	GND	No. of houses	House		
			Permanent	Semi-permanent	Temporary
Elahera	Damanayaya	39	36	3	-
	Kottapitiya-south	12	4	5	3
	Elahera	8	5	2	1
Palugaswewa	Namalpura	12	8	2	2
Galenbindunuwewa	Yakkala	9	7	1	1
	Ulpotha	6	4	1	1
	Total	**86**	**64**	**14**	**8**

Source:Baseline Social Sample Survey -2014, MCB Consultants

Access to other facilities

26. Eighty percent of houses have electricity. 22 percent of houses have telephones, while all use mobile phones. 78 percent have toilet facilities out of which 72 percent are water sealed. 43 percent of households have access to pipe-borne water, while other use stream water or dug wells (Table 12).

Table 12: Source of drinking water

DSD	GND	Water supply		
		Pipe borne	Well	Other
Elahera	Damanayaya	07	06	-
	Kottapitiya-south	00	03	-
	Elahera	-	01	-
Total		**07**	**10**	

Source: Baseline Social Sample Survey -2014, MCB Consultants

4. Socioeconomic Conditions of Physically Displaced Households

1. 27.17 households will be physically displaced by the Project. The canal will traverse through their land fully or partially affecting their dwellings and homesteads. These dwellings need to be rebuilt. In addition, one household will be separated from the community by the canal and, as a result, the household will not have access to a road or to the community. This household is also considered as a physically displaced household, as it needs resettlement assistance in the form of access road which will be built by the Project.

2. 28.All physically displaced households of the Project live in Elahera 3, Damanayaya and Kottepitiya-South GNDs. Four households (22 percent) are female-headed households. Among the physically displaced households, 13 are male-headed households (72 percent) and 04 are female headed households. (28 percent) See table 13. Three households fall below the poverty line - 01 female-headed household and 02 male-headed households. It was identified that 03 households are over 60 years. They are considered as vulnerable households who will receive special attention from the Project to restore and improve their livelihoods.

29. Most of the physically displaced households are concentrated in Samagipura village in Damanayaya. This village is well connected with nearby townships such as Bakamuna and Elahera. Regular bus service connects with Polonnaruwa where communities can use this transport facility to travel the district capital and markets.

Table 13: Number of Households Physically Displaced

District	DSD	GSD	Status of Household		Affected Dwellings	
			Male Headed	Female Headed	Physically displaced	Isolated
Polonnaruwa	Elahera	Elahera 3	1	-	1	-
		Kottapitiya south	3	-	3	-
		Damanayaya	9	4	12	1
		Total	**13**	**4**	**16**	**1**

Source: MCB Resettlement Census, 2014

30. The total number of persons of the 18 households is 58. Their demographic information is given in Table 14. 74 percent of them are in the category of 19-59 years of age. 55 percent of the population is women, and 22 percent are minors.

Table 14: Population, Sex, Marital Status and Age of Affected Persons

GND	Below 18 years				19 – 59 years						Over 60 years					
	Male		Female		Male			Female			Male			Female		
	Married	Unmarried	Married	Unmarried	Married	Unmarried	Widow	Married	Unmarried	Widow	Married	Unmarried	Widow	Married	Unmarried	Widow
Elahera 3		1			1	1	-	1	-	-	-		-	-	-	-
Damanayaya	-	2	-	6	11	5	-	11	4	1	-	-	1	-	-	1
Kottapitiya (S)	-	2	-	2	2	-	-	3	3	-	-	-	-	-	-	-
Total	**-**	**05**		**08**	**14**	**06**	**-**	**15**	**07**	**1**	**-**	**-**	**1**	**-**	**-**	**1**

Source: MCB Resettlement Census, 2014

31. The physically displaced 17 households are not 'native' to the Project area. All of them in different time phases arrived in their current settlements, when the dry zone land development programmes opened up more land for the landless and poor households. Table 15 shows that 72 percent of households arrived in the Project area after 1980.

Table 15: Arrival Phases of Displaced Household in the Project Area

Arrival Phase	Number of Households	Percentage
1960 – 1970	03	17
1970 – 1980	02	11
1980 – 1990	03	17
1990 – 2000	06	39
2000– 2010	02	11
After 2010	01	05
Total	**17**	**100**

Source: MCB Resettlement Census, June 2014

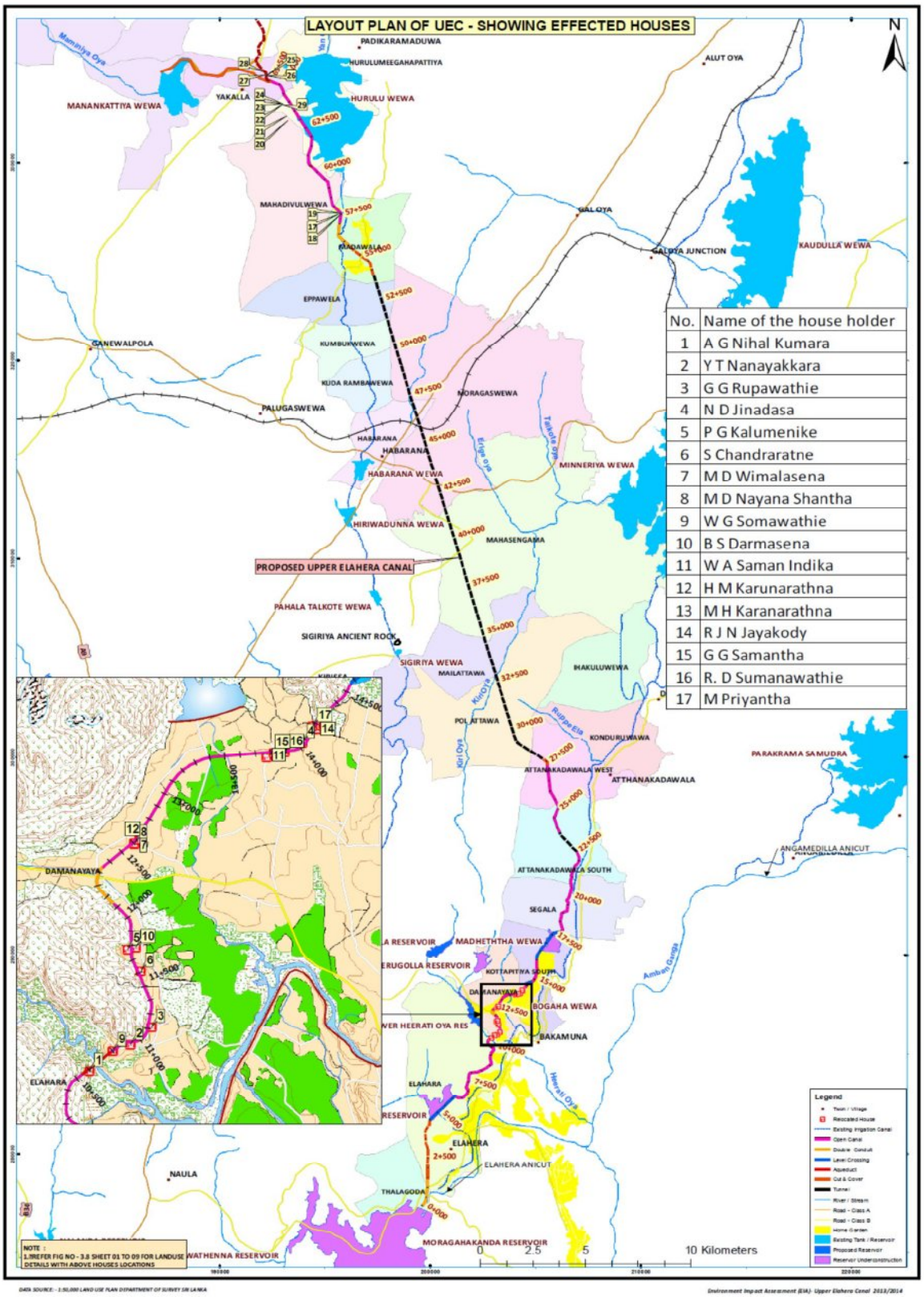
32. As discussed above, most of the cultivated land in the Project area is state land given on short-term or long-term lease to poor and vulnerable households. Such land after a long period of continuous cultivation becomes eligible to receive titles under the State's *Swarnabhumi* (golden land) and *Jayabhumi* (victory land) programmes.

33. Most of the landholdings identified for acquisition are dry highland cultivated only during the Maha (main) season in each year under rain-fed conditions. Highland cultivators do not have sufficient resources to dig deep wells or to pump water from a nearby water source to their allotments. The main crops cultivated on these lands are maize, sorghum, chillies, lime, groundnuts, vegetable, and few perennial trees such as jack, breadfruit and mango.

34. Chena (slash-and-burn) cultivation of government forest land is a source of earnings for a living of poor people. Depending on the man-power availability at a household or the resources available to mobilize labourers, a slash-and-burn plot could be as big as five acres or more. Both poor and non-poor households engage in slash-and-burn cultivation and the crops are mainly maize, sesame, millet and vegetables.

35. About 07 acres of paddy land (16 percent of the total acquired land in the project area) will be affected by the construction of the canal. Paddy land holdings too are cultivated only during the Maha season under rain fed conditions. In the Yala season, some farmers cultivate paddy in a portion of their paddy land with a high risk of drought and crop failure. During the past two Yala seasons paddy crops failed owing to drought.

Layout Plan of Affected Houses of Upper Elahera Canal Project



No.	Name of the house holder
1	A G Nihal Kumara
2	Y T Nanayakkara
3	G G Rupawathie
4	N D Jinadasa
5	P G Kalumenike
6	S Chandraratne
7	M D Wimalasena
8	M D Nayana Shantha
9	W G Somawathie
10	B S Darmasena
11	W A Saman Indika
12	H M Karunarathna
13	M H Karanarathna
14	R J N Jayakody
15	G G Samantha
16	R. D Sumanawathie
17	M Priyantha

5. Scope of Land Acquisition and Resettlement

36. As discussed above, 16 households will be physically displaced and one household will be isolated from the community as a result of the canal. The need for finding relocation sites for the physically displaced households will not arise as all of them prefer and plan to self-relocate in the vicinity of their present settlements. A household left with a sufficient homestead after the acquisition can rebuild its house on the remaining portion. It is estimated that 45 acres of land (18.2 ha) will be acquired from 112 households (including the 16 physically displaced). Only 07.1 acre (16 percent) of the affected land is paddy land, while the rest (38 acres) are un-irrigated highland which included home gardens (22 percent), cultivated highland allotments (30 percent) and 32 percent of chena land (Table 16). 04 households cultivate both highland allotments and chena land. Paddy lands are fragmented, and are cultivated only during the Maha season with monsoon rains.

Table 16: Amount and Type of land Acquired for the Project

Type of land	Acreage of land Acquired	Percentage
Paddy	07.10	16
Homesteads	09.82	22
Highland	13.75	30
Chena (Slash and Burn)	14.33	32
Total	**45**	**100**

Source: MCB Resettlement Census, June 2014

Condition of the Building Structures

37. Thirteen permanent, 02 semi-permanent buildings and 02 temporary houses will be affected by the project. Sixteen houses will be fully affected (Table 17). Only 02 homesteads will be fully acquired for the project. Because of the close proximity to the canal infrastructure, the remaining portions of homesteads will be considered as economically unviable and compensation will be calculated for the entire homestead of each affected household. In Palugaswawe and Galenbindunuwewa DSDs, no houses will be affected by the Project.

Table 17: Affected Structures (Dwellings) and Homesteads

GND	Houses Affected			Homestead Affected	
	Fully	Partly	Isolated	Fully	Partly
Elahera 3	01	-	-	-	01
Damanayaya	12		01	02	11
Kottapitiya	03				03
Total	16		01	02	15

Source: MCB Resettlement Census, June 2014

38. Thirteen out of 17 houses are well-furnished permanent houses. Fifteen households have electricity and 09 of them are connected to pipe borne water supply (Table 18).

Table 18: Type of houses Affected: Basic Information

GND	Tile/Cement/ Bricks			Asbestos/ Cement/Bricks			Tile/Floor tile/ Bricks			Semi-permanent			Temporary			Electricity		Pipe-Bourne Water	
	<750sq.ft	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	<750	751 - 1500	>1501	Yes	No	Yes	No
Elahera	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0	1	0
Damanayaya	3	2	0	1	2	1			2	1	1	-	-	-	-	11	2	5	8
Kottapitiya	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	3	0	3	0
Total	**03**	**02**	**0**	**01**	**04**	**01**	**-**	**-**	**02**	**01**	**01**	**-**	**02**	**-**	**-**	**15**	**2**	**9**	**8**

Trees Uprooted

39. 262 perennial trees and 112non-perennial trees will be uprooted for the canal, as outlined in table 19.

Table 19: Perennial Trees Affected

GND	Coconut	Teak	Burutha	Jak	Halmila	Mango	Ketakela	Mahagoni	Cashew
1	16	1		2		4	1		2
2	44	57	4	25	3	38	1	1	8
3		54				1			
Total	**60**	**112**	**4**	**27**	**3**	**43**	**2**	**1**	**10**
Non-perennial Trees									
GND	**Neem**	**Kaluwara**	**Murunga**	**Papaw**	**Banana**	**Orange**	**Lime**	**Guava**	**Cashew**
1			1	6					
2	17	1		2	47	1	29	4	
3						2	1	1	
Total	17	1	1	8	47	3	30	5	

Source: MCB Resettlement Census, June 2014

Acquisition of Land and Other Properties

40. The canal has been designed in a manner which would cause minimum losses to the households. During the design stage the canal trace has been changed to avoid project impacts on houses and other properties. During the Resettlement Census, for example, the resettlement team informed design engineers and project management how to avoid the demolition of two houses by slightly changing the canal trace. The recommendation was accepted. The resettlement team noted that the canal trace goes through the cemetery of kottapitiya south village and on the request of the affected villagers the canal trace has been changed to avoid the cemetery.

41. No land will be acquired under the ‘urgency section’ of 38 A of the Land Acquisition Act. In acquiring land and other property, the proposed actions of this RIP will be applied to expedite the land acquisition process.

42. During implementation some farmers may not be able to cultivate normally if there are delays in construction. Some farmers have encroached the canal reservations. Before canal construction their consent has to taken for those two matters. This can be done in the Kanna meeting where the issues should be discussed thoroughly and recorded in the meeting minutes with attendants’ signatures to be submitted. Consultations sessions are to be held before the meetings at the field level and President and the Secretary of each field level canal should submit their consent by signed letter. The Kanna meeting minutes are to be signed by the Government Agent who chairs the session, the Project Manager and key farmer representatives.

6. Policy and Legal Framework and Procedures of Land Acquisition

43. Land acquisition, compensation payment, relocation and income and livelihood restoration programmes of the Project will be guided by the Land Acquisition Act (LAA), 1950 and its amendments, National Involuntary Resettlement Policy (NIRP), 2001, National Policy for the Payment of Compensation, 2008, the Land Acquisition Regulations of 2009 (LA Regulations 2009), National Environmental Act of 1980 and amendments, and ADB's SPS (2009).

Land Acquisition Act (LAA)

44. The LAA provides a legal framework for acquisition of land for a 'public purpose'. It provides detailed procedures for land acquisition, consultations, calculation of compensation for land, structures, and crops at 'market value' and assistance packages. It guarantees that no person is deprived of his land except under the provisions of LAA, and provides a compensation package for acquired land, structures, damaged crops and disturbances caused by the project. The normal procedure for land acquisition begins with a request from a government agency made to the Minister of Land and Land Development (MLLD) to acquire a piece of land for a public purpose. Once acquired, the land is vested to the government agency.

45. Provisions of the LAA are inadequate to address all adverse impacts associated with land acquisition and involuntary relocation. The LAA is indifferent to land losers' socio-economic conditions and long-term adverse impacts on their incomes and livelihoods. The LAA prescribes that market value of land should be paid as compensation which amounts the price a property owner could expect if sold in the open market, whereas the SPS (2009) stipulates that 'replacement cost' should be paid as compensation which includes market value and other resettlement assistance packages. Post-acquisition monitoring of IR impacts is not part of LAA.

National Involuntary Resettlement Policy (NIRP)

46. The Government adopted NIRP in 2001 to ensure that (i) PAPs are fairly and adequately compensated, relocated, and rehabilitated; (ii) delays in project implementation and cost overruns are reduced; and (iii) better community relations are restored among PAPs and host communities.

47. The NIRP is based on LAA and its amendments, National Environmental Act of 1980 and amendments, and several other applicable laws such as Urban Development Authority Act and Coastal Conservation Act, Regulations of the Acts, and also on legal opinions of courts on land acquisition, compensation, consultation and income restoration.

48. Principles of the Policy are:

- IR should be avoided as much as possible by reviewing alternatives to the project as well as alternatives within the project.
- Where IR is unavoidable, PAPs should be assisted to re-establish themselves and improve their quality of life.
- Gender equality and equity should be ensured and adhered to throughout of the project.
- PAPs should be fully involved in the selection of relocation sites, livelihood development programs, compensation payment and development options at the earliest opportunity.
- Replacement land should be an option for compensation in the case of loss of land; and in the absence of replacement land cash compensation should be an option for all PAPs.
- Compensation for loss of land, structures, other assets and income and livelihood losses should be based on full replacement cost and should be paid promptly. This should include transaction costs.
- Resettlement should be planned and implemented with full participation of the provincial and local authorities.
- Participatory measures should be designed and implemented to assist those who are economically and socially affected to be integrated into their host communities.
- Common property resources and community and public services should be provided to resettlers.
- Resettlement should be planned as a development activity for PAPs.
- PAPs who do not have title deeds to land should receive fair and just treatment.
- Vulnerable groups should be identified and given appropriate assistance to improve their living standards.
- Project Executing Agencies should bear the full costs of compensation and resettlement assistance.

49. The Policy applies to:

- All development-induced land acquisition or recovery of possession by the State
- All projects regardless of the source of funding
- All projects in the planning phase on the date the policy came into effect and all future projects

50. The MLLD is responsible for implementing of NIRP. This is done in collaboration with a wide network of public agencies including CEA, Survey Department, Valuation Department, Ministries concerned, and Divisional Secretariats.

51. NIRP ensures that PAPs are treated in a fair and equitable manner, and that they are not impoverished in the process of land acquisition and resettlement. The Policy also enables establishing a framework for project planning and implementation that would meet international best practices in involuntary resettlement including involuntary resettlement safeguard policy principles and requirements of ADB.

National Policy on Payment of Compensation (2008) and LA Regulations (2009)

52. The Cabinet of Ministers approved the National Policy on Payment of Compensation (NPPC) in November 2008 in order to establish a uniform system of adequate compensation payment, based on LAA, NIRP and several other laws applicable to land acquisition and resettlement, and also to supersede all other *ad hoc* and special compensation packages used by government agencies such as Road Development Authority (RDA). The LA Regulations 2009, ratified by the Parliament of Sri Lanka in 2009 as Regulations of LAA gave effect to both NIRP and NPPC. The LA Regulations 2009 incorporated NIRP and NPPC principles into Sri Lanka's legal framework thereby improving the congruence between local regulatory framework for land acquisition and 9resettlement, and international best practices for involuntary resettlement.

National Environmental Act (NEA) 1980 and 1988

53. The National Environmental Act (NEA), No.47 of 1980, amended by Act No.56 of 1988 has some provisions relevant to involuntary resettlement. The Gazette notification No.859/14 of 23 February 1995 determined the projects and undertakings for which Central Environmental Authority (CEA) approval is needed in terms of Part IV – C of the NEA. Item 12 in the Schedule requires the formulation of RIP to address involuntary resettlement of 100 or more households.

Safeguard Policy Statement of ADB, 2009

54. The objectives of the involuntary resettlement safeguards policy of ADB are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

55. IR safeguards covers physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. IR safeguards apply whether such losses and involuntary restrictions are full or partial, permanent or temporary.

56. The IR policy principles are:

- Screen the project early on to identify past, present, and future involuntary resettlement impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons, including a gender analysis, specifically related to resettlement impacts and risks.

- Carry out meaningful consultations with affected persons, host communities, and concerned non-government organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programmes. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous People, and those without legal title to land, and ensure their participation in consultations. Establish a grievance redress mechanism to receive and facilitate resolution of the affected persons' concerns. Support the social and cultural institutions of displaced persons and their host population. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.

- Improve, or at least restore, the livelihoods of all displaced persons through (i) land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement value for land when the loss of land does not undermine livelihoods, (ii) prompt replacement of assets with access to assets of equal or higher value, (iii) prompt compensation at full replacement cost for assets that cannot be restored, and (iv) additional revenues and services through benefit sharing schemes where possible.

- Provide physically and economically displaced persons with needed assistance, including the following: (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities; (ii) transitional support and development assistance such as land development, credit facilities, training or employment opportunities, and (iii) civic infrastructure and community services, as required.

- Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.

- Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status.

- Ensure that displaced persons without titles to land or any recognisable legal rights to land are eligible for resettlement assistance and compensation for loss of non-land assets.

- Prepare a resettlement plan elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule.

- Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to affected persons and other stakeholders. Disclose the final resettlement plan and its updates to affected persons and other stakeholders.

- Conceive and execute involuntary resettlement as part of a development project or programme. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.

- Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout the project implementation.

- Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports.

Gap Analysis: Resettlement Regulatory Framework and IR Safeguard Policy of ADB

57. LAA is the legal framework for compensation for acquired land and structures and land development. The NRP and LA Regulations 2009 together with LAA provide a comprehensive resettlement regulatory framework which broadly matches IR safeguard policy objectives and principles. A Gap analysis matrix is given in Annex 1.

58. The key gaps between LAA and IR policy principles of SPS were (i) the entitlements of non-titled PAPs, (ii) compensation at replacement cost, (iii) income restoration and improvement, (iv) consulting PAPs and their host communities on relocation options; (v) special assistance to vulnerable PAPs, (vi) monitoring and assessment of resettlement outcome and impacts, and (vii) the formulation of RIP to address these issues.

59. The issue of non-titled PAPs' entitlements is addressed in LAA and elaborated in NIRP and LA Regulations 2009. Under the LAA any person having a 'right, title or interest in or over the land which is to be acquired or over which a servitude is to be acquired' (section 10(1) is entitled to compensation. A person who has 'interest' in land' apart from owner and co-owners, a mortgagee, a lessee, or an occupier absolutely for himself or in trust for another person or for any charitable, religious or other purpose, or a person having a servitude over the land (section 65 as amended in 1964). The Court of Appeal in 2001 added tenants to this list. The court also held that the occupier 'could not, in any event, be evicted without being compensated in respect of his improvement (if, in fact, he is the owner of such improvements'. The court distinguished between 'ownership of the property' and 'ownership of land improvement'. This matches with ADB's IR safeguard policy principle 7 that those who do not hold title to land are eligible for resettlement assistance and compensation for loss of non-land assets.

60. NIRP takes replacement cost as the norm for cash compensation.LA Regulations 2009 has given detail on how the total compensation package amounts to replacement cost of acquired land and other properties such as dwelling and business structures. MLLD's 'A Guide for Public Officials on Good Practices' (MLLD 2013) guides that in preparing the entitlement matrix 'to determine replacement cost for land and structures which will be acquired to the project'.

61. Restoration and improvement of income sources and livelihood of PAP is a key resettlement principle of NIRP. MLLD (2013) states that in preparing a RIP it is necessary to identify persons and households severely affected in terms of their income and employment losses; conduct consultations to develop an income restoration programme for all PAPs; and develop a special income improvement programme for vulnerable PAPs.

62. Consulting PAPs and their host communities on relocation issues is also a key resettlement principle of NIRP. Special assistance to vulnerable PAPs constitutes a core resettlement principle of NIRP and is elaborated further in LA Regulations 2009.

63. Monitoring and assessment of resettlement outcome and impacts which is an IR safeguard policy principle is not addressed in the resettlement regulatory framework.

64. NIRP and LA Regulations 2009 require the formulation of a RIP to address IR safeguard requirement. LA Regulations 2009 states that 'formulation of a RP and its implementation is the responsibility of the project executing agency and project management unit (PMU) of a development project.

IR Principles Applied to Project

65. Based on the comparative review of various resettlement policies, laws, regulations and guidelines of Sri Lanka and the ADB Involuntary Resettlement Policy, the following broad resettlement principles are distilled for this Programme to apply to its projects:

- Screen each project of the Programme to determine whether it triggers the following involuntary resettlement principles and to determine the scope of resettlement planning required.
- Take every effort to avoid physical displacement and/or any other adverse impacts on livelihood and income sources and community resources and infrastructure. If physical displacement and economic displacement are unavoidable, the following actions will be taken to ensure that they improve or at least restore their income and livelihoods and rebuild their socio-cultural systems.
- Consult and inform all PAPs on land acquisition, compensation, and rehabilitation, and their entitlements and grievance redress mechanism.
- Provide special project assistance to meet the needs of affected vulnerable people such as poor, landless, elderly, woman-headed households, informal settlers and squatters.
- Improve or at least restore livelihoods of all affected households through cash-for-land compensation at replacement cost for acquired or damaged non-land property, and cash-for-land or land-for-land for land acquired.
- Provide well-planned and budgeted income restoration and improvement programmes for the benefit of PAPs, especially for the poor and vulnerable groups.
- All common property resources lost due to the project will be replaced or compensated by the project;
- If land acquisition is through negotiated acquisition, the project will ensure that PAPs who enter into negotiated acquisition will maintain the same or better income and livelihood status.
- PAPs without title to land are eligible for resettlement assistance.
- Disclose resettlement information and RIPs including consultation documentation before the project appraisal in a form, manner and language(s) accessible to PAPs and other stakeholders. The final RIPs and their updates, if any, will also be disclosed to PAPs and other stakeholders in the same manner.
- The full costs of resettlement will be included in the project costs.
- Pay compensation and provide other entitlements to each eligible displaced person before physical displacement and any construction work starts.
- Monitor and assess the progress of RIP implementation and prepare monitoring reports to share with ADB, PAPs and other stakeholders.

66. In accordance with IR principles outlined above, all PAPs are entitled to a combination of compensation packages and resettlement assistance according to the nature of ownership/user/occupier rights and interests on lost assets and the degree of project impacts on socio-economic conditions and vulnerability of PAPs. Please refer to the Entitlements Matrix is given below.

Figure 1: Entitlement Matrix

Type of Loss	Application	Entitled persons	Entitlements	Implementation Agency	Implementation Procedures
Loss of Agricultural Land	Land acquired for the canal and related facilities such as service roads	Owner of titled land	a) Compensation for land at replacement cost b) Market value for trees and crops.	EA	1. Compensation rates are determined based on NIRP, and LA Regulation, 2009 2. Replacement land: PAHs will purchase replacement land in same locality using the cash grant provided regardless of the tenure type of acquired. The formula is given below. a) A PAH loses less than ¼ acre of land will receive Rs 500,000 as a grant to purchase 1R of land b) A PAH loses between ¼ and ½ will receive Rs 750,000 to buy land. c) A PAH loses between ½ and ¾ will receive Rs1,000,000 to buy land. d) A PAH loses between ¾ and one acre will receive Rs 1,250,000 to buy land. 3. other assistance outlined in RIP will also be provided by PIU
Loss of Agricultural Land	-do-	Leasehol der of state land	a) Compensation for loss of lease-hold land right; b) Market value for trees and crops	-do-	
Loss of Agricultural Land	-do-	Owner of State grant land	a) Compensation for land at replacement cost, and trees and crops at market value	-do-	
Loss of access to agricultural land	-do-	Owner of titled land	a)Compensation for land on replacement cost b) Compensation for crops and trees at market value	-do-	
Loss of access to agricultural land	-do-	*Ande* Farmer (Share cropper)	a) Compensation for loss of *Ande* right b) compensation for crops destroyed/damaged	-do-	
Loss of access to agricultural land	-do-	Non-titled user or squatter on State land	a) Compensation for land development b) Replacement cost of structures built c) Compensation for trees and crops at market value	-do-	

Residential Land and Structures					
Loss of Residential land and structures	Land acquired for canal, related facilities such as service roads	Owner of titled land (Main HH)	a) Compensation for structures and land at replacement cost, b) trees and crops at market value. c) Salvage materials from structures and trees without cost. c) Cash grant for purchase of housing allotment. d) Transport cost and other transaction cost e) Cash grant for temporary shed (Rs 50,000)	EA	1. Compensation rates are determined based on NIRP, and LA Regulation 2009 2. Replacement land will be purchased by households for relocation at same locality with the cash grant provided by PIU A cash grant to buy residential plot:: a) Rs 750,000 to purchase a residential plot if lost residential plot is less than ½ acre b) Rs 500,000 to purchase a residential plot if lost residential plot is less than ¼ acre. c) Rs 250,000 to purchase a residential plot if the lost residential plot is less than ¼ acre; 3. Cash grant of Rs 50,000 for sheds and temporary huts 4. other assistance outlined in RIP will also be provided by PIU
Loss of Residential land and structures . Loss of Residential land and structures	-do- -do- -do-	Owner with State grant land (Main HH) Leasehol der of state land Non-titled occupier	a) Compensation for structures and land at replacement cost, b) Trees and crops at market value. c) Salvage materials of structures and trees without cost. d) Cash grant for purchase of housing allotment. e) Transport cost and other transaction cost f) Cash grant for temporary shed (Rs 50,000) a) Compensation for structures at replacement cost b) trees and crops at market value, compensation for leasehold right for land c) Salvage materials of structures and trees without cost. d) Cash grant for purchase of housing allotment. e) Transport cost and other transaction cost. f) Cash grant for temporary shed. a) Compensation for structures at replacement cost b) trees and crops at market	-do- -do-	

			value, compensation for leasehold right for land c) Salvage materials of structures and trees without cost. d) Cash grant for purchase of housing allotment. e) Transport cost and other transaction cost. f) Cash grant for temporary shed.		
Other Private Property and Structures					
Loss of tombs or graves	-do-	All owners	a) In case of a family cemetery, compensation at replacement value will be paid for the lost land and structure b) If it is a public facility run by a local authority, compensation will be paid to the local authority	EA	1. Compensation rates are determined based on NIRP, and LA Regulation, 2009
Livelihood Restoration and Rehabilitation Assistance					
Materials Transport Allowance					
i) Loss of house and other structures		PAHs rebuilding house and other structures on same plot	a) Shifting allowance	EA	
ii) Loss of house and other structures		PAH rebuilding house and other structures at a relocation site.	a) Shifting allowance b) Transport allowance	EA	
Transition Subsistence Allowance					
Loss of house		Each member of severely affected household	Living allowance for six months	EA	As per LA 2009 Regulations.

Livelihood Restoration (Grant and Training)					
Loss of source of income or livelihood		PAPs/ household	a) Vocational & skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Permanent loss of income or livelihood sources		One member per household	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Permanent loss of income or livelihood sources		Severely affected household remaining on the affected land	a) Vocational & Skill training will be provided b) Training allowance and cash grant will be provided c) Work at project sites	-do-	
Special Assistance					
Loss of income or livelihood sources		Vulnerable PAPs including the poor and woman-headed household	a) Rs.25,000/= cash grant b) Priority in membership in Income restoration and improvement programmes c) assistance in official document search and registration.		
Community Assets					
Loss of local roads, footpaths, bridges, irrigation, water ways .		Divisional Secretary's Division, Local Authority and local community	a) All lost infrastructure facilities will be rehabilitated to their original conditions. b) If such affected infrastructure facilities cannot be provided, alternative infrastructure facilities will be provided	EA / PIU	- do-

HH = household; PIU = Project Implementing Unit, EA = Executive Agency, R = Root, P= Perch, A = Acre

Land values

67. Under the Project PAPs will be paid the replacement cost of the lost property. In case of houses and other structures replacement cost will be paid without deducting depreciating value. The basis for this costing is the current market value of the property. Land value

varies from place to place. The resettlement team in consultation with PAPs, GNDs and the Divisional Secretary and examining recent land transactions papers at Divisional Secretariat of Elahera, determined the current market value of land affected on the Bakamuna-Elahera road and in Damanaya village at Rs 40,000 to Rs 50,000 per perch. At other locations, a perch of a land was valued at Rs 20, 000 to Rs 25, 000 per perch. These prices were confirmed by the Divisional Secretaries of Elahera, Palugaswewa and Galenbundunuwewa DSDs.

68. The value of the acquired land specifies as market value by LAA. This is the price that the owner could receive if sold the land as a willing seller in the open market on the date of publication of the section 2 Notice. However, the valuation officer has the discretion to specify what the 'market value' should be. In this regard, the officer will be guided by the National Involuntary Resettlement Policy of 2001 and the 2009 LA Regulations. These two legal instruments help PAPs to get the replacement cost of the property lost to the project and additional resettlement assistance.

Resettlement Options

69. During the resettlement census, 05 households indicated their willingness to resettle on the remaining portion of their original land. They requested compensation for their lost land and properties. Eleven households requested cash compensation for houses and the land lost and additional assistance to buy land close to their current houses. At the stakeholders meeting held in July and August of 2014, the 11households stated that they would find suitable lands for relocation by themselves close to the current living places. Additional funds for purchase of housing allotments were requested by these households. The one female-headed household which will be cut off from the rest of the community stated that if she could get an access road from the project, she is willing to stay where she is; otherwise request compensation for the entire property and assistance in finding land and in building her house.

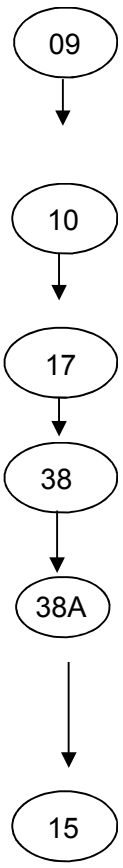
70. The approved unit of land per household is determined by the North Central Provincial Council and Central Provincial Council (where the Project is located) by taking into consideration the availability of state land for the Project. The current arrangement is to allocate one and half an acre of irrigable land, half an acre of highland agricultural land, to a household at the Medirigiriya resettlement site in Polonnaruwa District.

71. The need to distribute fresh land among affected households of UECP does not arise as physically displaced households are willing to resettle on the remaining portion of the same land or if it is not sufficient to relocate to a new location provided they could buy land of same quality in the locality. As a result, under the Project, there is no need to find a resettlement sites and develop it before the arrival of resettlers.

Figure 2: Land Acquisition Procedure

Time Frame (Weeks)	Section of LAA	Action
12	02	Preparation of application for the land to be acquired for the described purpose by EA. The application is submitted to Land and Land Development Ministry through line ministry. Land Minister authorizes the section 2 order. MLLD publishes section 2 order and soon after that, the Divisional Secretary publishes the section 2 notice on identified land for acquisition at relevant public places and informed the affected PAPs. The DS issues a survey requisition to the Survey Superintendent [SS] of the district to survey land. SS surveys the land through his field surveyors. The surveyors prepare advance tracing and send to SS. SS sends them to the Acquiring Officer / Secretary to MLLD.
	03	If the survey damaged the property, the land owners can make claims against the damages. The payment should be made to the owners under section 03 of LAA
	04	Objections from land owners against the acquisition of land are sent to the Secretary of the subject Ministry or his representative. The Secretary of the subject ministry informs the claimant of the land the result of the objection inquiry after informing the MLLD his recommendation.
02	05	Approval given by the Minister of Land& Land Development for the acquisition of such land.
16	06	After publication of Section 05 Gazette Notification issues a survey requisition by DS of the area to survey the land and preparation of preliminary plan by the Survey Department.
12	07	Publication of Gazette Notification on calling the claim for ownership status and compensation amount from the owners of the land and interested parties.

13	09	Acquiring Officer is holding an inquiry for the determination of ownership.
4	10	Decision of the ownership and informed to the claimants and Valuation Department for making valuation for the land to be acquired.
4	17	Award of compensation & payment.
4	38	Possession will be taken over of land after payment of compensation.
Total 71 **=======**	38A	If necessary possession can be taken under 38 A after publication of Section 02 notice. But interest should be paid until such time compensation will be made.
18 (Months)	15	There are no claimants.



72. The above flow chart indicates that the time frame is 71 weeks for the completion of land acquisition and compensation payment under LAA. However, delays can occur due to poor coordination among the agencies such as DS Office, Valuation Department, Survey Department and Land Registry. Therefore, a Land Acquisition and Resettlement Unit will be established at the Project Management Unit (PMU). The EA will appoint a well experienced Acquiring Officer to smooth implementation of the process and liaise with the Divisional Secretariats, Valuation Department, Survey Department and Land Registry to expedite the acquisition tasks. With efficient administration of the process, it is possible to complete the entire acquisition programme and compensation payment in 25 to 35 weeks.

73. Under the provision of Part IV C of the National Environmental Act No.72/22 of 24th June 1993 and No.859/14 of 23rd February 1995 the Central Environmental Authority (CEA) approval is require for a resettlement implementation plan for project causing involuntary resettlement exceeding 100 families other than resettlement affected under emergency situation.

7. Consultation, Participation, and Information Disclosure

Objectives of Consultation

74. The main objectives of consultations with PAPs and other stakeholders are:

- To provide PAPs with information on their entitlements including compensation package and resettlement assistance schemes.
- To obtain comments from PAPs on how to improve the resettlement process and comments on draft RIP.
- To create goodwill among PAPs and the project personnel.
- To describe project benefits to PAPs.

75. The project will have significant involuntary resettlement impacts on 221 PAPs in 58 households. 16 households will lose their houses and one household will lose access to its house. 58 households including physically displaced households will lose more than 10 percent of their land to the Project. The resettlement impact category of the Project is “A”.

76. The EA contacted PAPs and other stakeholders through MCB to discuss the scope of the project, its benefits and potential adverse impacts and proposed mitigation measures. The EA actively engaged in examining project alternatives, scope of land acquisition, potential direct and indirect impacts on economic activities, and social and cultural identity and networks of people, resettlement planning, implementation, and monitoring. In these key aspects, ADB assisted the EA.

77. EA conducted several project awareness programmes to meet PAPs, especially the potential physical displaces, vulnerable households, religious and community leaders, local elite, and community-based organizations (CBOs) such as farmer organisations. In such meetings, their views, opinions and recommendations on compensation packages, relocation programmes and the regarding the final trace of the canal were obtained. In these discussions, representatives of relevant government agencies (GNs, representative of the Divisional Secretary) and local business community also participated (See appendix 2 for a sample of awareness meetings).

78. Stakeholder consultation was in July 2014 in Damanyaya in Elahera DSD and Yakalla GND in Galenbindunuwe DSD in which members of all affected households participated. 67 persons participated in the workshop. 29 (43 percent) of them were women PAPs. Among the participants were the representatives of the 14 households who will lose their dwellings and land, and those who will lose land only to the Project under two DS divisions. Four Grama Niladaris and the Development Officer of the 02 DS offices also participated in the discussions. The Project Director of the Project presided over the meeting. Rev Saddhananda Thero, Chief Incumbent of Sri Anandaramaya (an AP of the Project) also participated. The consultations were held in an atmosphere conducive to

free exchange of views and recommendations without any intimidation from the government officials or project officials who attended the workshop. In fact, they supported the EA in understanding the resettlement issues better and the PAPs who need special attention and the issues that need urgent attention such as finding replacement land in the locality. The discussions proceeded smoothly over two hours. Consultations and participation of PAPs in resettlement planning and implementation will be gender-inclusive, gender-responsive, and gender-sensitive, and will be designed to address special needs of vulnerable project-affected households and groups.

Public Opinion on Resettlement and Related Issues

79. It was revealed during the socio economic survey and resettlement census that PAPs support the project. They, however, were interested to know about their compensation packages and the relocation options. They were of the view that their present livelihood pattern would be affected if they were to move out of their villages and resettle in faraway resettlement sites. Most of them cultivate more than one land plot scattered in the area and more than half of the affected households engage in cattle breeding programmes. Few households are having Government and private sector jobs in the area. Their children attend schools in Elahera and Bakamuna Townships. Because of the above facts, they are reluctant to move out from their villages. Some PAPs indicated that although their land will be acquired they will not be benefited from the project, as the canal will not provide water to their lands. The project authorities will decide how to accommodate this request during the canal construction and inform PAPs and other stakeholders.

80. Most of the participants possessed a good knowledge of the Project, and of how it would affect them adversely and positively. Each household which will lose its house to the Project indicated its compensation and resettlement preferences. Those who lose dwellings but will have sufficient land left after land acquisition prefer to reconstruct their houses on the same landholdings without moving out to a resettlement site. Those who will lose dwellings and land to the project, and will not have sufficient remaining land to rebuild houses want to remain in their current village/community. They plan to buy land in the same area to rebuild houses, so that they could continue with their current livelihoods and maintain socio-economic networks.

81. The key issues raised by PAPs are that:

(i) PAPs should get sufficient compensation promptly for their lost dwelling and land;

(ii) they should be allowed to stay in their communities/villages without relocation;

(iii) they should be supported financially and administratively by the Project in finding suitable and adequate land in the vicinity of their lost land to replace them;

(iv) households lost dwellings should get adequate compensation to rebuild houses;

(v) all affected households should be informed of the final trace of the canal including its reservations without delay;

(vi) project authorities publicize the timetable of land acquisition and details of the compensation packages;

(vii) all PAHs should be entitled to a compensation and resettlement package *regardless of current land tenure type* which would allow them to continue their income and livelihood activities without interruption

(viii) Compensation for structures, land and trees should be paid in time before taken over the land and property to the Government.

(ix) Project should not disturb the existing waterways and road network on which village depend.

82. APs expressed their fear about the project, based on their past land acquisition and relocation exercises. They have heard some bad experiences that resettlers of other projects have through during the past 20 years. Therefore, they do not want to move out from the present locality to distance places.

83. All the above demands are reasonable and project personnel agreed to all of them. The stakeholder consultation workshop helped in verifying the data collected during the socioeconomic survey and census. In formulating the RIP for the Project, the above suggestions and recommendations from PAPs were considered. The RIP provides sufficient budget to implement these strategies and a timeline. (see Appendix 01 for the list of attendees and photographs)

84. Consultations with PAPs and other stakeholders will continue during RIP implementation to ensure those PAPs and other stakeholders to inform them of project activities and their progress and to learn any corrective actions that the project should take. During the implementation of income restoration programme, project officers will be responsible for assisting and facilitating PAPs on development programmes designed for them.

Disclosure of Resettlement Information

85. Resettlement information - measurement of losses, detailed asset valuations, entitlements and special provisions, grievance redress procedures, timetable for cash compensation payment, physical displacement schedule and project construction schedule will be disseminated by EA through brochures, leaflets, or booklets written in Sinhala. For non-literate people, other communication methods such as small group discussions and posters will be used.

86. The RIP will be implemented in close consultation with the stakeholders, particularly with PAPs through focus group discussions and stakeholder consultation meetings. Women's participation will be ensured by involving them in public consultations at various stages of project preparation and implementation, and by arrangements which would enhance their ability to attend such meetings.

87. The EA will submit the following planning documents to ADB for disclosure on ADB's website:

(i) RIP before project appraisal;

(ii) a new RIP or an updated RIP, and a Corrective Action Plan (CAP), if any, prepared during project implementation; and

(iii) resettlement monitoring reports

88. Public Consultation and Disclosure Plan will be prepared by PMU and format is given in Figure 3.

Figure 3: Consultation and Disclosure Plan

Activity	Task	Timing (Date/ Period)	No. of Persons Attended (if applicable)	Agencies Attended (if applicable)	Feedback/ Issues/ Concerns	Remarks
Stakeholder/PAP Identification	Mapping of the project area					
Project information Dissemination	Distribution of information leaflets to PAPs					
Consultative meetings with PAPs during scoping phase	Discuss potential resettlement impacts of the project					
Public Notification	Publish list of affected lands/sites at Divisional Secretariat/GNOs; Publish eligibility cut-off date					
Socio-economic survey	Collect socioeconomic information and PAPs' perception on resettlement impacts					
Consultative meetings on resettlement mitigation measures	Discuss entitlements, compensation rates, grievance redress mechanisms					
Publicize RIP or at least its entitlement matrix	Distribute leaflets or booklets in local language					
Full disclosure of the RIP to PAPs	Distribute RIP in local language to PAPs					
Internet disclosure of the RIP	RP posted on ADB And EA website					
Consultative meetings during detailed measurement survey(DMS)	Face- to-face meetings with PAPs					
Disclosure after DMS	Disclose updated RIP to PAPs					
Internet disclosure of the updated RP	Updated RP posted on ADB and EA website					

89. The organizers of each meeting, consultation and interview will keep records of key topics discussed and decisions arrived at. Photographs of such meetings and interviews are to be attached to the records.

Gender Impacts and Vulnerabilities, and Mitigation Measures

90. In the Project areas, land tenure and income sources are generally considered as men's domains. The baseline social sample survey of 2014 examined the causes of this disparity and found that most of the lands affected are LDO or annual permit lands which were obtained by heads of household who are men. The 03 female-headed households found in the Project area are households where either husband is dead or husband and wife are divorced. In all three cases, women retained the land cultivated by the household.

91. There are several built in inheritance or sale barriers and as a result, many transactions take place under the table and in such exchanges invariably only men are involved. In order to avoid fragmentation of a land holding which would make the holding economically unviable, it is general practice in the area to pass on the holding to one child. If there is a son, he will get the holding to cultivate. Rarely a daughter gets a holding from her father. No women hold land as the owner or renter or tenant among the households affected by the Project.

92. Although women are not the owners of land, they play a significant role in local organizations or agricultural production or marketing activities. Their participation in rural organization is robust, and some of them hold executive positions in such organizations. Minutes of organization meetings indicates that they actively participate in agricultural, social and community level group activities. An example is that 43 percent of attendees at the stakeholder work shop were women.

93. Among vulnerable households are the female-headed households. During the socio-economic survey, these households were identified. They need more assistance and the Project will provide special cash assistance and income restoration for their benefit as outlined below. Women's focus groups discussions will be conducted to address specific women's issues.

94. The RIP provides special assistance to households will be differentially or disproportionately affected by the Project such as female-headed households, old and sick PAPs) because of their disadvantaged or vulnerable status in the community (see sections 128-130).

95. The communication strategy of the Project will include women group discussions that focus on possible displacement and relocation, potential impacts on their socio-cultural systems, any potential threats regarding their safety during construction owing to the presence of labourers from outside, potential opportunities for women to engage in project activities to earn an income, and on special care to be taken by contractors during project construction activities, if women are recruited as workers.

Cut-off-Date

96. 1st of July 2014 is the Project's cut-off date for compensation. The resettlement census of the households affected by the Project was completed on this date. This applies to non-titleholders such as squatters and informal settlers, encroachers, tenants and leaseholders. The Divisional Secretaries will disseminate this vital piece of information in the Project areas**.** The relevant local authorities will request through GNOs to refrain from granting approvals for new constructions within the Project area after the cut-off-date .EA/IA will disseminate information regarding the cut-off date throughout the project area through GNOs and DSs. Persons who occupy land in the project area after the cut-off-date are not eligible for compensation or resettlement assistance. Structures such as houses and other buildings including wells and parapet walls, crops, fruits trees and other timber species established after this date are also not eligible for compensation.

8. Compensation, Income Restoration and Relocation

Valuation of Lost and Affected Assets

97. The LAA, NIRP and LA Regulations 2009, outlined in section -- above, constitute the resettlement regulatory framework for determining the replacement cost. Replacement cost comprises fair market value of the property and other compensation packages that are elaborated in NIRP and LA Regulations 2009 (see below).The valuation of acquired property will be done by the Valuation Department on the request of the Divisional Secretary of the area where land is located. DS is the land acquiring officer. The compensation package has two components: compensation package under the LAA, and special assistance scheme under the LA Regulations 2009. The latter is given regardless of the type of land tenure of the affected households. Both packages together amount to the replacement cost of a property acquired; and in some cases, such as annual permit holders, exceeding the replacement cost. The entitlement matrix reflects these compensation packages and who is responsible for distributing these packages to PAPs.

Assessment of 'Replacement Cost'

98. LAA provides for determining compensation based on 'market value'. It defines market value as 'the amount which the land might be expected to have realized if sold by a willing seller in the open market as a separate entity on the date of publication of that notice in the Gazette … [Section 46(1)]. The NIRP states that compensation will be based on 'replacement cost' of acquired land and structures. 'Compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly. This should include transaction costs [Principle 6].

99. The LA Regulations of 2009 under section 63(2) (f) of the LAA did not adopt 'replacement cost' as the basis for compensation as LAA does not use the concept; instead it used 'market value' as defined in LAA together with several safeguard provisions to eliminate inequities arising from methods of valuation and determining 'market value' thereby upgrading compensation to the level of replacement cost.

100. The current IR regulatory framework ensures that persons affected by land acquisition receives replacement cost, so that they could maintain the same socio-economic status that they enjoyed prior to land acquisition, or that their living standards are raised to a higher level compared with the pre-acquisition level particularly in case of the poor. As outlined above, LA Regulations of 2009 under 'Disturbances' make the necessary provisions for compensating every possible cost incurred by a PAP during the acquisition of their properties. Section 3.11 of the LA Regulations 2009 provides a range of compensation for 'disturbances' that are caused by land acquisition. The total package of compensation and other payments would bring compensation to the level of 'replacement cost' which is also a best international practice in involuntary resettlement. The LA Regulations 2009 provides the following compensation packages to those who lost land to a public project.

- Where part of a land is acquired and when its value as a separate entity deems to realize a value proportionately lower than the market value of the main land, the compensation will be proportionate to the value of the main land.
- A building used for occupation or for business purpose, or was intended to be used for occupation or business purpose on the date the intention to acquire was published, the difference between the cost of re-construction and the value of building based for determination of market value will be paid as additional compensation.
- Value based on 'development potential' is considered in determining the value of land when a paddy land plot is acquired if the Agrarian Services Commissioner General's approval has already been obtained to convert it into a non-agricultural land.
- Where an acquired building is occupied by a tenant/statutory tenant protected under the provision of the Rent Act No 7 of 1972 (as amended thereafter) compensation will be ascertained in proportion having regard to the provisions of Rent (amendment) Act No 26 of 2006.

101. Damages caused by injurious affection and severance should be allowed fully. Compensation for disturbance is based on the "value to owner" will be paid based on written claims:

- Expenses incurred during appearing under LAA section 9 Inquiry: maximum payment is Rs 10,000.
- Expense of finding an alternative accommodation: maximum rental of Rs 10,000 per month for properties located in urban council areas, and Rs 5000 per month for properties located in *pradeshiyasabha* areas. If the anticipated physical displacement is temporary, maximum of three months rental; if the anticipated physical displacement is permanent, a maximum of 6 months rental of Rs 10,000 per month is payable for a house where floor area is less than 1000 square feet.
- Cost incurred in change of residence: Rs 10,000 for houses where floor area is less than 1000 square feet and Rs 15,000 for houses where floor area is between 1000 and 2000 square feet. Rs 25,000 for houses where floor area is more than 2000 square feet. If sub families live in a house, the payment should be divided proportionately. For other properties, maximum of Rs 25,000 is paid based on the nature of the occupation.
- Cost of advertising: permanent displacement of informal business establishment will get Rs 2,500 and a formal business establishment, Rs 15,000.
- Re-fixing cost of fixtures and fittings; transport expenses: Rs 5,000 for a house/residence. In case of a business premises or any other structure of specific nature, the amount should be based on actual expenses
- Loss of earnings from business: Rs 15,000 a month for informal businesses. For formal businesses compensation amount is based on accounts and tax returns

pertaining to preceding three years.

- Increased overhead expenses: will be paid according to the circumstances.
- Double payments, for example, rent or rates: This is to be calculated based on actual expenditure; all other expenses incurred by the owner in relation to the acquisition: losses sustained because of the compulsory sale of the business due to the acquisition, for example, sale of livestock.
- Other additional expenses for disturbance or compensation not considered under any other compensation item above: disturbance experienced by tenants fall into this category. A payment in respect of vulnerable persons such as old and disabled people who are dependent on affected persons. Another category is self-employment. The maximum payment for any of these disturbances is Rs 15,000.
- When an owner of a house or of an investment property is displaced, additional 10% of the market value is paid as compensation. This is conditional upon leaving the acquired property on the stipulated date.
- When a value of a piece of land is acquired based on its agricultural potential, the displacement cost and loss of income will be taken into consideration in determining its value.

102. Having considered the above regulatory framework and the desire of the Cabinet of Ministers to provide adequate assistance to all PAPs of the Project, the following compensations package area approved for the Project.

Compensation Package for Land and Resettlement

103. Community Consultative Groups (CCGs) will be established in each affected GND to assist affected households and PAPs in compensation determination, payment, appeals, housing and income restoration programmes. CCGs will also help affected households in finding alternative lands and in re-investment of cash compensation in productive activities especially in income -generating programmes. (Pl see, grievance redress mechanism below).

104. The 17 households, who will be losing their houses partially or fully, will be considered as severely affected households. These households are entitled to a compensation package under Land Acquisition Act and the Special Assistance Scheme at least to restore their livelihood at pre-project status. These entitlements will be given to them on a priority basis prior to the acquisition of land and other property. There are 02 households who will lose the total residential land and houses. Therefore, compensation and special assistance to purchase replacement lands will be released to them on priority basis.

105. 05 households opted to rebuild their new houses on the remaining portions of the acquired residential allotments. Each of the other 11 wants the project authorities to find

a piece of land in same locality where they now reside. During stakeholder consultation workshop, these 08 households changed their request and agreed to find suitable lands to construct their new houses.

Allocation of Funds to Purchase Residential Land Plots

106. The following formula has been approved by the EA in consultation with MLLD and Divisional Secretary.

Compensation for Land Losses

107. The compensation scheme below is a **special grant** from the Project in addition to the statutory compensation a household will receive from the government as compensation. The above special payment scheme is applicable to all 17 physically displaced households regardless of whether it has sufficient left over land after the acquisition to rebuild the house lost. The 02 payment schemes are formulated to accommodate land values at difference places in Elahera DSD in the Project area. Scheme A is for locations close to Bakamuna towmship and Bakamuna – Dambulla main road and scheme B is for locations which are remote from scheme A.

108. Scheme A:

1. A household which loses a ¼ acre or less of land to the Project is entitled to receive Rs 500,000 as cash compensation which will enable it to buy a land plot of similar quality and size in the locality.
2. A household which loses land between ¼ and ½ acre is entitled to receive Rs 750,000 as compensation which will enable it to buy a land plot of similar quality and size in the locality.
3. A household which loses land between 1/2 and ¾ acre is entitled to receive Rs 1000,000 as compensation which enable it to buy a piece of land in the locality.
4. A household which will lose land between ¾ and 01 acre is entitled to receive Rs.1, 250,000 as compensation.

109. Scheme B:

1. A household which loses between 01 and 20 perches of land to the Project is entitled to receive Rs 75,000 as cash compensation which will enable it to buy a land plot of similar quality and size in the locality.

2. A household which loses between 20 and 40 perches is entitled to receive Rs 125,000 as compensation which will enable it to buy a land plot of similar quality and size in the locality.

3. A household which loses land between 40 and 80 perches (¼ and 1/2 acre) is entitled to receive Rs 250,000 as compensation which enable it to buy a piece of land in the locality.

110. The 17 physically displaced households are expected to self-relocate or to stay on their current premises. The above calculation of land replacement values has taken into consideration the availability of infrastructure facilities such as electricity, water, and access roads. Therefore those who relocate will have to pay for such facilities when rebuild the houses.

Compensation for Loss of Access

111. There is one household which will not be acquired, but will get separated from the community because of the canal. The EA will build an access road so that it could continue to enjoy its relationships with other villagers.

Special Assistance Programme for Annual Permit Holders

112. There are 02 households who obtained residential land from the state under the annual permits. They are not eligible to get any compensation for the lands according to the law. However, both households are entitled to receive the special grant described above so that they could buy land in the locality.

Ande (Tenant) Cultivators

113. Each tenant cultivator will be compensated according to their share arrangement with land owners. Generally the arrangement is that 75 percent of the crop harvested is given to the tenant and 25 percent to the landowner. A tenant cultivator who loses ½ acre or more of paddy land is entitled to a homestead and farmstead at the Mahaweli Resettlement Site in Medirigiriya. A tenant cultivator, who has an informal arrangement on short term basis, will get cash compensation for loss of income, as determined by Department of Chief Valuer.

Encroachers

114. An encroacher who cultivates state land and was in occupation of the land plot on the cut-off-date of the Project will be supported by the Project to obtain a 'regularization' of the encroachment. However, if such land cannot be regularized because it is already reserved for any other public purpose, the encroacher will receive:

- Compensation for trees and crops planted and cultivated on the land plot their market value.
- Compensation for any improvement (structures) on the land at full replacement cost.

- One and half acre of irrigated land and 1/2 acre of homestead in Madirigiriya (System D under MASL) if acquired portion of the said land plot is ½ acre or more.

Technical Assistance for House Construction

115. The Project will provide technical assistance for house reconstructions such as designing house plans, supervision of construction work by the Technical Officers.

Loss of Trees and Crops

116. Farmers will be allowed to harvest their crops before construction work starts. Where crops cannot be harvested or the destruction of crops is unavoidable, cash compensation will be paid based on the market value of affected crops. All other structures and trees remain in the property such as privately owned trees (timber, fruit trees) would remain in the property. APs are entitled to sale of trees after determination of compensation.

117. Compensation for crops in land under tenancy and lease agreements will be based on the tenancy/lease agreement. Final compensation rates for such crops will be determined by the Chief Valuer's Department.

118. The losses of trees that belong to the State will be replenished through re-forestation schemes undertaken by the Project in consultation with the Forest Department.

Compensation for Loss of Houses and Other Structures

119. Owners of acquired houses and other structures such as sheds, wells, water tanks, retaining walls and fences will be compensated for full or partial losses at full replacement cost. This entitlement applies title holders, lease holders, tenants and encroachers occupying state land at the time of the cut-off date. Furthermore structures that are partly affected will be entitled to compensation at full replacement cost.

120. Owners of the property will have the right to taken salvage materials of the affected structures. The value of salvaged materials will not be deducted from the final compensation amount.

121. In case of partial loss, in order to recognize its injurious effect, the remaining land and other property, if renders useless or uneconomical, they too will be acquired applying the relevant compensation package to other land and property.

122. Re-locating households will be entitled to remove trees on their lands without cost if vacated the premises at the stipulated time. All entitlement will be paid before the household is required to move out from the affected area.

123. Displaced households will be assisted with the suitable relocation sites that they will be find out in the locality close to their present places.

1. Relocation of households will be entitled to a shifting allowance.
2. The resettlement assistance will be provided by the Project authorities to ensure effective social and economic integration of resettlers with host communities.

Displacement Assistance

124. In addition to paying cash compensation for lost property, each physically displaced household is qualified for the following assistance. Each physically displaced household is entitled to:

- a shifting allowance which will be determined by the Department of valuation according to the LA 2009 Regulation);
- Transport facilities will be provided free of charge for transportation of households goods. 02 free trips will be provided to each relocated household.
- an allowance Rs 50,000 to build a temporary shed at the new location (Total cost is Rs. 800,000.00 for 16 households who will physically move out their homesteads),
- a temporary accommodation allowance until the house is rebuilt and ready for occupancy. The allowance will be determined according to the rates prevail in the area. Temporary relocation should be avoided it would cause hardship to the household.

Damages Caused During Construction

125. Project Contractors will avoid damaging public and private property during the construction phase of the Project. If any such damaged is caused, the Project authorities/ Contractor will pay compensation promptly to the affected household, community or government agency. The Contractors will restore such damages to land, structures and infrastructures immediately.

Temporarily Loss of Private Land

126. Two options are offered to affected households.

OPTION 1:

127. Borrow pits will be established on state land whenever possible. If borrowed materials are to be obtained from land occupied, regardless of the tenure type, the land user is expected to sign a formal agreement with Project authorities or the contractor indicating the following in the contract:

- Period of occupancy
- Terms and compensation amount determination by the Chief Valuer.
- Compensation for other disturbances and damages caused to property.
- The frequency of compensation payment
- Guarantee that the land will be returned to the user at the end of the lease period after restoring it to its original condition or better condition, as agreed with the APS.

Option 2:

128. The project contractor obtain borrow areas at his own cost. Under this option, the Contractor could contract with private land owners/users and obtains permits to extract borrow materials. The Contractors under the agreement will pay the owner/user:

- compensation for material losses during temporary occupation,
- Compensation for other disturbances and damages caused to the property.
- the Contractor will rehabilitate/restore the land to its original condition, and
- Returns the land to the owner at the end of lease period.

Special Assistance to Vulnerable Households

129. Vulnerable households are women-headed households, disabled and elderly households, and households whose income is below the poverty line. 03 women-headed households and 03 other households with household income below the poverty line are identified as vulnerable households in the Project area. The Community Consultative Groups (CCGs) will identify households, if any, fall into this category. All vulnerable households will receive the following special assistance from the Project.

130. Relocating vulnerable households are entitled to get their houses rebuilt for them by the Project. Decisions in this regard will be taken by the CCGs.

131. Each vulnerable household is entitled to receive an income restoration grant and a homestead in the same village where its relatives live. A special development scheme will be drawn by the Project authorities to develop their lands based on the recommendations of CCGs (table 21).

Table 21: Special Assistance to Vulnerable Households

Type of household	Number of Households	Cost for household	Total Cost.
Women-headed households	03	25,000	75,000
Households below poverty line	03	25,000	75,000
		Total	**Rs.150,000**

Additional Assistance

132. Three key additional assistance programmes are:

- Assessment and establishment of small scale income generating schemes.
- Professional and technical assistance to re-invest compensation.
- Assistance to increase productivity on remaining land if any such land is increasing use of fertilizer and cropping intensity and introducing more production crops together with agricultural extension services by the Department of Agriculture and Agrarian Services

9. Income Restoration and Improvement

133. In the Project area, the majority of PAPs are rural agriculturalists who depend on small plots of paddy and highland to earn their living. Such land cultivation does not provide them sufficient income to live above the poverty threshold. As a result, they engage themselves in various other supplementary employments to augment their household incomes. In the project area, the affected households are nuclear households and no household has sub-families living with it. As a result, husband and wife earn the living of the household.

134. Land acquisition and physical displacement will adversely impact on their fragile income sources. Land acquisition for the Project will cause the following losses to households:

i. They lose a part of household income because of the acquisition of agricultural land.

ii. They will lose income because of their engagement in house reconstruction and movement.

iii. They lose day-to-day income as they will have to find time to attend to administrative requirements such as filling applications, searching for legal documents, and meeting officials and bank managers to collect their compensation packages.

iv. Temporary disturbances to their environment, dust and heavy vehicle movement in the vicinity and the need to use alternative routes affect their living codition during the construction period of the canal.

Table 22: Annual Average Household Income of Physically Displaced households

Below Rs.60,000	Rs.60,000 to Rs.120,000	Rs.120,000 to Rs.500,000	Above Rs.500,000
03	06	07	01

Source: MCB Resettlement Census – July 2014

135. Table 22 indicates that 09 (53 percent) households earn less than Rs 10,000 a month and among them are three *Samurdhi* recipient households. Of them, 02 households earn less than Rs. Rs.5,000 each a month. In case of 07 households (41 percent), monthly household income is between Rs.10,000 to Rs.40,000. Those 09 households fall below Rs 10,000 income a month deserve special income restoration *and* improvement programme.

136. In the displaced households, only 07 persons passed GCE (O/L) and of them 3 are degree/diploma holders. Others are engaged in casual labour work and especially the youth with poor educational qualifications aspire to obtain vocational training so that they could improve their socioeconomic status.

137. In formulating an income restoration and improvement programme for their benefit, several findings among the affected households are relevant. Among them are:

- Lack of institutional support
- Lack of entrepreneurship attitude
- Lack of working capital
- Lack of marketing support and
- Lack of opportunity for skill development

138. To overcome these constraints the programme designed under RIP is expected to be multi-dimensional and flexible. It is also aimed to broader socio-economic benefits of the target group of people who will be provided with training, working capital and institutional support. The main features of these programmes are:

i. Provision of capacity building training programmes;
ii. Development of entrepreneurship skills,
iii. Development of managerial skills among the selected APs,
iv. Formation of societies among women, youth and low income groups,
v. Provision of skill training facilities for youth.
vi. Provision of employment opportunities.

Income Restoration Programmes

Skill Development Programme for Unemployed Youth

139. The unemployed youth will receive skill development training such as carpentry, masonry, plumbing, and electrical work, focusing on the job market in the area, particularly in construction activities. The project personnel will identify such opportunities. Moreover, at least one person per household will receive training in one of the following skills. 50 percent of trainees will be women. Priority will be given in selecting for training to those households which are physically displaced and vulnerable households. Both physically displaced and economically displaced households will be eligible to receive employment training under the project.

140. The training fields are:

i. TV and radio repairing programmes
ii. Motor mechanism,
iii. Vehicle driving,
iv. Heavy machine operation,
v. Sawing machine training,
vi. Computer literacy

141. The young men and women from the Project area will be selected based on their educational qualification and abilities. There will be a Community Development Officer attached to the Project Office who will prepare the training curricula and liaise with vocational training institutions. Training period will be 2 weeks to 6 months depending on nature and quality of the training. Trainees will be given Rs. 6,000/- as an allowance per month.

Home Garden Development Programme

142. A home garden development programme will be introduced by giving the physically displaced households fruit plants, forestry plants and other varieties of plants to cultivate in their homesteads (Table 23). Both those who lost paddy land or highland or both will get plants free of cost from the Project.

Table 23: Cost of Planting Materials

Types of plants	No. of plants per person	No. of APs including (highland and paddy land)	Unit Cost Rs.	Total cost Rs.
Fruit plants	10	130	200	260,000
Forestry plants	25	130	50	162,500
Other plants (Banana etc.)	10	130	50	65,000
			Total	**487,500**

Skill Training Programmes

143. Based on the educational attainment levels of PAPs, especially the youth of physically displaced households, several skill development programmes have been identified to fund under the Project. These programmes include motor mechanism, heavy machine operation, driving vehicles and TV, radio and clock repair, a special skill development programme is planned for the benefit of unemployed women PAPs. There are 23 women (19-59 years) in the 17 physically displaced households. The Project will launch a tailoring business for their benefit. Twenty six women will receive six month training in sewing machine and each will get a sewing machine (Table 24). It is also proposed to introduce training program of computer literacy for school children of displaced households as children are living in very remote area where this facility is unavailable at present.

Table 24: Cost Estimate for Skill Training Programmes

Area of training	No. of Trainers	No. of months	Training Costs Rs.	Allowance for trainee. Rs.
Motor mechanism	05	06	300,000	180,000
Heavy machine operation	05	03	150,000	90,000
Driving of motor vehicles	10	02	200,000	120,000
Sewing machine training (for women)	23	06	1,410,000	828,000
TV & radio repairing	06	06	360,000	216,000
Computer literacy for school children	06	03	150,000	108,000
			2,570,000	1,542,000
			Total	**4,112,000**

Financial Assistance to Improve Household Income Sources

144. In addition to skill training for both men and women, the Project will provide financial assistance to improve their current income-generating activities at the household level. Twenty six women will receive sewing machines. The other programs include livestock development and poultry farming (Table 25).

Table 25: Costs of Income Generation Programmes for PAHs

Description	No of Houses	Unit Cost Rs.	Total Cost Rs.
Livestock development	16	50,000	800,000
Poultry	10	34,000	340,000
Grant for sewing machines	23	30,000	690,000
		Total	**1,830,000**

Institutional Arrangement for Skill Training

145. There are few training institutions available in the country. Among them are the Vocational Training Authority, Department of Technical and Education Training, Territory and Educational Commission are prominent. There are several non-governmental organizations conducting various vocational training programmes. These sources will be contacted by the project personnel before the Project work starts.

Rehabilitation Assistance

146. Apart from the provision of displacement support, the severely affected and vulnerable households will be supported through the following measures:

- Counselling on project impacts, preparation of compensation claims and bank investment assistance.
- Counselling on savings scheme and cash management.

- Assessment of current economic activities and potentials for improvement of these activities as well as advice on alternative income-earning opportunities
- Assessment and establishment of small-scale income generating schemes for severely affected households.
- Assistance to gain access to National and Local Poverty Alleviation and Credit programmes.
- One person in each severely-affected household will be entitled to skills and vocational training that would help in obtaining employment.
- Establish self-employment programmes through skill development assistance. Cost of training, accommodation, and subsistence during the training period will be borne by the Project. CCGs will determine who the severely-affected households are and select them on priority basis.
- Provide general information construction schedules, acquisition data, valuation, compensation, grievance resolution mechanism and employment opportunities at project sites and development initiatives and opportunities.
- Establishment of Community Consultative Groups (CCGs) to assist severely-affected and vulnerable people in particular and the other PAPs in general and to monitor the progress of physical and economic rehabilitation programmes and to recommend corrective measures, where necessary.

10. Grievance Redress Mechanism

147. The grievance redress mechanism of the Project will address PAPs' complaints and grievances promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of PAPs at no costs and without retribution.

Types of Grievances

148. Legal issues:

(i) Application of LAA and its limitations to arrive at the replacement cost of acquired property

(ii) Difficulties in obtaining abstracts of deeds from the Land Registry

(iii) Rules and regulations determining the ownership of land and amount of compensation

149. Practical issues**:**

(i) Lack of knowledge on the acquisition process and how to present claims to avoid the delays in the payment of compensation

(ii) Delays in the payment of resettlement assistance and provision of benefits.

(iii) Most contracts on leased land are verbal. Difficulty in transforming into written contracts.

(iv) Inability to find land for building new houses.

(v) Inability to construct new houses in a short period of time.

(vi) During the construction period temporary destructions are occurred.

150. During the socio-economic survey and resettlement census several CBOs were identified who are actively participate in people's affairs in the project area. It was also observed that almost all PAPs are members of CBOs. Farmer organizations and rural development societies are having a monthly meeting in which PAPs meet to discuss agricultural plans, fertilizer distribution and extension facilities and their problems. These organizations can be enlisted to deal with grievances of PAPs as a 'primary level redress forum' regarding land acquisition and resettlement issues.

Legal Frame work of Grievance Redress

151. Under the Land Acquisition Act, an Appeal Board has been constituted to deal with appeals against compensation offers. This process will minimize the grievances. However, a person who does not agree with the decision of the Board of Appeal can go before the Supreme Court claiming higher amount of compensation. But such an action

is rare as it would consume money and time. Appeal Board and the Supreme Court are located in Colombo and as a result, most PAPs are reluctant to go that far.

152. PAPs will need to obtain abstracts of land title deeds from the Land Registry which is located in Polonnaruwa city which is about 50km away from their villages.

Grievance Redress Committee

153. A grievance redress Committee (GRC) will be established at the project level to resolve disputes and grievances relating to land acquisition, relocation and implementation of the RIP, and environment-related grievance and complaints. The GRC will be an ex-gratia, legal, semi-structured body empowered to make decisions on disputes resolution during the implementation of RIP. The fundamental objective of formation of a GRC is to resolve disputes at the grass-roots level in order to avoid lengthy and costly judicial process. The GRC will not deal with matters pending in the court of law. Also it has no jurisdiction over the rate of compensation.

154. As the project may anticipate environmental grievances from the canal construction, the GRC will deal with social and environmental grievances.

155. The GRC will meet according to a published timetable. This information will be disseminated among all PAPs. It will call public meetings to arbitrate grievances. Each session/meeting will be held at a place which is convenient to PAPs to attend. GRC procedures will be publicized through notices and community meetings. PAPs will be made aware of the presence of GRM, its powers and benefits during consultations and group discussions. At such gatherings, PAPs will be encouraged to discuss their views on the structure and functions of GRM.

Composition of the Grievance Redress Committee

GRC at the EA level

156. This GRC consists of senior officer of the Executive Agency, Divisional Secretary in the area, Project Director of the Upper Elahera link Canal Project. The Chairman of GRC will be a senior officer of the Executive Agency appointed by the Secretary of MIWRM. GRC meetings will be held once a month at the Project Office. Project Director will be the Convenor of GRC. The Committee will inform the grieved parties of its decisions, through the Convenor, after recording the grievance, supporting documents and evidence. The total period of arbitration will not exceed six weeks.

GRC at the Project Level

157. The project level GRC will have as ex-officio members, the Project Director (PD) as the Chairman of the Committee, officers who handle land acquisition and resettlement,

Divisional Secretary and 04 representatives of the community consultative groups including women PAPs. Dispute resolution process will be quick, impartial and legitimate. Any PAP could present its case or evidence without any fear or harassment or intimidation.

158. If the Committee cannot resolve the issue, the Project Director as the convenor of the higher committee should submit the complaint or grievances to the Higher Committee. When PD submits the complaint to the Higher Committee, PD will make his observations on the issue. Once the Committee makes its decision on the issue, it will inform to the complainants in writing the decision. Every attempt will be taken to resolve the issue by the Committee within 04 weeks.

GRC Process

159. A PAP can make their complaint either in writing or verbally to the GN of the division or directly to a project officer. If the complaint is made verbally, the GN or the project officer will record it and forward the complaint to the Project Director who should obtain observations from the relevant officials of project on the compliant.

160. Project Director will submit complaints and the observations that he received from PAPs and officials to the Committee at the project level at the monthly meeting of the Committee. If necessary, it will call relevant parties to obtain their evidence and views. If there is a legal barrier to resolve the issues, Committee will inform the complainants how they should resolve the issue through legal institutions.

161. The GRC will attend to grievances and complaints on land acquisition cases, compensation payments, resettlement issues, ownership disputes, delays of payment of compensation issues and rehabilitation assistance programmes.

162. Information about the GRC and its procedures will be published as a leaflet and widely disseminated. Notices and timetable of community meetings will also be widely disseminated among PAPs.

11. Institutional Arrangements for Resettlement Administration

Project Management Unit (PMU)

163. The Programme will have a project Management Unit (PMU) established at MIWRM. It will oversee social safeguard compliance during social impact assessments, formulation of RIPs, their implementation and monitoring of implementation and progress review. The PMU will have Resettlement Unit or Cell with a full time specialist (s) who will assist the formulation of RIPs, resettlement due diligence reports and resettlement monitoring reports. PMU will develop the specialist(s)' TOR(s) and forward them to ADB for review. The specialist(s) key activities include: (i) screening of proposed projects for potential resettlement impacts and risks;(ii) reviewing of project alternatives to avoid or minimize resettlement impacts; (iii) assessing social impacts of the project; (iii) formulating an appropriate strategy for public consultations and resettlement information disclosure; (iv) formulating RIPs with resettlement consultants; and (v) establishing GRM and monitoring of their effectiveness.

Resettlement Staff and Consultants

164. While EA will be responsible for overall coordination, planning, and financing of resettlement programme, the implementation of RIP is the responsibility of PMU. Before commencing socio- economic surveys and the formulation of RIP, EA will recruit a social development specialist(s) as a staff member of PMU who is familiar with land and resettlement regulatory framework and ADB involuntary resettlement policy and procedures. The specialist(s) conduct surveys and formulates RIPs of the project. The specialist(s) through EA/IA could hire resettlement consultants to assist resettlement planning and implementation.

165. Involuntary resettlement is a sensitive process and officials who are engaged in resettlement programme need field experience in resettlement and rehabilitation and community development. In order to facilitate good rapport with affected communities and oversee resettlement implementation, experienced and well-qualified civil society organizations could be hired in project areas to assist PMU/PIU in RIP implementation especially in case of category 'A' project. Such organizations could play a role of facilitator and will work as a link between PMU and affected communities. They will assist PAPs in income restoration through training in skill development and getting access to various government development schemes and to agencies that provide financial assistance and loans for small enterprises

Project Implementation Unit

166. The PMU will be supported by project implementing units (PIUs) in the field. Each project will have a PIU working under the supervision of PMU of the Programme. If required, resettlement officers will be hired to assist PIU/field offices for social impact assessment, formulation of RIP and their implementation and monitoring.

167. The roles and responsibilities of various agencies to be involved in resettlement planning process and implementation of resettlement activities are summarized below.

Figure 4: Roles and Responsibilities of Resettlement Agencies

Agencies Responsible for Resettlement Planning and Implementation	
Activity	**Agency Responsible**
Establishment of Resettlement Unit at EA and appointment of a Resettlement Specialist (RS)	EA
Hiring of resettlement consultants (RC), external monitors (EM)	EA
Organizing resettlement training workshop (optional)	EA, RC
Screen Project affected area for resettlement effects	RS, RC
Determine the scope of RIP	EA in consultation with ADB
Social Assessment and preparation of land acquisition plan, Census, Socioeconomic Surveys, and RIP	EA/PMU and RS and RC
Hiring of Civil Society Organizations (NGOs), if applicable	EA
Public consultation and disclosure of RIP	RS,RC, NGO/CBO
Co-ordination with divisional administration for land acquisition	IA, PMU/PIU, RS and RC
Declaration of cut-off date	EA, DS, RS
Review and obtaining of approval of RIP from ADB	EA
Appointment of GRC	EA/ PMU/PIU
Submission of land acquisition proposals to Divisional Secretary (DS)	PIU
Compensation award and payment of compensation	DS, PMU/PIU, RS
Payment of replacement cost and special grant and other allowances	DS, PIU
Taking possession of acquired land and structures	DS
Handing over the acquired land to contractors for construction works	MLLD, DS
Notify the date of commencement of construction to PAPs	RS, RC, PMU/PIU, NGO
Assistance in relocation, particularly for vulnerable groups	RS, PMU/PIU, NGO, DS
Internal monitoring of overall RP Implementation	PIU, RS, RC,NGO
External Monitoring and Evaluation (M&E)	EM

12. Monitoring and Reporting

168. The PMU together with PIU of the Project will monitor the implementation of RIP to determine whether resettlement goals have been achieved and livelihood and living standards have been restored, and also to recommend on how to further improve RIP implementation.[2] The PIU will prepare half-yearly monitoring reports to submit to EA/PMU and ADB. The reports will focus on whether resettlement activities have complied with involuntary resettlement safeguard principles and loan covenants of the project. The report will also a document of consultations conducted with PAPs and summaries of issues identified and actions taken to resolve them. It will also provide a summary of grievances or complaints lodged by PAPs and actions taken to redress them and the specific activities conducted to restore and improve income sources and livelihoods of PAPs. The grievances include social and environmental issues and other grievances.

169. Resettlement monitoring will involve (i) to ensure implementation of the programs is on schedule and problems are dealt with on a timely basis; (ii) socio-economic monitoring including income restoration and improvement during and after any resettlement impacts, utilizing baseline information established during socio-economic surveys; and (iii) overall monitoring to assess the socio-economic status of PAHs. If any deviations from resettlement loan covenants or safeguard principles are reported in the monitoring reports, EA/IA will prepare a Corrective Action Plan (CAP) and will submit to ADB for review and approval. The monitoring reports and CAP will be posted on ADB website.

170. The Project is categorized as “A” for involuntary resettlement impacts. EA will engage a qualified and experienced internal monitoring specialist (IMS)who is not associated with the project planning. He should capable to monitor the resettlement implementation process and to suggest how to address if any weakness is detected.

171. In addition, IMS will be documented good practices as well as difficulties encountered in implementing RIP. This document will provide guidance for subsequent projects. A monitoring format is given below which needs to be elaborated during the RIP implementation stage.

172. As involuntary resettlement impacts envisaged in the Project is limited and the number of households involved is only 58, EA expects to complete land acquisition, compensation and special grant payment and income restoration and improvement in 12 to 18 months. EA will hire qualified professionals as skill trainers and organizers of income-generating programmes in the Project area. They will liaise with the income restoration groups of other Projects and work out a comprehensive programme for the benefit of PAPs. A separate and committed budget for this purpose is established as shown in the Section 13 of RIP.

[2] Please see (http://www.adb.org/documents/involuntary-resettlement-safeguards-planning-and-implementation-good-practice-sourcebook-d) for sample internal and external monitoring indicators.

Figure 5: Monitoring Framework

Activity	Progress	Remarks
Assessment of IR impacts of changes in project design, if any.		
Updating of RIP based on changes in project design, if any.		
Approval of updated RIP by ADB		
Appointment NGO, if required		
Disclosure of updated RIP		
Establishment of GRM/Committee		
Operations of GRC		
Capacity building of EA/IA, if required		
Verification of Census of PAPs		
Payment of compensation and special grant, resettlement assistance, and readjustments		
Land Acquisition prior to displacement		
Payment of compensation at replacement cost for land & assets		
Disbursement of special grant, and resettlement assistance to PAHs		
Disbursement of assistance to non-titledland holders		
Disbursement of special assistance to vulnerable groups		
Number of vocational training provided to PAPs		
Employment at Project sites		
Linking PAPs with local, provincial Development schemes		
Completion of construction of houses		
Shifting PAHs to new locations as per RIP		
Payment of transition allowance		
Payment of transport allowance		
Replacement/ shifting of community property resources		
Reinstallation of public utilities		

13. Resettlement Budget

Preparation of Budget Estimates

173. Cost estimates for lands, structures and trees acquired or affected were prepared based on the prevailing rates in the project area. This information and data were gathered from the Divisional Secretaries, GNs and from informal sale agreements signed between land buyers and sellers in the area. In preparing the cost estimates, the memo of 19.01.2010 issued by the Chief Valuer on the determination of valuation of land, structures and trees were taken into consideration. The costs of land acquired, structures, crops and trees will be determined by the Valuation Department at the time of receiving 10.1.A Notice from the Acquiring Officer. Therefore, costs could be increased at that stage of implementation due to increase of land and building prices. In order to meet this risk, 20 percent contingency cost is added to cost estimates. Transport cost and other cost under LA 2009 Regulation can be met under the contingency estimate.

174. Cost of income restoration programmes has been prepared based on the prevailing costs of each item. Cost of planting materials was prepared on the basis that each PAH will request planting materials.

175. Cost estimate for institutional development covers office accommodation, vehicles and other infrastructure facilities and staff salaries.

176. The full budget will be provided by the Government through the EA. The cost estimates are given in the RIP, covers the special assistance schemes limited to the project. Statutory compensation based on LAA will also be paid to PAHs. The estimates will become accurate only after the preparation of plans of acquired lands by the Survey Department and Chief Valuer determine the value of land, houses, crops and trees affected.

177. Sufficient funds will be available at the beginning of the Project to defray. All land acquisition, compensation, and rehabilitation, administrative, monitoring and consultants' cost, income and livelihood restoration cost will be considered as an integral component of project costs and will be borne by EA. The EA will ensure timely disbursement of sufficient funds for RIP implementation. The EA, through its IA and in consultation with PAPs and appropriate divisional and provincial officials will determine the cost of land acquisition, resettlement and rehabilitation. The approved cost will be allocated in advance in the annual budget of EA. All cash compensation packages will be paid to PAPs before any construction activity of the project commences. Resettlement assistance programmes will start before construction works start and may continue during the project implementation phase.

Investment Budget

178. The total investment budget for land acquisition and resettlement has been developed under five components as given below.

1. Cost of compensation for land, structure and trees
2. Cost of relocation (purchase of land)
3. Cost of income restoration programme
4. Cost of monitoring and evaluation
5. Cost of institutional development

Total Investment Budget

179. The total investment Budget is **Rs 153,462,672**

Table 25: Cost of Compensation for Land, Structures and Trees

Land	**Extent**		**Unit Cost Per acre**	**Total Cost**
	A. R. P.			
Housing allotments	09 03 10		1,000,000	9,950,000
Highland allotments	13 03 00		800,000	11,000,000
Paddy lands	07 00 15		450,000	3,200,000
Chena lands	14 01 15		200,000	2,875,000
			Sub Total	27,025,000
Structures	Type	Sq.ft.	Rs. Per sq.ft.	
Permanent buildings	13	19,000	3,000	57,000,000
Semi-perm. buildings	02	1750	3,000	5,250,500
Temporary buildings	02	1500	1,000	1,500,000
			Sub Total	**63,750,500**
Trees				
No. of trees – perennial	584 x 10,000/-			5,840,000
No. of trees – non perennial	485 x 1000/-			485,000
			Sub Total	**6,325,000**
			Grand Total	**97,100,500**

Table 26: Cost of Buying Land for Relocation in Elahera DSD

Loss of Land	No. of Households	Unit Cost Rs.	Total Cost Rs.
Households losing up to ½ acre of land	08	750,000	6,000,000
Households losing up to ¼ acres of land	06	500,000	3,000,000
Households losing up to 1/8 acre of land	02	250,000	500,000
		Sub Total	9,500,000
Temporary sheds	16	50,000	800,000
		Grand Total	**10,300,000**

Table 27: Cost of Income Restoration Programme

Cost Item	Cost Rs.
Cost of planting materials	487,500
Cost of training programmes	4,112,000
Cost of special assistance to vulnerable HHs(06)	150,000
Cost of income generation programme	1,830,000
Total	**6,579,500**

Table 28: Total Cost of Resettlement Implementation and Monitoring

Description	Amount Rs.
Cost of compensation for land, structure and trees	97,100,500
Cost of relocation (purchase of land)	10,300,000
Cost of income restoration programmes	6,579,500
Sub Total	113,980,000
Monitoring and Evaluation (2%)	2,,279,600
Sub Total	116,259,600
Cost estimate for institutional development (10%)	11625960
Sub Total	127,885,560
Contingencies (20%)	25,577,112
Grand Total	**153,462,672**

180. The disbursement of cash compensation to PAPs for land and other property losses and damages will be done by the Division Secretariats in the project areas. The approved amount will be deposited by EA/ IA in the Divisional Secretariat accounts and the disbursement will be done by the divisional administration.

14. Implementation Schedule

181. The key involuntary resettlement-related activities such as census and socio-economic survey, cut-off-date publication, resettlement planning, public consultation have already been completed. Disclosure of information on land acquisition, compensation payment, relocation, income restoration and improvement, monitoring and evaluation of resettlement implementation are be detailed in the implementation schedule.

182. The EA/IA will ensure that no physical/or economic displacement of affected households will occur until: (i) compensation at full replacement cost has been paid to each displaced person for project components or sections that are ready to be constructed; (ii) other entitlements listed in the resettlement plan are provided to PAPs; and (iii) a comprehensive income and livelihood rehabilitation programme, supported by adequate budget, is in place to help displaced persons, improve, or at least restore, their incomes and livelihoods.

Figure 6: Resettlement Planning and Implementation Schedule

Resettlement Activity	Time Schedule	Progress
Screen Project areas to identify potential resettlement impacts – land acquisition, relocation, impacts on income and livelihood sources	2014 June – August	Completed
Determine the scope of resettlement planning and resources required – number of PAPs and PAHs affected and land area to be acquired	2014 August-September	Completed
Socioeconomic Survey for social impact assessment of the Project	2014 May/June	Completed
Census of PAPs and PAHs in Project areas	2014 June and July	Completed
Declaration of cut-off date	2014,June 01	Completed
Determine the scope of land acquisition and resettlement programme	2014 August	Completed
Formulation of RIP	2014 September	Completed
Hiring of Civil Society Organizations (NGOs), if required	2014 October	N/A
Public consultation and disclosure of RIP	2014 September	
EA co-ordination with divisional administration on land acquisition	2014 August-2015 December	
Approval of RIP by ADB	2014 December	
Appointment of Grievance Redress Committee	2014 December	
Submission of land acquisition proposals to Ministry of Land and Land Development	2014 September	
Compensation award and payment (statutory compensation)	2015 June and July	
Payment of special assistance, vulnerable PAH grant, and other IR allowances	2015 June and July	
Taking possession of acquired land and structures	2015 July – August	
Handing over of acquired land to contractors	2015August –	

	September	
Notify the date of commencement of construction to PAPs	2015 August	
Assistance programmes for PAPs, especially for vulnerable PAHs	2015 June-August	
Internal monitoring of RIP Implementation	2014 September-2016 December	
Assessment of income restoration and improvement programmes	2016 September	
Resettlement Completion Report		

Annex 1: Gap Analysis between Programme's Involuntary Resettlement Safeguards and ADB Involuntary Safeguard Policy Principles, and Programme's Safeguard Implementation Capacity

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of the Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
1. Screen the project to identify involuntary resettlement (IR) impacts and risks. Determine the scope of resettlement planning through a survey and/or census of displaced persons and a gender analysis	Yes	IR country safeguard system provides for screening IR and risks as part of resettlement planning. NIRP requires that a RIP is prepared for projects where 20 or more households are affected. If less than 20 households are affected a RIP is to be prepared at a 'lesser level of detail'. Part of resettlement planning is identifying key stakeholders and exploration of viable project alternatives to minimize social impacts especially involuntary displacement, and assess whether resettlement and social impacts are significant or not. See 2008 LAA Regulations	MLLD is responsible for implementing of NIRP in collaboration with network of public and CSOs including CEA, PEA, the Ministries concerned and Divisional Secretaries. These agencies and EA have sufficient experience in applying this principle in formulating RIPs for projects.
2. Conduct meaningful consultations with affected persons (APs), host communities, and NGOs. Inform APs of their entitlements and resettlement options. Ensure APs, especially vulnerable household participation in project planning, implementation and monitoring. Establish a grievance redress mechanism. Support socio-cultural institutions of APs. If IR impacts are complex and sensitive, provide	Yes	The country safeguard system (CSS) has specific guidelines on consultations with PAPs, vulnerable groups and other stakeholders and NGOs; establishment of a GRM; recording of decisions at consultative meetings; and social preparation phase of RIP planning.	EA and IAs of the programme have excellent experience in conducting meaningful consultations with PAPs and other stakeholders. GRM is a component of RIPs in the Mahaweli Systems and other irrigation programmes. EA and IAs have used social preparation phase in their projects. The capacity to implement this

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of the Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
social preparation phase			principle exist at the Programme and project levels.
3. Improve or at least restore the livelihoods of all DPs. Land-for-land compensation when affected livelihoods are land-based where possible or cash-for-land compensation when land the loss of land does not undermine livelihoods; prompt replacement of assets, prompt compensation at replacement cost for assets that cannot be restored. Provide additional revenue and services through benefit-sharing schemes.	Yes	The country safeguard system provides opportunity to identify persons, households severely affected in terms of their income and employment losses. Income restoration programmes are to be developed in consultations with APs in order to re-establish themselves and improve their quality of life. Replacement land is It is an option for compensation in the case of land loss; in the absence of replacement land cash compensation is an option for all APs. See NIRP Payment of full replacement cost of lost assets to PAPs is a key principle of NIRP. LA Regulations 2008 provide a comprehensive compensation package including the market value of property acquired. The total package amounts to replacement cost of lost assets.	EA/IAs are aware of this key principle and have applied in several projects.
4. Provide all APs needed assistance: if relocated, secured tenure to resettlement land, better housing, access to employment and production opportunities, and integration of resettlers with host communities, extension of project benefits to host communities, transitional support and civic infrastructure and	Yes	The CSS recognizes the special needs of physically relocated PAPs. PAPs involve in the selection of resettlement sites, livelihood compensation and development options at the earliest opportunity. Gender equality and equity are to be ensured and adhered to in resettlement programmes. The CSS provides for assisting PAPs to be economically and socially integrated into the host communities. Participatory measures are to be designed and implemented by the resettlement planners and	Our field visits to current resettlement sites of projects (Moragahakanda Reservoir project) indicate that EA/IAs have sufficient understanding of this principle and have applied in several other projects.

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of the Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
community services, as required.		implementers.	
5. Improve the standards of living of the displaced poor and vulnerable groups	Yes	CSS, especially NIRP and LA Regulations 2008, emphasize the importance of improving standard of living of the affected vulnerable and poor groups.	EA/IAs in their previous RIPs have paid sufficient attention to this key principle. Entitlement Matrices indicate this practice which is satisfactory.
6. Develop procedures in a transparent, consistent and equitable manner if land acquisition through negotiated settlement to ensure that APs maintain the same or better income and livelihood status	Yes	Although negotiated acquisition is recognized as a method of land acquisition by CSS, it is subject to LAA procedures of land acquisition which could cause delays. However, the NIRP and LA Regulations 2008 provide a legal framework for ensuring that PAPs maintain the same or better income and livelihood status	The application of LA Regulations 2008 and NIRP by EA/IAs in several other projects is satisfactory. They have the capacity to apply this principle.
7. Ensure that APs without titles to land or recognizable legal rights Non titled households are eligible for resettlement assistance and compensation for loss of non-land assets.	Yes	Compensation for non-land assets of non-titled persons is a well-established principle in CSS. Often such non-titled persons are provided with land at resettlement sites to ensure that they will have better socioeconomic status during post-displacement.	EA/IAs have planned and implemented several RIPs which include this key principle. EA/IA possess sufficient capacity.
8. Prepare a resettlement plan with APs' entitlements, income and livelihood strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound	Yes	CSS, especially NIRP and LA Regulations 2008 require RIP for any project which is likely to have resettlement impacts. Necessary guidance is also published by MLLD on how to prepare RIP.	EA/IAs have vast experience in RIP formulation and implementation

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of the Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
implementationschedule			
9. Disclose resettlement plan including documentation of the consultation process in a timely manner, before project appraisal in an accessible place and a form and language understandable to APs and other stakeholders. Disclose final resettlement plan and its updates to APs and other stakeholders.	Yes	CSS, especially NIRP and LA Regulations 2008 require disclosure of RIP. LAA discloses the land which has been identified to acquire for a public purpose and calls for views, opinions and objections.	EA/IAs possess sufficient experience and capacity in RIP disclosure and consultations on resettlement information with PAPs. This has been done in several projects.
10. Conceive and execute involuntary resettlement as a part of development project or programme. Include the full cost of resettlement in the project costs and benefits. If significant resettlement impacts are found, consider implementing the IR component of the project as a stand-alone operation.	Yes	IR is considered as a key component of any development project in Sri Lanka and in this regard, NIRP and LA Regulations 2008 provide sufficient guidance.	EA/IAs have sufficient experience in calculating resettlement cost as part of project cost and in obtaining sufficient funds from the Treasury to pay compensation and implement resettlement programmes including income restoration programmes for the benefit of PAPs.
11. Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement RP under close supervision throughout project	Yes	CSS focuses on this key safeguard principle. Payment of compensation before displacement is the law except in case of urgency clause 38(a) of LAA.	EA/IAs are cognizant of the importance of paying compensation prior to displacement. Delays do occur because of lack of sufficient funds and

ADB Policy Principle	Triggered by the Programme	Assessment	
		Assessment of Adequacy of the Programme IR Safeguard Regime to Meet SPS IR Safeguard Requirements	Assessment of Implementation Capacity
implementation			litigation over land ownership. EA/IAs have sufficient experience and capacity to apply this principle
12. Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the RP have been achieved based on baseline conditions and the results of resettlement monitoring.	Yes	Monitoring and assessing resettlement outcomes are not well developed in the IR regulatory framework. Special arrangements are to be introduced to overcome this deficiency in CSS	Project-based internal and external monitoring of IR impacts are part of donor-funded projects which EA/IA have planned and implemented. They have gained sufficient capacity in this regards which could be applied to the Programme.

Annex 2

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Stakeholders meetings on affected persons and Stakeholders of upper Elahera canal/ Elhera D.S. Division

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1				
2	R.J.			
3	M.			
4	K.			
5	J.S.			
6	H. G. S. Thelakarathna	Development Officer	Dawanayaya, Bakamoona	
7.	M.H.			
8	R.D.			
9.	M.			
10.	M.D.			
11	G.V.			
12	B.M.			Geethe
13	D G.			
14	R.D			
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16				
17	D.M.			
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19	H M			
20				
21	L.G.			
22				
23	W.G.			
24	N.G.J.		Dawanayaya	
25				
26	D.H			

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27	G.H. [illegible]	[illegible]	[illegible]	[illegible]
28	W.A. [illegible]	[illegible]	118 [illegible]	[illegible]
29	W.A. [illegible]	[illegible]	118 [illegible]	[illegible]
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33	G.G. [illegible]	"	" "	[illegible]
34	H.G.A. [illegible]	"	" "	[illegible]
35	T.M.S.R. Tennakoon	"	Dambulugama	[illegible]
36	[illegible]	"	[illegible]	[illegible]
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44	M.M. [illegible]	[illegible]	31/1 [illegible]	[illegible]
45	K.G. [illegible]	[illegible]	78 [illegible]	J. P. Kumara
46	D. [illegible]	[illegible]	[illegible]	[illegible]
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53	M. [illegible]	[illegible]		[illegible]

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54	[illegible]	[illegible]	[illegible]	[illegible]
55	[illegible]	[illegible]	[illegible]	[illegible]
56	[illegible]	[illegible]	[illegible]	[illegible]
57	R.G. [illegible]	[illegible]	[illegible]	[illegible]
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60	H.B [illegible]	[illegible]	[illegible]	[illegible]
61	B.H [illegible]	[illegible]	[illegible]	[illegible]
62	W.G [illegible]	[illegible]	[illegible]	[illegible]
63	R.G [illegible]	[illegible]	[illegible]	[illegible]
~~B.~~ 64	B.H [illegible]		[illegible]	[illegible]
65	A.G. [illegible]	[illegible]	[illegible]	[illegible]
66	[illegible]	[illegible]	[illegible]	Pricymi
67.	L.G.S.R. [illegible]	[illegible]	03, [illegible]	[illegible]

Stakeholders' Workshop in Elahera DSD on 26-07-2014

Stakeholders' Workshop at Elahera DSD on 26-07-2014:
Project Manager explains the compensation package to a physically displaced person.

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Stakeholders meetings on affected persons and Stakeholders of upper Elahera canal/ Galenbindunwewa D.S. Division

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Stakeholders meetings on affected persons and Stakeholders of upper Elahera canal/ Galenbindunwewa D.S. Division

සහභාගීත්වය / Participation

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27	W.A.G. [illegible]	[illegible]	[illegible]	[illegible]
28	K.D. [illegible]	〃	[illegible]	[illegible]
29	R [illegible]	〃	[illegible]	[illegible]

Stakeholders' workshop at Yakalla village of Galenbindunuwewa on 2014-07-27

Stakeholders' workshop at Yakalla village of Galenbindunuwewa on 2014-07-27

APPENDIX 13

ENVIRONMENTAL ASSESSMENT AND REVIEW FRAMEWORK

Sri Lanka
Project Number: 47381
November 2014

Sri Lanka: Water Resources Development Investment Programme

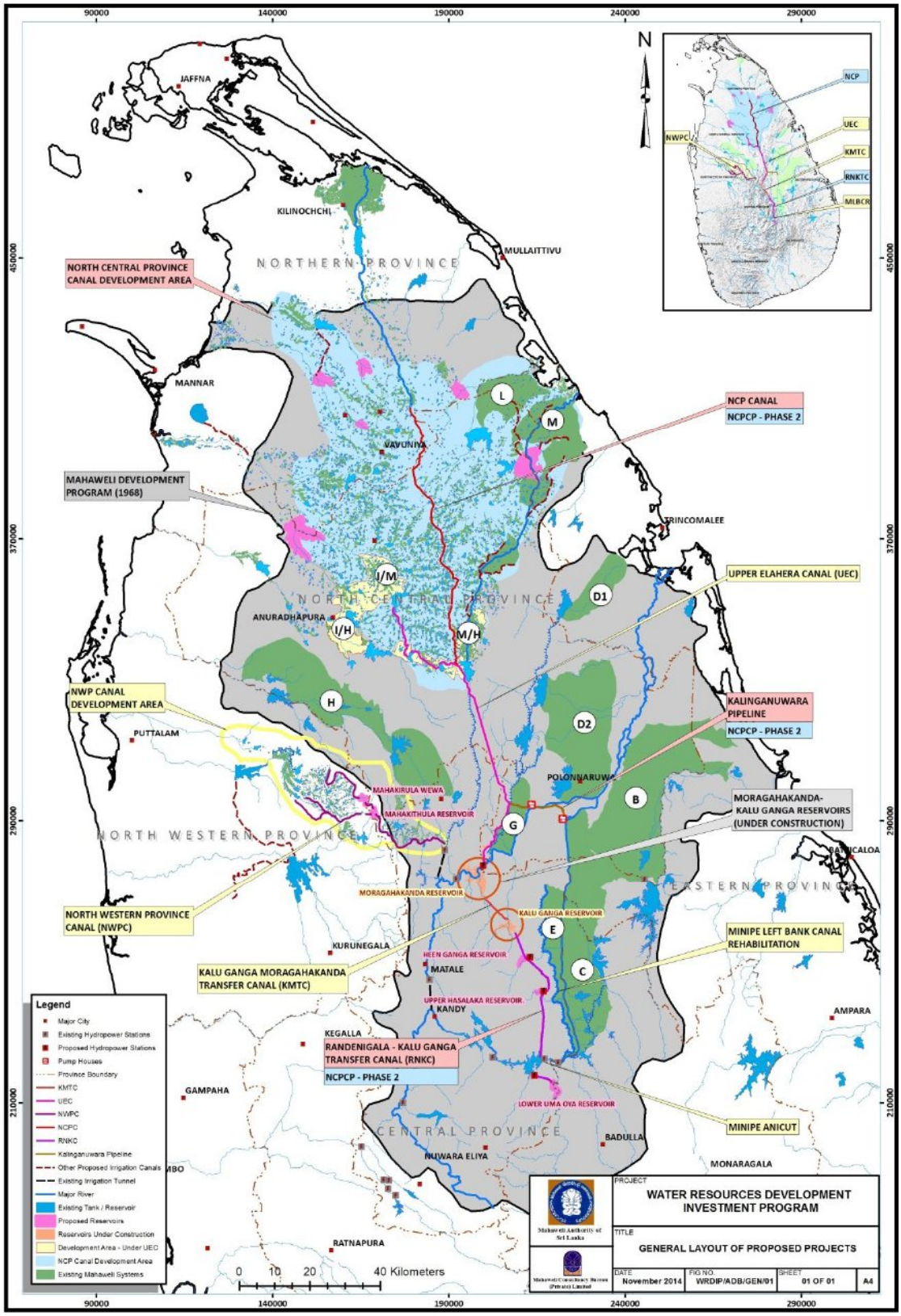
Environmental Assessment and Review Framework (revised, Final Draft)

Ministry of Irrigation and Water Resources Management
Democratic Socialist Republic of Sri Lanka

Contents

Abbreviations

ADB	Asian Development Bank
CBO	Community-based organization
CEA	Central Environmental Authority
EA	Environmental Assessment
EAR	Environmental Assessment Report
EARF	Environmental Assessment and Review Framework
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Management Plan
IA	Implementing Agency
IEE	Initial Environmental Examination
IEER	Initial Environmental Examination Report
GNO	*Grama Niladhari* Officer
GRM	Grievance Redress Mechanism
GRC	Grievance Redress Committee
MI&WRD	Ministry of Irrigation and Water Resources Development
MOE&RE	Ministry of Environment and Renewable Energy
NGO	Non-Governmental Organization
NEA	National Environmental Act, 1980
PAA	Project Approving Authority
PAP	Project-affected person
PP	Project Proponent
SPS	Safeguard Policy Statement of ADB (2009)
TOR	Terms of Reference
WRDIP	Water Resources Development Investment Programme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140000
190000
240000
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370000
290000
210000
N
NCP
UEC
NWPC
KMTC
RNKTC
MLBCR
JAFFNA
KILINOCHCHI
MULLAITTIVU
NORTHERN PROVINCE
NORTH CENTRAL PROVINCE CANAL DEVELOPMENT AREA
MANNAR
VAVUNIYA
NCP CANAL
NCPCP - PHASE 2
MAHAWELI DEVELOPMENT PROGRAM (1968)
TRINCOMALEE
UPPER ELAHERA CANAL (UEC)
ANURADHAPURA
NORTH CENTRAL PROVINCE
NWP CANAL DEVELOPMENT AREA
PUTTALAM
KALINGANUWARA PIPELINE
NCPCP - PHASE 2
POLONNARUWA
MAHAKIRULA WEWA
MAHAKITHULA RESERVOIR
MORAGAHAKANDA-KALU GANGA RESERVOIRS (UNDER CONSTRUCTION)
NORTH WESTERN PROVINCE
BATTICALOA
EASTERN PROVINCE
MORAGAHAKANDA RESERVOIR
KALU GANGA RESERVOIR
NORTH WESTERN PROVINCE CANAL (NWPC)
KURUNEGALA
HEEN GANGA RESERVOIR
MINIPE LEFT BANK CANAL REHABILITATION
KALU GANGA MORAGAHAKANDA TRANSFER CANAL (KMTC)
MATALE
UPPER HASALAKA RESERVOIR
KANDY
AMPARA
KEGALLA
RANDENIGALA - KALU GANGA TRANSFER CANAL (RNKC)
NCPCP - PHASE 2
GAMPAHA
LOWER UMA OYA RESERVOIR
MINIPE ANICUT
CENTRAL PROVINCE
BADULLA
NUWARA ELIYA
MONARAGALA
RATNAPURA
0 10 20 40 Kilometers
Legend
Major City
Existing Hydropower Stations
Proposed Hydropower Stations
Pump Houses
Province Boundary
KMTC
UEC
NWPC
NCPC
RNKC
Kalinganuwara Pipeline
Other Proposed Irrigation Canals
Existing Irrigation Tunnel
Major River
Existing Tank / Reservoir
Proposed Reservoirs
Reservoirs Under Construction
Development Area - Under UEC
NCP Canal Development Area
Existing Mahaweli Systems
PROJECT
WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM
TITLE
GENERAL LAYOUT OF PROPOSED PROJECTS
DATE
November 2014
FIG NO.
WRDIP/ADB/GEN/01
SHEET
01 OF 01
A4

Water Resources Development Investment Programme

Environmental Assessment and Review Framework

1. Introduction

1.1 This Environmental Assessment and Review Framework (EARF) outlines the requirements that the executive agency of the Water Resources Development Investment Programme (WRDIP) will comply with in conducting an environmental assessment (EA), and in planning and implementing an environmental management plan (EMP) for a project of the WRDIP. Among these requirements are screening and categorizing potential project environmental impacts and risks; assessment of environmental policy and legal frameworks applicable to the project; its anticipated environmental impacts and risks; assessment of socioeconomic conditions in the project area; public consultation and information disclosure arrangements; grievance redress mechanisms; institutional arrangements to ensure environmental soundness and sustainability of the project and their adequacy; monitoring of EMP implementation; adequate budget, and a time schedule. These requirements are found in Sri Lanka's environmental policies, laws, regulations and guidelines, and in the ADB's Safeguard Policy Statement of 2009 (SPS). The Central Environmental Authority (CEA) and ADB will review and approve each environmental assessment report (EAR) prepared according this EARF. An EA can take the form of an Environmental Impact Assessment (EIA), Initial Environmental Examination (IEE), or environmental due diligence/audit.

1.2 The Ministry of Irrigation and Water Resources Management (MIWRM) is the executing agency of the WRDIP. It will conduct an EA or a due diligence exercise to formulate an EIA report or IEE report together with an EMP or a due diligence report for each project which indicates potential environmental impacts and risks. The MIWRM will submit the above environmental planning instruments to project approving authorities (PAAs) in Sri Lanka and ADB for review and approval prior to the commencement of project implementation.

1.3 In the context of the WRIDP, the need for an EARF arises from the fact that it will be implemented as a Multi-tranche Financing Facility (MFF). A MFF requires an EARF before ADB approves a MFF to state and clarify environmental safeguard principles and requirements that govern projects of tranches of WRDIP in order to ensure that projects implemented under WRIDP comply with local environmental regulatory framework and ADB's environmental safeguard objectives, principles and requirements.

1.4 The WRDIP will have three projects implemented in three tranches. Implementation of all three projects will be initiated in Tranche 1. Therefore, all three projects have been categorized and assessments prepared prior to ADB Board approval. This EARF outlines the measures and procedures to be followed if there are any changes to the layout, design and scope of the projects subsequent to ADB's approval. .

2. The Water Resources Development Investment Programme

2.1 ADB supports the Government of Sri Lanka to plan and implement the WRIDP through the MIWRM by financing the following three investment projects of the planned North Central Province Canal Programme (NCPCP). The WRIDP is a multitranche financing facility (MFF) amounting to $650 million. The MFF will comprise three tranches financing three loan "Projects". The Projects will comprise the following individual investment projects:

(i) The Kaluganga-Moragahakanda Transfer Canal (KMTC) will convey up to 771 MCM of water annually between Kaluganga and Moragahakanda Reservoirs, both of which are under construction (funded by other financiers). The reservoirs will retain local runoff and Mahaweli River flow diversions before commanding downstream irrigation and water supply schemes. The length of the canal is 9 kilometers (km) and comprises about 8 km of tunnelling.

The Upper Elahera Canal (UEC) will annually convey up to 974 MCM northwards from Moragahakanda Reservoir, along a 70 km canal (including about 20km of tunnels and 16 km of cut-cover conduits), to the existing Huruluwewa and Manankattiya Reservoir, which in turn feed existing irrigation and water supply schemes.

(ii) The North Western Province Canal (NWPC) will annually withdraw 130 MCM from Dambulu Oya River and the existing Nalanda Reservoir to command new and existing irrigation and water supply reservoirs located throughout North Western Province via 80 km of new and upgraded canals including a new 700 meter (m) tunnel.

(iii) Minipe Left Bank Canal Rehabilitation (MLBCR), located downstream of the Mahaweli Hydropower Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork's weir by four meters to regulate generation inflows, and (b) rehabilitate the 76 km Minipe Left Bank Canal to improve conveyance and reliability of service to existing farmers.

2.2 The investment programme will be implemented over ten years and its proposed structure is shown in **Table 1**. The investment programme will also include three consulting packages comprising: (i) "improving system efficiencies and water productivity" (ISEWP); (ii) "strengthening of integrated water resources management" (SIWRM); and (iii) the Programme Management, Design and Supervision Consultant (PMDSC) which will support the MIWRM to manage the Programme and prepare packages.

Table 1: Tentative Investment Program Structure and Implementation Schedule

Project	Value ($, millions)	Subproject	Schedule
Construction Works			
Project-1	175	UEC Stage 1 NWPC Stage 1 MLBCR	Q1 2015 – Q4 2019
Project-2	275	UEC Stage 2 and KMTC	Q1 2016 – Q4 2024
Project-3	200	UEC Stage 3 NWPC Stage 2	Q1 2018 – Q2 2024
TOTAL	**650.0**		

KMTC = Kaluganga – Moragahakanda Transfer Canal; MLBCR = Minipe Left Bank Canal Rehabilitation; NWPC = North Western Province Canal; UEC = Upper Elahera Canal; Q = quarter of a year.

Source: Asian Development Bank

3. Environmental Assessment and Review Framework

3.1 The MIWRM recognizes that rehabilitation and construction activities under the WRDIP will generate positive social and economic benefits as well as adverse environmental impacts and risks. As an environmentally informed and socially responsible Ministry of the Government, the MIWRM is committed to avoid, minimize, or at least to mitigate adverse environmental and social impacts of the WRDIP. By combining national environmental safeguard regulatory frameworks and ADB's environmental safeguard policy principles, this EARF will guide the MIWRM on screening and categorizing potential environmental impacts and risks, consultations, conducting assessments and the formulation of EA reports and EMPs, their disclosure, establishment of grievance redress mechanism, implementation of EMPs, monitoring of results, and adequate reporting of monitoring results.

3.2 The EARF focuses on environmental safeguard compliance of the WRDIP, and is guided by the MIWRM's commitment to integrate environmental protection into the WRDIP in a proactive manner in order to contribute towards sustainable development of water sources. To achieve a balance among developmental imperatives, environmental sustainability, and social well-being of its operations, the MIWRM:

(i) Will identify adverse environmental and social impacts and risks of the WRDIP at early stages of the project cycle, and will avoid, minimize, and mitigate them

(ii) Is committed to comply with all environmental policies, laws, and regulations of the Government, and will remain fully responsive to environmental and social safeguard policy requirements of ADB and other development partners

(iii) Will apply the EARF to projects of the WRDIP as per the safeguard principles and procedures, outlined in the EARF.

Objectives of the EARF

3.3 The EARF:

(i) Outlines safeguard best practices that will be applied to WRDIP

(ii) Provides a screening and categorizing system to screen potential environmental impacts of the WRDIP

(iii) Guides MIWRM in conducting meaningful consultations with all project stakeholders.

(iv) Guides the MIWRM in the preparation and updating of IEEs, EIAs, EMPs, and environmental due diligence reports

(v) Guides the MIWRM in the disclosure of environmental information to all project stakeholders

(vi) Outlines institutional arrangements for the implementation of safeguard planning instruments, monitoring and reporting, and for undertaking corrective action plans, if any

(vii) Helps enhance institutional capacity for safeguard compliance at MIWRM, affiliated institutions and local government agencies, and among WRDIP contractors.

4. Environmental Regulatory Framework of Sri Lanka

4.1 The regulatory framework for environment comprises policies, laws, regulations and guidelines form a composite framework for environmental planning, implementation and monitoring of development projects.

The National Environmental Policy of Sri Lanka, 2003

4.2 The Constitution of Sri Lanka makes it "the duty of every person in Sri Lanka to protect nature and conserve its riches". The National Environmental Policy (Policy) acknowledges this duty and provides directions according to which steps will be taken to conserve and manage all aspects of Sri Lanka's environment.

4.3 The Policy renews the commitment of the government, in partnership with the people, to effectively manage the environment for the benefit of present and future generations. The Policy aims to ensure sound environmental management within a framework of sustainable development in Sri Lanka. This Policy is supported by many other policies and strategies for other sectors.

4.4 The Policy emphasizes that caring for the environment is the bounden duty of any institution, government or non-government, and of any individual that uses, or otherwise carries out an activity that has an impact on environmental resources.

4.5 The Policy binds all organisations and individuals who use environmental resources or otherwise have an impact on the resources to exercise due care to avoid environmental degradation. The implementation of the Policy will pave the way for sustainable development.

Policy Objectives

4.6 The Policy anticipates achieving the following objectives:

(i) To promote the sound management of Sri Lanka's environment in its entirety without compromise, balancing the needs for social and economic development and environmental integrity, to the maximum extent possible, while restricting inimical activities

(ii) To manage the environment by linking together activities, interests, and perspectives of all groups, including the people, nongovernment organizations and government at both the central and the local levels

(iii) To assure environmental accountability

Policy Principles

4.7 Policy principles are:

(i) The guiding principles of environmental management will be “polluter pays” and the need to reduce consumption, and recycle and reuse materials to the maximum extent possible.

(i) When living natural resources are used, it will be ensured that such use is wise, sustainable, and consistent with the integrity of ecosystems and evolutionary processes.

(ii) When non-living resources are used, it will be ensured that such use is consistent with environmental best-practices, bearing in mind the need to provide also for future generations.

(iii) Traditional knowledge and practices will be respected in the development of environmental management systems.

(iv) Effective governance will be ensured through the decentralization of environmental management services to the maximum extent possible.

Policy Statement

4.8 The following statement summarizes its key aims:

(i) Resources such as land, water, air, minerals, and biodiversity will be managed in a manner consistent with the viability of ecological processes.

(ii) Environmental management will be through participatory, transparent, predictable and accountable decision-making processes at all levels.

(iii) In addition to protecting the environment from abuse, management systems will take into account the need to restore environments damaged in the past.

(iv) Environmental management systems will be encouraged to be flexible so as to adapt to changing situations and adopt the precautionary principle.

(v) The economic value of environmental services will be recognized so as to assure the sustainability of such services for the benefit of the people.

(vi) The state of the environment will continuously be assessed and reported on, through an appropriate institutionalized monitoring framework based on a comprehensive set of indicators.

(vii) The institutional framework for sound environmental management will be strengthened through capacity building, legislative enactments, and improved inter-institutional coordination and linkages.

(viii) “Life cycle” and “cleaner production” principles will be applied to improve the efficiency of natural resource use and to improve environmental quality.

Environmental Laws

The Constitution of Sri Lanka

4.9 The Constitution of Sri Lanka contains several provisions relating to the environment such as Article 18 ("It is the duty of every person of Sri Lanka to protect nature and conserve its riches") and Article 27 (14) ("The state shall protect, preserve and improve the environment for the benefit of the community"). The 13th Amendment to the Constitution created a new institution at the provincial level for environmental protection and management. Each provincial government under this Amendment has legislative and executive powers over environmental matters (Articles 154 (A), 9, 19 and (III) 17). Using such provincial legislative and executive powers, the North Western Provincial (NWP) Council, adopted the North Western Provincial Environmental Authority to supervise and monitor environmental activities in the North Western Province of Sri Lanka. To date of the nine provincial councils it is only the NWP that has adopted its own authority.

National Environmental Act No. 47 of 1980 (and its Subsequent Amendments)

4.10 The National Environmental Act (NEA) provides conservation and development guidelines for natural resources management including water, forest, flora and fauna in Sri Lanka. The 1988 amendment to the Act appointed the CEA as the enforcement and implementing agency of the Act. The CEA has special powers to assess and monitor critical environmental conservation programmes and to advise the government on environmental protection, conservation, management and development issues.

4.11 Types of projects that need mandatory environmental clearance ("prescribed projects") were made public after the amendments to NEA was approved in 1988. The Act 1988 states that all prescribed projects undertaken by any government department, corporation, statutory board, local authority, company, firm or an individual will be required to obtain approval before their implementation. The approval will have to be obtained from the appropriate PAAs who are concerned or connected with such prescribed projects. At present, there are 31 such PAAs to deal with review and approval of environmental plans. The CEA has an oversight function over the PAAs.

4.12 Projects under the WRDIP could also come under the purview of the following Acts according to the specific circumstances. However, screening, scoping, formulation of any EIAs, IEEs, EMPs and procedures for their disclosure and public consultations will be governed by NEA of 1980 and its subsequent amendments of 1988 and 2000, and by environmental regulations (see below).

Pradeshiya Sabha Act No. 15 of 1987

4.13 Section 12 (2) of the Pradeshiya Sabha Act authorizes the appointment of a committee at the divisional level to advice on environmental matters. Section 105 of the Act prohibits polluting water or any streams, while Section 106 refers to pollution caused by industry and related offences. The Pradeshiya Sabha grants permission for construction activities within its jurisdiction. Such construction will have to comply with environmental requirements stipulated in permits.

Flood Protection Ordinance, Act No. 22 of 1955

4.14 This ordinance provides for the acquisition of land or buildings or part of any land or building for the purpose of flood protection.

State Land Ordinance, Act No. 13 of 1949

4.15 The State Land Ordinance provides guidelines for:

(i) The protection of natural water springs, reservoirs, lakes, ponds, lagoons, creeks, canals, and aqueducts.

(ii) The protection of the source, course and bed of public streams.

(iii) The construction or protection of roads, paths, railways, and other means of internal communication systems.

(iv) The prevention of soil erosion.

(v) The preservation of water supply sources.

4.16 Section 75 of the Ordinance highlights riparian proprietors' rights and duties. The occupier of land on the banks of any public lake or public stream has the right to use water in that water body for domestic purpose, but cannot diverted water through a channel, drain or pipe or by any other mechanical device.

Soil Conservation Act, No. 25 of 1951

4.17 The Soil Conservation Act provides for the conservation of soil resources, prevention or mitigation of soil erosion, and for the protection of land against damage by floods and droughts. Under the Act, it is possible to declare any area defined as an 'erodible area' and prohibit any physical construction. The following activities are also prohibited under Act:

(i) Weeding of land or other agricultural practices that cause soil erosion;

(ii) Use of land for agriculture purposes within water sources and banks of streams

(iii) Exploitation of forests and grassland resources and setting fire in restricted areas

Mines and Minerals Act No. 33 of 1992

4.18 Under this Act, mining falls within the purview of the Geological Survey and Mines Bureau (GSMB). Mining of minerals including sand must be done with a license issued by the GSMB. Mining is not permitted within archaeological reserves or within specified distances from such monuments. New mining licenses are subject to the EIA process, if the type and extent of mining is listed under the EIA regulations. Additionally, the GSMB has the power to stipulate conditions including cash deposits and insurance policy for the protection of environment. Regulations made by the GSMB under the Act cover a variety of environmental stipulations, criteria and conditions for licensing and operating mines. This also covers the disposal of mine wastes. The Act also deals with the health, safety and welfare of miners. Mining rights on public and private land are subject to licensing by the GSMB, and all minerals wherever situated belonging to the State. The right to mine public land parcels are subjected to EA procedures.

Fauna and Flora Protection Ordinance, Act No. 49 of 1983 (and Subsequent Amendments)

4.19 The Act provides for the protection, conservation, and preservation of the fauna and flora of Sri Lanka. Under the Act, five categories of protected areas are established, namely, strict nature reserves, national parks, sanctuaries, nature reserves, jungle corridors, and intermediate zones. The Section 9 (a) states that “no person or organization, whether private or state, shall within a distance of 1 mile of the boundary of any national reserve declared by an order issued under Section 2 of the Ordinance carry out any development activity of any description whatsoever, without obtaining the prior written approval of the Director”. Each application for a development activity has to follow the procedures stipulated under NEA. An application falls within the meaning of Section 9(a) has to be supported by an EIA or an IEE according to the significance of expected environmental impacts. Since some of the activities under the WRDIP are within areas under the jurisdiction of the FFPO this law is applicable to the Programme.

Forest Ordinance, No 17 of 1907 (and its Amendments)

4.20 The Forest Ordinance of 1907 was amended by Act No. 13 of 1966, No. 56 of 1979, No. 13 of 1982, No. 84 of 1988, No. 23 of 1995 and No. 65 of 2009. It is now cited as the 'Forest Conservation Ordinance'. The four categories of forests protected by the Forest Conservation Ordinance are Conservation Forest, Reserved Forest, Village Forest and Other forests (with the exception of Conservation, Reserved and Village forests). Each category is declared under the Forest Ordinance. Provisions to protect and manage them are provided in the Ordinance. Acts prohibited in conservation forests are given in Section 6, in reserved forest in Section 7, in village forest in Section 14, in forest other than conservation, reserved forest or village forest in Section 20. Protected Areas under the Department of Wildlife Conservation are National Reserves - Strict Natural Reserves, National Parks, Nature Reserves, Jungle Corridors, Refuge, Marine Reserves, Buffer Zone, and Sanctuaries. Under Section 5 of the Ordinance, a Forest Officer has power to

stop any public or private watercourse which goes through a reserved forest. It shall be lawful for the District Secretary to determine the amount of compensation to be paid in case that the water course adversely affects the interests or one or more individuals. Under Section 6 of the Act, the following activities are prohibited: trespassing or permits cattle to trespass; damage by negligence in felling any tree, cutting or dragging any timber; wilfully strip off the bark or leaves from, or girdles, lop, taps, burns or otherwise damage any trees; poison water; mine stone, burns lime or charcoal, or collect any forest produce; and extracts coral or shells or digs or mines for gems or other minerals

The Urban Development Authority, Law, No 41 of 1978

4.21 The Urban Development Authority (UDA) promotes integrated planning and implementation of social, economic and physical development of areas which are declared as urban development areas under the UDA Act. UDA provides technical support to local councils who require assistance in developing plans. It has the authority to develop plans when local authorities fail to do. The UDA monitors urban areas, and develops land use policies for designated development areas. Municipal Council Ordinances and Acts – Urban Council Ordinance 61 of 1939, Act 29 of 1947, Act 18 of 1979, and Act 13 of 1979.

4.22 The Municipal Councils and Urban Councils share with Pradeshiya Sabhas powers regarding the approval of buildings plans, control of solid waste disposal, sewerage and other public utilities. Under these laws, new constructions and modifications to current buildings require approval of Municipal or Urban Council or Pradeshiya Sabha. Municipal and Urban councils follow planning and building guidelines of UDA.

4.23 The Environmental Policy, NEA and its amendments, and several other policies and Acts relevant to the WRDIP outlined above show that environmental policies and the legal or regulatory framework is comprehensive and adequate to address and manage potential environmental impacts and risks associated with canal refurbishment and construction of new canals and related facilities under the WRDIP.

Antiquities Ordinance

4.24 An Archeological Impact Assessment (AIA) for new projects is required under section 47 and 43A of the Antiquities Ordinance. (Extraordinary Gazette no 1154/14 dated 4th October 2000.)

5. Environmental Assessment Process in Sri Lanka

5.1 The EA processes is primarily concerned with assessing direct and indirect impacts of a project on the biophysical and human environment, and ensuring that these impacts are addressed by appropriate environmental protection and enhancement measures.

5.2 The laws, regulations, and procedures that govern an EA of a project are found in the NEA and environmental regulations. They are supported and elaborated by sector specific laws and their regulations, outlined above.

5.3 The NEA of 1980 recommends the adoption of an environmental assessment for each development project. The amendment to NEA in 1988 made an environmental assessment mandatory for each project with significant potential environmental impacts. The 31 types of projects that need EIAs are listed in the Gazette Extraordinary No 772/22 and No 1104 of 1993. Under the National Environmental Act, prescribed projects are stipulated in three parts listed in the schedule of the respective Gazette. Part I identifies prescribed projects based on type and magnitude; Part II identifies prescribed projects as, all subprojects identified in Part I, irrespective of their magnitude and selected high-polluting industries, if near culturally and/or environmentally sensitive areas defined in Part III of the schedule Gazette Extraordinary of 772/22 of 24 June 1993. All industrial projects that are located close to environmental, archaeological, or culturally-sensitive areas require full environmental impact assessments.

5.4 The evaluation and approval of environmental assessment reports (EARs) are delegated by CEA to various agencies depending on the nature of the project. Among these PAAs are Ministries of National Planning, Lands and Land Development, Irrigation and Water Resources Management, Transport and Highways, Energy, Agriculture and Forests, Urban Development authority, Board of Investments, Department of Wildlife Conservation, GSMB, Ceylon Tourist Board, and the Mahaweli Development Authority. A project proponent cannot perform the functions of PAA for the same project, and but should refer the project's environmental planning documents to CEA for approval.

5.5 The EA process guides projects to report on viable alternatives to ensure that environmentally less damaging options are also considered.

5.6 Project proponents will provide relevant, adequate, and accurate information and data required by the PAA to conduct an effective review of a project proposal. The PAA conducts scoping of the proposed project to determine its potential environmental impacts and risks.

5.7 The PAA solicits project-affected persons' views and opinions, queries project proponents for clarifications, and decides the categorization of the project as "prescribed" or "non-prescribed". If categorized as a prescribed project, the PAA will decide based on the significance of potential environmental impacts of the project, whether an EIA is required

or a less comprehensive environmental assessment such as an IEE is sufficient to address and resolve identified adverse environmental impacts of the project. It will prepare the terms of reference of the EA in either case.

5.8 Project proponents formulate an EIA or IEE with subject matter specialists following the approved ToR and submits the EIA or IEE report to the PAA in Sinhala or Tamil or English for review and approval. It will be translated into the other two national languages.

5.9 The PAA discloses the EA for public comments. The PAA will announce in national newspapers in three national languages that the EIA is available for 30 days for comments. It will also disclose the locations where it could be read. Such comments will be considered in finalizing EA reports.

5.10 The PAA and/or CEA review an EIA report. An IEE is reviewed by PAA based on the information provided by project proponents. A review of an EA report by the CEA and/or the PAA is guided by the following criteria:

(i) Environmental considerations are integrated into overall project planning
(ii) Environmental assessment is sound
(iii) Proposed environmental mitigation measures are adequate and effective

5.11 If the proposed project is controversial, the PAA or CEA may decide to conduct public hearings on the project and the EA. A public hearing can also be initiated if such hearing would help in verifying facts and findings of the EA, and the adequacy of proposed mitigation measures.

5.12 The PAA in consultation with the CEA approves or disapproves the EA. Alternatively, an EA can be approved subject to conditions to be met within the stipulated timeframe. If the project is rejected because of an unsatisfactory EA, project components can appeal against the decision to the CEA.

5.13 If the project is approved, the project proponents and PAA monitor the implementation of the EMP prepared together with the EA to set out remedial actions and to ensure that they meet the standards established.

5.14 Generally, the application of environmental laws and regulations to development projects is satisfactory. The EA process is well understood by officials and by the public. The courts have interpreted environmental laws proactively and insist on close adherence to procedures in formulating environmental planning documents and their implementation. The EA process has succeeded in introducing mechanisms for transparency, consultation, and disclosure of EA reports, their results and monitoring reports.

5.15 The environmental training programmes conducted by the Ministry of Environment and Renewable Energy (MERE), the CEA, universities, and development partners have

produced hundreds of trained environmental professionals in the government and private sectors, among civil society organizations and academia. In addition, the EA process is being taught at postgraduate level at local universities. As a result, the capacity to formulate, implement and monitor environmental plans exists adequately in Sri Lanka.

5.16. Sri Lanka has ratified several international environmental conventions, protocols, and framework conventions. Several of them apply to the Programme. Each EIA of the Programme will follow applicable international environmental agreements to examine its environmental impacts and risks, and to propose remedial and mitigation actions (see below)

Figure 1: International Environmental Agreements Ratified by Sri Lanka

Agreement	Ratification Date	Key Objectives
Atmosphere		
Vienna Convention for the Protection of the Ozone Layer (1985)	15 December 1989	Protection of the Ozone Layer through international cooperation in scientific research, monitoring and information exchange.
Montreal Protocol on Substances That Deplete the Ozone Layer (1987)	12 December 1989	Reduction and the eventual elimination of the consumption and production of Un-anthropogenic Ozone Depleting Substances
United Nations Framework Convention on Climate Change (UNFCCC 1992)	23 November 1993	Stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climatic systems
Kyoto Protocol (1997)	3 October 2002	The Annex 1 parties (Developed Countries) to reduce their collective emissions of greenhouse gases by at least 5% of the 1990 level by the period 2008 –2012.
Biodiversity		
International Plant Protection Convention (1951)	12 February 1952	To maintain and increase international co-operation in controlling pests and diseases of plants and plant products, and in preventing their introduction and spread across national boundaries
Plant Protection Agreement for Asia and Pacific Region (1956)	27 February 1956	To prevent the introduction into and spread within the region of destructive plants
CITES - Convention on International Trade in Endangered Species of Wild Fauna & Flora (1973)	4 May 1979	To protect certain endangered species from being over-exploited by adopting a system of import/export permits, for regarding the procedure.
Convention on the conservation of Migratory Species (CMS-1979)	6 June 1990	To protect those species of wild animals which migrate across or outside national boundaries
Convention on Biological Diversity (CBD-1992)	23 March 1994	Conservation of biological diversity, sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including appropriate access to genetic resources and by appropriate transfer of relevant technologies and appropriate funding

Agreement	Ratification Date	Key Objectives
Cartagena Protocol on Bio Safety (2000)	28 April 2004	To ensure adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specially focusing on trans boundary movements.
Land		
United Nations Convention to Combat Desertification (UNCCD- 1994)		To combat desertification and to mitigate the effects of drought in countries experiencing serious droughts and/ or desertification with the final aim being to prevent land degradation in the hyper arid, arid, and semi-arid, dry sub humid areas in the countries that are parties of the Convention
Chemicals		
Basel Convention on the Control of Trans-boundary movements of Hazardous Wastes and Their Disposal (1989)	28 August 1992	To reduce trans-boundary movements of hazardous waste; to dispose of hazardous and other waste as close as possible to the source; to minimize the generation of hazardous waste; to prohibit shipments of hazardous waste to countries lacking the legal, administrative and technical capacity to manage & dispose of them in an environmentally sound manner; to assist developing countries in environmentally sound management of the hazardous waste they generate
Rotterdam Convention (1998)	19 January 2006	To promote shared responsibility and cooperative efforts in the international trade of certain hazardous chemicals, to protect human health and the environment; to contribute to the environmentally sound use of those hazardous chemicals by facilitating information exchange, providing for a national decision-making process on their import/export
Stockholm Convention on Persistent Organic Pollutants (POPs -2001)	22 December 2005	To protect human health and the environment from persistent organic pollutants (POPs).

6. ADB's Environmental Safeguard Policy Principles

6.1 The environmental safeguard policy principles of ADB are embodied in the SPS (2009). It applies to all projects and programmes supported by ADB. The SPS aims to (i) help avoid adverse project impacts on the environment and on affected people and communities, (ii) minimize, mitigate and/or compensate for adverse project impacts, if unavoidable, (iii) help borrowers to strengthen their safeguard systems; and (iv) develop their capacity in managing the environmental and social risks.

6.2 The environmental safeguards policy principles are:

- Use screening process for each proposed project to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.
- Conduct an EA for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential trans-boundary and global impacts, including climate change. Use strategic EA where appropriate.
- Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.
- Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.
- Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance.
- Disclose a draft EA (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected

people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.

- Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.
- Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programmes to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development and management of renewable natural resources.
- Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the *World Bank Group's Environmental, Health and Safety Guidelines, 2007*. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage.
- Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.
- Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.
- Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.

6.3 The WRDIP is likely to trigger all environment safeguard policy principles of the SPS. In order to ascertain how well the national environmental regulatory framework meets ADB's environmental safeguard policy principles, a comparison between the two is done in the next section. (See Annex 1 for details).

7. National Environmental Regulatory Framework and ADB's Environmental Safeguard Policy – A Comparison

7.1 The NEP addresses all relevant aspects of environment protection, environmental sustainability and enforcement. The Policy matches the environmental safeguard policy principles of the SPS. The NEA, its amendments, and sector level legislation that support it have sufficiently transformed the Policy into a satisfactory environmental regulatory framework.

7.2 The composite government environmental clearance process, in principle, is consistent with ADB's environmental assessment process and public disclosure requirements. Disclosure of the EIAs for development projects that are categorized as "prescribed" projects is mandatory. The prescription is based on the magnitude and potential for adverse environmental impacts of a proposed project. The CEA and PAAs have been reviewing and approving the EIAs for prescribed projects since 1993 and have developed a solid technical expertise and capacity for this task with technical assistance projects from United States Agency for International Development (USAID), the Netherlands, ADB, and the World Bank over the past two decades.

7.3 Both ADB and NEA prescribe that the implementation of an EMP will be a part of construction contract. Both CEA/PAA will monitor the progress in implementing an EMP.

7.4 ADB and the CEA require that EAs would not award contracts until the EIAs/IEEs and EMPs are endorsed by them.

7.5 The procedures of ADB and CEA differ on categorisation of environmental impacts and risks. ADB's environmental categorisation has four categories, namely, A, B, C and FI, whereas the CEA uses 'prescribed' and 'non-prescribed' projects. As outlined earlier, the criteria for determining whether the EA should take the form of an EIA or IEE are also different.

7.6 In the following key areas, Sri Lanka's environmental assessment displays some weaknesses and deficiencies for which the following gap-filling measures are adopted from ADB's environmental safeguard policy principles and international best practices.

7.7 As per the NEA and its amendments of 1988 and 2000, and regulations, a project proponent provides the PAPs and other stakeholders an opportunity to express their views, comments, and complaints before finalising an EA report.. The draft EIA report is usually made available to the public for 30 days in the local government offices, at district CEA offices, and at the CEA Head Office at Battaramulla. In many projects, the PAPs do not know about the project or its EA report, until it is too late. Often the project proponents do not provide sufficient project information to the PAPs or adequately disclose the EA reports. As a result, the PAPs often fail to interpret and understand EA

reports. These difficulties are partially alleviated by public hearings conducted on EA reports In such gatherings project proponents and EA consultants could explain in local languages the salient features of the project and its environmental impacts and measures to avoid or at least to mitigate them. But such public hearings are held at the discretion of the PAA. Moreover, the IEEs are not required to be presented for public consultation. These weaknesses can be overcome by following the public consultation and participation, and disclosure procedures of the EARF, which outlines how to conduct meaningful consultations with all stakeholders including the PAPs. Such consultations are to be conducted periodically starting from project planning through implementation and monitoring.

7.8 The local environmental regulatory framework does not prescribe a due diligence or environmental audit to check existing facilities at project site(s) to determine whether they could cause or is causing environmental impacts and risks. The SPS requests environmental due diligence or audit in such circumstances. If the project does not foresee any major expansion except refurbishment of existing buildings and facilities, the due diligence or environmental audit constitutes the environmental assessment for the project.

8. Screening and Categorization of Potential Environmental Impacts

8.1 In screening a project for environmental impacts and risks, use the screening and categorisation system outlined in the SPS to determine whether it will have any significant potential environmental impacts and risks and their magnitude. ADB with project authorities will screen each proposed project at the earliest stage of project preparation when sufficient project information is available. The purpose of the exercise is to identify environmental impacts and risks, their significance, and to identify the level of assessment and institutional sources required to prepare safeguard planning instruments. It will also indicate disclosure requirements of such planning instruments. The environmental impact category of a project is determined by its most environmentally-sensitive component, including direct, indirect, cumulative, and induced impacts within the project area of influence.

8.2 The project screening and categorization system applicable to WRDIP is given below:

(i) Category A: The project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented, and may affect an area larger than the sites or facilities subject to physical works. An EIA and a comprehensive EMP are required.

(ii) **Category B:** The project is likely to have adverse environmental impacts that are less adverse than those of Category A, which are site-specific, few, mostly reversible, and in most cases, mitigation measures can be designed more readily than in Category A projects to address them. An IEE and EMP are required.

(iii) **Category C:** The project is likely to have minimal or no adverse environmental impacts. No EA is required although environmental implications of the project need to be reviewed and addressed.

8.3 Fill in environmental categorisation form (to be obtained from ADB) in consultation with ADB to submit to the Chief Compliance Officer at ADB for endorsement. The category endorsed in the preliminary categorisation phase can be revised at any time with the permission of CCO. Under this MFF all subprojects have been screened and categorized as follows: (i) The Kalu Ganga Moragahakanda Transfer Canal and Upper Elahera Canal Project – Category A; (ii) North Western Province Canal Project – Category A; and (iii) Raising of Minipe Anicut and Rehabilitation of Minipe Left Bank Canal Project – Category B. Since the investment is a time slice investment, all three sub projects will be initiated in Tranche 1. With the exception of the Minipe Anicut and Rehabilitation Project the other two projects continue through to Tranche 3. Therefore, all three tranches are categorized as A. Under the National Environmental Act too the first two projects require EIA's and the last project required an IEE. Therefore, categorization based on SPS and NEA was equivalent. The terms of reference initially drafted by CEA were amended to incorporate ADB's SPS requirements. Since all three projects will be initiated in tranche 1, the two

EIAs and IEE will need to be approved by ADB prior to Board approval and contract award, and by CEA prior to contract award.

8.4 During project implementation if there is any change in the alignment or scope of the project MIWRM will inform CEA and ADB. Once ADB is informed of these changes, ADB will reassess the category of the project and if required re-categorize the project and also assess the need for additional studies or fresh assessments to update the EIA's and/or IEE.

9 Consultation and Participation

9.1 The MIWRM will conduct meaningful consultations with PAPs and other stakeholders throughout the project life. Consultations: (i) begin early in the project preparation phase and continue through all phases of the project; (ii) share adequate information with the PAPs and stakeholders in a timely manner, (iii) conduct consultations in an atmosphere which is conducive to arrive at decisions that are beneficial to the project, the PAPs, and other stakeholders; and (iv) include women and vulnerable groups in discussions. This ensures that the views of all affected parties are taken into consideration in environmental planning. For environment category 'A' projects, such consultations will at least include a round of consultations at the early stage of EIA fieldwork, and again when the draft EIA report is available for disclosure and discussion before the project is appraised by ADB.

9.2 The MIWRM will prepare a consultation plan and inform the PAPs and other stakeholders the locations where consultations will be held. The Environmental Group at the Program Management Unit (PMU) of the WRDIP will lead the consultations with the help of environmental officer at the Project Implementation Unit (PIU). The proceedings and outcome of such consultations will be recorded. The EA report will have summaries of such consultations – who attended, the manner in which they were conducted, key topics discussed, and the decisions arrived at with participants' support and participation.

9.3 The MIWRM will actively seek the PAPs' participation in formulating the EA reports and EMPs and their implementation. The MIWRM will discuss with the PAPs and other stakeholders the draft EIA/IEE and EMP to obtain their views on the EIA/IEE and EMP. Through periodic consultations and grievance redress mechanism, the MIWRM will engage them in project planning, implementation, and monitoring.

10. Anticipated Environmental Impacts of WRIDIP

10.1 Both beneficial and adverse environmental impacts of a project will be identified during the environmental assessment. Direct, indirect; reversible and irreversible; long-term and short-term; and cumulative impacts on physical, biological, socioeconomic, and physical and cultural resources will be examined to determine their significance and scope. Impact identification focuses on design and planning (pre-construction), construction, and post-construction phases. Initial stakeholder consultations and field surveys would reveal key impacts that need further study to formulate comprehensive mitigation measures. In the WRIDIP, some of them have already been avoided or at least minimized through design modification and route realignment.

10.2 Impacts and risks of a project will be analysed in the context of project's area of influence. In the context of three projects – UECP, NWCP and MLBCR – such impacts and risks have already been analysed and the beneficial and adverse impacts are discussed based on the environmental assessment undertaken at each of the projects.

Anticipated Beneficial Impacts

Income and Employment Benefits

10.3 The WRDIP aims to improve agricultural production through better irrigation facilities in several regions of the dry zone. The positive impact of the diversion of the Mahaweli River water to medium and small reservoirs in the dry zone, where acute problem of water scarcity prevails, will be significant. The WRDIP is geared towards to increasing the cropping intensities and agricultural production under reservoirs by providing water to cultivate total cultivable area in the Yala (dry) season as well. This will generate more employment opportunities for agricultural labourers, thereby increasing their income and living standards. These changes will have direct beneficial impact on food security and rural poverty.

Community Benefits

10.4 The Programme will also provide drinking water to rural communities. Such benefits directly impact on households' health, sanitation and labour. The availability of drinking water, for example, releases women from fetching water daily from faraway places. This would provide time for them to engage themselves in productive activities such as home gardening and other income-generating activities and also to participate in community activities.

Benefits to Wildlife

10.5 Canals will act as a barrier to encroachment by people onto protected areas. The provision of water bodies along canals will benefit wild life especially during drought seasons. On the other hand, the canals will act as a barrier to wild animals crossing into human settlements thereby removing the need to maintain electric fences at those locations.

Impacts Requiring Mitigation, Compensation and Correction

10.6 Most of these impacts need careful planning of mitigation measures at pre-construction, construction and post-construction phases. Mitigation measures together with resources, institutional support and a time table are to be elaborated in EMP against each adverse impact identified.

Impacts on Physical Resources

Water and Hydrology

10.7 Anticipated environmental impacts of the WRDIP on water and hydrology are changes in groundwater levels, changes in stream flow including environmental flows, changes in drainage patterns and their impacts on ecosystems. There can be risks such as soil erosion, water contamination, drains and waterways blockages during site clearances. Vegetation not properly disposed of could also spread invasive species causing environmental degradation. Pools of stagnant water could generate health risks by creating vector populations. Site clearance could also lead to or aggravate soil erosion, especially during the rainy season.

Waste Generation

10.8 Any construction will generate construction debris which unless disposed of appropriately and in a timely manner will pollute adjoining areas, including potentially sensitive sites and residential areas. The lack of proper construction waste disposal could also block natural drainage systems and create breeding grounds for mosquitoes and for waterborne diseases. The lack of appropriate mechanisms to dispose of hazardous and toxic waste could lead to the contamination of soil and water resources.

Resource Extraction

10.9 The construction and refurbishment of irrigation canals will generate a big demand for construction materials creating a burden on natural resources in project areas. Sand mining in nearby rivers and stream and extraction of gravel from borrow pits and quarries could create adverse environmental impacts on nearby communities.

Impact on Air Quality

10.10 Air quality can deteriorate during the pre-construction and construction phases of a project owing to dust and exhaust fumes, transportation of construction materials and rock blasting. Transportation of construction material will increase traffic on most roads in the project area, and the amount of dust released into air will be significant. Resettlement site development, building of worker camps, land clearance, drilling, tunnelling and other construction activities will keep adverse impacts on air quality over several months or years.

Noise Pollution

10.11 Tunnel excavation, particularly through drill and blast methods will increase noise pollution that will affect human beings and wildlife. Noise and vibrations generated by excavation, cutting, filing and compaction work as well as operation of heavy vehicles during the construction phase will cause disturbance especially to the fauna that inhabits in project areas. Birds and mammals will also be affected as some projects will traverse through sanctuaries and nature reserves. Most of the tunnel sections will be constructed using tunnel boring machines reducing noise and vibration.

Soil Stability and Soil Erosion

10.12 Loss of soil stability and soil erosion can take place due to the removal of vegetation cover for project activities. It can cause loss of soil fertility and induce slope instability. Such risks are expected to be heavy during the construction phase. Dumping of excavated soil and rocks on river banks and slops could cause environmental damage by soil wash and subsequent siltation of downstream land areas or water bodies.

Impact on Mineral Resources

10.13 Canal sections, cut and cover sections, conduits and tunnel sections, all of which are concrete lined, comprise restricted cross sections. Along their lengths, the canals pass several types of mineral deposits, and especially through some quartz veins of high purity. Tunnelling has to pass through marble in confined areas. The excavation method adopted for tunnelling would determine the usability and disposability of marble coming out as tunnel muck.

Ecological Impacts

Fauna

10.14 The WRDIP will construct canals which will traverse through protected areas and modified habitats. The main habitat types observed along the canal traces include undisturbed and degraded dry-mixed evergreen forest, scrubland, riverine forests, vegetation associated with rock outcrops, grasslands, home gardens, paddy lands, abandoned land, *chena* (slash-and-burn) land, and teak tree plantations. Each habitat supports a rich faunal and floral assemblage especially in protected areas. The main negative impact of the WRDIP on them will be the loss of habitat and the blockage of movement paths of animals, especially, elephants and other ground-dwelling species.

Impact on Biodiversity

10.15 The projects will be located in low country dry zone of Sri Lanka, with the exception of the Minipe rehabilitation project. The dry zone habitat and rich repositories of indigenous flora, fauna, especially large animals such as elephants and leopards. In project areas, dry-mixed evergreen forests, disturbed evergreen forests and scrubland function as rich biodiversity repositories. Several hectares will be lost permanently to the WRDIP which will have an irreversible impact on the biodiversity inhabiting these habitats. Environmental specialists will assess the major threats to biodiversity which include destruction of habitat and introduction of invasive alien species and on the use of natural resources in unsustainable manner.

Impacts on Archaeological Sites

10.16 All archaeological remains are to be located and identified and recorded on maps with the assistance of the Archaeological Department. The project authorities will identify each of such archaeological remains and decide whether they fall within the identified areas of proposed project activities. Preliminary findings of a survey conducted in several project areas indicate that there are a large number of archaeological remains in the proposed project areas.

Socioeconomic Impacts

Loss of Property and Physical Relocation

10.17 Acquisition of land belts along canals will directly affect many households. Some of them will lose their residences or land or both. Disturbances to human settlements, forced relocation, social conflicts between resettlers and their host communities, loss of income sources, livelihoods, social networks and safety nets are associated with land loss and relocation. These key project impacts will be addressed through the Resettlement Implementation Plans (RIPs) formulated for each project of the WRDIP. Both social and

environmental safeguard planners will work together on this impact by sharing information and data.

Exposure of Construction Workers to Occupational Hazards

10.18 The recruitment of construction workers for project activities will necessitate the establishment of campsites and they will generate sewerage, waste water, and solid waste. Workers may engage in activities that are detrimental to natural habitats such as hunting, gem excavation, and illegal extraction of timber. On the other hand, construction workers are exposed to occupational hazards, unless proper safety procedures are followed at construction sites.

Environmental Management Plans

10.19 An EMP provides a link between the impacts predicted and mitigation measures to address them. While there is no standard format for an EMP, it should reflect a project's specific environmental circumstances and requirements.. In case of three projects of the Programme, detailed EMPs have already been completed.

10.20 Each EMP clearly indicates different phases of a project's physical activities. For each phase, it includes proposed mitigation measures against adverse environmental impacts and risks, institutional arrangements to deliver them, capacity development and training measures, implementation schedule, cost estimates, environmental monitoring indicators, and reporting requirements. The EMP will define expected outcomes as measurable events and include performance indicators or targets that can be tracked over a defined period of time. The Programme will not support any activities identified in ADB's Prohibited Investment Activities List in the EIA and EMP (Annex 3)

12. Disclosure of Safeguard Planning Documents

12.1 Project specific safeguard planning documents – the EIA, IEEs, EMPs, due diligence reports, mitigation plans, and corrective action plans will be disclosed to the PAPs and other stakeholders. Environmental safeguard monitoring reports of projects will also be disclosed to the PAPs and other stakeholders, and copies will be made available at project offices, the WRDIP PMU Office and at the MIWRM. These documents will also be uploaded to the ADB website. Each of these documents will be translated into Sinhala or Tamil or both in its entirety based on the locations of the project. The translated documents too are disclosed. In addition, key environmental information about the project will be kept at project locations which are accessible to all the PAPs and others for reference. The translation of documents and their disclosure will be done in a timely manner by competent translators.

12.2 All environmental planning documents will be sent to ADB and the CEA for review. The Program Director of the WRDIP will submit to ADB and the CEA the following documents for review and disclosure on ADB's website:

(i) Draft EIA/IEE (including the draft EMP)
(ii) Final EIA/IEE with EMP
(iii) New or updated EIA/IEE and corrective action plans, if any, during implementation
(iv) Environmental monitoring reports.

13 Institutional Arrangements and Responsibilities

Executing Agency and Implementing Agencies

13.1 The MIWRM will be the executing agency of the WRDIP, and it will be responsible for the overall coordination of WRDIP's planning, implementation, and monitoring. The proposed package on 'Strengthening of Integrated Water Resources Management' (SIWRM) will strengthen the MIWRM's water resources management capacity and will also help strengthening water resources management and irrigation sector policies, legislation and institutions.

Project Management Unit

13.2 Each project of the WRDIP will get advice on safeguard policy issues and safeguard compliance from the environmental unit at the PMU of the WRDIP located in Colombo in the MIWRM. The unit will be operated by an environmental safeguard specialist who possesses good academic background and at least 10 years of field experience in environmental safeguards. Three project implementation units (PIU) will be established for the implementation of the three projects and will be based in the locality of the project sites. The PMU environment specialist will be supported by three environment officers based in each of the three PIUs. An international and national environmental specialist attached to the Program Design Management Consultancy group will provide technical guidance and support the PMU and PIU environmental officers in their tasks.

13.3 The environmental unit at the PMU together with a safeguard focal person at each PIU will be responsible for the (i) preparation of checklists (if there are any changes in scope or alignment during implementation that warrant more studies), updating the EIAs, IEEs, and EMPs; (ii) conductance of due diligence and preparing reports; and (iii) monitoring of safeguard compliance. It will also formulate and use safeguards awareness training models on environment safeguards. Such activities could be outsourced; but the responsibility for environmental planning, implementation, environmental sustainability of projects and monitoring of their results will stay with MIWRM.

13.4 The environmental unit at the PMU of the WRDIP will ensure that the EMPs are included in contract documents. It will also ensure that contractors will adhere to the implementation and mitigation measures listed in the project EMPs.

13.5 The environmental unit at the PMU will organize awareness programmes and training sessions for IA staff at the project level on environmental safeguard requirements and safeguard compliance. It will prepare safeguard training materials and pamphlets for the benefit of project personnel, safeguard monitors, the PAPs and project contractors.

13.6 The environmental unit will establish direct links with all projects of the WRDIP and will develop and maintain an environmental safeguard database. It will be shared with project personnel, monitors and project stakeholders. The environmental unit could

obtain the services from outside, if required, for EA, safeguard awareness programmes, and training sessions.

Project Implementing Unit (PIU)

13.7 PIU of each project will be responsible for overseeing project construction works and for ensuring such works are in compliance with safeguard requirements, outlined in this EARF. Each PIU will appoint an environmental officer who will be in direct contact with the environmental unit of PMU at MIWRM for all safeguard issues at the project level. The official will coordinate with district and provincial CEA offices and divisional secretariats. The official will help the contractor to obtain permits and licenses and other clearance for project activities that would trigger environmental impacts. The safeguard official's key role is to ensure that all new construction and refurbishment of canals and other facilities comply with environmental safeguards, and EMPs are implemented in a timely and satisfactory manner.

13.8 It is necessary to prepare a full plan of institutional arrangement for each project indicating the agencies involved, their ToRs, time tables, and budgets. A diagram should outline the proposed institutional arrangements and their links with the PMU.

14 Grievance Redress Mechanism

14.1 At the state level, the CEA is the agency which deals with grievances and complaints regarding environmental safeguard compliance. The CEA has district offices, but they often lack resources to carry out safeguard compliance functions. Complaints pertaining to environmental adverse impacts are initially dealt with by district CEA offices with the help of the line department and or agency. Delays in hearings are frequently noted. Resorting to the court system for redress is always an option available to a grieved party; but it could delay project construction works by months or years.

14.2 The GRM is a part of any project supported by ADB. The GRM is a bottom-up multi-tiered structure. The local environmental regulatory framework does not provide for an institutionalized GRM at the project level..

14.3 The MIWRM will establish a GRM at each project and will develop procedures of establishing a grievance redress committee (GRC), its functions, powers, membership, and budget.

14.4 The GRCs will receive and facilitate the resolution of the PAPs' grievances regarding the project's activities that will have environmental impacts. The GRM at the project level will have to be scaled to the environmental impacts and risks anticipated. The PMU will facilitate the establishment of a GRM at each project and determine the responsibilities of GRC, its organizational structure, and powers.

14.5 A two tier GRC is proposed for this program. All complaints regarding social and environmental issues will be received either orally or in writing by the Project Proponent (PP) or the Construction Contractor (CC). A key part of the GRM is the requirement for the PP /CC to maintain a registry of complaints received at the respective project site offices. All complainants shall be treated respectfully, politely and with sensitivity. Every possible effort should be made by the PP or the CC to resolve the issues referred to in the complaint within their purview. However, there may be certain problems that are more complex and cannot be solved through project-level mechanisms. Such grievances will be referred to the Grievance Redress Committee. The GRC at the local level will be headed by the Grama Niladhari. The committee will comprise of Village level government officer (agrarian services/ irrigation department), community based organization leaders, Project representative (environment and social resettlement officers). Project affected parties, Contractor or his representative and any other person/government officer if required based on the issue. If the issue is not resolved at this level it will be forwarded to the second tier committee at the divisional secretary level. The GRC at the divisional secretariat level will comprise of Divisional Secretary (Chair). Grama Niladaris of relevant GNDS, Project director or his representative of PIU, CBO leaders, Contractors or his representative, relevant line agencies. If issues still remain unresolved they will be raised at the national steering committee.

14.6 The GRC will be responsive to the PAPs' needs, and to facilitate this, it will develop approaches that would enable all PAPs to gain access to the GRC. Cultural appropriateness of the constitution of the committee and procedures of hearings will be governed by cultural traditions in the project area. A feedback mechanism has to be built into the GRM to check how its clients treat it and their acceptance of it as an impartial and fair mechanism open to all project-affected persons. The Committee will address the PAPs' concerns and complaints promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to the PAPs at no cost.

14.7 Each complaint will be recorded and acknowledge by the GRC's Secretary. A complaint will be dealt with within four weeks and the decision of the GRC will be conveyed to the complaint in writing soon after the decision is made.

14.8 A GRC's decision can be challenged at the district-level CEA Office. If not satisfied with the district level decision, the complainant could appeal to the CEA in Colombo.

14.9 The GRM will not impede a PAP's desire to access judicial remedies.

14.10 The Program Director in consultation with the PMU environmental unit will examine the possibility and desirability of establishing one GRC to deal with environmental and resettlement issues, complaints and grievances. The MIWRM will inform PAPs and other stakeholders the scope of the GRM in each project.

15. Monitoring and Reporting

15.1 The WRDIP will ensure that environmental safeguard impacts and risks are adequately addressed. Periodic monitoring by the PMU and PIUs and ADB's assistance in addressing any weaknesses will help enhancing the quality of the application of environmental safeguards to projects of the Programme. The PMU will develop a mechanism with ADB's assistance to reduce safeguard risks through an environmental monitoring system.

15.2 An environmental monitoring system will be a part of the EMP(s). It will ensure that the proposed mitigation measures have the intended results and meet national environmental standards and ADB's environmental safeguard policy requirements.

15.3 The PMU's environmental unit will establish an environmental monitoring system. The monitoring system will have the following components:

- Monitoring indicators for evaluating the performance of each mitigation measure
- Monitoring mechanisms and methodologies
- Monitoring staff
- Monitoring frequency
- Monitoring locations
- Safeguard compliance reporting plan
- A budget

15.4 The PMU environmental unit will:

- Verify a project's compliance with safeguard requirements
- Document and disclose monitoring results and identify necessary corrective and preventive actions in biannual monitoring reports
- Submit safeguard monitoring reports to ADB
- Follow up on recommended actions to ensure desired outcomes are achieved

15.5 The monitoring data of each project will be fed into the safeguard database maintained at the PMU Office. Such data will be the baseline for verification of results in the spheres of environmental safeguard application, adequacy, and sustainability.

15.6 The Contractors will submit an environment method statement in keeping with the EMP at start of contract and obtain approval from the Project Engineer. The Contractor in his periodic progress reports should described the implementation of the EMP and any issues arising from it.

15.7 For the two category A projects MIWR will submit semi- annual and for the Category B project annual environmental monitoring reports to ADB and CEA. During loan review

missions, ADB will monitor environmental safeguard compliance of selected projects of the WRDIP and work with the PMU to develop action plans, if significant lapses in safeguard compliance are noted. A draft environmental monitoring report format is presented in Annex 2.

Annex 1

Comparison between Local Safeguard Regulatory Framework and Environmental Safeguard Policy Principles of ADB

Policy Principle	Triggered by the Programme	Gap Analysis	
		Congruence Between Local Environmental Regulatory System and ADB's Environmental Safeguard Requirements	Assessment of Implementation Capacity
1. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment	Yes	The NEA of 1980, its1988 amendment and Gazette Extraordinary No. 772/22 and No.11064 of 1993 provide for screening of each proposed project by a PP. The PP submits preliminary information about the project to PAA to initiate EIA/IEE process. The PP submits preliminary information through the Basic Information Questionnaire which could be obtained from the CEA Head Office or Provincial/District Offices, or downloaded from CEA website. As in case of SPS screening criteria, NEA screening guidelines use the type, scale, and magnitude of the proposed project as well as its location in determining the category— prescribed or non-prescribed. If the category is "prescribed", then PAA decides whether EIA or IEE should be prepared for the project. The environmental safeguard policy principle and procedures of SPS are congruent with that of Sri Lanka's environmental screening process applicable to WRDIP. SPS provides more details of environmental categorization which could easily be adapted to the local regulatory system. The difference between NEA and SPS requirements is that NEA applies a prescribed list whereas in ADB's case all projects will be categorized.	The CEA, MIWRM and MASL have adequate experience in screening and categorization of projects for environmental impacts and risks.
2. Conduct an environmental assessment for each proposed project to identify potential direct,	Yes	PAA provides the TOR for environmental assessment. It guides project proponents in selecting qualified experts to do necessary fieldwork and consultations.	MIWRM has environmental safeguard expertise. This is augmented by hiring qualified

Policy Principle	Triggered by the Programme	Gap Analysis	
		Congruence Between Local Environmental Regulatory System and ADB's Environmental Safeguard Requirements	Assessment of Implementation Capacity
indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic, and physical cultural resources in the project's area of influence.		The local regulatory system applicable to WRDIP is adequate for this task. Guidelines for environmental assessment in local regulatory framework is compatible with environmental principles and procedures of SPS	specialists or outsourcing environmental assessment to competent agencies or persons to complete under the supervision of PMU of WRDIP
3. Examine alternatives to the project's location, design, technology, components, and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the "no project" alternative.	Yes	The local environmental regulatory framework through PAA provides sufficient guidelines on examining alternatives to the project location, design, and technology. In tranche 1, preliminary traces of canals were selected after considering several alternatives to avoid harm to environment and human settlements.	See above.
4. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an EMP that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.	Yes	See note on Principle 1 above. Each "prescribed" project with environmental impacts will require an EIA or IEE and an EMP. The environmental regulatory framework provides limited directions on the actual formation of IEE and EMP when compared with ADB's safeguard requirements, although through TOR, PAA provides guidance for IEE and actions to overcome the adverse environmental impacts. The WRDIP's EARF will provide sufficient and comprehensive guidance in this regard. The EMP is considered an integral part of IEE and is not submitted separately to PAA for review. IEE includes all action plans to overcome adverse impacts. A detailed outline of EMP and a format of an EMP are provided below to overcome this gap (Annex 2).	MIWRM is aware of the importance of avoidance and minimization of adverse environmental impacts and enhancement of positive impacts. Its past projects reflect these capabilities and their adequacy. Capacity building measures such as the appointment of the Environmental Group at PMU of WRDIP would certainly further augment this capacity.

Policy Principle	Triggered by the Programme	Gap Analysis	
		Congruence Between Local Environmental Regulatory System and ADB's Environmental Safeguard Requirements	Assessment of Implementation Capacity
5. Carry out meaningful consultation with affected people and all other stakeholders. Continue consultations during project implementation.	Yes	The environmental regulatory framework provides limited opportunity for consultation with PAPs and other stakeholders although consultations are part of IEE/EIA formulation and approval under NEA. It is limited to presenting comments, complaints, and recommendation at the EIA/IEE review phase. 30 and 21 days are given for such public response in case of an EIA/IEE. PAA could hold a public hearing to ascertain facts and to get affected persons views and recommendation which will be incorporated into EIA/IEE when final document is prepared. Consultation during implementation of a project is the responsibility of PP and PAA.	There is no institutional vehicle to ensure consultation with all stakeholders at MIWRM, with the exception of consultation with farmers prior to water issuance. This needs development as part of capacity development of WRDIP. The establishment of the Environmental officer at PMU and the appointment of a focal safeguard officer at each project would help resolve this capacity deficiency.
6. Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.	Yes	Environmental regulatory framework directs PAA to disclose draft EIA/IEE to the public and to seek their views, comments and recommendations. Public meetings could be organized by PAA for public hearing. The Framework however, does not provide for the disclosure of final EIA/IEE to the public. EARF provides an adequate framework for the disclosure of planning documents.	To enable MIWRM to ensure timely disclosure of safeguard documentation in local languages, it is necessary to build institutional capacity at PMU and PIU levels. The establishment of an Environmental officer at PMU would help to address this gap.
7. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.	Yes	Limited scope in the local regulatory framework to monitor the implementation of actions in EIA/IEE and the formulation of corrective actions, if required. The EARF has elaborated these requirements and provide guidance on this aspect.	An EMP is sometimes not a part of the contract documents of a project. Hence, the probability that contractors follow good safeguard practices is low. Training and capacity building are needed in the implementation of EMP at the

Policy Principle	Triggered by the Programme	Gap Analysis	
		Congruence Between Local Environmental Regulatory System and ADB's Environmental Safeguard Requirements	Assessment of Implementation Capacity
			project level. Also EMP should be part of a contract.
8. Do not implement project activities in areas of critical habitats. If a project is located within a legally protected area, implement additional programmes to promote and enhance the conservation aims of the protected area. Use a precautionary approach to the use, development, and management of renewable natural resources.	YES- located within legally protected areas	The regulatory framework provides for adequate protection of critical habitats and environmentally sensitive areas. Projects in environmentally sensitive areas will fall into EIA category of "prescribed" projects under NEA 1980.	MIWRM has sufficient experience in implementing programmes to promote the conservation aims of protected and reserved areas. It applies the precautionary approach in selecting project traces to avoid critical habitats and to manage renewable natural resources.
9. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions,	Yes	NEA and its amendments and regulations provide sufficient instructions in this regard. Environmental regulatory framework generally meets the World Bank's Environmental, Health and Safety Guidelines. The EARF has elaborated them further.	The general recommendation for more training, awareness creation and capacity building among project personnel and contractors is valid here too.

Policy Principle	Triggered by the Programme	Gap Analysis	
		Congruence Between Local Environmental Regulatory System and ADB's Environmental Safeguard Requirements	Assessment of Implementation Capacity
waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.			
10. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.	Yes	The environmental regulatory framework provides for the conservation of physical cultural resources and to protect such resources.	Sufficient expertise and programmes are available with MIWRM to conserve affected cultural resources.
11. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures.	Yes	The local laws and procedures cover sufficiently these aspects.	Need better training on safety of workers and communities and resources.

ADB = Asian Development Bank, CEA = Central Environmental Authority, EIA = environmental impact assessment, EMP = Environmental Management Plan, IEE = initial Environmental Examination, MIWRM = Ministry of Irrigation Water Resources Development, NEA = National Environmental Act, PAA = project approving agency, SPS = Safeguard Policy Statement, 2009, TOR = terms of reference, WRDIP = Water Resources Development Investment Programme.

ANNEX 2
Draft Outline for Environmental Monitoring Report:

A safeguard monitoring report may include the following elements:

(i) Background/context of the monitoring report (adequate information on the project, including physical progress of project activities, scope of monitoring report, reporting period, and the monitoring requirements including frequency of submission as agreed upon);

(ii) Changes in project scope and adjusted safeguard measures, if applicable;

(iii) Qualitative and quantitative monitoring data;

(iv) Monitoring parameters/indicators and methods based on the EMP previously agreed upon with ADB;

(v) Monitoring results compared against previously established benchmarks and compliance status (e.g., obtaining necessary approvals for establishment of certain facilities, national environmental emission and ambient standards and/or standards set out in the WB's EHS guidelines; timeliness and adequacy of environmental mitigation measures;, and training; budget for implementing EMP, timeliness and adequacy of capacity building, etc.);

(vi) Monitoring results compared against the objectives of safeguards or desired outcomes documented (environmental impacts avoided or minimized, etc.);

(vii) If noncompliance or any major gaps identified, include a corrective action plan;

(viii) Records on disclosure of monitoring information to affected communities;

(ix) Identification of key issues, or grievances from affected people, or recommendations for improvement;

(x) Monitoring adjustment measures recommended based on monitoring experience/trends and stakeholders response;

(xi) Information about actual institutional arrangement for implementing the monitoring program/plan provided or adjusted, as may be required;

(xii) Proposed items of focus for the next report and due date.

Annex 3
ADB Prohibited Investment Activities List

The following investment activities will not qualify for ADB support:

(i) Production or activities involving harmful or exploitative forms of forced labour[1] or child labour;[2]

(ii) Production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phase outs or bans, such as (a) pharmaceuticals,[3] pesticides, and herbicides,[4](b) ozone-depleting substances,[5] (c) polychlorinated biphenyls[6] and other hazardous chemicals,[7](d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora,[8] and (e) trans boundary trade in waste or waste products;[9]

(iii) Production of or trade in weapons and munitions, including paramilitary materials;

(iv) Production of or trade in alcoholic beverages, excluding beer and wine;[10]

(v) Production of or trade in tobacco;[10]

(vi) Gambling, casinos, and equivalent enterprises;[10]

(vii) Production of or trade in radioactive materials,[11] including nuclear reactors and components thereof;

(viii) Production of, trade in, or use of unbonded asbestos fibres;[12]

(ix) Commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and

(x) Marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

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[1] Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty.

[2] Child labor means the employment of children whose age is below the host country's statutory minimum age of employment or employment of children in contravention of International Labor Organization Convention No. 138 "Minimum Age Convention" (www.ilo.org).

[3] A list of pharmaceutical products subject to phaseouts or bans is available at http://www.who.int.

[4] A list of pesticides and herbicides subject to phaseouts or bans is available at http://www.pic.int.

[5] A list of the chemical compounds that react with and deplete stratospheric ozone resulting in the widely publicized ozone holes is listed in the Montreal Protocol, together with target reduction and phase-out dates. Information is available at http://www.unep.org/ozone/montreal.shtml.

[6] A group of highly toxic chemicals, polychlorinated biphenyls are likely to be found in oil-filled electrical transformers, capacitors, and switchgear dating from 1950 to 1985.

[7] A list of hazardous chemicals is available at http://www.pic.int.

[8] A list is available at http://www.cites.org.

[9] As defined by the Basel Convention; see http://www.basel.int.

[10] This does not apply to investee companies who are not substantially involved in these activities. Not substantially involved means that the activity concerned is ancillary to an investee company's primary operations.

[11] This does not apply to the purchase of medical equipment, quality control (measurement) equipment, and any equipment for which ADB considers the radioactive source to be trivial and adequately shielded.

[12] This does not apply to the purchase and use of bonded asbestos cement sheeting where the asbestos content is less than 20%.

Annex 4

Environmental Safeguard Requirements in Contracts

The following environmental safeguard requirements are to be included in the section on employers requirements in the bid documents together with the individual EMPs prepared for each project.

A. General

(i) The Contractor and contractor's employees adhere to the mitigation measures set down in the EMP and take all necessary measures required to prevent harm, and to minimize the impact of operations on the environment.

(ii) The contractor on completion of construction should take full responsibility in ensuring a clean and safe construction premises.

B. Disposal of solid waste and debris

(i) All construction debris and residual spoil material including any left earth shall be disposed by the contractor at a location approved by the Local Authority for such a purpose.

(ii) The debris and spoil shall be disposed in such a manner that (i) waterways and drainage paths are not blocked; (ii) the disposed materials will not be washed away by floods; and (iii) such materials should not cause public nuisance.

C. Protection of Ground Cover and Vegetation

Contractor shall provide necessary instructions to his workers not to destroy ground vegetation cover unnecessarily.

D. Soil Erosion

(i) Contractor shall take all steps necessary to ensure the stability of slopes including those related to temporary works.

(ii) Work that will lead to heavy erosion shall be avoided during the rainy season. If such activities need to be continued during rainy season, prior approval must be obtained from implementing agencies and local authorities by submitting a proposal on actions that will be undertaken by the contractor to prevent erosion.

(iii) The work, permanent or temporary, shall consist of measures as per design to control soil erosion, sedimentation and water pollution. Typical measures would include grass cover, slope drains, retaining walls etc.

E. Labour Camps

(i) Labour camps shall be provided with adequate and appropriate facilities for disposal of sewage and solid waste. The sewage systems shall be properly designed, built and operated so that no pollution to ground or adjacent water bodies/watercourses takes place. Garbage bins shall be provided in the camps and regularly emptied. Garbage should be disposed of in a hygienic manner.

(ii) Contractor shall ensure that all camps are kept clean and hygienic. Necessary measures shall be taken to prevent breeding of vectors and diseases.

(iii) Contractor shall report any outbreak of infectious disease of importance at a labour camp to the Medical Officer of Health (MOH) or to the Public Health Inspector (PHI) of the area immediately.

(iv) Contractor shall remove the labour camps fully after its need is over, empty septic tanks, if instructed by the engineer shall be closed, remove all garbage, and debris; and clean and restore the area back to its former condition.

F. Dust Management

(i) To prevent dust pollution during the construction period, the Contractor shall carry out regular watering of the construction site and shall cover material stocks onsite to prevent dust and other particles getting airborne.

(ii) All vehicles delivering materials shall be covered to avoid spillage and dust emission.

G. Health and Safety

(i) Contractor shall take necessary actions to prevent breeding of mosquitoes at places of work, labour camps, material stores, etc. Stagnation of water in all areas including gutters, used and empty cans, and containers shall be prevented.

(ii) Contractor shall keep all places of work, labour camps, plus office and store buildings clean and devoid of garbage to prevent breeding of rats and other vectors such as flies.

(iii) Construction vehicles, machinery, and equipment shall be used and stationed only in designated areas of the work site and should not pose any danger to nearby communities, if any.

(iv) Material stockpiles shall be located sufficiently away from the areas from human settlements and water bodies.

(v) Construction sites should be fenced out temporarily in order to avoid any risk posed to people who live nearby areas from construction activities.

(vi) The contractor shall enforce vehicle speed limits for construction vehicles in areas near and inside construction premises

H. Sourcing of Raw Material

The contractor shall ensure that all raw materials such as sand, rubble, metal, and timber required for the construction of the building are sourced from licensed sources. If the contractor plans to operate own quarry/sand pit, all necessary approvals should be obtained from relevant authorities.

APPENDIX 14

POVERTY AND SOCIAL ASSESSMENT

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

APPENDIX 14

POVERTY AND SOCIAL ASSESSMENT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
CP	–	Concept Paper
DOI	–	Department of Irrigation
EIA	–	Environment impact assessment
GOSL	–	Government of Sri Lanka
IA	–	implementing agency
ISEWP	–	improving system efficiencies and water productivity
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MRB	–	Mahaweli River Basin
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
MFF	–	multitranche financing facility
NCPCP	–	North Central Province Canal Program
NWPC	–	North Western Province Canal
PDA	–	project design advance
PMDC	–	program management and design consultant
PPTA	–	project preparatory technical assistance
SIWRM	–	strengthening integrated water resources management
SLPI	–	Sri Lanka Prosperity Index
UEC	–	Upper Elahera Canal
WTP	–	willingness to pay

CONTENTS

TABLES

I. OVERVIEW

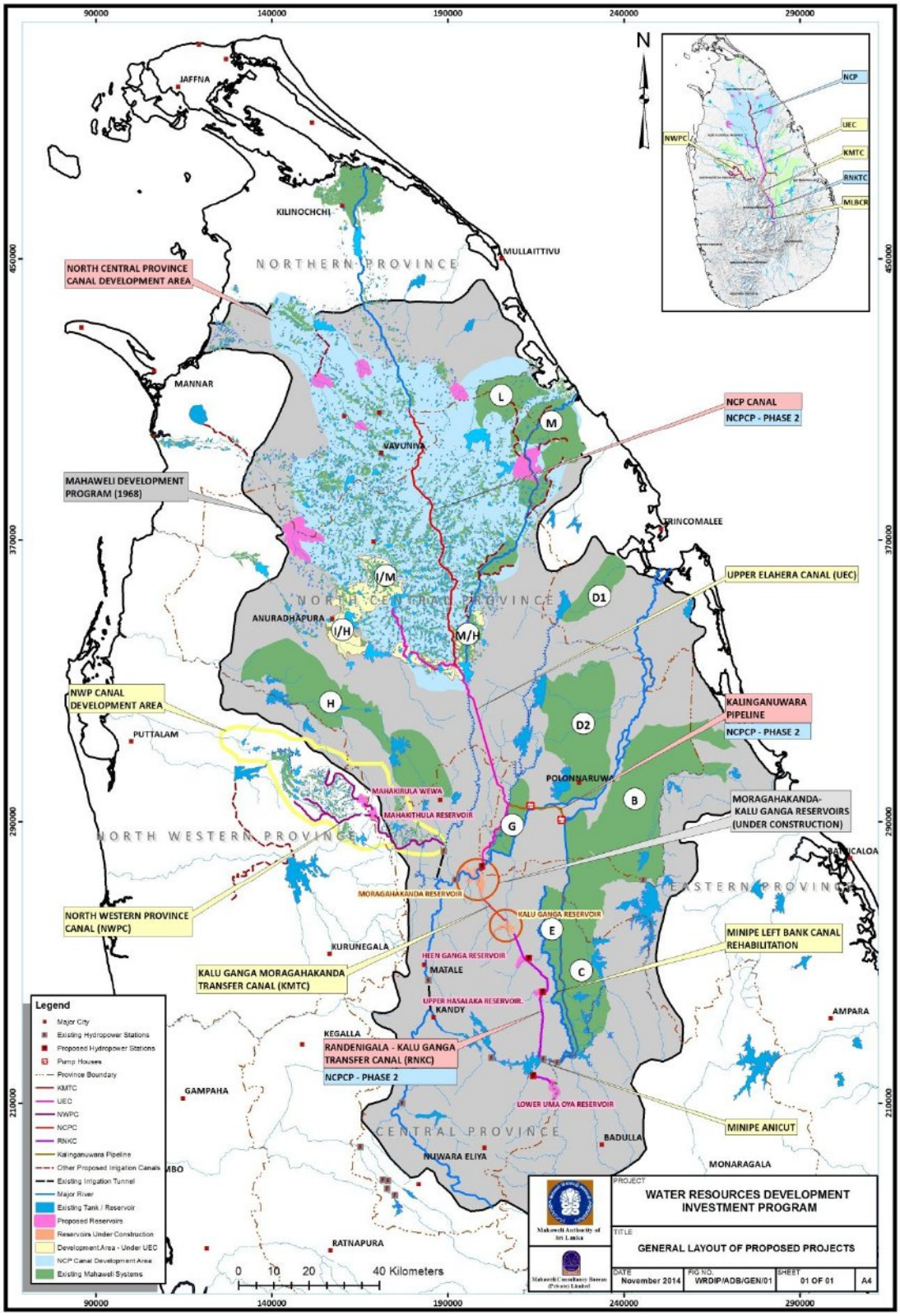
A. Introduction

1. This report analyses social and poverty dimensions of the communities who live in the proposed project areas of the Water Resources Development Investment Program (WRDIP). This Poverty and Social Assessment (PSA) covers three investment projects of WRDIP, namely, the Upper Elahera Canal Project (UECP), North-Western Province Canal Project (NWPCP), and the Minipe Left Bank Canal Rehabilitation Project (MLBCRP). It is based on the findings of pre-feasibility socio-economic surveys, resettlement census, environmental field surveys, and academic studies that have been conducted in the project areas in the recent past to examine opportunities, constraints, and potential social impacts of the proposed projects on affected communities. Poverty and social impacts are considered in a broader context taking the communities in the project areas as the scope of the report because the data and information collected from a narrow and linear canal trace are inadequate to elicit poverty patterns and social organisation in affected communities, and the impact of economic opportunities that the Program will provide to overcome poverty and vulnerability. The main focus of the report is on the NWCP and UECP. This is because the two projects will directly be impacted by land acquisition, displacement and loss of sources of income and livelihood. The benefits that will accrue to them from the Program are not site-specific. The MLBCRP, on the other hand, will have direct positive impacts because of the refurbishment of the Left Bank Canal, although some farmers will experience temporary crop losses. Community level poverty and social dimensions of the communities are broadly similar in the three projects. Therefore, most of the findings of NWPCP and UECP are applicable to MLBCRP as well.

B. The Water Resources Development Investment Program

2. The WRDIP will assist the government to complete outstanding water conveyance investments under the Mahaweli Development Program (MDP). The completion of MDP is a key priority of the government, as it will maximize the productivity of the water sources of the Mahaweli River Basin by transferring water to water-deficit areas in the northern dry zone for irrigation, drinking, commercial, and industrial purposes. This will, in turn, accelerate local and national economic growth and living standards of local people by providing opportunities and resources to improve their household incomes and food security.

3. The WRDIP focuses on water scarcity, food security, and poverty issues in project-affected areas. It aims to provide better and secured irrigation water supply enabling the cultivation of most of paddy land in both Maha and Yala seasons in each year, thereby improving incomes of farming households who constitute more than 90% of project-affected households (PAHs). It will also provide drinking water to water-deficit areas, particularly to North Central, North Western and Northern Provinces. By improving irrigation facilities and increasing drinking water supplies, the Program will directly deal with poverty, food security, environmental degradation, and poor health of the people in the dry zone of Sri Lanka. The project areas of the Program are shown in **Figure 1**.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NCP
UEC
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KMTC
RNKTC
MLBCR
JAFFNA
KILINOCHCHI
MULLAITTIVU
NORTHERN PROVINCE
NORTH CENTRAL PROVINCE CANAL DEVELOPMENT AREA
MANNAR
VAVUNIYA
NCP CANAL
NCPCP - PHASE 2
MAHAWELI DEVELOPMENT PROGRAM (1968)
TRINCOMALEE
UPPER ELAHERA CANAL (UEC)
NORTH CENTRAL PROVINCE
ANURADHAPURA
NWP CANAL DEVELOPMENT AREA
PUTTALAM
KALINGANUWARA PIPELINE
NCPCP - PHASE 2
POLONNARUWA
MAHAKIRULA WEWA
MAHAKITHULA RESERVOIR
MORAGAHAKANDA-KALU GANGA RESERVOIRS (UNDER CONSTRUCTION)
NORTH WESTERN PROVINCE
BATTICALOA
EASTERN PROVINCE
MORAGAHAKANDA RESERVOIR
KALU GANGA RESERVOIR
NORTH WESTERN PROVINCE CANAL (NWPC)
MINIPE LEFT BANK CANAL REHABILITATION
KURUNEGALA
HEEN GANGA RESERVOIR
MATALE
KALU GANGA MORAGAHAKANDA TRANSFER CANAL (KMTC)
UPPER HASALAKA RESERVOIR
KANDY
AMPARA
KEGALLA
RANDENIGALA - KALU GANGA TRANSFER CANAL (RNKC)
NCPCP - PHASE 2
GAMPAHA
LOWER UMA OYA RESERVOIR
CENTRAL PROVINCE
MINIPE ANICUT
BADULLA
NUWARA ELIYA
MONARAGALA
RATNAPURA
Legend
Major City
Existing Hydropower Stations
Proposed Hydropower Stations
Pump Houses
Province Boundary
KMTC
UEC
NWPC
NCPC
RNKC
Kalinganuwara Pipeline
Other Proposed Irrigation Canals
Existing Irrigation Tunnel
Major River
Existing Tank / Reservoir
Proposed Reservoirs
Reservoirs Under Construction
Development Area - Under UEC
NCP Canal Development Area
Existing Mahaweli Systems
0 10 20 40 Kilometers
PROJECT
WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM
TITLE
GENERAL LAYOUT OF PROPOSED PROJECTS
DATE
November 2014
FIG NO.
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1. Rationale of the Program

4. Water is the principal medium in the dry zone of Sri Lanka through which climate change exhibits its environmental, economic, and social impacts. Many communities are vulnerable to droughts and other water-related disasters such as floods which destroy lives, assets and incomes. Moreover, the widespread chronic kidney disease threatens the lives of rural populations of the northern dry zone. The risks associated with climate uncertainty and change can be mitigated by storing and distributing water wisely when it is scarce, and by planning ahead to protect communities from droughts and floods. Coping with water-related risks requires the collective involvement and broad planning. The WRDIP addresses these key development issues (Table 1).

5. No new lands are identified for irrigation by the Program (although some existing lands will become officially part of the service area of the Mahaweli Scheme, which therefore increases). The main benefit of the Program will be increased cropping intensity of existing cultivated lands under major and minor irrigation schemes. In addition, the Program will provide safe drinking water to a large population which suffers now from drought and the lack of safe drinking water.

6. Providing safe drinking water and managing water resources wisely will improve health of the people in the dry zone, and open opportunities for them to improve their income sources and livelihoods. In many poor communities, fetching water from distant sources and queuing for water are physically-demanding and time-consuming responsibilities borne primarily by women and girls. Women as a result, have less time to engage in productive activities, while in case of young girls, school attendance is often considered a lesser priority. A gender bias that creates an imbalance in school enrolment ratios has been noted in the project areas, although the imbalance has been progressively declining. Disparities in women's education and involvement in decision-making can disadvantage them in earning an income or voicing their views on affairs of their community. By improving living standards and providing water for domestic use, the Program will enhance the quality of life of women. Income restoration and improvement strategies of resettlement Programs under the Program will pay special attention to women, especially to vulnerable women.

II. KEY MILLENNIUM DEVELOPMENT GOALS

7. The key MDGs applicable to the Program are the goals for poverty alleviation, elimination of hunger, environmental sustainability, and gender equality. The Millennium Development Goals (MDGs) provide a broad operational framework for poverty and social assessment (Table 1).

Table 1: Water, Poverty, and the Millennium Development Goals

Millennium Goal	Direct Impacts of Investments in Water Supply	Indirect Impacts of Investments in Water Supply
Poverty: To halve the proportion of the poor whose income is less than $ 1/day per person	• Improved water supply for homestead gardening, irrigated agriculture, industry and for other economic activities • Investments in water infrastructure and services act as a catalyst for local and regional development	▪ Reduced vulnerability to water-related hazards boosts investment, production and development ▪ Reduced ecosystem degradation boosts local-level sustainable development ▪ Improved health from better quality water
Hunger: To halve the proportion of the people who suffer from hunger	• Irrigation water expand grain production • Reliable water supports subsistence agriculture, livestock, and tree crops • Sustainable production of fish and other foods gathered in common property.	• Ensure ecosystems integrity to maintain water flows to food production • Reduced urban hunger by cheaper food grains from more reliable water supplies for irrigated agriculture in rural areas
Environmental Sustainability: To stop the unsustainable exploitation of natural resources and to halve the proportion of people who are unable to reach or to afford safe drinking water	• Improved water management, including pollution control and sustainable levels of abstraction, key factors in maintaining ecosystems integrity • Supply of safe and adequate drinking water for poor and poorly-serviced communities.	
Gender Equality: Equality and empowerment of women should be demonstrated by ensuring that girls and boys have equal access to primary and secondary education		• Women's participation in community-based water management improves social capital of women. • Improved domestic water supplies reduce time and health risks of women and allow more time for women to engage in income earning activities. • Balanced gender roles

Source: Asian Development Bank, 2003

A. Poverty Alleviation and Community Health

8. Investment in water infrastructure and services is a catalyst for development and poverty alleviation (Table 2).

- Reduced ecosystem degradation makes livelihood systems more secure.
- Improved water services increase employment opportunities to local communities because of secured and regular cultivation of land.
- Community-based organisations for water management will improve the social capital of women by promoting their leadership, networking, and building solidarity among them which leads to their empowerment.

9. Responsible water resources management protect physical environment and improve health and wellbeing of the community (Table 2).

- Better water management reduces mosquito habitats and lowers the incidence of water-borne diseases.
- Safe drinking water and basic sanitation help prevent chronic kidney disease and other water-related diseases.
- Reliable drinking water supplies and improved water management in human settlements reduce transmission risks of malaria and dengue fever, and can reduce biological pathogens and chemical hazards.
- WRDIP facilitates reconciliation of upstream and downstream water-user arrangements.
- Biodiversity conservation combats desertification of land.
- Careful use of water resources help prevent surface and ground water contamination and minimize water treatment costs

10. Socio-economic development, education and empowerment start with a healthy and safe community (Table 2).

- Water-related illnesses cause health costs that can claim much of the household income of the poor. At present, in the dry zone, kidney diseases are quite widespread. Better domestic water supply is the key to overcome this threat.
- Household livelihoods depend on income-producing members; adults who are ill themselves or who are caring for sick children are less productive. Malaria takes up a significant proportion of productive time from households.
- Water and sanitation facilities located closer to homes reduces the risk of sexual assault on women and girls when gathering water and searching for privacy. Better health improves school attendance rates among girls and boys.

Table 2: WRDIP and Millennium Goals

Millennium Development Goal	Applicability to WRDIP	How it could help achieve the goal	Comments
1. Eradicate Extreme Poverty	Yes	Having a sustainable, safe water supply, and begetting from its economic opportunities such as better and secure irrigated agriculture help break the vicious circle of poverty	Key objective of WRDIP
2. Achieve Universal Primary Education	Yes	A safe and secure water supply helps boys and girls to stay at school, and enables women to participate more actively in income generating activities and in their community activities	One of WRDIP's broad development goals
3. Promote gender equality and empower women	Yes	See above.	See above
4. Reduce child mortality	Yes	Safe drinking water and improved sanitation are central to health and well-being of children and their parents.	See above
5. Improve maternal health	Yes	See above	.See above
6. Combat HIV/AIDS, malaria & other diseases	Yes	See above	See above
7. Ensure environmental Sustainability	Yes	Better management of water resources lessens pollution and improves water conservation towards ensuring sustainable, life-supporting ecosystems.	Key development goals of WRDIP
8. Develop a global partnership for development	Yes	Water knows no political or ethnic boundaries and is especially vulnerable to human impacts. WRDIP works with people and agencies to use this irreplaceable resource wisely	Contribute to deal with vulnerability of communities regardless of their ethnicity and class.

11. Improved water services free up time for productive activities – especially for women and girls (Table 2)

- Women and girls are the primary collectors of water and primary carers for sick household members.
- Time women lose for other productive activities contribute household poverty.
- Reducing these burdens enables more girls to attend primary and secondary schools and increases more women to participate in adult education, community activities and organizations, and leisure activities.

B. Water Poverty and Vulnerability

12. Fighting poverty is the main challenge for achieving equitable and sustainable development. In this regard, water plays a vital role in relation to human health, livelihoods, economic growth as well as sustaining ecosystems. According to Global Water Partnership, the 'water poor' households share the following characteristics:

- Their natural livelihood base is persistently threatened by drought and floods.
- Their livelihood depends on cultivation of food and their water sources for agriculture are not dependable or sufficient.
- Their natural livelihood base – land – is subject to erosion and degradation.
- Living far from a year-round supply of adequate drinking water
- Spend a relatively high proportion of household income on water
- Their water supply is bacteriologically or chemically contaminated, and they cannot afford to have access to alternative water sources.
- Living in areas with high level of water-associated diseases without means of protection
- Women and girls spend hours in a day collecting water, putting their security, education, productivity, economic stability and nutritional status at risk.

13. The strong linkages between water and poverty are evident in the dry zone. Agricultural production either for subsistence or sale is the main livelihood in rural areas of the dry zone. The poor also depend on water-based resources such as fresh water fish, aquatic plants and roots in meeting their food needs. Furthermore, water-related diseases spread with floods jeopardizing the health conditions of the local people. Also land degradation including water logging and salinity, water pollution burden the poor.

14. Agricultural intensification, a key objective of WRDIP, through provision of better irrigation is considered as a key strategy for poverty reduction for several reasons:

- It improves security of productivity, economic stability, employment opportunities, and income of farming households and farm wage labour;

- It creates linkages and multiplier effects for the wider economy;
- It provides opportunities for diversification of rural livelihoods
- It allows multiple use of irrigation water supplies
- It improves food security at the household level

15. In the above context, it is important to recognize that irrigated farming varies widely in its form and inputs, and has diverse local attributes and impacts. Therefore water resource management decisions are to be based on a holistic and livelihood-centred assessment of irrigation benefits and costs that go beyond the object of food production. The significant risk in this regard is that badly designed and managed irrigation system could negatively impact on poverty and food security.

III. SOCIO-ECONOMIC AND DEVELOPMENT SETTING

16. The planned development efforts in the dry zone can be traced from the settlement schemes implemented under the policy of 'state-aided land colonization'. 'Colonisation' is defined as the settlement of peasants outside their native villages in small family-sized farms'. Those who moved into colonisation schemes were voluntary migrants from the poor segment of the population, particularly, in the wet zone. Colonisation schemes are also known as 'land settlement schemes' and 'land colonization schemes'. Prior to the implementation of the state-aided colonisation scheme strategy, the dry zone remained unattractive to people from outside because of its hash climate, remoteness, and the prevalence of malaria.

17. The Land Development Ordinance (LDO) of 1935 created a new tenure system to lease land on long-term basis to settlers in the colonisation schemes. Land was distributed with some limits imposed on the user with regard to land use, subdivision, sale, mortgaging or transfer. Governments, since then allocated state land for the poor and landless under several land development programs: colonisation schemes, special project schemes, village or land expansion schemes, middle-class alienation schemes, marginal land alienation schemes, youth colonisation schemes, highland settlement schemes, and cooperative farms. The land affected by the Upper Elahera Canal Project (UECP) falls under the category of highland settlement scheme, where the poor landless were given highland un-irrigated land to develop a homestead and a rain-fed farm. The land affected by the North-Western Province Canal Project (NWPCP) falls under the categories of highland settlement schemes and marginal land alienation schemes. The Minipe Land Colonisation Scheme falls under the category of colonisation scheme. The Minipe Colonisation scheme provided irrigated land allotment and a highland un-irrigated allotment to each chosen settler-household.

18. Voluntary migrants from the wet zone to the dry zone preferred irrigated landholdings. The government to encourage them to move to the dry zone gave them the priority in allocation of land in colonisation schemes and provided basic infrastructure and 'survival assistance', enabling them to start their lives in the new settlements. Among the push factors was the desire of landless, poor farmers to own paddy land, by which they could acquire a better social status.

19. The attempts at developing the dry zone through colonisation resulted in the productive utilisation of a large proportion of state-owned land which previously remained under-utilised and uncultivated. Following the Independence in 1948, investment in irrigation works in the dry zone has intensified. This policy was culminated in the Accelerated Mahaweli Development Project (AMDP). It is the largest and the most ambitious multipurpose integrated project undertaken in the country to date.

20. The AMDP introduced an advanced form of land development planning in Sri Lanka. In contrast to previous colonisation schemes, the AMDP was planned to create clustered settlements. The four-tier hierarchy, consisting of hamlets, villages, area centres, and townships shows the order of key locations in a settlement. It was expected that the townships would function as 'growth poles' and benefit the 'hinterlands'. The project included 13 systems designated alphabetically from A to M in order to make the administrative functions easier. The Moragahakanda and Kaluganga reservoirs are the two last large reservoirs under the AMDP, and the WRDIP will

facilitate the completion of the conveyance of the water of the two reservoirs to Central, North Western, North Central and Northern Provinces to provide irrigation water and domestic water to drought-prone remote areas in the dry zone.

A. Social Structure and Organisation

1. UECP and NWCP

21. The Upper Elahera Canal and North Western Canal will traverse through scattered *purana* (old or traditional) villages and LDO settlements. The Minipe Colonisation Scheme was built in a similar landscape. It has its own settlement pattern which is characterised by irrigation canal network, clusters of homesteads, common lands and large-scale encroachment on canal reservation land.

22. The title purana village signifies their continuity over a long period of time. Relative to comparable rural communities in the wet zone, purana villages in the dry zone remain sparsely populated with a mean population size of 300 distributed in about 60 households. The communities are widely scattered; each community is surrounded by a stretch of jungle used by local people to do slash-and-burn cultivation known as chena farming. Only a few purana villages in the Project areas have small village reservoirs to conserve rainwater for paddy cultivation. They are drought-prone and as a result, especially in the Yala season encounter loss of crops, and food insecurity. The operation and maintenance of such village reservoirs are done by villagers themselves displaying their communal organisation and interdependence for survival. During droughts, when water level in a village reservoir drops, the extent of paddy land each farmer is permitted to cultivate is reduced in proportion to the size of his landholding under the bethma system (proportional division of available water in the reservoir among the shareholders). It allows the utilisation of water in a limited cropping area for the benefit of the entire community).

23. Each purana village is a single caste population unified through kinship bonds. Interactions across village communities traditionally took the form of exchange of goods and services based on caste-related livelihoods such as blacksmith, tom-tom beaters and potters). The local ecosystem inclusive of man-made irrigation works largely determined the nature of social organisation of a *purana* village and its relative stability.

2. Minipe Colonisation Scheme

24. The Minipe Colonisation Scheme (MCS) is one of the major colonisation schemes in Sri Lanka and one of the oldest. After 1978, it has become part of the Mahaweli Development Project. The MCS has evolved from the 1930s with a linear expansion of land area that cultivated with irrigation supplies of the Minipe Left Bank Canal (MLBC). The MCS has four phases of settlement. Settlers in phases I and II received large allotments ranging from 5-8 acres of highland and irrigated lowland. The size of allotments became smaller (1.5 paddy land and 0.5 highland) as the MCS expanded into its III and IV phases. Settlers were brought in from far away locations. They were settled as clusters enabling them to continue their social and cultural contacts without much disruption. This reduced the initial social adaptation problems.

25. The MCS benefitted from the Protected and Guided Colonisation Policy of the 1930s and the Special Projects Schemes introduced in the 1960s. From the late 1970s, it has been assisted by the AMDP. Initially MCS moved towards commercial farming thereby increasing household incomes. Later, this process has been affected by heavy land fragmentation, illegal land transactions, and encroachments. As settlers of a 'special project', Minipe farmers received a variety of incentives from the state in the 1970s and 1980s to improve their cultivation practices. But most of such incentives were captured by influential farmers leaving many settlers, especially the poor settlers, at the subsistence level. Illegal land transactions within the Scheme have created a group of affluent settlers. The degree of disparity in livelihoods between the poor settlers and the rich settlers has increased. The poor settlers increasingly depend on the affluent settlers for livelihood and survival. For the majority of settlers, especially for the third generation and fourth generation farmers, it is an experience of going back to the traditional purana village subsistence economy which is characterised by land fragmentation, landlessness, and unemployment.

IV. POVERTY: CHANGING PERCEPTIONS

26. The government has used the dry zone colonisation schemes to raise the living conditions of the rural poor. This development strategy has been implemented under the name of 'colonisation' during the pre-Mahaweli period and focused on the development of agriculture, especially paddy cultivation, in the dry zone. The AMDP took that strategy further to promote rural development and alleviate poverty through diversified agricultural development.

27. Today, agriculture-based livelihoods are becoming less attractive especially among young villagers and settlers. They actively respond to poverty in the changing socio-economic and political context. At the same time, how they respond to poverty is determined by several factors, ranging from personal motivation for a better life to opportunities and constraints framed by local and global socio-economic and political environment. Livelihoods of most households have been replaced or supplemented by remittances from women working in the Middle East, free trade zones in the Western Province, youth working in the private sector and soldiers working in the security forces. Such changes in livelihoods generate changing perceptions of poverty, opportunities, constraints, capabilities, and vulnerabilities in uncertain local and global contexts.

A. Income Groups

28. Villagers in settlements and villages, especially second and third generation (and fourth generation in MCS) settlers tend to categorise their fellow villages and settlers into broad classes or income groups. These classes are based on multi-faceted criteria. First, they differentiate pohosath (the rich) from duppath (the poor). Then they identify a group in between called madhyama panthiye aya (those who belong to the middle class). They again subdivide the poor into two further categories: duppath aya (the poor) and ithamath duppath aya (vulnerable or extremely poor).

29. The above wealth ranking ascribes several characteristics to each 'class':

1. The Rich

30. The rich are those who own large landholdings and other assets such as tractors, cars, large houses and homesteads. They engage in business and trade, and maintain good links with the market, locally powerful politicians, government officers, local money lenders and mill owners. They are well travelled people with a variety of household assets to indicate their luxury living. Liquor sellers and money lenders are also considered as rich. Some government servants who owned paddy land are also identified as rich.

31. They control social and political resources in the communities and hold prominent positions in village and regional organisations. Their children attend good schools in nearby towns and cities. The rich also employ others to help them with housework, and provide seasonal employment in their paddy lands and highlands.

2. Middle Class

32. The middle class consists mostly of government servants and farmers who own highland and paddy lands, owners of shops in the settlements, Middle East migrants, and small-scale money lenders. Many of them own well-built spacious houses, possess good educational background, and enjoy a good quality of life. Having a regular pension is also an indicator of middle class, as it provides future security.

3. Poor

33. The poor are the households which do not own land; mortgaged their land; and engage in casual work in agricultural or non-agricultural sectors to earn a living. Poor encroachers, disabled, female-headed households and alcoholics also fall into this class. The poor consists mainly of landless farmers and labourers who do not have good houses to live in and have more dependents or large families. They do not have a good educational background, and often are not in good health. The poor houses are small and poorly furnished; these households have more children. Most of them are poorly educated and engaged in informal wage earning activities.

4. Extremely Poor

34. The unemployed and those who are in debt belong to this class. They live *in temporary huts and do not have proper clothes to wear.* They engage in *ad hoc* or seasonal work. Elderly people without anyone to look after them; those who cannot find their day's meal; patients; women-headed households with many dependents also fall into this class. The poorest have similar attributes to the poor, though in many respects they are worse off than the poor. Having a large family was previous considered to be a sign of wealth in agricultural settlements. However, with the changing production patterns and decreasing land resources, it is now mainly considered a burden among the poor. In the Samurdhi program, which was a national poverty alleviation program, extremely poor has defined as economically non-productive group.

35. In all three project areas, one could find at least three generations of settlers and villagers. Each generation has its own parameters of perceiving poverty. Such perceptions also vary according to age, gender, employment, marital status, and migratory experience.

B. How First Generation Feels Poverty?

36. *Reduced capabilities* are the key factor that contributes to their poverty. Declining health contributes to the creation and perpetuation of poverty in old age. After several decades of hard work in harsh weather, most of them have entered old age with chronic illnesses. They started their lives in a harsh social and physical environment, which most of them have become accustomed to. The health dimension is also related to gender. While many of the first generation men engaged in land cultivation, women had many other responsibilities. They worked on family farms (unremunerated), looked after their children, and performed household duties from dawn to dusk. Their mobility outside the settlement or village was constrained by their different gender roles and gendered responsibilities. Compared to men, they have spent their youth working hard. Unlike men in Sri Lankan rural society, women depend greatly upon social and familial networks

for their survival. The departure of children, especially daughters, on marriage or employment increases their household chores.

37. Access to Land: Many first generation settlers are gradually losing their access as they hand over their land to their sons to cultivate. Although they are forced to hand over their responsibilities and assets to their next generation, they expect their children to listen to their advice. Losing access to land is losing power which pushes them to a marginal position at home and in the community.

38. Gender: In settlements and villages, the gender dimension of old age poverty has become a critical issue because of the land inheritance laws which create unequal property relations between men and women. The legal inheritance of land always favoured men, as they have been identified as heads of households. This has left many women in a vulnerable position as their access to land depends on their relationship with male landowners. In Sri Lanka, due to its high level of human development compared to other countries in the region women tend to live longer than their husbands. Consequently, they experience poverty well into old age. Along with old age, if such women become separated or widowed they become poor and vulnerable.

39. Deterioration of Culture, Tradition, and Moral values: Elderly people are worried when they are not in a position to fulfil their family or social roles and obligations. They expect that the community should listen to their voices too. In villages, they could regain power through their participation in social and religious institutions. Traditionally, older people served as village headmen and senior priests at the temples, where they received deference from others. However, this pattern of recognition is changing. External social and economic changes have gradually filtered into the settlements in the form of 'new money' fuelled by new job opportunities. As a result, village traditions and culture is being replaced by modernity. As stated earlier, older women are particularly vulnerable to poverty in the absence of their husbands or other family members. The situation is worsened in the colonisation schemes as access to land, the main productive resource, is constrained by inheritance laws. Many of them feel insure, fearful, stressed and desperate. Along with these dimensions, alienation has also been identified as a dimension of poverty.

40. Feeling Lonely: Alienation: Many first generation settlers face different types of alienation due to the changing socio-economic context of their settlements. The second and third generations are gradually moving away from agricultural employments and making their living mainly from non-farm activities outside their villages or settlements. This creates a vacuum in the old age security of those who remain in the villages or settlements as elders.

C. How Second and Third Generations Feels Poverty?

41. Employment: Unemployment and under-employment have become a serious issue in many dry zone settlements and *purana* villages. The lack of employment or under-employment is considered as the main cause of poverty. For the youth, poverty is basically about not having an employment. Most of them believe that they have been deprived of their fair chance of tapping employment opportunities in the government sector, as they do not have access to higher education, technical and vocational education, compared to those living in the urban areas.

42. Lack of opportunity: The perception of poverty is directly related to the ability to participate in local markets. The villagers and settlers cannot access national labour markets due to their low capabilities, or low human capital. Many of them are not educated to a sufficiently high level to secure a well-paid job in the government or private sector. At the same time, many of them are not in a position to negotiate jobs in the labour market in their respective regions, as jobs are often controlled by politicians and distributed based on political patronage.

43. Education: Poverty in the dry zone is also linked to education. The first generation of settlers did not achieve much in terms of education, and some did not even attend school. Although at that time they did not appreciate the importance of education, they now regret it due to their inability to read and write. The second and third generation have done much better than their parents in schooling. But the lack of teachers for key subjects such as Mathematics, Science and English and the poor quality of teaching, teacher absenteeism, and distance to schools are important factors that influence their ability to get a better education. Many villagers cannot afford to send their children to town schools. In rural areas, because of the lack educational infrastructure, many children do not study at least up to the GCE (O/L) – grade 10. The settlers are worried that their children also would fail to secure employment opportunities because of the low level of education they receive.

44. Housing: Housing is a dimension of poverty. It is identified in terms of the quality and the ownership of land where the house is built. Many settlers have built their houses on encroached land. Currently, the quality of housing is measured in terms of the construction materials used. Most households feel the need to build a brick-walled house. Women who migrate to the Middle East or who work in garment factories and men who work in the army have better houses. According to them, mobility and the influence of media are some of the factors that have influenced their desire to have better housing.

45. Land: The lack of land or access to land is another dimension of poverty. Scarcity of land for agriculture has become a significant problem in projects areas. Population increase is frequently linked to land fragmentation, as noted in MCS. Landlessness and the lack of fertile, well irrigated land were also identified as important dimensions of poverty. Second and third generations do not place much emphasis on land as a dimension of poverty. As income from agriculture has increasingly being replaced by income derived from non-agricultural activities, land was not seen as an important factor. The first generation perceives poverty in terms of losing their control over land which results in the loss of power too. The second and third generations are not attached to the land of their parents. But they are hopeful that the government will give them freehold title under the Jayabhoomi and Suwarnabhoomi Land Grant Programs. On such land, they expect to develop non-agricultural businesses and trade.

46. The multi-dimensional and complex nature of poverty is confirmed from the above perceptions of different generations of settlers and villagers. The perceptions of what constitutes poverty are wide ranging in the project areas. Their perceptions vary according to generations, especially in the way they rank the poverty dimensions. Their perceptions of poverty are linked to the changing social perceptions of poverty in the wider society which, in turn, are influenced by their increasing links with the outside world at the national- and global levels.

V. GENDER DIMENSION OF POVERTY

47. Despite their poverty and lifecycle changes, the women, especially second and third generation women, were found to be shouldering the burden of providing for their families. This is not to say that women of the first generation have become passive. They too contribute to the wellbeing of their own families and their children's families. The women of second and third generations are building homes, buying productive resources, educating their children, supporting their extended families, contributing the local community, and had become more 'powerful' than the first generation women. They had become active agents of change, exploiting the available opportunities despite the constraints. This is evident in their increased presence in rural organisations such as farmer organisations, rural development societies and death donation committees. They not only are members of such organisations but also on many organisations hold executive positions such as president, vice president, secretary and treasury.

48. The different ways in which women contribute to save their families from poverty are not only stories of success but also sacrifices, hard work, powerlessness, vulnerability, and isolation. Whether these women would be able to (i) continue to save their families and themselves from poverty?; (ii) enjoy their power at home and in the community in a sustainable way?; and (iii) achieve various other aims in their lives? Are important questions, as settlers' subsistence and survival sources depend upon several unstable, unpredictable and threatening contexts? Secured income from homesteads and paddy fields served by irrigation water will release them from subsistence level of living to explore better opportunities to improve their income and social mobility. This is one of the objectives of the WRDIP.

49. Women in settlements sustain their household economy by engaging themselves in various livelihoods. Generally men's perception of a 'livelihood' is related to their day-to-day income earning activities. In contrast, many women hold the view that a livelihood is not only about making a living, but also a 'good' life at a stable household. The 'good life' component is reflected in their perceptions of poverty and is the rationale behind what they are doing today.

50. Triggered by various socio-economic factors, women, especially young women, are gradually moving out of their households in search of employment elsewhere. Employment opportunities are changing traditional gender roles and relations at both household and community levels. Finding livelihood opportunities outside village communities and settlements is not without constraints. While some young women found employment in the garment factories, young men found employment opportunities in the security forces and in the booming construction industry. They also get a few informal sector employment opportunities which do not demand specific high skills or educational qualifications. However, for the middle-aged, married women and men, employment opportunities are very limited, as the garment industry, construction work sites, and security forces require young people. Faced with poverty and fewer opportunities for paid work both within and outside the settlements, some married women have migrated to the Middle Eastern countries with a conscious choice to break the vicious cycle of poverty. Compared to other sources of locally earned income, this avenue provides an attractive income for women who are able to migrate.

51. Compared to the situation a couple of decades ago, women now participate more in household decision-making in the project area, especially in the MCS. Previously even in wealthy families women did not have the power to make important decisions regarding agricultural activities, even though they were knowledgeable on the subject. This situation has changed considerably now. In the context of the Middle East migration, work opportunities in urban garment industry, and who controls remittances from the Middle East are evidently critical for understanding changes in gender relations.

52. Their mobility outside their homes and the interaction with people outside the settlements and village communities improve women's knowledge in investing their income in profitable economic activities. This change in attitude and relationships can be compared with that of women who are working locally. Especially the first generation men and women believe that women who locally find work could maintain a better family life than those migrated. In general, locally employed women are respected more in the local society compared to migrant women.

53. Women who are employed outside their communities have more decision-making powers over matters relating to their family life than those women who are locally employed. Economic power of women who have migrated out of the communities to engage in employment has started to affect the social image of men in village communities, especially in settlements in a negative way. Prolonged absence of women who work in the Middle Eastern countries or in urban garment factories has compelled some men, especially husbands, to take full responsibility for the tasks previously performed by their wives or sisters.

54. Most men who remain at home while their wives and sisters employed in places away from the community or country find that they cannot cope with housework, especially if they have young children to care for, and also to search for work or to cultivate small pieces of land. Some of them have withdrawn from making any economic contribution to the family after their wives have become the major providers. Local community do not hold such men in high regard. This shows how men's social position in communities deteriorates when they become dependent on their wives' and sisters' incomes. In some cases husbands spend money earned by their spouses on drinking and gambling and it leads to family disorganization and poverty.

55. Investment decisions relating to remittances depend on several factors such as the economic situation of the recipient family, the migrant's marital status, and their position in the family. Also the priority in investing remittances changes with life course changes. In the case of married women, migration is associated with building a house. Most of them want to have a regular source of income and to escape poverty. It is apparent that escaping poverty is not only about earning money but also about having their own home, buying land, saving money, educating children and securing a better future.

VI. LIVELIHOOD SOURCES

56. Although the livelihood resources have been multiplied and gender dimension has gone through changes, land remains the main source of income of the majority of households. In the three project areas, the main attraction for outsiders to arrive in the areas is land. When land is combined with irrigation water, the recipients of such land are considered as fortunate by others and by themselves. In MCS, from the 1930s, thousands of landless poor families arrived in phases on receipt of irrigated land and un-irrigated homesteads from the State. In the UECP and NWPCP, the arrival of settlers began in the 1970s, culminating in the 1990s. Such settlers are less fortunate, as they did not get irrigated landholdings to cultivate upon arrival in the area. The purana village communities by that time had unviable landholdings owing to land fragmentation. In this context, it is possible to identify several land tenure types in the project areas:

- **Private titled deeds**: The private land deeds are registered at the Land Registry under the Act of Registration of Documents. A deed can be transferred to any person through sale or lease or rent on agreed terms between the parties in front of a Notary Public. Such land are found in purana villages and owned by the wealthy households.
- ***Jayabhoomi* and *Swarnabhoomi* Deeds**: These land grant deeds are issued under the Land Development Ordinance for agricultural and residential purposes with certain conditions. A *Jayabhoomi* or *Swarnabhoomi* land grant can be transferred to a specified person described in the Schedule of the Land Development Ordinance. A *Jayabhoomi* or *Swarnabhoomi* land holder is the owner of the allotment.
- **Land Development Ordinance (LDO) land Permits**: They are issued under Land Development Ordinance for a specified period of time. It can be transferred to a person described in the Schedule of the Land Development Ordinance.
- **Long-term Leases**: These leases are issued under the State Land Ordinance for commercial, residential or other purposes described under the Act. Leased period is 30 years with certain conditions. A long-term lease can be transferred to another person with the approval of the concerned authority.
- **Annual Permits**: The permit is a legal document that allows the permit holder to cultivate a piece of state land for a period of 12 months. A levy is charged from the permit holder. He cannot claim any right or interest over the land allotment.
- **Encroached Land**: Use of state land without permission for various purposes, mainly to cultivate highland crops. An encroachment could continue over several years. Periodically, the State 'regularizes' some of encroachments mainly as a part of the strategy to alleviate rural poverty.

57. Because of land fragmentation over generations, the cultivation of small holdings has become economically unviable. This uneconomical land fragmentation has become a serious issue in villages and settlements. The shortage and the lack of commercially viable land have had an adverse impact on households in terms of poverty. As discussed earlier, many

households in the project areas have become increasingly more dependent on transfers and remittances from family members working in urban areas and abroad, and in the security forces.

58. Table 3 indicates that 43% of households still consider farming as their main source of income. Such income does not come only from their homesteads, highland and paddy land, but also seasonal wage work and children's or spouses' employment in non-agricultural sector. Most of the 21% of self-employment also fall into this category. Among them land 'ownership' is minimal, as they are the second and third generation settlers who do not own land, although their fathers possess some land mostly labelled as LDO allotments with restrictions on inheritance and division. Nearly one-fifth of the labour force is engaged in private sector employments. These are mainly temporary employment outside their communities. The educated youth find jobs as sale assistants, computer operators, factory workers, employees of garment industry and migrants to the Middle East as housemaids and low skilled technicians. Traders are mostly from the villages and the wealthy households earn an extra income from retail businesses, transport and marketing of local produce.

Table 3: Employment Status of Project-affected Households

Project &GND	State Sector	Private Sector	Trade	Self-Employment	Farming
UECP					
Elahera 3	01				
Damanayaya		02	01	04	04
Kottapitiya				02	
Madawala					03
Yakkalla	01	02	01		04
Sub total	**02**	**04**	**02**	**06**	**11**
NWPC					
Lenadora North		01	01		01
Ethabandiwewa				01	02
Welemitiyawa	01				03
Danduyaya				01	
Ranwedliyawa		01		01	
Pahalbambawa		03			01
Kospota		01			01
Konwewa	01			01	01
Sub total	**02**	**06**	**01**	**04**	**09**
Grand total	**04**	**10**	**03**	**10**	**20**
Percentage	***09***	***21***	***06***	***21***	***43***

Source: MCB Resettlement Census, July 2014; GND = Grama Niladari Division

59. Education and employment patterns in communities are closely linked. In project areas, educational levels of the project-affected households are low. Nearly 40% have studied a few years in school (1-5 standard) while 55% studied six years or more up to 11th grade (Table 4). Ten percent passed GCE (O/L) and three persons GCE (Advanced Level) There are no degree holders. Only one woman did not attend school at all. This education profile of the project areas indicates that only less than 15% of adults could find white collar employment at the lowest level in the government sector or private sector (table 04). There is no wide gap between the educational levels between men and women.

Table 4: Educational Levels of Project-affected Persons

Project & GND	Level of Education											
	1-5		6-11		O/L		A/L		Degree		No Schooling	
UECP	M	F	M	F	M	F	M	F	M	F	M	F
Elahera 3	1	0	1	1					0	0	0	0
Damanayaya	2	3	10	9	2	2	1	2	0	0	0	1
Kottapitiya	1	3	2	3	0	0	0	0	0	0	0	0
Madawala	3	2	2	4	0	0	0	0	0	0	0	0
Yakkalla	8	6	7	5	1	3	0	0	0	0	0	0
Sub total	**15**	**14**	**22**	**22**	**03**	**05**	**01**	**02**	**00**	**00**	**00**	**01**
NWPC												
Lenadora North	2	0	0	0	0	0						
Ethabandiwewa	3	0	1	0	0	0						
Welemitiyawa	1	0	3	0	0	0						
Danduyaya	0	0	0	0	1	0						
Ranwedliyawa	0	0	2	0	0	0						
Pahalabambawa	2	0	2	0	0	0						
Kospota	1	0	1	0	1	0						
Konwewa	1	0	2	0	0	0						
Sub total	**10**	**00**	**11**	**00**	**02**	**00**						
Grand total	**25**	**14**	**33**	**22**	**05**	**05**	**01**	**02**	**00**	**00**	**00**	**01**

Source: MCB Resettlement Census, July 2014

A. Household Income

60. About 13% of the displaced households in NWPCP and UECP areas earned less than SLR 5000 a month (Table 5). They are the poor and are often exposed to food insecurity and the lack of basic amenities. Those households earn a monthly income between SLR 5,000 and 10,000 each (12%) and could be considered as 'tomorrow's poor'. They live a precarious life with the possibility of falling into the poor category at any time. Those households located closer to large reservoirs such as the Huruluwewa Reservoir have better access to irrigation water to cultivate paddy and highland with secured irrigation water than those LDO settlers whose lands are prone to drought in both Maha and Yala cultivation seasons. The former constitute about half of the sample households each of which earns between SLR 10,000 to SLR 42,000 a month. Among those in the highest income groups (more than SLR 42,000 a month) are the households (8%) with working members in the formal sector employment with fixed salaries and those who are engaged in business. They have several income sources and land cultivation is one of them. In the project areas, they display non-poor characteristics both in their monthly income and assets at home. A household with a monthly income over SLR 42,000 could be considered as a middle class household which lives a comfortable life with electricity, easy access to water including pipe-borne water and spacious houses.

Table 5: Monthly Income of Project-affected Households (SLR)

Project & GND	Below 5000	5000-10,000	10,000-42,000	Over 42,000
UECP				
Elahera 3			01	
Damanayaya	02	04	04	01
Kottapitiya			02	
Madawala			02	01
Yakkalla	01	01	05	02
Sub total	**02**	**05**	**14**	**04**
NWPC				
Lenadora North	01		01	
Ethabandiwewa	01	01	02	
Welemitiyawa		04		
Danduyaya			01	
Ranwedliyawa			02	
Pahalbambawa		01	03	
Kospota	01		01	
Konwewa		01	02	
Sub total	**03**	**07**	**12**	**00**
Grand total	**06**	**12**	**26**	**04**

Source: MCB Resettlement Census, July 2014

61. The above income distribution data indicate the income dimension of poverty in the settlements. As a welfare measure directly focused on the poor and vulnerable households, the State runs an island-wide *Samurdhi* Program during the past several decades. However, data relating to *Samurdhi* benefit distribution is to be interpreted with care because the *Samurdhi* beneficiaries are not selected based on their monthly income. The allocation of *samurdhi* benefits is often arbitrary and politicised. Although the issue of beneficiary selection has been at the core of the *Samurdhi* Programs' reform in the recent past, there is no clear directions on how this will be managed by the Government. In the NWPC and UECP areas, 25% receive *Samurdh*i allowances (Table 6). The amount received by poor and vulnerable households is inadequate to ensure their food security and basic expenses. Only 25% of Samurdhi recipients are happy with their allowances.

Table 6: Project-affected Households Who Receive *Samurdhi* Allowances

Project & GND	Number of Households	Monthly Allowance and Number of Samurdhi Recipients (SLR)				Satisfaction	
		615	500	415	330	Yes	Now
UECP							
Elahera 3							
Damanayaya	03		02	01		01	
Kottapitiya							
Madawala	02	01			01		
Yakkalla	02		02				
Sub total	**07**	**01**	**04**	**01**	**01**	**02**	**05**
NWPC							
Lenadora North							
Ethabandiwewa	01		01				01
Welemitiyawa	02	01			01	01	01
Danduyaya							
Ranwedliyawa							
Pahalbambawa	01			01			01
Kospota							
Konwewa	01		01				01
Sub total	**05**	**01**	**02**	**01**	**01**	**01**	**04**
Grand total	**12**	**02**	**06**	**02**	**02**	**03**	**09**
Percentage	**100**	**17**	**49**	**17**	**17**	**25**	**75**

Source: MCB Resettlement Census, July 2014

B. Household Expenditure

62. Households spend as high as three-fourths of their income on food in the UECP and two-thirds in NWPC. Such high food expenditure leaves households with very little money to spend on health, education, clothes and transport. They depend on public health and educational facilities which are largely provided by the state free of cost (Table 7).

Table 7: Average Annual Household Expenditure (SLR) (N= 48 households)

Project	Food	Health	Education	Transport	Clothes	Other	Total
UECP	10,600	700	680	780	1050	575	14385
%	74	05	05	05	07	04	100
NWPC	8580	1025	865	870	750	1255	13345
%	64	08	06	07	06	09	100

Source: MCB Resettlement Census, July 2014

63. Because of the living on the border of poverty many of them are in debt. They obtain cultivation loans from the Bank of Ceylon, Samurdhi Bank, and the People's Bank. A few obtain loans to build a house and for business development. In the NWPCP area, 21% households and 50% in the UECP area obtained credit from institutional sources. Fifteen% of such loans are for cultivation purposes, 12% for house construction, and 20% for business development. More than half of loans were spend on household expenses such as weddings, children's education and pilgrimages. The highest amount borrowed from the People's Bank was SLR 550,000 to build a house. Another household borrowed SLR 550,000 from the Bank of Ceylon

to improve agricultural land. The average amount of household debt in the NWPC and UECP areas was SLR 30,000. The informal money lending is rampant in the project areas, and many poor villagers depend on money lenders to borrow money for their daily expenses and pay exorbitant interest rates when crops are harvested or household members send money home from their employment.

C. Housing

64. Housing is a key indicator of a household's income and wealth. Regardless of the income bracket of a household, all households want to build a better house with basic amenities such as water, electricity, and a sealed toilet. Most of the remittances from outside are dedicated to build better housing facilities and to buy TVs, cookers, DVD players, motor bicycles and three-wheelers.

65. Fifty percent of households live in small but permanent houses (Table 8). Only 13% households live in spacious houses with the area more than 1500 sq.ft. Two-thirds of households are connected to power supplies and one-third of households receive pipe-borne water. Only three households live in temporary huts.

Table 8: Types of Buildings and Facilities

Project & GND	Permanent			Semi Permanent			Temporary			Electricity		Pipe-borne Water	
	1	2	3	1	2	3	1	2	3	Yes	No	Yes	No
UECP													
Elahera 3		1								1		0	1
Damanayaya	4	2	3	2						8	3	7	4
Kottapitiya							1	1		0	2	0	2
Madawala	1	1					1			1	2	2	1
Yakkalla	5	2	2							5	4	2	7
Sub total	**10**	**06**	**05**	**02**			**02**	**01**		**15**	**11**	**11**	**15**
NWPC													
Lenadora North	2										2		2
Ethabandiwewa	4									2	2	2	2
Welemitiyawa	1	2	1							4		1	3
Danduyaya		1								1			1
Ranwedliyawa	1	1								2			2
Pahala Bambawa	1			02						3			2
Kospota	1			02						2		1	2
Konwewa	3									3		1	2
Sub total	**13**	**04**	**01**	**04**						**16**	**04**	**4**	**16**
Grand total	**23**	**09**	**06**	**06**			**02**	**01**		**32**	**15**	**16**	**31**

1 = <750 sqft; 2 = 751-1500 sqft; 3 = >1500 sqft

VII. ANTICIPATED PROJECT BENEFITS AND ADVERSE IMPACTS

A. Employment Opportunities

66. The project activities will generate employment opportunities which will directly benefit local people, especially project-affected persons. They expect that the EA and project contractors would give priority to local people in selecting skilled and semi-skilled labourers for project construction works. Political interference and recruitment of outsiders would create social and income problems for them.

B. Increase in Agricultural Production

67. Primary benefits of the projects will be the increased agricultural production through improved irrigation. More specifically, improved irrigation is expected to result in:

(i) An increase in yields of existing crops (paddy and other field crops)

(ii) An increase in the cultivated area (during the dry season, a substantial part of agricultural land is left fallow in areas that are not served by irrigation systems)

(iii) An increase in the production of high-value crops (such as fruit or vegetables)

68. The availability of irrigation water has a major impact on the existing cultivated area. About 60% of rain-fed land (where paddy is cultivated during the Maha season) is left fallow in the Yala season. In case of irrigated land under irrigation schemes, only 16% of cultivated land fall into this category. Similar observations are made about other field crops (OFCs), although differences in net yields and cultivated areas are less extreme than for paddy, given that most OFCs are less dependent on water than paddy. The relationship between the availability of irrigation water and the increase in the production of high value-added crops are less straightforward, because such crops require inputs that are not easy to model, notably access to markets and marketing support.

C. Health and Water

69. The accessibility to water for domestic use is affected by the distance to travel for water collection, the time waiting at the source, and the quality of water at source. Fetching water from long distances consume time and energy, especially of women and children, mostly disturbing them in their household activities, income generation opportunities, leisure activities, and in educational activities. This is especially noted in the communities where households live on LDO allotments.

70. The projects will provide better water supplies to water-deficit areas in the dry zone. This is particularly urgent given the chronic kidney disease has become a major health issue in NCP, EP and NWP. Recent research studies conducted by WHO and University of California proposed authorities to provide good quality drinking water to reduce chronic kidney disease. Provision of good quality drinking water will also reduce gastrointestinal diseases especially among children and old people.

D. Application of Labour Laws

71. The educated people (teachers, government officials and chief incumbents of Buddhist temples) in project areas expect that civil work contractors comply with labour laws and regulations of Sri Lanka. Parents would not send their minors as labourers to work sites. Women who expect to work at work sites as day labourers expect that men and women will be paid equal wages for similar work, and the contractors provide measures to ensure health and safety of workers, including appropriate sanitation facilities for women.

72. People in several project areas indicated their past unpleasant experience of having worker camps nearby. They think that the presence of worker camps close to their houses would generate adverse impacts on their families, and health and safety of the community. They also pointed out that solid waste generation and water pollution at worker camps and worksites would harm them. The impacts depend on the location of sites and their management. They expect that the project authorities would take measures to overcome them.

73. People are concerned about tunnel excavations and their associated risks to the workers who may have limited experience with machines. Fire hazard, getting into contact with moving parts, inadequate ventilation, getting exposed to harmful gases are some of the likely safety risks that they are concerned about.

74. In case of drilling and blasting rocks, use of explosive materials and accidental blasting are some of the safety risks to which villagers and settlers are exposed. In open channel excavations and in the transport of excavated material, use of heavy machinery, dust and exhaust gases can affect the workers and the people who live in the vicinity. Villagers want a safety Program at such locations before any physical work starts. They also want safety fences along the canals to protect their children and animals.

E. Social impacts of Construction Activities

75. Local communities will experience difficulties when using existing major roads as well as by-roads that connect major roads with construction sites. Dust pollution and noise pollution are two major adverse impacts. Generation of high levels of dust and particulate matter, and release of exhaust fumes (by operation of vehicles and machinery) in the air especially during the construction work in the dry seasons would harm people in project areas.

76. Bad influence of migrant workers on local youths is a grave concern of parents. They believe that the arrival of work gangs with contractors would expose their youth to various nefarious habits such as drug additions and alcoholism.

77. Some households felt that alternative schooling facilities are to be provided in case children cannot go to school because of the construction activities. They fear that noise and dust pollution at construction sites would disrupt school work and expose children to various illnesses and hazards. Several households are worried about the potential separation of households by the canal. They want bridges across the canals to maintain their social relationships without interruption. They are grateful that no one will be physically removed from their communities although many of them will lose their houses and homesteads to the projects.

F. Impacts on Community Health and Safety

78. Environmental pollution especially of water sources because of construction activities will affect community health especially of children, elderly and sick persons. Increase of vector-borne diseases such as dengue due to construction of trenches, pits, any other structures that can hold stagnant water.

79. No record of HIV/AIDs is found in the project areas. The spread of sexually transmitted diseases as a result of the influx of migrant construction workers is low as locally hired labourers will work at most of the work sites. But people in project areas are concerned about the possibility of arrival of prostitutes from towns and cities, and the risks to their youth are exposed.

80. Timely dissemination of information and awareness creation among construction workers and communities on the risks of sexually transmitted diseases and HIV/AIDS are important. Measures of anti-trafficking of women and children should also be made part of the health and safety Program implemented at construction camp sites.

81. Two GNs suggested that a baseline health status survey of the affected communities would be very useful in monitoring changes in health status of local people during the operation and maintenance phases of the projects. Such a database, they think, would provide an objective threshold to monitor health impacts and to identify those who deserve compensation from contractors.

APPENDIX 15

STAKEHOLDER ANALYSIS AND STRATEGIC COMMUNICATIONS PLAN

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROJECT PREPARATORY TECHNICAL ASSISTANCE

TA-8633

ANNEX 15

STAKEHOLDER ANALYSIS AND COMMUNICATIONS BASED ASSESSMENT

DECEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
APs	–	Affected Peoples
ARPA	–	Agriculture Research & Development Assistants
AFD	–	Agency Francaise de Development
CP	–	Concept Paper
DOI	–	Department of Irrigation
DCS	–	Development Communication Specialist
CBA	–	Communication-Based Assessment
CSOs	–	Civil Society Organizations
CEA	–	Central Environment Authority
CCBO	–	Communication and Capacity Building Officer
EIA	–	Environment Impact Assessment
FGDs	–	Focus Group Discussion
GOSL	–	Government of Sri Lanka
GA	–	Government Agent
GN	–	Gramasewa Niladaree
DFC	–	Department of Forest Conservation
DWLC	–	Department of Wild Life Conservation
DNP	–	Department of National Planning
DPMCU	–	District Project Management Communication Unit
ERD	–	Department of External Resources
DOI	–	Department of Irrigation
DAD	–	Department of Agrarian Development
DDO	–	Devineguma Development Officer
DOA	–	Department of Agriculture
DFC	–	Department of Forest Conservation
DSs	–	Divisional Secretaries
DCC	–	District Coordinating Committee
DPD	–	District Project Director
DAC	–	District Agriculture Committee
DACM	–	Divisional Agriculture Committee Meeting
EDO	–	Economic Development Officer
FO	–	Farmer Organization
GRC	–	Grievance Redress Committee
IA	–	Implementing agency
ICS	–	International Communication Specialist
IMD	–	Irrigation Management Division
IEC	–	Information Education Campaign
IFAD	–	International Fund for Agricultural Development
JICA	–	Japan International Cooperation Agency
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program

MRB	–	Mahaweli River Basin
MIWRM	–	Ministry of Irrigation and Water Resources Management
MFP	–	Ministry of Finance and Planning
MLLD	–	Ministry of Land and Land development
MWRC	–	Ministry of Wild Life Resources Conservation
MNH	–	Ministry of National Heritage
MDM	–	Ministry of Disaster Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
NCPCP	–	North Central Province Canal Program2
NWPC	–	North Western Province Canal
NLDB	–	National Livestock Development Board
NCS	–	National Communication Specialist
NGO	–	Non-Government Organization
PMDSC	–	Program Management, Design and Supervision Consultant
PRDA	–	Provincial Road Development Authority
PMC	–	Project Management Committee
PMU	–	Project Management Unit
PMCU	–	Project Management Communication Unit
PPTA	–	Project preparatory technical assistance
PAP	–	Project Affected People
RPM	–	Resident Project Manager
SIWRM	–	Strengthening integrated water resources management
SCP	–	Strategic Communication Plan
UEC	–	Upper Elahera Canal
WB	–	World Bank

GLOSSARY

Pradeshiya Sabha: Local authorities established under the Pradeshiya Sabhas Act Number 15 of 1987. Smallest political unit in peri urban and rural areas.

Yala season: The southwestern monsoon season from May to September.

Maha season: The northeastern monsoon season from October to March.

CONTENTS

ANNEXES

I. EXECUTIVE SUMMARY

A. Background

1. The project preparatory technical assistance (PPTA) for preparing the Water Resources Development Investment Program (WRDIP) was approved by ADB on 02 April 2014 and by the government on 10 April 2014. The PPTA team mobilized in April 2014. For the PPTA, ADB recruited a National Communication Specialist (NCS) to assess communication needs of the WRDIP through a stakeholder analysis and communications-based assessment in order to support the development of a strategic communications program (SCP). This report presents the main findings, conclusions, and recommendations of the stakeholder analysis.

2. The Ministry of Irrigation and Water Resources Management (MIWRM) is the executing agency (EA) of the WRDIP. A Program Management Unit (PMU) responsible for coordination, management, monitoring and supervision of the investment program has been established by MIWRM and Individual project implementation units for each of the three investment projects will assist project implementation and monitor day to day construction works. The PMU will be set up communication unit and each of PIUs will consist of the communication officer to implement the proposed SCP.

B. Objectives of the Communication base Assessment

3. Key objectives of the communications-based assessment are to identify, analyze, and evaluate parties that have a potential interest or stake in the WRDIP- people who might be directly or indirectly affected or who might contribute to or jeopardize the initiative. The recommendations in this report will inform the SCP by identifying the key pathways towards information dissemination, education and awareness raising, engaging stakeholders and encouraging dialogue, fostering behavioral change, and mitigating project risks. The SCP is being developed to guide information sharing, consultation with all stakeholders, and enhance design of the investment program. Such information sharing will help to build consensus and ensure continuous stakeholder support throughout the investment program. This consensus building can help identify and address civil society concerns at an early stage so as to avoid escalation of complaints later.

C. Methodology

4. The report is based on desk analysis, key informant interviews with stakeholders and focus group discussions (FGDs) that were conducted when the NCS met with representatives of each stakeholder group and made site visits to NWPC, MLBCR and UEC project areas. The stakeholder analysis is a useful exercise in itself, but its ultimate purpose is to inform the development and implementation of the forthcoming communication strategy. With this in mind, the consultant's research, interviews and analyses focused on the communications characteristics of each stakeholder group regarding the project, and in particular, project affected people, beneficiaries, higher ranking officers, district- and divisional-level officers, local level political leaders, field level officers and key civil society stakeholders.

D. Organization of the Report

5. The communication-based assessment identifies the knowledge, perceptions, fears, and expectations of the stakeholders affected by the development initiative. When used at

the initial stage of designing a development intervention, communication can make an integral contribution to development. This communications based assessment report is divided into seven sections as follows.

1. Stakeholders

6. This chapter identifies the most influential stakeholders based on a communications-based assessment. Primary and secondary stakeholders are identified in Table 1 presenting a summary of their roles, interests/issues, importance to civil society groups, and suggested communication channels. The most important primary stakeholders were identified to be project affected people, project beneficiaries, government officials and policy makers, (includes ministries department, authorities and boards, provincial council, district and divisional secretaries, local government and multilateral agencies). The most important secondary stakeholders were identified to be commercial media, people in positions that convey influence, community leaders, civil society organizations, businesses, advocates, and people with academic or research interests in community activities and community at large.

2. Findings

7. A stakeholder analysis is one of the most complex and important components of any development initiative. The main findings of the stakeholder analysis are discussed in this section.

3. Current Status of Communication Activities

8. An overview of the communication activities conducted by the MIWRM is discussed herewith to provide a better understanding of the present status of communication activities conducted to-date and identify key issues of conducting communication activities.

4. Information and Communication Gaps

9. Information regarding communication gaps among all stakeholders is presented in this section. Both stakeholders and government officials felt they were facing challenges obtaining and disseminating important information in a timely manner.

5. Communication Channels

10. In this section the relevant communication networks for the WRDIP are described in detail. This includes the respective existing communication platforms, to be utilized as information management resources during the investment program. These include the Project Management Committees (PMCs), District Coordinating Committees (DCCs), District Agriculture Committees (DACs), and Divisional Coordinating Committees (DCCs).

6. Conclusions

11. Stakeholders of the WRDIP were identified and studied in this stakeholder analysis based on discussions with key persons in the project areas, literature reviews and the NCP's professional experience in the field. Stakeholder mapping is used to illustrate their relationship, interest influence, expectation, concern potential for collaboration and potential to affect the program. The most notable issues found in the analysis include less than optimal awareness about the WRDIP's activities and stakeholders' roles and responsibilities, and a lack of

effective feedback mechanisms between the major parties (e.g., local irrigation engineers and farmers). Improvements in the coordination and participation of stakeholders at different levels, and through targeted means of communications, will benefit the implementation of the program.

7. Recommendations

12. The stakeholder analysis has identified the need for a more formal communications structure to improve coordination and information dissemination, which will also benefit the technical specialists and engineers available to support WRDIP, line agencies and other groups. Ten recommendations are proposed based on the findings and conclusions in the study.

II. INTRODUCTION

A. Description of the Program

14. The investment program will support MIWRM to finance water conveyance infrastructure investments under the government's planned North Central Province Canal Project (NCPCP, map shown in Annex 1). It will be financed under a $675 million multitranche financing facility (MFF). The MFF will comprise three tranches financing three separate loan "Projects". The Projects will comprise the following individual investment projects.

(i) The Upper Elahera Canal Project (UECP) comprises two main components. The first component is the 9 km KMTC that will convey up to 771 MCM of water annually between Kaluganga and Moragahakanda Reservoirs, both of which are currently under construction. The reservoirs will retain local runoff and Mahaweli River flow diversions before supplying downstream irrigation and water supply schemes. The second component is the 65.5 km Upper Elahera Canal (UEC) that will annually convey up to 974 MCM northwards from Moragahakanda Reservoir to the existing Huruluwewa Reservoir, and a further 16.7 km of canals to supply the existing Manankattiya, Eruwewa and Mahakanadarawa Reservoirs; these existing reservoirs supply existing irrigation and water supply schemes.

(ii) The North Western Province Canal Project (NWPCP) will construct 96 km of new and upgraded canals, including a new 940 m tunnel and two new 25 m tall earth gravity dams impounding the planned Mahakithula and Mahakirula Reservoirs to annually withdraw 130 MCM from Dambulu Oya River and the existing Nalanda Reservoir (via the existing Wemedilla Reservoir) to command new and existing irrigation and water supply reservoirs located throughout North Western Province.

(iii) Minipe Left Bank Canal Rehabilitation (MLBCR) project, located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork's weir by four meters to regulate generation inflows, (b) construct new automatic downstream-controlled intake gates to the left bank canal; (c) construct new emergency spill weirs to both left and right bank canals; and (d) rehabilitate the 74 km Minipe Left Bank Canal, including regulator and spill structures, to improve conveyance and reliability of service to existing farmers.

B. Scope of the Communication Based Assessment (CBA)

15. Some of the major elements of the communication-based assessment include:

- Reviewing and evaluating the existing and planned communication activities of the government in relation to this investment program, and recommending additional activities, if any.
- Mapping stakeholders; their positions on the project; their communication requirements (especially those of the project-affected people); gauging stakeholders' level of understanding; identifying their interests and their level of influence.

- Assessing the existing communication dynamics including, but not limited to: how the stakeholders receive and process information; important media outlets; traditional forms of information dissemination practices; new media and technology; key opinion leaders and social interaction, etc.
- Analyzing the media and communication channels that will be critical to sharing information, enabling feedback and participation, building consensus and community mobilization and otherwise supporting the project objectives. Identifying strategic approaches and materials for engaging stakeholders through these various communication and media channels.
- Evaluating the communication capacity of the relevant institutions – both government and non-government – that are involved in the implementation and/or managing the implementation of the communication program and identify priority areas for capacity building.

16. One of the most critical elements of a communications based assessment is the stakeholder analysis, which identifies stakeholders within the scope of the investment program and assesses their communication needs with particular emphasis on project affected people and civil society organizations.

17. Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively.

18. Objectives of the stakeholder analysis are assessing communication needs of program-affected people within the project areas, civil society organizations, and more broadly, other stakeholders within the scope of the investment program.

C. Methodology

1. Desk Review

19. Background information about the WRDIP and familiarity with potential communications areas was obtained by thorough reviews of project reports such as the PPTA Inception and Interim Reports (May 2014 and July 2014), the Aide Memoires from ADB missions to support the WRDIP (January, May and July 2014), Interim and Environment Impact Assessment (EIA) reports, and other documents. These were provided in advance by officers in the Department of Irrigation (DOI), Mahaweli Authority of Sri Lanka (MASL) and the Mahaweli Consultancy Bureau (MCB), who have been contracted by the MIWRM to prepare the feasibility studies and detailed designs for the projects.

20. The desk study was used to identify stakeholders that operated at the village, regional, national and international levels for the WRDIP. The stakeholders were classified as being governmental agencies and departments, civil society organizations, local communities, media, academic and research organizations, private sector organizations and individuals. These initial lists were reviewed by MIWRM and ADB for validation before the field visits were made. The desk study was used to identify the primary, secondary and key stakeholders at the all regional level of the WRDIP.

2. Interviews with Project Staff and Focal Persons

21. First-hand information about the project and its activities were gathered through personal interviews with the Program Director of the WRDIP. Additional information was elicited from the focal persons of institutional stakeholders during visits to their respective offices in Colombo and in the project areas. Key informant interviews were carried out with systematically selected individual stakeholders representing local community groups, as well as government departments and agencies (see Annex 04 for a list of persons met). This technique was employed to capture the views and perspectives of individuals representing different government stakeholder organizations. A key informant questionnaire was used to collect information (see Annex 2). Open ended questions were used and separate questions were used for different key informants.

3. Field Visit and Focus Group Discussions (FGDs)

22. Field visits were conducted during August to September 2014 to the project areas of the UEC/KMTC, NWCP and MLBCR. FGDs were held with project-affected people and beneficiaries, including women and youth, farmer organizations, and field level officers who are working under the divisional secretary (refer to Annex 04). The discussions generally cantered on (i) project-related interests, issues, and concerns and potential effects on their livelihood; (ii) benefits of the program, (iii) potential negative impacts of the program; (iii) information seeking behavior; (iv) knowledge sharing on irrigation system; (v) current levels of awareness about the project, information gaps and needs; (vi) preferred communication platforms for the program; and (v) communication problems encountered in the past and how they were successfully resolved. An FGDs schedule was used to gather information (see Annex 3).

4. Case Studies

23. Case studies were undertaken with a limited number of individuals representing the project-affected stakeholder groups in Galewela and Elahera. The purpose of this technique was to capture the perceptions of informants regarding the program, as reflected by representative individuals in the communities.

III. STAKEHOLDER ANALYSIS

25. Stakeholders are those people and groups that need to be considered in achieving project goals and whose participation and support are crucial to its success. Stakeholder analysis identifies all primary, secondary and key stakeholders who have a vested interest in the issues with which the project or policy is concerned. The goal of stakeholder analysis is to develop a strategic view of the human and institutional landscape, and the relationships between the different stakeholders and the issues they care about most. More importantly, when done well, a stakeholder analysis helps ensure that the interest of poor and vulnerable people are not overlooked, and contributes to judging feasibility and assessing the risk of an initiative. The results normally have implications for targeting stakeholder participation throughout the various phases of an operation.

26. Stakeholders may include locally-affected communities or individuals and their formal and informal representatives, project beneficiaries national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community, or other businesses. These stakeholders can be divided in to two groups called primary and secondary stakeholders.

A. Primary Stakeholders

27. Primary stakeholders include people or groups who are ultimately impacted either positively (beneficiaries) or negatively (such as people who may feel they have something to lose as a result of a particular decision or project, such as power over or access to resources). **Table 1** outlines the roles, interests, and importance of each primary stakeholder.

1. Project Affected People (PAP)

28. According to the data obtained from Resettlement implementation plan report, There are a total 22 physically displaced households and 474 economically displaced households in the NWPC project area and 16 physically displaced households and 86 economically displaced households in UEC project area. The safeguards needs and issues of the larger stakeholder groups, such as involuntary resettlement are to be addressed by the PPTA and are not covered in this report.

2. Project Beneficiaries

29. Field level direct beneficiaries will be water consumers, farmers, women, youth and business people of the respective project areas. 7500 ha and 15,500 farmer families will be benefited in implementing MLBCR and it will result in receiving 10MCM drinking water facilities. 12,500 ha and 40,000 farmer families will be benefited due to NWPC and it will be an increase of 10 MCM drinking water facility. 17,200 ha and 25,000 farmer families will be benefited with the increase of 25 MCM drinking water facilities in implementing UEC. The proposed project will benefit 80,000 families in 393 Grama Niladhari (GN) Divisions in 7 Divisional Secretary Divisions.

3. Government Officials and Policy Makers

30. Relevant government agencies and their organization structure are summarized as follows:

Government of Sri Lanka (GOSL)
Cabinet
Ministries
Ministry of Irrigation and Water Resources Management (MIWRM)
Ministry of Finance and Planning (MFP)
Ministry of Land and Land Development (MLLD)
Ministry of Wild Life Resources Conservation (MWRC)
Ministry of National Heritage (MNH)
Ministry of Disaster Management (MDM)
Ministry of Power and Energy (MPE)
Ministry of Health (MOH)
Ministry of Environment and Renewable Energy (MERE)
Ministry of Education (MOE)

Departments
Department of Irrigation (DOI)
Department of Forest Conservation (DFC)
Department of Wild Life Conservation (DWLC)
Department of National Planning (DNP)
Department of External Resources (ERD)
Department of Agrarian Development (DAD)
Department of Agriculture (DOA)
Provincial Road Development Department (PRDD)
Department of Archaeology (DA)

Authorities and Board
Central Environment Authority (CEA)
Mahaweli Authority of Sri Lanka (MASL)
National Livestock Development Board (NLDB)
Ceylon Electricity Board (CEB)
National Water Supply and Drainage Board (NWSDB)

Provincial Councils
North Western
North Central
Central

Local Government (Pradeshiya Saba)
Minipe, Mahawa, Polpihigama, Galewela, Dambulla, Elahera

Government Agent (GA)/ District Secretariat
Kandy, Anuradhapura, Polonnaruwa, Kurunegala, Matale

Divisional Secretariats (DSs)
Elahera, Medirigiriya, Galenbidunuwea, Palugaswewa, Dambulla, Galewela, Polpithigama, Mahawa, Ehetuwewa, Abanpola, Galgamuwa, Naula, Minipe, Hasalaka, Laggala Pallegama, Wilgamuwa

Multilateral Agencies
Asian Development Bank (ADB)
World Bank (WB)
Japan International Cooperation Agency (JICA)
International Fund for Agricultural Development (IFAD)
Agency Francaise de Development (AFD)

a. Cabinet

31. The Cabinet of Sri Lanka is the council of ministers that forms the central government of Sri Lanka. It is responsible to and answerable to Parliament. The President is a member of and head of the Cabinet.

b. Ministry of Irrigation and Water Resources Management (MIWRM)

32. The MIWRM remains committed to manage of the irrigation sector and water resources of the country, maintaining the equilibrium between the trends in rapid economic development and sustainable use of water resource base. The MIWRM is executing agency for implementing WRDIP.

c. Ministry of Finance and Planning (MFP)

33. The ministry is responsible for formulation of national economic and financial policies and strategies of the country. Formulation of fiscal policy and macro fiscal policy management, preparation of national development plan and management of financial resources, management of national tax policy and effective use of government revenue and coordination with the Central Bank on the formulation of monetary policies and overall macroeconomic management are some of its other responsibilities

34. In addition, the coordination of public and private sector activities and facilitation of the private sector for economic development, coordination with international agencies and mobilization of foreign resources ensuring effective use, management and accounting for the consolidate fund and publication of annual accounts of the country on international standards, overall management of revenue agencies and administrative and monitoring functions in respect of state banking and financial institutions are important functions performed by this ministry.

d. Ministry of Land and Land Development (MLLD)

35. The Ministry for the subject of “Lands” was established in 1932, as per the recommendation of the Committee appointed in respect of the subject of Land and Agriculture of the State Council 1931. The main objectives of establishing this Ministry were to implement activities such as formulate and implement State Land Policies, conserve State Lands, land settlement, land acquisition of lands for public purposes, with in the country.

e. Ministry of National Heritage (MNH)

36. The MNH is the Sri Lankan government ministry responsible for “Identifying and preserving national heritages in Sri Lanka towards the prosperity of our nation and thereby promoting such heritages. The NWCP area and the areas in close proximity are of special archaeological importance, being located in areas related with folktales to Anuradhapura,

Kurunegala and Yapahuva ancient kingdoms. Some highly respected and worshipped Buddhist temples and ancient ruins are also situated in close proximity. Before implementing project activities necessary approval should be taken from the MNH.

f. Ministry of Disaster Management (MDM)

37. The MDM facilitate harmony and the prosperity and dignity of human life through effective prevention and mitigation of natural and man- made disaster in Sri Lanka.

g. Ministry of Power and Energy (MPE)

38. The MPE is a ministry of the Government of Sri Lanka that directs the formulation and implementation of policies relating to the generation, transmission, distribution and retailing of electrical energy in Sri Lanka.

h. Ministry of Health (MOH)

39. The MOH is responsible for formulating and implementing national policy on health, nutrition, disease prevention, and other subject which come under its purview. Many of the proposed project areas suffer kidney disease. Ministry of health is responsible to take action to prevent water bone diseases.

i. Ministry of Environment and Renewable Energy (MERE)

40. The MERE of Sri Lanka remains committed for the management of the environment and natural resources of the country, maintaining the equilibrium between the trends in rapid economic development and use of natural resource base.

j. Department of Irrigation (DOI)

41. The DOI enhance the development and management of land and water resources towards the socio economic development of Sri Lanka and DOI plan, design, and control and manage land and water resources to derive optimum benefits for irrigated agriculture Hydropower and flood control by harmonizing the modern technologies and human resources. The WRDIP will be implemented by the DOI.

k. Department of Wildlife Conservation (DWLC)

42. The DWC is the principle government institution responsible for the protection of wildlife resources of the country over its entire land and sea territories.

l. Department of National Planning (DNP)

43. The Department of National Planning as a part of the apex Ministry of Finance and Planning committed to policy development, planning and implementation, to accelerate Sri Lanka's economic growth and social progress.

m. Department of Project Management and Monitoring (DPMM)

44. The mandate of the Project Management and Monitoring Department of the Ministry of Finance and Planning is to monitor all the development work of the government with

special emphasis to review the progress of the foreign funded projects and programs to ensure expeditious implementation of the government's development projects and programs.

n. Department of External Resources (ERD)

45. The ERD of the Ministry of Finance and planning is responsible for mobilizing and coordinating foreign assistance to Sri Lanka.

o. Department of Agrarian Development (DAD)

46. The DAD established on October 1st 1957 with an idea of providing supply services that are initial for Agriculture schemes empowered by the Paddy Land Act No. 1 in 1958 and presently governed by the Agrarian Development Act no.46 in 2000. It provide for matters relating to landlords and tenant cultivation of paddy lands, for the establishment of Agrarian Development councils, land bank, agrarian tribunals, Farmer Organizations (FOs), and management of irrigation water within the area of authority of FOs.

p. Department of Agriculture (DOA)

47. The DOA functions under the Ministry of Agriculture and it is one of the largest government departments with a high profile community of agricultural scientists and a network of institutions covering different agro ecological regions island wide. The objectives of the DOA are focused on maintaining and increasing productivity and production of the food crop sector for the purpose of enhancing the income and living condition of the farmer and making food available at affordable prices to the consumer. It will help to increase productivity of land in WRDIP areas.

q. Department of Archaeology (DA)

48. The DA of Sri Lanka is to function as Sri Lanka's apex institution and chief regulatory body for the management of its archaeological heritage.

r. Central Environment Authority (CEA)

49. The CEA was established on 12th August 1981, under the provision of the National Environmental Act No: 47 of 1980. The Ministry of Environment which was established in December 2001 has the overall responsibility in the affairs of the CEA with the objective of integrating environmental considerations into the development process of the country. The CEA was given wider regulatory powers under the National Environment (Amendment) Acts No: 56 of 1988 and No: 53 of 2000.

s. Mahaweli Authority of Sri Lanka (MASL)

50. The implementation of the MDP is a mandate of the MASL established in 1979 by an Act of Parliament. The MASL's current task is to implement the envisaged project plan in the balance areas proposed by the Master plan and also gazetted areas. This includes rehabilitating and maintenance of the irrigation network, administration of the land, enhancing the production of agriculture and the post settlement process. In addition to its current responsibility managing irrigation of 175,000 ha of irrigable land is also accountable to managing irrigation of water of the 180,962 ha of irrigable land in the Dry Zone. MASL will be a project implementing agency of the UECP.

t. Provincial Road Development Department (PRDD)

51. The PRDD is responsible for development, maintenance and operation of an effective Provincial Road Network with optimum utilization of resources and professional skill to uplift the standard of living of all road users.

u. National Water Supply and Drainage Board

52. The Organization had its beginnings as a sub department under the Public Works Department, for Water Supply & Drainage. In 1965, it became a division under the Ministry of Local Government. From 1970, this division functioned as a separate department under the Ministry of Irrigation, Power and Highways and remained so until the present Board was established in January 1975 by an Act of Parliament.

53. The National Water Supply and Drainage Board (NWSDB), which presently functions under the Ministry of Water Supply and Drainage, is the principal authority providing safe drinking water and facilitating the provision of sanitation in Sri Lanka.

v. The Ceylon Electricity Board

54. The Ceylon Electricity Board (CEB) is responsible for generation, transmission and distribution of electrical energy. The electricity generation and distribution is owned or largely controlled by the government in Sri Lanka. CEB has to share the water with other sectoral water use agencies in producing hydro-electricity.

w. Provincial Councils

55. Provincial councils of Sri Lanka are legislative bodies of the nine Provinces of Sri Lanka. In accordance with the Sri Lankan constitution, the provincial councils have legislative power over a variety of matters including agriculture, education, health, housing, local government, planning, road transport and social services.

x. Local Government

56. Local government is the third and lowest level of government in Sri Lanka, after the central government and provincial councils. The local government bodies are collectively known as local authorities. They are responsible for providing a variety of local public services including roads, sanitation, drains, housing, libraries, public parks and recreational facilities. Local authorities are divided into three different groups: municipal councils, urban councils and divisional councils (pradeshiya sabha).

y. District Secretariat

57. A Government Agent (GA) or a District Secretary (DS) is a Sri Lankan civil servant of the Sri Lanka Administrative Service appointed by the central government to govern a certain district of the country. The GA/ DS is the administrative head of public services in the District.

z. Divisional Secretariat

58. The districts of Sri Lanka are divided into administrative sub-units known as divisional secretariats. The Divisions are administered by a 'Divisional Secretary', and are known as a D.S. Division.

Table 1: Roles, Interests and Importance of WRDIP Primary Stakeholders

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
Affected People					
	Local people residing in the particular area Women's groups Farmers' groups Other community members Private sector and industries (Rice Milles ,Inland fisheries, Youth group Land owners	Leverage off of project to improve their standard of living (health, education, income) Protect their special interests (preserving livelihood, material things, access to land and services)	Resettlement and compensation Improved crop yield improved quality of life Enhanced household income. better social security increased opportunities for skill development Better opportunity to seek gainful employment	Complicate resettlement and compensation negotiations with villages Potential misrepresentation of PAP preferences and interests, leading to misinformation that could misinform plans and work against the interests of the PAP Potential misinformation about the project disseminated to the communities, resulting in unnecessary or misinformed resistance to the project Delays in project (both construction and social/environment subprojects), distribution of compensation Prevent exposure to adverse effects to them from project plans	Direct Communication FGDs Awareness Meeting Communication committee in affected people through Field level officers, Gramasewa Niladaree, Agricultural production Assistant, Divineguma Development officer, Economic development officers Assistant engineer Resident project manager Face to face meeting Letters Posters Leaflets GRM
	Local people residing in the particular area	They will access to	Improved living standard, better social	Improved life condition	Direct Communication

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
	Women's groups Farmers' groups Other community members Private sector and industries Youth group	water ,new income generation activities Practice water management policy	infrastructure, increased business opportunities, empowerment Income generation Improved quality of life Better social security Increase opportunities for skill development Better opportunity to seek gainful employment		Through Project management committee(PMC) Awareness Meeting through Field level officers, Gramasewa Niladaree, Agricultural Production Assistant, Divineguma Development officer, Economic development officers Assistant engineer Resident project manager (RPM) Letters Posters Leaflets
Central Government	Cabinet	Project Identification and Approval Project appraisal with government policies and donor requirements and policy implementation through the project	Solution for water scarcity problem efficient implementation of developmental programs. Desire to get public support to implement the project	Effective Policy Implementation through approved project	Direct communication Monthly quarterly and annually progress report Web site Mass media campaign
	Ministry of Irrigation Water Resources Management MIWRM	MIWRM is the responsible and accountable agencies at the national level for managing,	Providing wellbeing of community while fulfilling all water needs through Water Resources Management.	effective monitoring and supervision of the planned	Formal communication Quarterly and annual reports on all WRDIP activities, including Separate situation update

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
		protecting and developing water resources in the country. This is the accountable agency to the national government through Ministry of Finance and planning: and responsible agency to other stakeholders and general public through PMU. Committed to improve socio economic condition of the rural poor, regardless of how, when, and where they are affected by the program. They are the key stakeholder transparent, efficient, timely and target - oriented implementation of WRDIP avoiding duplication of efforts and concordance with national initiatives,		program with continuous improvement	reports on any separate WRDIPs upon request. Progress review meeting Monitoring report Day-to-day management of the investment program through the Program Management Unit. Program steering committee meeting (PSC)

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
		strategies and plans Plans and manages the implement of the proposed irrigation system Effective resource allocation, implementation policies laws etc. Monitoring and supervision of the program			
	Ministry of Finance and Planning (MFP)	Recipient of ADB loan, responsible for repayment Receive and Pay back loan coordination with international agencies and mobilization of foreign resources ensuring effective use, management and accounting for the consolidate fund. Manage and oversee government budget Approval of loan	Economic development	. effective and efficient financial management as per ADB loan agreement achieving planned goals as per government budget”	Direct formal communication Progress report (quarterly , annually progress report, project completion report, fund disbursement report) Web Site PSC meeting

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
		agreement			
	Ministry of Land and Land Development (MLLD)	Acquisition of crowned and private land for construction and resettlement and for reservations The lands are acquired under the provisions of the Land Acquisition Act MLLD responsible for implementing national voluntary settlement plan	Resettlement reserve the land for project area	Clearance of land for construction Timely/effective resettlement	Direct formal communication Letters PSC
	Ministry of Wild Life Resources Conservation (MWRC)	Clearance of environmental safeguard documents.	reservation of land for project area having assessed wild life protection	Implement wildlife conservation activities	Formal communication Awareness program Progress review meeting PSC meeting Leaflets
	Ministry of Power and energy (M	Obtain clearance certificate to due to crossing of power line Obtaining power supplies for operation of Tunnel Boring Machine, project offices, worker camps and other facilities of the project	Project implementation support	respective clearance certificates are obtained wherever it is applicable	Direct communication Letters Leaflets Web Newsletter

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
	Ministry of National Heritage (MNH)	Preparation of an independent Archaeology Impact Assessment for the project To protect archaeological sites	Assessing protect archaeological sites	Preserve archaeological site without damage and disturbance	Direct communication PSC meeting Letters
	Ministry of Disaster Management (MDM)	Protection of the community from disasters in project implementation	Project implementation support minimizing disasters	Minimize man- made disasters	Direct communication Program steering committee meeting Letters
	Ministry of Health	Awareness and giving remedies for chronic kidney disease	Supply fresh water	Reduce rapid increase of chronic kidney disease	Letter PMC meeting Discussion
	Ministry of Environment and Renewable Energy	Issue of letters of consent and any conditions for proceeding with the EIA process for the project.	management of the environment and natural resources	maintaining the equilibrium between the trends in rapid economic development and use of natural resource base	Direct communication PSC meeting Letters
	Ministry of Education	Giving schools to project affected schools children	Providing quality drinking water for school children	Educated future generation	Direct communication Letters, Meeting
	DOI	Consulting, assessing and paying compensation in time	Plan, design, control and manage land and water resources to derive optimum benefits for Irrigated agriculture Resettlement Management, operation	Develop and construction new projects without damaging existing irrigation Safeguard the beneficiaries of existing irrigation scheme	Direct communication Progress Report Awareness programs to field level officers in DOI in relevant project areas Progress review meeting

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
			and maintenance of irrigation systems	All affected individuals and families were compensated before start the physical works Livelihood enhancement and minimum negative impacts on the natural resources and cultural properties planned project activities are implemented efficiently and effectively through monitoring and supervision	PSC meetings Day-to-day management of the investment project through the Project Implementation Unit
	Department of Forest Conservation (DFC)	Issue of letters of consent and any conditions for proceeding with the EIA process for the project. Giving DFC Clarence for project activities after assessing the degree of impact and recommending mitigation measures Clearance to conduct construction within Forest areas forest Clarence for trees in forest area for construction	Sustainably manage forest and tree resources	DFC regulations are followed during the implementation process and mitigation measured are adequately taken	Formal communication PSC meeting Awareness program of field level forest officers Leaflets on project Progress review meeting in national level and field level

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
		Forest Conservation			
	Department of Wild Life Conservation (DWLC)	Clearance of EIA (giving DWLC Clarence for project activities after assessing the degree of impact and recommending mitigation measures) Clearance to conduct construction within National parks and Sanctuaries (e.g. Minneriya National park, Elahera-Giritale Sanctuary and Minneriya-Giritale national Parks) Wild life conservation Propose wild life conservation activities considering disruption of movement ,pattern and death or injuries of wild elephant and	Protect wild life and habitat Concern human elephant conflict	DWLC regulations are followed during the implementation process and mitigation measured are adequately taken	Direct communication Sign MOU with PMU to implement wildlife projection activities Awareness programs field level officers and officers in national park and sanctuaries in project implementing areas Progress review meeting Brochures Booklets

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
		others due to falling into canal			
	Department of National Planning (DNP)	Providing a national perspective to policies to implement program Implementing support	Formulate policies on socio-economic development; formulate and implement development consolidation strategies, appraise, select and prioritize projects, monitor projects	Goal of the approved plan is accomplished efficiently and effectively	Direct communication Web site update Progress review meeting PSC meeting
	Department of External Resources (ERD)	Project approval Coordination with funding agency and executing agency Release of foreign funds	Development of National economy Coordination, implementation and monitoring project activities	Mobilizing and coordinate foreign assistance	Direct communication Progress review Letters Website
	Department of Project Management and Monitoring	Keep constant dialogue with the Project Directors, Department of Treasury Operations, Department of National Budget and Department of State Accounts to ensure cash flow	Monitor the implementation of Foreign Funded Projects; the utilization of foreign aid and intervene to accelerate the implementation of development projects and programs.	key partner to achieve development effectiveness. Of the WRDIP	Web site PSC meeting Reports

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
		requirements of the projects of the projects are met in an uninterrupted manner for the smooth implementation of projects			
	Department of Agrarian Development (DAD)	Safeguard tenancy and land owner rights, strengthening farmer's institutions and providing agrarian services	Livelihood improvement And rehabilitate minor irrigation tanks	Agrarian inputs are received to farmer community and land owner rights are protected in project area	Direct communication Letters Project steering committee meeting Website
	Department of archaeology	Preparation of an independent Archaeology Impact Assessment for the project	Assessing protect archaeological sites	Preserve archaeological site without damage and disturbance	Letters Meetings Program Steering committee
	Department of Agriculture (DOA)	Improving food crop productivity through research, extension, production of seed and planting material, and regulatory services.	Livelihood improvement supportive	food crop productivity is improved within the project area"	Direct communication Letters Website PSC meeting
	Provincial Road Development Department (PRDD)-Kurunegala	Access roads creation and Modification of existing roads.	Loss of their road due to North Western Canal Project	Implementing support Provincial roads are constructed in par with specifications and regulations and developed roads are taken over for maintenance	Direct communication Letters Meeting

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
	Mahaweli Authority of Sri Lanka (MASL)	Functions of implementing agency of UECP	UEC implementation supervision Resettlement Compensation Management, operation and maintenance of the systems	Implementation support Project monitoring	Direct communication Formal communication Letters Progress review PSC meetings Day-to-day management of the investment project through the Project Implementation Unit
	Central Environment Authority (CEA)	Clearance of EIA Review and update mandate of National Commission for the Protection of Environment CEA responsible for review of impact and mitigating measures of project involving involuntary resettlement.	Environmental protection	environmental mitigation measures are adequately taken without violating CEA and other agency regulations stipulated in the EIA/IEE	Direct communication Letters Reports Meeting PSC meeting Web site Discussion
	National Water Supply and Drainage Board	Pipe borne water supplies to project	Supply quality water	providing safe drinking water	Discussion PSC meeting Letter
	National Livestock Development Board (NLDB)	Acquisition of land a portion of NLDB land is given to the project	Compensation	Implementing support	Direct communication Letters Discussion Meeting Brochures

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
District Secretaries	Anuradhapura Polonnaruwa Kurunegala Kandy Matale	Coordination of project activities through district level stakeholder agencies and community by making use of administrative power as a DS/GA More decision making power for district level development activities	Project implementing support Resettlement Project monitoring Assurance of water issuing for Polonnaruwa District (Polonnaruwa)	Project activities are meaningfully coordinated among district level stakeholder agencies and public and district level administrative decisions are made as necessary	Direct communication Progress review meeting in District level Awareness all district level government officers and politicians in District coordinating committee meeting Leaflets Progress report Web Hoardings PSC meetings
Divisional Secretaries	Elahera Medirigiriya Galenbidunuwewa, Palugaswewa Dambulla, Galewela, Polpithigama, Mahawa, Ehetuwewa, Abanpola, Galgamuwa, Naula Minipe Hasalaka Laggala Pallegama Wilgamuwa	Coordination of project activities through divisional level stakeholder agencies and community by making use of administrative power as a Divisional Secretaries Removal of trees during land preparation	Project implementing Resettlement Solve water issues in their administrative areas	Project activities are meaningfully coordinated among divisional level stakeholder agencies and public and divisional level and village level administrative decisions are made as necessary Land acquisition Resettlement	Formal communication Awareness program to Awareness meeting Progress review meeting Divisional coordinating committee meeting Quarterly Newsletter Leaflets Brochures Booklets
Provincial Government	Provincial councils North western Central North Central	Coordination of project activities and approval other than to District Secretary	Project implementation support	Project activities are meaningfully coordinated among Provincial level stakeholder agencies and public and provincial level administrative decisions are	Direct communication Letters Awareness program Progress Review

Stakeholder Group	Main Group in the Project Area	Role in the Program	Interests/Stake	Potential Impact of the Group	Suggested Communication Channels
				made as necessary	Quarterly Newsletter Leaflets Booklets Web
Local Government	Pradeshiya Sabha Minipe Elahera Mahawa Polpithigama Galewela Dambulla	Approval under the Pradeshiya Sabhas Act No.15 1987 for the construction of the buildings, access roads, waste disposal	Solve water issues in their administrative areas	Local government approvals are given in time	Direct communication Progress review meeting Letters Progress review meeting Brochures Booklets Web Mass media campaign Quarterly Newsletter Leaflets Booklets
	Municipal Council – Dambulla	Coordination of project activities and approval	Project approval	Project Implementing and resettlement support	Direct communication Awareness Meeting Booklets Brochures Posters Quarterly newsletter, Letters Progress review
Multilateral Agencies	ADB World Bank JICA IFAD	Disburse loans Provide technical assistance Invest fund to improve irrigation and water resource management	Providing fund Implementing support Project monitoring Other donors interested to invest in the sector	Solve water issues in their	Direct communication Progress report Web Site WRDIP Summery reports

B. Secondary Stakeholders

59. The secondary stakeholders are stakeholders that play some intermediary role and may have an important effect on the investment program's outcome. The secondary stakeholders of the WRDIP are summarized in **Table 2**.

1. Media (print, mass media, web sites, etc.)

60. Media includes print, audio video, web, social media, and mobile platforms.

2. People in Positions that Convey Influence

61. **Community leaders:** These might be people who are respected because of their position of leadership in a particular community, or may be long time or lifelong residents who have earned the community's trust over years of integrity and community service. (eg, Chairman of the Farmer Organization, School Principal, Ayurvedic Medicine Doctor).

62. **Advocates:** Advocates may be active on either or both sides of the issue you're concerned with. It will include Pradesiya saba or National political leaders in project area. People with academic or research interests related to a targeted issue or population. Their work may have convinced them of the need for an intervention or initiative, or they may simply be sympathetic to the goals of the effort and understand them better than most.

63. **Community activists:** Organizations and individuals who have a philosophical or political interest in the issue or population that an effort involves may organize to support the effort or to defeat it.

3. Civil society organizations

64. Civil societies such as environment, death donation societies, women and youth associations and wildlife conservation societies will be secondary stakeholders.

4. Businesses

65. The business community usually will recognize its interest in any effort that will provide it with more and better workers, or make it easier and more likely to make a profit. By the same token, it is likely to oppose efforts that it sees as costing it money or imposing restrictions on it.(e.g. Rice millers , Boutique, Inland fisherman)

5. Community at large

66. When widespread, community support is needed. The community as a whole will be the key stakeholder.

6. School Children

67. Today children will be future water users and they will be key stakeholders.

Table 2: Roles, Interests and Importance of Secondary Stakeholders

Stakeholder Group	Main Group in the Project Area	Role on Project	Interests/Stakes	Potential Impact of the Group on Project	Suggested Communication Channels
Media	Local Media Agencies and International Media Agencies	Stakeholder awareness	All news worthy information related to the WRDIP	Awareness of the program	Direct communication National level and district level media corresponded should be awarded Arranging awareness program with project tours Supply and demand driven communication and information Dissemination provision of press Releases and other newsworthy information
NGOs	Environmental Foundation Limited	Share project goal to reduce environment problems and improve environment	interested in monitoring environmental impact ,resettlement	Partnership opportunities.	Direct communication Moderate important Letters Brochures Mass media
	Centre for Environmental Justice	Share project goal to reduce Environment problems and improve environment	interested in monitoring environmental impact ,resettlement	Partnership opportunities.	Direct communication Moderate important Letters Brochures Mass media
	Federation of Environmental Organization SL	Share project goal to reduce environment problems and improve environment	Run public campaigning and activism to protect the environment	Partnership opportunities.	Direct communication Moderate important Letters Brochures Mass media
People in positions that convey influence	Clergy members	Project goal and benefits implementation method Convey community	Influence general public	Delaying project implementation	Direct communication Advocacy Print media Mass media Face to face meeting

		with			
	Community leaders	Project Implementing support	Influence general public for Corruption free project implementation	Delaying project implementation	Direct communication Advocacy Print media Mass media Face to face meeting
	Academic or research interests	Conducting research on water resource sector and giving comments to development and improvement of the system	Improvement of development activities	Improvement of the system quality	Meeting Letters Web
	Community activists	Project goal and benefits implementation method Convey community with	Compensation and other assistance required for relocation must be provided prior to displacement	Delaying project implementation due to if there are concern	Direct communication Advocacy Print media Mass media Face to face meeting
Community at large		General Awareness on project	Overall development of the country	Less awareness of the community at large will be delaying implementation of the WRDIP	Website FAQ ,WRDIP stands , Project model ,Stickers ,Public notice boards Erecting of hoardings, Digital Light Boards, Billboards, social media , Paper Supplements, Newspaper supplements to be included in the three newspapers (of the three languages) that have a high circulation on the day the program is to be launched. Newsletters Design and publish quarterly newsletters to highlight the latest major events happening in the WRDIP Feature articles

					Publish features articles to educate people on core aspects of the programs, Advertisements in national newspapers, local newsletters, Articles for magazine Advertorials Radio Radio Program comprising (i) jingles (10 jingles on different themes during different phases of the project) radio discussions comprising professionals of DOI, community representative, three panel discussions per year on the program Television TV documentaries, strollers, advertisements, Panel discussions. Television and radio news bulletins every quarter for the first 5 years PMU to organize special events on World Health day, World Water Day, Environment Day, DOI WariDsathiya Digital story telling competition Production of short video documentaries DOI to participate in external events, exhibitions, conference seminars Organize to participate in the national Deyata Kiruala exhibition

School Children		To make them aware of WRDIP and on wise use of water resources	Interested in future development activities and modern technology adopted	Future water consumers	Awareness program Drama competitions in all three languages amongst the schools in the program areas. PMU to provide criteria for competition and them for drama Poster competitions. Selected best three posters to be used for aware of the WRDIP Quiz competition on water management, environmental protection. Have semi-finals, finals to be telecast on TV channels and get the sponsorship of construction company Photographic competition, Essay competition

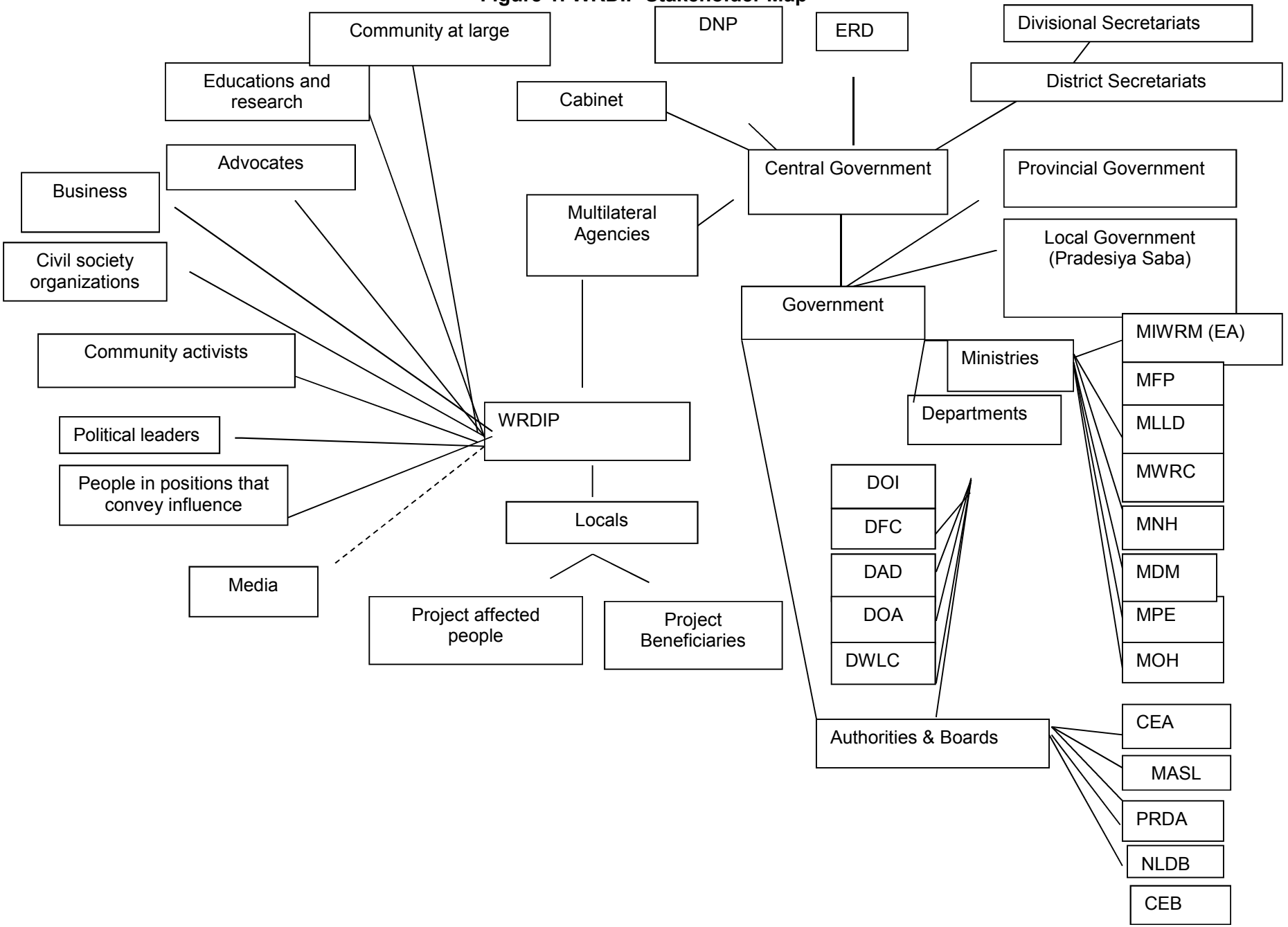
C. Stakeholder Mapping

68. Stakeholder mapping is done normally taking into account different functional view points and administrative levels, such as international, national, provincial, district, divisional and village. Stakeholder discussions are divided into four categories: (i) direct beneficiaries, (ii) indirect beneficiaries, (iii) pressure groups, and (iv) other interested groups. It may however be noted that this categorization is done for practical purposes. The first two categories, direct and indirect beneficiaries, are relatively easy to map, and so is the 'other interest groups' category. Key direct beneficiaries include water consumers, affected people, business people, and the public sector service providers (DOI, ERD, DNP, CEA, DFC and DWLC). Indirect beneficiaries include consultants, suppliers, contractors and the country at large. The pressure groups include some political parties and civil society organizations.

69. In large-scale water resources project, primary and secondary stakeholders were identified including government organization including national and provincial , international partners, politician, locals, traditional authority, government service, civil society organizations, academic and research institutions, businesses and individuals who have benefitted and affected, community at large and media. As can be seen in **Figure 1**, a stakeholder map was produced as a result of WRDIP stakeholder identification.

70. This result could be used to guide the design and implementation of communication activities in support of the WRDIP, for example, communication objectives, messages to be disseminated, media and messengers, and indicators by which the impacts of communication.

Figure 1: WRDIP Stakeholder Map



1. Expectations, Issues and Concerns

71. From a benefit point of view, stakeholders have been grouped into nine categories including: (i) project affected, (ii) beneficiaries/water consumers, (iii) policy makers, (iv) officers of the IAs, (v) funders, (vi) service providers, (vii) regulators/administrators, and (viii) and other interest groups. Their expectations, issues and concerns are summarized in **Table 3**. It is quite evident from the table that the benefits expected are quite varied and definite.

72. While expecting significant benefits from the proposed program, the stakeholders expressed their concerns on issues related to likely implications of implementing this type of project in their respective localities. This table is prepared based on FGDs was conducted during communication base assessment and desk review.

Table 3: Expectations, Issues and Concern of the Stakeholders

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
Project affected people	Farmers	They have built their houses over a long period of time, step by step facing difficulties. Therefore they expect a sufficient compensation package. The APs with affected houses need land for re-establishing their affected homesteads. They prefer to have money for constructing the houses in the land given to them or remaining land as alternative to their land lost due to the proposed project. Water related problems for crop cultivation and other livelihood activities will not be disturbed due to construction period. Transport along the channel which are being used as main and other roads will not be impacted by the project during construction. All the families in UEC those are able to do so unanimously express their interest in locating themselves within the remnant parts of their lands which will not be affected by the project. People affected will be losing less than 20% of the land. If the houses are damaged there is a sufficient land to rebuild a house. Famers of the Elahera area expect to get water for cultivation for agriculture and drinking and domestic purposes from the UEC. Compensation should be based on the market value of lands and properties.	Project affected people concern about resettlement procedure. If there is relocation, they expect secured tenure to relocation land, better housing at resettlement sites, access to employment, business and production opportunities access to schools, market and transport facilities. Project affected people of UECP raised their concern in the FGDs they have already developed their land if they lose their land, they need to take effort to developed land again and they expect land development facilities. The project affected farmers stated that many problems arose due to loss of their lands and houses. Their livelihood mainly depends on the crop cultivation and they work as agricultural labors. Civic infrastructure and community services, as required. Some of the project affected people in NWCP mentioned that they don't like to change their They have doubt government valuation will be low and not pay in a sufficient level will be delayed. Communities of three project areas raised

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
		The people who have not yet received license for lands in NWCP areas they expect guidance and assistance for obtaining such license so that they would not be deprived of compensation.	issues on loss or degradation of, or impeded access to, important renewable natural resources such as agricultural land, wildlife, habitats, timber and non-timber forest products, fish stocks, etc. Compensation for the physically and Livelihoods. Construction would commence only after all compensation is done they have doubts about government valuation approaches, i.e. that it will be low and not pay sufficient amount and that it will be delayed. NWCP area Project affected people in UECP and NWCP are concern on resettlement and compensation activities and they expect proper resettlement option. People concern in place of resettlement. How they find land, from where do they find The most common concern from the project affected in UEC to be the loss of connection with relatives, friends and neighbors they enjoy prior to relocate. They expect to relocate as near as possible to their previous areas of residence. The current relationships were built over a long period of time and it is difficult to rebuild such relationships with the new families. Noise and vibrations that will arise due to

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
			activities such as excavation, cutting, drilling and filling and compaction work, as well as operation of construction related vehicles during the construction phase Clearance of plant cover during the construction phase will lead to increased soil erosion The lands affected by the project include agriculture land, with permanent and seasonal crops. The farmers /owners of these land expect assistance to carry out their livelihood activities Whether the transport activities would be disturbed during the construction period. If so, they are concerned whether alternative arrangements will be made or not. Communities living near to a project site, the effects of noise, dust, vibration, traffic, and lighting associated with construction can cause disturbances and emotional stress, as well as pose a physical or health hazard. Whether for large capital works or minor construction activity, it is good practice to give the public notification of the following: • the purpose and nature of the construction activities • the start date and duration • potential impacts • information on whom to contact if there are concerns/ complaints related to the contractor
	Land owners	Land owners expected to receive compensation	Where the canal passes through human settlements villagers will need bridges across the canal.

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
		The land owner situated on either side of the UEC will be separated due to construction of the proposed canal. They expect project will provide New bridges over the canal.	Some land owner expressed that most of the families are having one acre or half an acre of land and losing a part of it is a problem to their livelihood and that they expect a sufficient amount of compensation
	Youth	Youth of all project areas expect to receive employment opportunities and training on new income generation activities. Some people has to give up and youth expect new job opportunities so, they expect new job training or employment opportunities.	Environment pollutions
	Women	Improve the standards of living of the women. Women in UECP and NWCP areas expected to receive legal and affordable access to land and resources, and women in urban area expect to get with appropriate income sources and legal and affordable access to adequate housing and compensation. Project affected widower concern about resettlement procedure. If there is relocation, they expect secured place with access to employment opportunities. Young women expected to receive new income generation activities	They have Environmental concerns such as scarcity of drinking water, human-elephant conflict and damage to crops and property, increase of non-communicable diseases such as the kidney disease.
	Business (Rice Millers, boutique,)	Seed paddy producers, rice millers, inland fisherman Business ventured in the affected areas expects special attention and compensation to reestablish the business.	If the present livelihood is lost in displacement they have concern on whether necessary assistance and support would be provided to begin new activities in the new area.
Beneficiaries Water Consumers	Farmers, domestic water users, fishermen, livestock keepers, people using water for domestic purpose, It includes women and	Farmers in Minipe scheme expect they would receive more water after completion of the project. Most of them expressed a desire to get water for the paddy fields which are	Farmers in Minipe They concern whether the provision of water for drinking and domestic purposes due to raising of anicut.

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
	youth.	located at the tail end of the canal and which currently do not receive sufficient water. Farmers of Minipe scheme expect to engage more livelihood and income generation activities after completion of the project. Communities of the NWCP areas expect All activities connected with the community to be done with utmost transparency and the true scope of the project be revealed to the beneficiaries Community of the NWCP expect that project designing would be done with the presence of their representation The water users in NWCP, UECP expect that they will have an assured supply of water due to the implementing this project. Beneficiaries of MLBCR expect, they would store more water and they expect water availability of the tanks will get enhanced due to arising of anicut and beneficiaries of NWPC expect they will receive enough water to cultivate both Yala and Maha seasons and they would use fresh water for drinking. It would be solution or kidney problem. So they can engage in their livelihood activities with the assured supply/availability of water. Project beneficiaries expect to start new income generation activities. As well as they expect improvement of infrastructure of their	Some famer concern if there a program to carrying out water to other parts of the country through raising Minipe Anicut and rehabilitation of the Minipe canal (since they traditionally face severe droughts in the Yala season and the additional saving water is only allocated to the farmers in the project area). If not, they do not give their agreement for this. Youth of minipe scheme concerned about the employment opportunities that will be created during the construction work of the Minipe raising project. Communities of all three project are concerned whether they will get adequate information relevant to the proposed project, implementing date, completion date, benefits of the project likely negative impacts of the projects (forgoing cultivation seasons, disturbances to livelihood activities like fishing, livestock keeping) during the construction period If it is temporary, say, one season, somehow they can adjust and overcome the livelihood disturbances. But, they are not sure of this, given the Government Agencies are known for their delays. Beneficiaries of NWCP and UECP are concern about delaying project and they need to complete project activities and get benefit soon. Community consultation – communities are also concerned that they may not be

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
		villages such as road, telecommunication.	Consulted on any front. Communities like to take part in project monitoring. Whether the infrastructure improvement activities would be implemented satisfactorily by the contractors. Farmers' organization - They would like to participate fully in the project, they have drought whether such a provision/ opportunities would be . They want to use this as an opportunity to ensure improvement in irrigation efficiencies – coverage and quantity. They also would like to participate project monitoring. They expect transparency in project information specially cost Environment They concern on environment pollution in construction period. Farmers face problem wildlife especially elephant and they concern whether is there solution to mitigate human elephant conflict. Drinking water consumers – drinking water may contaminate with pesticides. employment opportunities, and training and local enterprise support; community health, safety, hazards, and other risks progress in the transfer of physical assets and land to other owners or users environmental and ecological rehabilitation future status of services and infrastructure

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
Policy makers	Ministries (ministers and higher level bureaucrats)	Implementation of the project in line with the development policy framework in the country.	Implementation of the project in terms of the policies and procedures in force in the country. Understanding the policy related problems and issues in implementing the development projects of this nature to initiate policy changes in the desired directions. Proper communication system to convey the right message reflecting the objective of the investment program properly. Otherwise miscommunication campaign will start.
Officers in DOI and MASL	DOI, IMD, MASL	Safety of the systems under their charge and their sustainability. Improvement in system operation and management due to physical and institutional interventions and introducing technically sound physical features to the head works of investment program. Improvement of communication infrastructure in the field level office Staff with improved knowledge and skill for system operation and management Use of improved technologies for system operation System operation made easy through automation of gates and other infrastructure operations	Timely completion of the project development activities in such a way not to disturb the livelihood activities of the people. The ADB procedures could delay procurement. Drawing up of a realistic implementation schedule and adhering to it, including completing investigations, preparing tenders, ensuing civil contracting and engineering supplies etc. Capacity Support – Institutional / Implementation arrangements as well as supplementary human resources to prepare plans and effectively mobilize communities through a systematic communication system Implementation of the project with minimum negative impacts on the physical and socioeconomic environment. Capacity Building – New machinery and new

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
			systems might demand new skills and whether project provides for appropriate capacity building support.
Donor agencies	ADB, co-financiers	Investing funds for project implementation. The regulators expect that the project would be implemented within the existing rules and regulations of ADB so that the affected parties would be adequately compensated and negative impacts of the project on the livelihoods of people and cultural properties etc. would be minimal.	Project implementation without delay and with no adverse social and environmental impacts
Service providers	GAs, DSs, DMC, MLLD, DOA, DAD	Water supply for cultivation and domestic usage without interruption. Acquisition of crowned and private land for construction and resettlement DOA help to communities to develop agriculture program in a given irrigation system. DAD responsible to feed minor irrigation system	Timely and satisfactory completion of the interventions proposed under the project. Minimum disturbances to the public and those that is likely to be affected. Human health impacts from waste transportation accidents, such as oil or chemical spills. Ineffective treatment or disposal of hazardous and non-hazardous wastes
Regulators /administrators/Coordinators	GAs, DSs, GNs, PD, EDO, DDO,APA, DPM	The regulators expect that the project would be implemented within the existing rules and regulations so that the affected parties would be adequately compensated and negative impacts of the project on the livelihoods of people and cultural properties etc. would be minimal. The regulators also expect that the proposed project will bring effective and improved infrastructure and institutional arrangements to exercise/enforce rules, regulations and other governance in effective manner.	Implementation of the project within the existing rules and regulations in force in the country. Payment of adequate compensation for the parties that would be affected due to the project. Proper coordination of project activities with relevant field officers in project areas. GNs should aware project activities in village level.

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
		The Government agent (GA) and Divisional Secretary DS) are highly concerned if farmers are compelled to forgo a cultivation season and farmers press them for poverty alleviation and other government relief assistance	
Support services	MWC ,DWLC ,DOF,CEA ,	They are stakeholders support clearance of EIAs. Implementation of the project in line with environment and wild life conservation in the country. Minimum negative impact on the natural resources	DWLC concern Drowning of wildlife especially small to medium sized animals in the canal Animals falling in and or drowning in the canal. Prevention and reduction of location at which animals, especially can cross the area containing the UEC as it acts as a barrier Provision of drinking water for wildlife especially for elephants and other large animals. DFC and DWLC concern Habitat loss, fragmentation and degradation especially of forest and wildlife protected areas. Loss, fragmentation, degradation and increased risk of landslides in forest hill areas with high biodiversity. Loss, degradation of habitat and negative impacts on fresh water plants and animals in steams crossed by the UEC. Disturbance of wildlife from noise, vibration, lighting, traffic etc., especially during breeding and migrating seasons

Nature of Stakeholders	Stakeholders	Expectation and Benefits	Issues and Concerns
Other interested parties and pressure groups	Some civil society organizations, media, individuals, some politicians and political parties	They expect that the risk associated with issuing water in existing areas and water will be issued to north by the proposed project. In this case pressure groups like politicians can claim that they influenced the implementation of the project for the benefit of exiting people.	Implementation of the project in such a way to solve the problems that the project has been designed for. Assuring minimum negative impacts on the socioeconomic and physical environment. Environment civil societies concern about whether there is opportunities to community participation on project implementation and monitoring activities. Community activism concern on wildlife conservation and forest conservation , resettlement and compensation of the project affected people Project may not secure adequate technical support and skilled personnel for managing cultural property.
	MNH, DA	Cultural Heritage Preservation	

2. Assessing stakeholder influence and importance

73. Influence refers to the power that the stakeholders have over a project. This power will be in the form of stakeholders that have formal control over the decision-making process of it can be informal in the sense of hindering or facilitating the project's implementation. Importance relates to the question how important the active involvement of the stakeholder is for achievement of the project objectives. Based on this classification stakeholders were assessed.

74. Both the influence and importance of the different stakeholders were ranked along simple scales and mapped against each other. The importance was indicated by using a 3-point scale low, medium and high in horizontally and the vertical line concerns information about the influence of the stakeholder over the project. A 3-point scale was used to display the relative influence that each of the identified stakeholders has over the project (low, medium and high).Table 04 is Mapping of Stakeholders for Effective Communication Flows.

75. The appropriate approaches for involving stakeholders of differing levels of influence and importance can be as follows:

- Stakeholders of high influence and high importance should be closely involved throughout the preparation and implementation of the project to ensure their support for the project.
- Stakeholders of high influence but low importance are not the target of the project but could possibly oppose the project that you propose. Therefore, Program has to keep them informed and acknowledge their views on the project in order to avoid disruption or hindrance of the project's preparation and implementation.
- Stakeholders of low influence and high importance require special efforts to ensure that their needs are met and that their participation is meaningful.
- Stakeholders of low influence and low importance are unlikely to be closely involved in the project and require no special participation strategies (beyond information-sharing to the general public).

Table 4: Mapping of Stakeholders for Effective Communication Flows

Influence of Stakeholder Group	Importance of Stakeholder		
	Low	**Medium**	**High**
Low Influence	Advocates MPE	DAD DOA MNH DA MOH	Project Beneficiaries MLLD MWRC DF DWLC CEA
Medium Influence	Provincial Road Development Authority NLDB	Provincial Councils Pradeshiya Sabha People with academic or research interest	
High Influence		Media Clergy members	Project Affected people Multilateral Agencies Cabinet Ministries MFP MIWRM, Departments DOI, DNP,DER, DPM DSs/GAs Divisional Secretaries Community leaders Community at large MASL Political leaders

IV. FINDINGS

A. Current Status of Communication Activities

76. MIWRM arranged a stakeholder meeting on 21 July 2014 to make government and non-government organizations aware of the proposed investment program, PPTA progress, environmental safety measures, issues pertaining to minimize human elephant conflict, and to solicit feedback from all attendees. About 60 people attended the meeting and their names are included in **Annex 5**.

77. The MIWRM conducted eighteen awareness programs for project affected people, and beneficiaries in all project areas during feasibility studies see Annex 09.

1. UECP

78. There was a continuous information disclosure engaging stakeholders at all levels during the project design and feasibility studies. Meetings were held with Divisional Secretaries, Chairmen of Pradeshiya Sabhas and government officers were informed on the project by the feasibility team during the initial period. Such meetings were held in Elahera, Galenbindunuwewa, and Yakalla Divisional Secretary Offices and Officers representing following agencies were present: (i) MIWRM, (ii) Irrigation Department, (iii) Divisional Secretaries, Galenbindunuwewa/ Yakalla, (iv) Grama Niladaries of relevant GN divisions, (v) Land Officers of DS office, and (vi) consultants.

79. The programs have been carried out under the two sections. The first section of the program dealt with the awareness of the community about the UEC project. Those included information about the canal trace, design, benefits of the project, time period, budget, etc.

80. The second section of the program have concerned with raising the awareness of the affected community about the resettlement and compensation program. That included the location, inundation area, information related to the affected community Loss of houses, homesteads and paddy lands, families to be resettled, compensation system, Relocation options etc.

81. The first part of the program was conducted by project engineers of the UEC staff and explained clearly all the information regarding to the project. The consultants explained the environment, social and economic impacts to the affected community.

2. NWCP

82. Meetings have been held with Divisional Secretaries, Chairmen of Pradeshiya Sabhas and government officers were informed on the project by the feasibility team during the initial period. Such kind of meetings have been held in Dambulla, Gelewela and Polpithigama Divisional Secretary Offices and also a workshop has been held at the Galgamuwa Irrigation Training Institute on 12 December 2013 on the proposed NWPCP participating following representing officer: (i) MIWRM, (ii) Irrigation Department, (iii) District Secretary, Kurunegala, (iv) Divisional Secretaries, Polpithigama, Galgamuwa, (v) Agrarian Development Department, (vi) Department of Wildlife Conservation, (vii) Department of Forest, (viii) MASL, and (ix) Mahaweli Consultancy Bureau.

83. A series of meetings have been held with the participation of stakeholders in the villages along the canal trace at village level. A presentation on the MDP has been presented at the outset explaining how water is diverted to NWPCP. These meetings have been organized by respective Grama Niladaris with the patronage of Divisional Secretaries of Dambulla, Galewela, Polpithigama and Mahava DS Divisions, which would be affected by the proposed Project. Officers of Irrigation Department, Economic Development Officers and Grama Niladaris of DS Divisions and officers of Mahaweli Consultancy Bureau attended these discussions. Representatives of ADB have participated in the small group discussions held in Pannampitiya and Lenadora South GNDs.

3. MLBCR

84. Discussions have been carried out with Divisional Secretaries, Irrigation Engineers, Residential Project managers and government officers who were informed about the project in Minipe and Wilgamuwa Divisional secretary areas by the EIA team during the initial period of feasibility studies.

85. They have published an article on the WRDIP in the Sunday Observer newspaper on 24th August 2014.

B. Media Environment of Sri Lanka

86. Media of Sri Lanka consist of several different types of communications media: television, radio, newspapers, magazines, mobile and web sites. State and private media operators provide services in the main languages Sinhala, Tamil and English. The government owns two major TV stations, radio networks operated by the Sri Lanka Broadcasting Corporation (SLBC), and newspaper titles in Sinhala, Tamil, and English.

87. A community-driven radio or TV, planned, managed and owned by the community themselves, is yet to be introduced in Sri Lanka.

88. Several international broadcasters operate radio stations aimed at Sri Lankan audiences but broadcasting from outside Sri Lanka: All India Radio, BBC World Service Sinhala Service (Sandeshaya), BBC World Service Tamil Service (Tamilosai), China Radio International Sinhala Service and China Radio International Tamil Service, Radio Veritas Asia.

89. After the growth of Sri Lankan economy, many satellite TV channels were introduced. There are over a dozen privately owned radio stations and more than 30 privately operated television stations.

90. The use of the internet is a growing force within Sri Lanka, many of the newspapers now have online editions.

C. Information and Communication Gaps

91. There are information and communication gaps among the stakeholders. Government officers are concerned about this issue. Some of the stakeholders mentioned that they were facing problems such as less awareness relevant field level officers about investment program, lack of publication, lack of available information on compensation and resettlement procedure getting information in a timely manner. There are certain stakeholder issues, such

as land acquisition and resettlement, for example, that may be particularly sensitive and this carries potential risks to the implementation of the WRDIP if pertinent information is not communicated and managed effectively. In these cases, it may be better to release information about the issue at the same time as conducting face-to-face consultations. In this way, any mis-information and immediate reactions of the affected parties can be addressed right away with the facts. They should be made aware if they have concern whom they can contact to get more information.

92. Field level government officers, specially GN, DDOs, EDOs, and ARPAs, were less aware about the proposed investment program. They are the key government officers in every village. Local community uses them to get relevant information relevant to such projects. It is therefore necessary to make these officers better aware of the WRDIP with comprehensive and accurate information.

93. Provide meaningful information in a format and language that is readily understandable and tailored to the target stakeholder group. The aim should be for the information provided to enable people and organizations to make informed judgments about changes that will affect their lives.

94. Ensure the accessibility of information by thinking through how the intended recipient will most readily receive and comprehend the information. The more a particular stakeholder group is materially affected by a component of the project, the more important it is for them to be properly informed and encouraged to participate in matters that have direct bearing on them. Including proposed mitigation measures, the sharing of development benefits and opportunities, and implementation or monitoring issues. Resettlement planning, designing and implementing community development programs, and engagement with vulnerable peoples' such as women and youth are good examples of where informed participation by affected stakeholders can lead to better outcomes on the ground. In certain situations, capacity-building programs may be needed to enable affected people to aware.

D. Preferred Communication Channels

95. The following channels are currently in used in proposed project areas for information dissemination: Personal contact; radio broadcasts; television; publications, field days and meetings and cultural activities.

1. Personal Contact

96. Information dissemination by personal contact in the project areas involves the use of field level officers such as Gramasewa Niladaree (GN) Agriculture Research and Production Assistant, Devineguma Development officer, Economic Development officer, they are village level government officers and community used to get information relevant to the economic and development activities through them and farmers used to get information on irrigation related activities through resident project manager or divisional engineer, Farmers get information relevant to the farm practice through Agriculture Instructor or extension agents.

2. Publications

97. Since the majority of the youth in the FGDs in three project areas are well educated, the use of publication materials such as guides, posters, billboards, newsletters and leaflets is widespread. Posters are highly valued by this category of farmers. Normally the posters are fixed on the notice boards at their meeting place or village shop. These groups are willing to read publication.

98. Many of the elderly farmers used to read newspaper daily and some of the farmers read newspaper only weekend, they used to read specially Sunday Lankadeepa. Youth willing to read newspaper such as *Tharunaya Ada.*

99. All the young women participate in FGDs attended secondary schools and all the young women frequently read newspapers extension publication on processing and on recipes. Other publications the group indicated having access to are newspapers, magazines, and bulletins. They prefer to read women newspapers such as *Tharuni, Sirikatha, and Nawaliya and Birida* in addition to posters, billboards, and brochures, handbills.

100. Many of the elderly women are literate. They used to read newspapers and publication relevant to religions.

3. Radio

101. All the elderly farmers have their own radios. They all listen to radio programs on agriculture, news, politics, etc. Many of the elderly farmers usually listen to programs from Baudhaya Chanel and Rangiri Radio to listen to religious talk. The farmers reported that they enjoy listening to agricultural program, local news, political programs, and traditional songs.

102. Elderly farmers prefer the program to be broadcast between 6:00 am and 9:00 am or 6.00 pm and 9.00 pm

103. Many of the youth do not have radio set and they listen to radio through mobile phone or while their travailing by bus. They prefer to listen to music Radio channel like Shaa FM, Sri FM, Some of the youth listen radio to get current affairs and news, they like to get such information through Hiru FM or Neth FM. All the youth participants in Minipe, NWP and UEC areas don't like to listen Sri Lanka Broadcasting Radio Channels.

104. The young women all prefer radio because of its easy access.

105. They listen radio channels such as to Hiru FM, Sri FM, Neth FM and Lakhada .Musical Programs, women programs , Drama, News and requests are their favorite programs. They are more interested in song, and entertainment programs. About 50% of the respondents prefer programs aired between 8:00 am and 9:00 am, while the rest prefer 11 am–2 pm as the most suitable timing for their radio programs.

106. Some of the elderly women own radios. Others listen to radios owned by their husbands or sons. They prefer to listen religious channels and private FM such as Hiru, Sirasa, Neth. The women reported that they would prefer to listen to radio programs in the morning 6 am to 10 am, afternoon around 2.00 pm and after 9 pm. At this time they would have finished their work.

4. Television

107. All the youth participants have Television in their home and they reported they used to receive more current affairs and news, entertainment activities and development activities through TV. They prefer the program to be telecasted between 7:30 pm and 9:00 pm.

108. The elderly farmers reported that they have their own television sets and that they have interest in watching religious activities. Most of the farmers in Minipe and UEC and NWP project areas they used to watch religious TV Channels such as Buddhist , Rangiri , They used to watch current affairs and news though Private TV Channel like Hiru, Sirasa, Swarnawahini and Derana. Those who are in Stage 3 area in Minipe have lack of infrastructure for TV. They used to get information through FO meeting or posters.

109. Many of them like to watch private TV channels such as HIRU and Sirasa TV Channels. They prefer to watch TV programs together with their families. The young women prefer programs aired on TV between 7:30 and 9:30 pm. The young women generally like teledrama, films, and musicals, preparation of some particular food process as well as news.

110. The elderly women have more interest in television programs. They occasionally watch agricultural, religious, and other programs on income-generating activities for women. The Women prefer programs aired from 7:00 to 9:00 pm. They do enjoy entertainment programs such as drama, films.

5. New Technology

111. Young male consists of literate members and therefore they have the capacity to understand technical information much more than the older farmers. Some of the youth already engaged agricultural activities and some of them are doing labor work and business. Youth are willing to get new technology all participants have mobile phone and 35% of the participants use internet at least once a week. They use to get internet facilities using cyber cafe. They face problem with connectivity in their village. Young women are ready to embrace new technologies and the elderly women are aware that there are technologies that can help them increase their productivity.

6. Drama

112. Youth consider this is not considered a popular medium of information dissemination. They prefer to watch drama in TV during their leisure times. But the elderly farmers said it could be a very efficient medium because it is being used in other fields. The farmers are willing to participate as actors if called upon to do so. Young women expressed they like to watch drama through TV. Elderly women like to watch drama in stage.

7. Meetings and field days

113. Young men and elderly farmers used to attend meeting and field days. They attend FO meetings, death donation society meetings, welfare society meetings, village development meeting and Samurdhi beneficiaries meetings are held in every much as well as they participate field day program conducted by DOI, DAD or DOA. Leaders of FOs attend meeting on PMC, DAC, and DCCM.

114. The young women reported that they do not usually participate in meetings or field days. However, they had attended such activities before getting married and confirmed gaining a lot from them. They said that sometimes their husbands tell them whenever they attend such activities but maintained that it has been long since they heard about it. They are willing to participate in self-employment training program such as dress making, computer and agriculture activities.

115. Women generally do not attend field days. Most of them are aware that men (their husbands and sons) attend these activities. The elderly women reported that men sometimes tell them what they saw at the field days or meetings. However, women attend society meeting such as death donation, welfare, Samurdhi Beneficiaries meetings and women societies.

8. Festivals/ Cultural Activities

116. There are social and religious activities, which enable the farmers to interact. Usually, they share information on virtually everything during such ceremonies and they are willing to conduct and participate these activities after harvesting. Young women are willing to attend cultural activities and festivals. Attending such functions serve as a means of socialization and information dissemination. The women rated the FOs the best and most reliable form of information dissemination available to them.

E. Other Important Communication Channels

117. There are existing communication channels to convey message to farmers and other stakeholders. The respondents however expressed their preferred information channel would be the FOs. Farmers of major irrigation system stressed they would also like to get information relevant to the investment program through the PMC.

118. The PMC comprises representatives of FOs and government staff involved in agriculture and irrigation. The chairman and secretary are farmer representatives and meeting is chaired by Resident Project Manager (RPM) of the IMD. The Irrigation Act stipulates that a majority of the members of a PMC must be farmers' representatives. This is the best platform to disseminate information relevant to the WRDIP for major irrigation areas.

119. A meeting of the District Coordinating Committee (DCC) is held every month to monitor progress of development activities and discuss social issues in district. All head of government officers in particular district and politicians are participate. This meeting chaired by the senior politicians in district. This platform can be used to increase awareness of the WRDIP to all government officers and politicians.

120. A meeting of the District Agriculture committee (DAC is held every month in district secretary office and the meeting is chaired by District Secretary with participation from terminal administrators, banks, the Irrigation District Office, DOA, the Agricultural Support Department, and DAD, DLM, farmers' representatives, and others attend. This is the platform to increase awareness among government officers relevant to agriculture and farmers who are in major irrigation system.

121. A meeting of the Divisional Coordinating Committee DCM is held every month in the divisional secretariat and this platform can be used to increase awareness of the WRDIP in

minor irrigation systems. This meeting is chaired by the Divisional Secretary and farmer leaders from minor irrigation schemes, and field level officers participate.

122. A Kanna (season) meeting is held twice a year before each cultivation season to agree on points such as the land area and zones under cultivation, the dates when irrigation cultivation starts and stops, the rules for operating reservoir gates, and the methods of rotating irrigation from each distribution canal. The meeting is chaired by the District Secretary with participation from terminal administrators, banks, the Irrigation District Office, DOA, the Agricultural Support Department, the DLM, farmers' representatives and others attend.

123. The DOI has established unit offices in the field to enable communication with farmers in each irrigation scheme. The head of the unit office is an engineering assistant. The farmers may come to the unit office anytime of the day to report any issues regarding the current cultivation season. The staff attached to unit office will attempt to solve their problems of farmers promptly at the unit office level.

124. These communication channels are existing platforms for disseminating information relevant to the WRDIP to project affected, beneficiaries and government officers.

V. CONCLUSIONS

125. Stakeholders in the WRDIP have been identified and studied through the PPTA's stakeholder analysis and communications based assessment. This study was the outcome of extensive discussions with key persons who were involved with the development and planning of the WRDIP, literature reviews and professional experience. Stakeholder mapping has been done to illustrate their relationships, interests, influence, expectations, potential for collaboration, and potential to affect the program. Stakeholder identification and analysis provides important steps to assess the impact of communications management on people, institutions and resources during implementation of the investment program.

126. **Table 1** indicates that the MIWRM, MASL, DOI, MFP, MLLD, MWR, MNH, MDM, DFC, DWLC, DNP, ERD, DAD, DOA, CEA, concerned provincial departments and district institutions as well as the beneficiaries and affected peoples are the primary stakeholders in the WRDIP. The media, civil society organizations, advocates, research/ education centers, and the community at large are the secondary stakeholders in WRDIP. Water scarcity in the dry zone is major development problem in Sri Lanka. Water resources management policy involves a wide range of stakeholders in public and private sectors at different levels in the country. The roles and responsibilities of all water-related stakeholders are inter-related. Different stakeholders have different perceptions and levels of awareness of the existing water management arrangements and institutions. At the local level, FOs desire modernization of irrigation infrastructure, sufficient technical expertise, and financial support.

127. The most notable issues found in the analysis include insufficient awareness about some of the current activities of the program, and the roles and responsibilities of the various stakeholders specially project affected people, project beneficiaries, and field level government officers. It is necessary to strengthen consultative and feedback mechanisms in order to improve coordination and participation at different levels of stakeholders in the WRDIP.

128. For major schemes, consultation and participation of the relevant FOs in the project areas through the PMC presents the opportunity to offer and respond to communications about the program, while communications with farmers in minor irrigation systems can be addressed similarly through the DCCM. The establishment of a new project steering committee comprised of key stakeholders, national level and provincial level departments along with key local authorities will serve as a central communications platform for the program.

129. The development of major new water resources projects such as the WRDIP need to be undertaken carefully at the local level and should take into account the existing political, cultural, socio-economic and physical features of the specific project area. In many areas to be affected by the program, local communities still rely on the coordination or support of the political hierarchies, in national and local level district level authorities, etc. to make important decisions. Effective coordination and feedback among concerned stakeholders will be challenging but achievable in most cases.

VI. RECOMMENDATIONS

130. To stimulate informed discussion and allow for flexibility, the following recommendations explain the aims and functions of the sub-committee and identify the key options and considerations to setting up said sub-committee. The considerations ensure that past lessons inform the development of the new structure and that the changes support rather than duplicate existing structures or resources. It is also to stimulate discussion towards a consensus about how the proposed sub-committee can be given an effective mandate and remain transparent without diminishing the important local role and authority of the newly established WRDIP. These policy recommendations were discussed during the community level consultations and refined through field level officers in DOI. Based on key informant discussion and FGDs following recommendation were suggested.

A. Recommendation 01: Formation of Sub-Committees

131. It is proposed to create sub-committees at the provincial level to support coordination of the program among provincial departments and local authorities. The sub-committee would consists of officers in DPD, GAs, and DSs in relevant project areas, Divisional forest officers, Director Agriculture, Commissioner Agrarian Service, Director Wildlife, chairman of PMCs. It would assist in building a common understanding among stakeholders in District level and it will be flat form to disseminate information in divisional level stakeholders

B. Recommendation 2: Establish Program Communication Units

1. Institutional Arrangements

132. The MIWRM will be the EA for the WRDIP. The PMU, supported by the PMDSC will have primary responsibility for implementation of the SCP through communications units doing the overall coordination, planning and implementation of communication activities. The PMU of the WRDIP located in the MIWRM will set up a communication unit. The unit operated by communication officer who processes good academic background and at least 8 years of experience of field of communication and have ,experience working on communications with stakeholders including media, local communities, government and the private sector. They will work closely with the Program Director in the PMU to carry out the following: A TOR for communication officer is attached Annex 6.

(i) Lead the implementation of the SCP

(ii) Develop local institutional mechanisms to promote participation, consultation and mobilization and further updating of the SCP as necessary

(iii) Monitor strategic communication activities

(iv) Ensure a sense of ownership of the program among stakeholders

(v) Ensure effective coordination of communication activities and materials among all levels of the project staff to ensure consistent messaging

133. Three project implementation units (PIU) will be established for the implementation of the three projects and will be based in the locality of the project sites. The PMU Communication Officer will be supported by three communication officers based in each of the three PIUs. Graphic designer and management assistant will be appointed in PMCU to

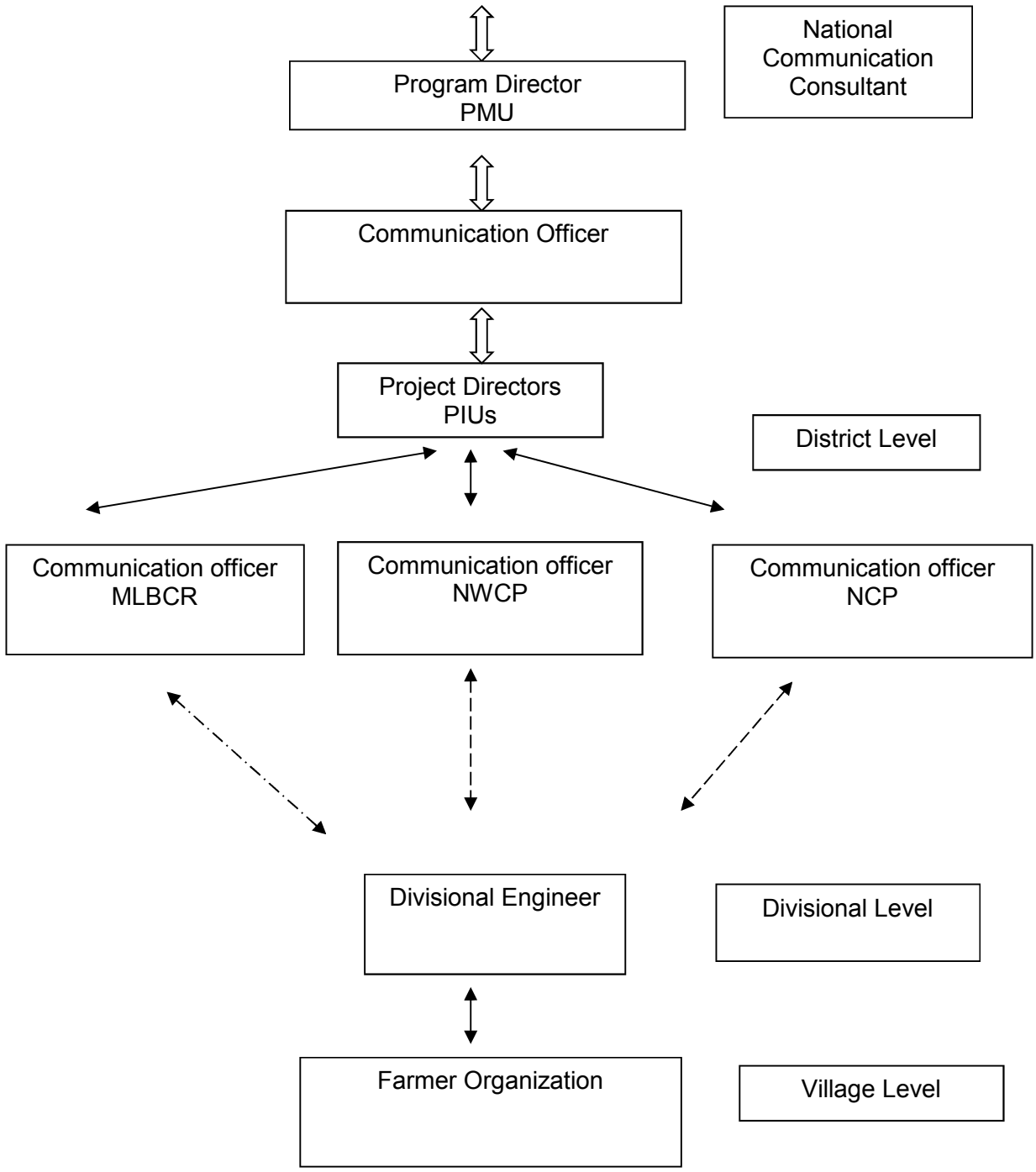
support Communication officer. The PMU should allocate sufficient budget and resources for implementation of the SCP.

134. . When recruiting communications officers for the PIUs, the MIWRM should consider in particular person who will have good academic background in communication with be able to develop and maintain good working relationships with the local communities. Qualities to look for include good people and communication skills, a good understanding of the local language and community/cultural dynamics, open-mindedness and respect for the views of others, a solution-oriented approach, a high integrity/degree of trustworthiness, and a genuine commitment to the program and its goals. The TOR for PIUs Communication Officer is attached Annex 7.

135. National Communication specialist attached to the Program Design Management Consultancy group will provide technical guidance and support the PMU and PIU communication officers in their tasks.

136. Farmer organization is responsible for conducting and arranging communication activities in their villages.

Structure 1: Structure of the WRDIP Communication Units



Note: Communication Officers in PIUs Coordinate with Divisional Engineer through Project director

C. Recommendation 3: Implement an Information Education Campaign (IEC)

138. An information education campaign (IEC) should be conducted to raise awareness among all stakeholders. The development of IEC materials will be in the PMU and PIUs. It will be necessary to design, plan and implement an IEC to inform the affected persons particularly regarding:

- Benefits of the program
- Resettlement policies including compensation arrangements
- Timelines of the project, relevant updates, and announcements about upcoming activities

139. The campaign will include measures such as the distribution of information booklets, leaflets, notices and other materials among the farmers/beneficiaries and field level officers, through community meetings, public announcements, and any other means necessary to provide information in a timely and effective manner.

140. Political authorities including the local Pradeshiya Sabha level to the national level should be properly informed about the WRDIP to ensure they are aware of the current situation and implementation of the project. There are many important reasons to establish and maintain good working relationships with governmental authorities at different levels, and to keep them informed of the project's activities and anticipated impacts.

D. Recommendation 4: Local Leadership and Capacity Building

141. It is necessary to strengthen the capacity of the local communities, especially leaders in the FOs, so that they maximize the benefits made available from the program. Training should be provided to the FO members. Capacity building programs should include a wide range of areas such as proper management of the new assets created under the projects, modern water management and conservation methods, new livelihood activities, methods of environment conservation and organic cultivation, project development and improved agricultural practices, and effective communication skills. This kind of training program can be conducted getting support from line department such as DAD, DOA, and ED.

142. The MIWRM will provide training to stakeholders, especially PMU and PIU staff, as well as field level officers, farmers and FO leaders on important laws and policies, so that they are aware of their rights and duties. This training should cover aspects such as:

- ADB Safeguards Policies
- Environment and conservation policies
- Administration, regulations and guidelines for the program

E. Recommendation 5: Participation in Grievance Redress

143. An effective and well-functioning grievance redress mechanism is an essential part of managing community relations. The communication officer(s) of the PMU and PIUs will be active participants in all stakeholders' meetings and dialogues in order to help facilitate grievance resolution, for example by playing a key role in assisting stakeholders in presenting their grievances or queries to the GRCs.

F. Recommendation 6: WRDIP Transparency and Accountability

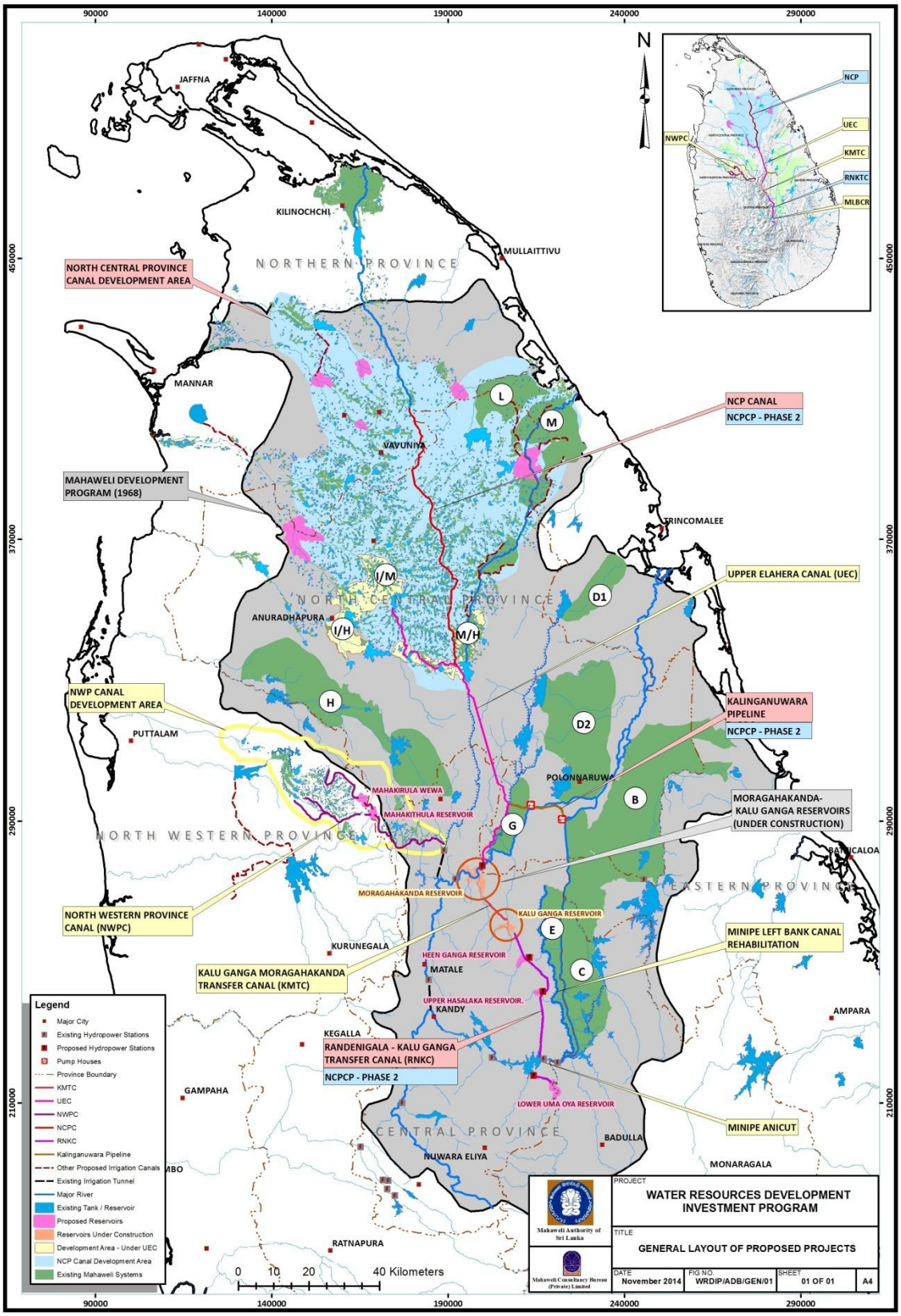
144. Good communications practice involves taking steps to increase transparency and accountability as a means of promoting understanding about the WRDIP and engendering public trust. A lack of information can lead to the spread of misinformation about the program, which can be damaging to the program's reputation and undermine efforts to engage in an informed dialogue with stakeholders. One way to satisfy stakeholder concerns and promote transparency is to involve direct stakeholders in implementation and monitoring programs. Such participation and the flow of information generated through this process can also encourage ownership of the program among local stakeholders. Community score card system can be introduced monitor the investment program.

145. The stakeholder analysis needs updating regularly by Communication Officer in PMU with the help of Program Director to reflect new activities and shifts in attitude and behaviors of the various stakeholder groups, such as after major milestones of the program are achieved.

G. Forthcoming Communications Strategy

146. Implementation of the SCP will engage and inform relevant WRDIP stakeholders with timely, accurate and extensive information shared among them. Such information sharing will help to build consensus and ensure continuous stakeholder support throughout the investment program.

ANNEX 1
MAP: NORTH CENTARL PROVINCE CANAL PROGRAMME (NCPCP)



ANNEX 2
KEY INFORMANT INTERVIEW SAMPLE

Introduction: I'm Samanmalee Swarnalatha, National Communication specialist from the ADB project preparatory technical assistance (PPTA) team in Sri: Water Resources Development Investment Program (WRDIP). We assist the government of Sri Lanka completing outstanding water conveyance investments under the Mahaweli Development program.

An important first step in my effort is to undertake a diagnostic of the overall communication needs, both project design and into implementation relevance to the WRDIP. To do that, I'm conducting interviews with key stakeholders. The themes that emerge from the interviews will be used to develop communication strategy to the WRDIP.

Your statements will not be attributed to you, but a list of interviewees will be included at the end of the report. Your knowledge would be very valuable and we hope you could make yourself available for in interview.

The interview will only take 30 minutes.

Director General Irrigation

1. How would you describe the current status of the Water Resources Development Investment Program?
2. Who are the key field workers in investment program?
3. Could you please describe how the project has approached communication so far?
4. How effective do you think it has been?
5. What communication issues/challenges do you face?
6. Who do you think should be responsible for carrying out this plan and whether they have the necessary resources and capacities?
7. Who do you think are the major stakeholders on the project?
8. {if it helps, you can show them your list and ask if they think you left anyone off}. Which of the stakeholders do you think will be most happy about/supportive of the project? Why? Are there any that might be critical? Why?

Forest Conservator General

1. Are you aware of the water resources development investment program?
2. If yes how do you aware it
3. Do you satisfy with information relevance to Water Resources Development Investment Program so far?
4. If no
5. Which type of information do you need?
6. Do you face any problems getting information relevance to program?
7. What issues/challenges do you face?
8. If there are issues, what are the solutions for overcome information receiving?
9. 4. How would you like to receive future information relevant to program?
10. What is your perception about water resources development investment program?
11. What is your concern about water resources development investment program?

Secretary of the Ministry, Project Director Dam Safety

1. How would you describe the current status of the WRDIP?
2. Could you please describe how the project has approached communication so far?
3. How effective do you think it has been?
4. Who are the key field workers in the WRDIP?
5. What communication issues/challenges do you face?
6. Who do you think should be responsible for carrying out this plan and whether they have the necessary resources?
7. Who do you think are the major stakeholders on the project?

District Secretary /Divisional Secretary /Provincial Council Officers

1. Are you aware status of the WRDIP?
2. If yes, how do you aware it?
3. Do you satisfy with information relevance to the WRDIP?
4. If no which type of information do you need?
5. Do you face any problems getting information relevance to program?
6. What issues/challenges do you face?
7. If there are issues, what are the solutions for overcome information receiving?
8. Who do you think are the major stakeholders on the project in your division/province?
9. {If it helps, you can show them your list and ask if they think you left anyone off}. Which of the stakeholders do you think will be most happy about/supportive of the project? Why? Are there any that might be critical? Why?
10. What mechanisms do the project affected people or other stakeholder have to let the project know about concerns? Do you think these are adequate?

Divisional Secretary Questions - Polpithigama

1. Till now how much interaction have you been having with Project Director and other staff of NWP?
2. What communication activities with the beneficiaries have been carried out by your field officers so far?
3. How regularly are your field officers in touch with the affected people? What concerns are they reporting back?
4. What platforms do the field officers have to share information with the beneficiaries?
5. What capacity building or support do the field officers need to communicate effectively to the beneficiaries? Who would need to give this support?
6. How do you counter mis-information?
7. How effective do you think the communication has been across the agencies involved and to various levels of officials?
8. Have there been any challenges in this? How can these be addressed?
9. What mechanism does project affected or other stakeholders have to inform officials about their concerns related to the project?
10. From which stakeholders do you expect support and from which do you expect criticism?
11. What do you expect are the possible areas of concern that may be raised on this project?
    a. Elephant – human conflict
    b. Tensions over perceived loss of water
    c. Kidney disease
12. What are the NGOs most active in your area? Which will have the most interests in this project? Are they likely to raise criticism?

13. Are there any pre-existing tensions in this area or historical context in this area – e.g., social, environmental or political-- that might be inflamed by this project? e.g. any projects that didn't deliver previously, social tensions.

Divisional Secretary - Galewela

1. What were you taking away from the stakeholder meetings on the 28th August?
2. What communication activities with the beneficiaries have been carried out by your field officers so far?
3. How regularly are your field officers in touch with the affected people? What concerns are they reporting back?
4. What platforms do the field officers have to share information with the beneficiaries?
5. What capacity building or support do the field officers need to communicate effectively to the beneficiaries? Who would need to give this support?
6. How do you counter mis-information?
7. How effective do you think the communication has been across the agencies involved and to various levels of officials?
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Project Directors and officers in irrigation department

1. Who are the key field workers in investment program?
2. How effective the communication has been so far?
3. What is the structure of communication flow in the Department of Irrigation at the district level/at the field level? Who is responsible for carrying out communication activities?
4. What structures have been put in place to ensure that the system is followed?
5. How are communication activities communicated to farmers/beneficiaries / Project affected people?
6. From what you've observed, do the farmers/beneficiaries have a good understanding of the project?
7. What mechanisms do the project affected people or other stakeholders have to let the project know about concerns? Do you think these are adequate?
8. Who do you think are the major stakeholders on the project? {If it helps, you can show them your list and ask if they think you left anyone off}.
9. Which of the stakeholders do you think will be most happy about/supportive of the project? Why? Are there any that might be critical? Why?

10. What is the initial plan for communicating project activities? How are they being communicated to?
11. Are there other people you think we should talk to? Have we covered everything you think is important?

Field level officers

1. Are you aware of any major new developments taking place in irrigation system? (This questions for Gramasewaka and Divineguma officers.)
2. What are the types of communication modes that farmers are familiar with in your working area?
3. How do the farmers assess the different communication modes described above?
4. How do you ensure that the different types of communication modes are being effective? Is there a way for farmers to give their feedback?
5. How many times has feedback happened so far? Do you think this system is adequate?
6. What are the problems facing you in communicating on project information?
7. What would make it easier for you to communicate project information?

Field level Officers – Polpithigama

1. Till now how much interaction have you been having with Project Director and other staff of NWP?
2. From what source have you been getting information about NWP?
3. Do you think you have enough information to effectively explain the project details to the communities you work in?
4. How do you coordinate and share information with your Divisional Secretary and other project staff? How effective are these communication channel?
5. What communication activities with the beneficiaries have you carried out so far?
6. What platforms do you use for sharing information with beneficiaries and APs?
7. What are the problems you have faced in getting information to the beneficiaries/affected people?
8. How can these be solved?
9. Is there a way for farmers to give their feedback if they have questions or concerns about the information given?
10. What concerns have been raised by the beneficiaries when you have talked to them about the project?
11. At the moment how are grievance handled?
12. Do you think it is working well? Does it need changing?
13. What would make it easier for you to communicate? Do you need any capacity building or support to communicate effectively with the beneficiaries? What would you need? Who would need to give this support?
14. How do you counter mis-information?
15. From which stakeholders do you expect support and from which do you expect criticism?
16. What do you expect are the possible areas of concern that may be raised on this project?
    a. Elephant – human conflict
    b. Tensions over perceived loss of water
    c. Kidney disease
17. What are the NGOs most active in your area? Which will have the most interests in this project? Are they likely to raise criticism?

18. Are there any preexisting tensions in this area or historical context in this area – e.g., social, environmental or political-- that might be inflamed by this project? E.g. any projects that didn't deliver previously, social tensions.

Farmer Organization / Community Leaders

1. Are you aware of any major new developments taking place in irrigation system?
2. What are the types of communication modes that farmers are familiar with in your working area?
3. Which of the communication modes you mentioned above are the most useful to you?
4. How do you ensure that the different types of communication modes are being effective? Is there a Feedback system? How many times does feedback happen?
5. Have you received any information on new water projects in your area?
6. Where have you received information so far "do you feel the information you received is sufficient and clear.
7. In what ways would you like to get further information?
8. If you have any questions or concerns, would you know where to direct them?
9. What are the problems facing you in communicating on project information?
10. What are the solutions for communication gaps in the field?

Political Leaders

1. Are you aware of any major new developments taking place in irrigation system?
2. What types of information do you need related to project activities?
3. Where have you received information from so far?
4. Is the information you received sufficient?
5. How would you like to receive future information?
6. What are the problems facing you in communicating on project information?

Officers in Department of National Planning

1. What types of information do you need relevant to Sri: Water Resources Development Investment Program?
2. Where have you received information from so far?
3. Is the information you received sufficient?
4. How would you like to receive future information relevant to program?
5. What are the problems facing you in communicating on project information?

Close: Thank you very much for your time. Your knowledge and insights will be very helpful to me.

Thank you again.

ANNEX 3
FOCUS GROUP DISCUSSION SAMPLE

Date: _____
Group Interviewed: _____
Interview Completed by: _____

I'm Samanmalee Swarnalatha , National Communication specialist from the ADB project preparatory technical assistance (PPTA) team in WRDIP. We assist the government of Sri Lanka completing outstanding water conveyance investments under the Mahaweli Development program. This focus group discussion will be used to develop communication strategy for the WRDIP.

My purpose in meeting with you today is to learn your thoughts, feelings, and experiences with the WRDIP. Your insights will help to develop strategic Communication plan. Nothing you say will be personally attributed to you in any reports that result from this focus group.
Do you have any questions before we begin?

1. Let's do a quick round of introductions. Can each of you tell your name and employment?
2. Are you aware of any major new developments taking place in irrigation system?
3. If No, I will introduce briefly
4. If Yes, How did you first learn about the WRDIP? What do you like best about the WRDIP?
5. What are the potential benefits to you and your organization of the WRDIP has defined it?
6. What are the potential disadvantages to you and your organization of the WRDIP has defined it?
7. What kind of information needs relevance to the WRDIP?
8. What is your preferred way to get this information?
9. Have you had any problems getting information relevance to the WRDIP so far?
10. Do you have any suggestion to overcome these problems?
11. What activities do you think the project can do to help keep the entire stakeholder fully informed?
12. What are the things that you are sure would attract people in effected and beneficiaries in the WRDIP?
13. What are general problems of the involved stakeholder's current irrigation system?
14. What effects will the project have?
    a. on your household / family? Are the effects beneficial? Why or why not?
    b. on your livelihood? Are the effects beneficial? Why or why not?
    c. on your organization? Are the effects beneficial? Why or why not?
    d. on the community? Are the effects beneficial? Why or why not?
    e. On the country as a whole? Are these effects beneficial? Why or why not?
15. What other effects will the project have? (pursue potential political conflicts or others, if any)
16. Do you have any other concerns about the project? If yes, what are these?
17. Have you communicated these concerns about the project? If yes, who did you communicate with and what was the response?

18. If you would have any other concerns about the project, how would you relay the information?
19. Are there other key people or groups (aside from farmers) that are interested in the project**?** If yes, who are these / which groups are these?
20. (For each person or group) What are their interests in the project?
21. Will they be supporting or opposing the project? Why?
22. How influential are these people / groups?

Focus Group Questions - NWP

1. Let's do a quick around of introductions. Can each of you tell your name and employment?
2. What do you know about the NWP project?
3. How did you first learn about NWP?
4. What effects, positive or negative, will the project have on?
    a. On your farming outputs and livelihood?
        i. In addition to the positives you just shared, do you see any potential negative effects?
    b. On your access to water
        i. In addition to the positives you just shared, do you see any potential negative effects?
    c. On the environment and wildlife in your area?
        i. In addition to the positives you just shared, do you see any potential negative effects?
    d. On your health? (prompt discussion of kidney disease if not raised)
        i. In addition to the positives you just shared, do you see any potential negative effects?
    e. On (the Farmer Organization/ women/young people)
        i. In addition to the positives you just shared, do you see any potential negative effects?
5. Which are the stakeholders who will be most supportive of the project?
6. Who will be the most critical?
7. Are there any pre-existing tensions in this area or historical context in this area – e.g., social, environmental or political-- that might be inflamed by this project? e.g., any projects that didn't deliver previously, social tensions.
8. Who are the most active NGOs in your area? How will they feel about this project?
9. What has been your main source of information about this project so far?
10. What kind of additional information do you need in regards to the NWP?
11. Have you had any problems getting information relevant to NWP so far? If so what? How can these problems be solved?
12. What is your preferred way to get future information?

13. If you had a concern about the project, who would you report it to?
14. Now I'd like to ask you some questions about what kinds of communication channels you use.
15. What is your must trust worthy source of information?
16. Out the following three, which are the most trusted sources of information (common answer from 14)

    GN officer
    TV
    Newspaper
    Radio

17. Can I ask everyone to raise your hand if?
18. You have a TV
    a) Which channel you watch most often?
    b) What channel do you use to get news?
    c) At what time do you watch most often?
19. If you read the newspaper
    a) Which paper you read most often?
    b) Which days do you read the paper?
    c) If you have a mobile phone
20. Do you have a smart phone
21. If you have a radio

a) What station do you listen to most often?
b) What about for news and information?
c) At what time do you listen the most?

22. If you use the internet

a) How often do you log on?

ANNEX 4
LIST OF PARTICIPANTS

Stakeholders – Minipe

Date - 18th -20th August 2014

Project Beneficiaries

Focus Group Discussion
Farmer Organization – D35 Bedun Ela Farmer Organization- Weraganthotha

Name	**Profession**
Mr .W.A.Appuhami	Farmer
Mr .A.M.Wije Banda	Farmer
Mr .PalithaRabukwella	Farmer
Mr .SampathsriBuddkiaBandara	Farmer
Mr .Y.M.Rajarathna	Farmer
Mr .W.M.Wijerathna	Farmer
Mr .A.W.Wijesingha	Farmer
Mr .H.M.Ranbanda	Farmer
Mr .W.G.Lensuwa	Farmer
Mr .H.M.Muthubanda	Farmer

Women -D35 BedunEla Farmer Organization- Weraganthotha

Name	**Profession**
Ms.H.M.ThamaraKanthiHerath	Farmer
Ms.B.U.GangaIndraseeli	Farmer
Ms.K.M.G.Indumala	Farmer
Ms.H.M.ChandrawathiMenike	Farmer
Ms. MaduraneeRabukwella	Farmer
Ms.W.M.K.G.Bisomenike	Farmer
Ms.K.A.WijithaMangalika	Farmer
Ms.G.W.KusumRenuka	Farmer
Ms.H.G.IranganiDisanayaka	Farmer
Ms.P.W.DhanawathiKumariRabukwella	Farmer

Youth - D35 BedunEla Farmer Organization- Weraganthotha

Name	**Profession**
Ms.E.M.G.M.SachniAbiseka	-
Mr.K.B.SapumalIshara	-
Mr.W.M.W.G.D.K. Premarathna	Security –School
Mr.K.M.G.RuwanMadhusanka	Student

Mr.D.M.S.B.DasunJayathilaka	Water controller
Mr.A.M.Senaka Bandara Abeysingha	Technical Officer
Mr. SampathsriBuddkiaBandara	Farmer

Field Level Officers Weragantotoa and NaminiOya

Name	**Profession**
Ms.W.M.ChandraKumari	Samurdhi Development Officer
W.M.M.Weerasekara	Gramasewa Officer
Mr.M.W.G.Wimala Banda	Economic Development Officer
Mr.H.M.M.G.Thilakarathna Banda	Economic Development Officer
Mr.A.M.IshanDhanushka	Work superintendent
Mr.S.W.G.M.P.Ananda Bandara	GramasewaNiladari
Mr.A.G.P.R.Warnasuriya	Economic Development Officer
Ms.R.G.Ashoka	*Agricultural* Production and *Research Assistants*

111 stage – NaminiOya- D 52 Ela Farmer Organization

Name	Profession
W.P.G.MahindaWijesuriya	Farmer
W.G.Piyasena	Farmer
W.G.Ariyadasa	Farmer
G.M.Thilakaratna	Farmer
I.P.Punchibanda	Farmer
M.M.P.G.Somadasa	Farmer

Key Informant Discussion

Mr.W.P.G.MahindaWijesuriya	Chairman D 52 Ela
Mr.W.G.Siyasena	Treasure D 52 Ela
Mr.H.G.Sarath Kumara	Farmer D 52 Ela
Mr.M.A.D.Bandara	Resident Project Manger
Mr.S.W.G.M.P.Ananda Bandara	GramsewaNiladari
Mr.W.A.WasanthaJayasundara	Chairman –PradesiyaSaba - Minipe
Ms.S.D.Nagahathenna	Divisional Secretary – Minipe
Ms.H.M.E.G.A.P.Herath	Economic Development Officer – Weraganthota
Mr.H.M.G.Senewiratna	District Secretary – Kandy
Mr. Mediwaka	Project Director - Minipe

Focus Group Discussion - Elahera

Name	**Profession**
Mr .L.G.M.P.Bandara	Farmer
Mr .L.Amith Kumara	Farmer
Mr .W.G.Somawathi	Farmer
Mr .N.G.J.Pushpakumaea	Marketing Dealer
Mr .G.Wijesuriya	Farmer
Mr .L.G.Wijewardhana	Farmer
Mr .L.Dhammika	Marketing
Mr .M.D.NayanaShantha	Farmer
Mr .L.Sudath Kumara	Farmer
Mr .R.W.Wilasena	Farmer
Mr .M.D.Wimalasena	Farmer
Mr .Nelson	Farmer
Mr .R.M.SumithChandrarathna	Farmer
Mr .G.V.Weerasingha	Farmer
Mr .H.G.S.Thilakarathna	Development Officer – Elahera Divisional secretary
Mr.W.Anura Hearth	Farmer
Mr .B.M.PrasadDhammika Kumara	Farmer
Mr .H.B.Dharmawardhana	Farmer
Mr .B.H.Dharmasena	Farmer
Mr .B.H.SenakaJayaweera	Farmer
Mr .P.G.KapMenika	Farmer
Mr .W.G.Premalatha	Farmer
Mr .N.G.S.SurikaDamayanthi	Farmer
Mr .K.G.DilukaPriyadarshani	Marketing
Mr .G.G.Rupawathi	Farmer
Mr .J.A.ShanthaJayakodi	Farmer
Mr .N.W.G.D.Y.T.Nanayakkara	Farmer
Mr .A.G.Nihal Kumara	Farmer
Mr .T.A.Ariyarathna	Farmer
Mr .M.M.Premarathna	Farmer
Mr .B.A.Karunarathna	Farmer
Mr .D.M.PalithaDisanayaka	Farmer
Mr .H.M.Karunarathna	Farmer
Rev. Sadda Nanda Tero	Reverent Tero
Mr .G.G.Kumarasingha	Farmer
Mr .P.P.M.Hearth Banda	Farmer
Mr .J.K.BandulaRanathunga	Farmer
Mr.P.G.Thisera	Farmer
Mr.R.G.Aslin	Teacher
Mr,G.W.Wickramasinha	Farmer

Key Informant discussion

10th September 2014

Name	**Profession**
Mr.Nimal Abeysiri	District Secretary –Polonnaruwa
Eng.R.M.P.Karunarathna	District Engineer -Polonnaruwa
Eng.R.I. Jauasinhe	Divisional Irrigation Engineer

Field level Officer
Venue – PolpithigamaPradesiyaSaba

Name	**Designation**
Mr.B.M.S.S.Basnayaka	Gramasewaniladaree -351,Pallekele
Mr.W.A.PriyanthaWerasinghe	Gramasewaniladaree- Polpithigama
Mr.W.A.Wasantha	Gramasewaniladaree 338 Bulnewa
MrK.BW.M.N.R.Bandara	Gramasewaniladaree -Moragollagama
Mr.D.M.S.Ruwan Kumara	Gramasewaniladaree -Poharawaththa
Ms.J.Jayawathi	Institutional development officer
Ms. NisansalaHandagama	Development officer -
Ms. S.PD.S. Priyadarshani	Development officer

Department of Irrigation

Eng. B.A.S.S. Perera	Director of Irrigation /Director North Western cannel Programme
eng.G.M.R.A.Perera	Deputy Project Director
eng.M.L.A.V.Omeshani	Engineer assistant
eng.G.P.S.Sanjeewa	Engineer assistant
Eng. H.M.U.B. Herath	Divisional Irrigation Engineer

FGDs Farmer organization
Venue –Hearthgama Community Hall - Polpithigama

Name	**Designation**
W.M.K.NimalRajapaksha	Secretary
W.H.Upathissa	Randeniya Sub Secretary
E.M.B.Senewirathna	Siriparakum Farmer organization
H.M.Wijerathne	Pahaakele Farmer organization
Mr.S.A.Karunarathne	Pahaakele Farmer organization
Mr.R.M.Wimalasuriya	Pahaakele Farmer organization
Mr. H.M.D.Mudiyanse	Member Farmer organization
MR.H.M.Thilakarathne	Member Farmer organization
Mr.R.M.P.Kiribanda	Chairman of farmer organization
Mr.Amila Kumara	Member Farmer organization
Mr.H.M.R.Gunawardhana	Member Farmer organization

Mr.H.M.Aeyrathne	Herathgama Farmer Organazation
Mr.A.A. RicherdAlwis	Chairman, Herathgama Farmer Organization
Mr.R.M.Dissanayaka	Chairman
Mr.H.D.Nandasena	Hakwatunawa Chairman
Mr.J.A.NimalAriyasingha	Hakwatunawa Chairman
Mr.A.M.U.K.Karunarathne	Secretary -Siyabalawewa
Mr.S.D.A.Amarathunga	Treasure - Farmer organization
Mr.P.W.SarathChandrasena	Galgamuwa Farmer organization
Mr.H.M.K.Hearh Banda	Polpithigama Farmer organization
Mr.N.M.T.B.Nawarhna	Galgamuwa Farmer organization
Mr.D.M.Kiribanda	Abakolawewa Farmer organization
Mr.G.M.Kiribanda	Abanpola Farmer organization
Mr.H.M. Hearth Banda	Hearthgama Farmer organization

Women
Venue –Hearthgama Community Hall

Name	**Designation**
Ms.R.M.Kumarehami	Farmer
Ms.PathmaniRathnayaka	Farmer
Ms.P.M.R.MalaniAmerasingha	Farmer
Ms.H.M.NiroshaSadamalee	Farmer
Ms. H.M.ShhelaKumariHerath	Farmer
Ms. E.M.Muthumenika	Farmer
Ms. ThalathaAdikari	Farmer

Youth
Venue –Hearthgama Community Hall

Name	Designation
Mr.H.M.SamanthaKumara	Farmer
Mr.J.A.Amila Kumara	Farmer

Affected people –NWCP

Date – 11th September 2014

Galewela Community Hall

Name	**Gramasewa Division**
Mr.W.A.SarathChandrasiri	Ranakeliyawa
Mr.M.P.Rahila	Kepitiya
Ms. S.A.M.A.Leelawathi	Hombawa
Ms. E.M.ChandraKumarihami	Hombawa
Mr.W.A.Akmon	Hombawa
Ms.ThanujaDilhani	Hombawa
Mr.K.G.Wijerathna	Hombawa
Ms. M.G.I.Padma	Hombawa
Ms.Kusumawathi	Hombawa

Mr.H.M.Chandrawathi	Hombawa
Mr.Nandana Bandara	Ranmediyawa
Ms. M.G.Chithrawathi	Hombawa
Ms.R.P.Indrawathi	Daduyawa
Ms.G.H.Karunawathi	Hombawa
Mr.S.G.Chandrasiri	Daduyawa
Ms.H.W.MalaniDissanayaka	Hombawa
Mr. UpulShantha	PahalaBanbawa
Mr.H.A.AsokaTutas	Banbawa
Mr.H.A.AnuraJayarathna	PahalaBanbawa
Ms.P.D.Pemawathi	Kospotha
Ms.M.G.Anulawathi	Hombawa
Ms.D.M.Dingirimenike	Hombawa
Ms.G.L.A.G.Chandima	Danduyaya
Ms.DeepaniMallika	Danduyaya
Mr.G.L.A.Hemachandra	Danduyaya
Mr. G.L.A.Gandanasiri	Danduyaya
Mr.I.B.KapilaGaminiImbulana	Danduyaya
Ms. P.A.DeepaniPodimenike	Ranmediyawa
Mr.P.A.Wijerathna Bandara	Ranmediyawa
Ms.S.Pajeera	Keppitiya
Mr.R.B. HErath	Kospotha
Mr.W.M.M.G.Senarathna	Andagala
Mr.H.M.Jayathilaka	Katupotha
Mr. P.G.Thilakarathna	Katupotha
Mr.K.U.W.S.Bandara	Dabduyaya
Mr. U.G.Karunarathna	Dabagolla
Mr.R.G.Piyasena	Dabagolla
Mr.S.P.M.Buddhdasa	Katupotha
Mr.I.G.JuseeApphu	Katupotha
Mr.W.A.Dhanapala	Katupotha
Mr.G.H.Sumanathissa	Katupotha
Ms.J.A.D.Karunawathi	Keppetiya
Mr.S.Amarsainha	PahalaBambawa
Mr.S.R.Amarasingha	PahalaBambawa
Mr.H.A.Hendry	PahalaBambawa
Mr.J.H.Fernando	Daduyaya
Mr.W.M.Senarthna	Daduyaya
MR.A.M.U.C.Alahakoon	PahalaBambawa
Mr.G.R.M.G.Wijethunga	PahalaBambawa
Mr.H.M.Senewirathne	Palamwewa
Mr.C.Abeythenne	Homwaba
Ms. Chandra Seemathi	Daduyaya A
Ms. J.A.I.Shamalee	Daduyaya A
Ms. J.A.Indranee	PahalaBambawa
Ms. Chandra Latha	PahalaBambawa
Mr.Diglous Fernando	PahalaBambawa

Mr.Premadasa	Kospotha
Mr.KamalThalakiriyagama	Kospotha
Mr.r.Bandara	Kospotha
Mr.R.H.A.LankaKusum	Kospotha
Ms.SadalathaJayalath	Kospotha
Ms.K.Peramma	Bogasyaya
Mr.H.M.InokaKumari	Bogasyaya
Ms.R.M.Somawathi	Daduyaya A
Mr.M.W.Sirisena	Kepetiya
Mr.G.L.Refass	Ranmediyaya
Mr.M.S.M.Masuud	Keppetiya
Mr.A.Hisan	Keppetiya
Mr.Jagath Bandara	Keppetiya
Mr. Ba ndaWijethunga	Kospotha
Mr.R.F.Shefaniee	Rangiriyaya
Mr.R.G.Wijerathne	Kospotha
Mr.M.B.Jayasingha	Kospotha
Mr.A.G.Pabisih	Kospotha
Mr.R.G.Jayarathne	Kospotha
Mr.S. Fawzer	Keppetiya
Mr.G.G.S.Anurasiri	Keppetiya
Ms. J .ThusareePriyadarshani	Keppetiya
Ms.Sriyanee Swarnalatha	Kospotha
Mr. W.D.Sumanawathee	Kospotha
Mr.R.G.Ariyasena	Kospotha

Key Informant Interview – Officers

Name	Designation
Mr. W.G.W.Wanasignha	Divisional Secretary -Polpithigama
Mr.L.R.RanjthWijenayaka	Chairman PradesiyaSabaPolpithigama
Eng.R.M.A.R.Bandara	Divisional Irrigation Engineer
Eng. D.S.N.Jayamanne	Divisional Irrigation Engineer –Hiriyaya
Eng.W.M.D.Wijesinha	Irrigation Engineer –NWPCP
Ms. A.M.K.C.K. Athapathtu	Divisional Secretary- Galewela

Field Level Officers – Galewela
Venue – Galewela Divisional Secretariat

11th September 2014

Name	Designation
Ms. KusumHewage	Divineguma Development Officer
Ms.A.G.Jayawathi	Agriculture production Assistant -
Ms.S.L.Farnina	Economic Development Officer - Ranmediyawa

Ms. E.G.A.M.Wimalarathane	Development Officer

Key Informant Interview

Mr.AnuraSathurusingha	Conservator General DFC
Eng. Badra Kamaladasa –	Director GeneralID
Mr.Saman Fernando -	Additional Secretary– MWRC
Eng. K.R.S.Perera –	Director, Development MWRC
Mr.Mahinda Senewirathna	Director – Operation - DFC
Mr. Manjula Amararathna	Deputy Director- DWLC
Mr. E. Perera	Safegurd officer
Ms. Manjula Amerasnghe	Environment Specialist –SARD

ANNEX 5
A LIST OF PARTICIPANTS

Stakeholder Meeting on ADB Funded Water Resources Development Investment Program
Date: 21.07.2014
Time: 2.30 p. m.
Venue: Conference Room (9th Floor) of Ministry of Irrigation & Water Resources Management
No. 500, T. B. Jayah Mawatha, Colombo 10

Eng. K. W. Ivan de Silva	Secretary	MIWRM
Eng. N. C. M. Navaratne	Director General	DOI
Mrs. Udeni Wickramasinghe	Secretary	MWLRC
Eng. N. C. M. Navaratne	Deputy Director General (Technical)	MASL
Mr. W. Samaraweera	Additional secretary	MDM
Mrs. N. R. Ranjani	Additional secretary-Development	MWSD
Mr. Lance Gore	Mission Leader	ADB
Dr. B. Freeman	Team Leader	PPTA
Dr. Jayantha Perera	Consultant	ADB
Ms. R. M. S. Swarnalatha	Communication Specialist	PPTA
Mr. Ahsan Tayyab	SLRM	ADB
Mr. Andre Oosterman	Economist	ADB
Mr. Jayantha Perera	Safeguards Specialist	ADB
Eng. Manjula Amarasinghe	Environment Specialist	ADB
Mr. N. C. Gunasekara	Social Development & Gender Specialist	ADB
Dr. Palitha Bandara	Focal Point	ADB
Mrs. N. Jeyawadani	Director	MED
Mrs. K. R. S. Perera	Director	MWLC
Eng. W. P. D. Rajamanthri	Deputy Chief Secretary (Engineering Services)	NW Provincial Council/ Chief Secretary of Kurunegala
Mrs. Kanthi de Silva	Director (EIA)	CEA
Mrs. N. K. Attanayake	Deputy Director (EIA)	CEA
Mrs. Menaka Rajaguru	Assistant Director	ERD
W. K. B. H. Prame	Deputy Director	GSMB
Prof. D. Weerakoon	Fauna Specialist	University of Colombo
Mr. Varuna Dharmaratne	Project Specialist	JICA Sri Lanka
Mr. Ayumu Ohshima	Rural Development Department	JICA HQ
Mr. Kazu Shimazuki		JICA HQ
Ms. Namiko Yamada		JICA Sri Lanka
Dr. H. Manthrithilake	Head - SL Development	IWMI

	Initiative	
Mrs. Shermin de Silva	Director	Udawalawe Elephant Research
Mr. S. P. Vidanage	Programme Coordinator	IUCN
Ms. Lyu Lining	Assistant Commissioner	CDB
Mr. Jayantha Jayawardena	Management Trainee	Biodiversity Trust
Mr. Pubudu Weerarathna		Species Conservation Centre
Mr. R. A. Jayawardena	Vice President	Wildlife & Nature Protection Society
Mrs. Sunela Jayawardena		Federation of Environmental Organizations
Mr. A. Perera	CID	
Eng. B. A. S. S. Perera	Director (Kurunegala)/ PD NWPCP	DOI
Eng. M. Thuraisingham	Additional Director General	DOI
Eng. W. L. H. M. T. Bandara	Additional Director General	DOI
Eng. G. M. R. A. Perera	Deputy Project Director NWPCP	DOI
Eng. S. Shanmugashivanandan	Director Irrigation	DOI
Eng. S. D. Medivaka	Project Director MLBR	DOI
Mr. A. M. R. B. Attanayake	Director (Forest)	MASL
Eng. H. H. Leelarathna		MASL
Eng. S. A. A. Dharmasiri	Project Director UEC	MASL
Mr. A. Liyanagama	System Analyst	MCB
Eng. J. A. S. A. Jayasinghe	Consultant	MCB
Eng. J. Jochimthasan	Consultant Engineer	MCB
Eng. K. A. U. S. Imbulana	Consultant Engineer	MCB
Eng. M. R. S. Wickramaratne	Consultant Engineer	MCB
Eng. N. D. T. M. Amerasekara	TL, NWP	MCB
Eng. P. W. C. Dayaratne	TL, NCP	MCB
Eng. S. S. Ranatunga	Consultant	MCB
Eng. N. A. Sisira Kumara	Additional Secretary. (WRP)/ Programme Director (WRDIP	MIWRM
Eng. R. M. W. Ratnayake	Additional Secretary (Technical)	MIWRM
Mr. D. D. Ariyaratne MIWRM	Director (PI)	MIWRM
Ms. L. P. C. Fernando	Asst. Director (PI)	MIWRM
Eng M. M. S.R. Perera	Environment Consultant	MIWRM
Eng. P. H. Jayawardena	Eng. Consultant	MIWRM
Eng. M. N. Ismail	Engineer	MIWRM

ANNEX 6
TOR FOR COMMUNICATION OFFICER IN PMU
SRI: Water Resources Development Investment Program

Objective and Purpose of the Assignment
The Water Resources Development Investment Program (WRDIP) will assist the Government of Sri Lanka complete outstanding water conveyance investments under the Mahaweli Development Program (MDP). Completion of MDP is a key priority of the government and will maximize the productivity of Mahaweli River Basin water resources by transferring available water to the country's northern dry zone areas for irrigation, drinking and commercial purposes. This will accelerate local and national economic growth.

The North Central Province Canal Program (NCPCP) is an outstanding investment component of MDP, and will be implemented in two sequential phases. WRDIP will implement Phase 1, comprising three investment projects:

(i) The Upper Elahera Canal Project (UECP) comprises two main components. The first component is the 9 km KMTC that will convey up to 771 MCM of water annually between Kaluganga and Moragahakanda Reservoirs, both of which are currently under construction. The second component is the 65.5 km Upper Elahera Canal (UEC) that will annually convey up to 974 MCM northwards from Moragahakanda Reservoir to the existing Huruluwewa Reservoir, and a further 16.7 km of canals to supply the existing Manankattiya, Eruwewa and Mahakanadarawa Reservoirs; these existing reservoirs supply existing irrigation and water supply schemes.

(ii) The North Western Province Canal Project (NWPCP) will construct 96 km of new and upgraded canals, including a new 940 m tunnel and two new 25 m tall earth gravity dams impounding the planned Mahakithula and Mahakirula Reservoirs to annually withdraw 130 MCM from Dambulu Oya River and the existing Nalanda Reservoir (via the existing Wemedilla Reservoir) to command new and existing irrigation and water supply reservoirs located throughout North Western Province.

(iii) Minipe Left Bank Canal Rehabilitation (MLBCR) project, located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork's weir by four meters to regulate generation inflows, (b) construct new automatic downstream-controlled intake gates to the left bank canal; (c) construct new emergency spill weirs to both left and right bank canals; and (d) rehabilitate the 74 km Minipe Left Bank Canal, including regulator and spill structures, to improve conveyance and reliability of service to existing farmers.

Scope of Work
The MIWRM will be the executive Agency for the WRDIP. The PMU, supported by the PMDSC will have primary responsibility for implementation of the SCP through communications officer in PMU. Under the supervision of the WRDIP Program director, the media relations and communications officer will be responsible for implementing WRDIP's communications strategy and work plan,

Strategic Communications

(i) Developing a communications strategy and annual plan for the WRDIP for the steering committee's approval. The communication strategy will contain effective approaches for different audiences;

(ii) Build and maintain close ties with national ,regional and district media correspondence

(iii) Provide strategic advice to PIUs communication officers on high profile or sensitive internal or external communications issues in which proactive interaction is critical to WRDIP's credibility

(iv) Develop content for major communications activities including key messages/ talking points, news releases, opinion pieces, and background documents

(v) Coordinate and interface with National communication specialist in PMDSC to develop communications and promotional materials, collaterals and multimedia products

(vi) Develop effective messages on issues and initiatives

(vii) Train senior staff on media and communications skills

(viii) Managing the contents of the WRDIP website and mailing list for effective and up to-date

(ix) Develop and disseminate on WRDIP knowledge products and news

(x) Monitor and evaluation of communication plan

(xi) Implementing Communication capacity building plan for PMU and PIUs staffs

Knowledge Sharing

(i) Promote knowledge sharing and collaboration by managing, writing and editing communications materials and developing communications products to support knowledge product dissemination.

(ii) Ensure key messages and communications products are disseminated through appropriate channels to maximize efficacy.

Staff Supervision

(i) Provide leadership and support to Communication officers in PIUs and supporting staff in Communication Unit in PMU.

(ii) Supervise the performance of reporting staff, providing clear direction and regular monitoring and feedback on performance.

(iii) Ensure the on-going learning and development of staff members in communication unit and communication officers in PIUs.

Minimum Qualification Requirements

The successful candidates will have relevant post-graduate qualifications in communication, journalism, social sciences, public affairs, political science, or international relations, be senior communication professionals with a minimum of 8 years of experience in the field of communications and development projects/programs. The communication officer will have

the ability to interact effectively across socio-political, economic, and cultural affiliations. In addition, the specialists are expected to have the following qualifications:

(i) Proven experience in designing and managing development communication programs and public communication programs.

(ii) Experience with new media, social media and development communication an advantage.

(iii) Solid understanding of and ability to apply communication tools and techniques,

(iv) Strong management skills in planning and financial management of communication work.

(v) Educational background in communication, journalism, social sciences, public affairs, political science, or international relations.

(vi) Knowledge and understanding of socio-political, economic, and cultural background of Sri Lanka.

(vii) Demonstrated interpersonal and diplomatic skills, as well as the ability to communicate effectively with all stakeholders and to present ideas clearly and effectively; proven ability to work in a collaborative and multi-stakeholder team environment.

(viii) Strong interpersonal skills and recognized as a team player

(ix) Demonstrated ability to manage /mentor staff and managing complex relations

(x) Performs work independently in own field of specialization

(xi) Experience in similar work in foreign funded project or working with INGO will be an added advantage, along with experience in the irrigation and water resources management sectors.

ANNEX 7

SRI: Water Resources Development Investment Program

Terms of Reference for the Communication Officer –PIUs

Objective and Purpose of the Assignment

The Water Resources Development Investment Program (WRDIP) will assist the Government of Sri Lanka complete outstanding water conveyance investments under the Mahaweli Development Program (MDP). Completion of MDP is a key priority of the government and will maximize the productivity of Mahaweli River Basin water resources by transferring available water to the country's northern dry zone areas for irrigation, drinking and commercial purposes. This will accelerate local and national economic growth.

The North Central Province Canal Program (NCPCP) is an outstanding investment component of MDP, and will be implemented in two sequential phases. WRDIP will implement Phase 1, comprising three investment projects:

(iv) The Upper Elahera Canal Project (UECP) comprises two main components. The first component is the 9 km KMTC that will convey up to 771 MCM of water annually between Kaluganga and Moragahakanda Reservoirs, both of which are currently under construction. The second component is the 65.5 km Upper Elahera Canal (UEC) that will annually convey up to 974 MCM northwards from Moragahakanda Reservoir to the existing Huruluwewa Reservoir, and a further 16.7 km of canals to supply the existing Manankattiya, Eruwewa and Mahakanadarawa Reservoirs; these existing reservoirs supply existing irrigation and water supply schemes.

(v) The North Western Province Canal Project (NWPCP) will construct 96 km of new and upgraded canals, including a new 940 m tunnel and two new 25 m tall earth gravity dams impounding the planned Mahakithula and Mahakirula Reservoirs to annually withdraw 130 MCM from Dambulu Oya River and the existing Nalanda Reservoir (via the existing Wemedilla Reservoir) to command new and existing irrigation and water supply reservoirs located throughout North Western Province.

(vi) Minipe Left Bank Canal Rehabilitation (MLBCR) project, located downstream of the Mahaweli Hydro Power Complex on the Mahaweli River, will: (a) add upstream storage by heightening the headwork’s weir by four meters to regulate generation inflows, (b) construct new automatic downstream-controlled intake gates to the left bank canal; (c) construct new emergency spill weirs to both left and right bank canals; and (d) rehabilitate the 74 km Minipe Left Bank Canal, including regulator and spill structures, to improve conveyance and reliability of service to existing farmers.

Scope of Work

The MIWRM will be the executive Agency for the WRDIP. The PMU, supported by the PMDSC will have primary responsibility for implementation of the SCP through communications officer in PMU. Under the supervision of the Communication Officer in PMU

PIUs communications officer will be responsible for implementing WRDIP's communications strategy and work plan.

Job Description

Reporting communication officer in PMU and Project Director PIUs, the communication officer in PIUs will have a responsibility to developing and implementing a communication strategy of the WRDIP, support conducting IEC campaign, preparation and dissemination of updates ,briefing notes, lesion learnt and project progress ,develop training and communication materials ,web site , social media , press release and use mass media to aware stakeholders on WRDIP activities and community media.

Specific task

(i) Support communication officer in PMU to planning designing implement effective communication strategy to reach WRDIP stakeholders.

(ii) Produce effective communication material

(iii) Build and maintain close relationship with district media correspondence

(iv) Managing the contents of the WRDIP website and mailing list for effective and up to-date

(v) Develop and disseminate on WRDIP knowledge products and news

(vi) Monitor and evaluation of communication plan

(vii) Implementing Communication capacity building plan for PIUs staffs

Knowledge Sharing

(i) Promote knowledge sharing and collaboration by managing, writing and editing communications materials and developing communications products to support knowledge product dissemination.

(ii) Ensure key messages and communications products are disseminated through appropriate channels to maximize efficacy.

Minimum Qualification Requirements

The successful candidates will have relevant post-graduate qualifications in communication, journalism, social sciences, agriculture extension, public affairs, political science, or international relations, be senior communication professionals with a minimum of 5 years of experience in the field of communications and development projects/programs. The communication officer will have the ability to interact effectively across socio-political, economic, and cultural affiliations. In addition, the specialists are expected to have the following qualifications:

(i) Proven experience in designing and managing development communication programs and public communication programs.

(ii) Experience with new media, social media and development communication an advantage.

(iii) Solid understanding of and ability to apply communication tools and techniques,

(iv) Knowledge and understanding of socio-political, economic, and cultural background of Sri Lanka.

(v) Demonstrated interpersonal and diplomatic skills, as well as the ability to communicate effectively with all stakeholders and to present ideas clearly and effectively; proven ability to work in a collaborative and multi-stakeholder team environment.

(vi) Strong interpersonal skills and recognized as a team player

(vii) Experience in similar work in foreign funded project or working with INGO will be an added advantage, along with experience in the irrigation and water resources management sectors.

(viii) Able to develop and maintain good working relationships with the local communities. Qualities to look for include good people and communication skills,

(ix) a good understanding of the local language and community/cultural dynamics, open-mindedness and respect for the views of others,

(x) a solution-oriented approach, a high integrity/degree of trustworthiness, and a genuine commitment to the program and its goals.

ANNEX 8
NEWSPAPER ARTICLE

FINAL PHASE OF MAHAWELI DEVELOPMENT SCHEME UNDERWAY:

Drought emphasizes need for urgent completion

by Gamini Warushamana

The final phase of the Mahaweli Development Project (MDP) is now underway to address water shortages in the Dry Zone up to Northern province. The prevailing drought has emphasised the need for urgent completion of the project.

Additional Secretary, Ministry of Irrigation and Water Resource Management (MIWRM), Sisira Kumara told Sunday Observer Business that this project, especially the North Central Province (NCP) canal is the only way to provide water to remote areas of the NCP and North Province (NP) and a long-term and sustainable solution for the issue.

Excerpts of the interview.

There is a misconception that the NCP Canal project is only to provide water to the Iranamadu tank in the North.

Iranamadu tank is the last major reservoir included in the MDP to provide Mahaweli water under the NCP Canal similar to other major reservoirs in the NCP which benefited from the diversion of Mahaweli waters.

In the next 25 years water will become the most important commodity and sharing this equitably while establishing the water rights of the farmers who enjoy such rights at present, will be the only way to take this country to prosperity while improving the living standards of the poor farming community in the area.

There are three major components of this phase; Moragahakanda and Kalu Ganga reservoirs and North Central Province (NCP) Canal. Construction works of the two reservoirs are now under way and are the last two major reservoirs in the Mahaweli Development Project planned in 1968.

The Moragahakanda reservoir is the most important in the Mahaweli system to address irrigation water deficit of developed Mahaweli areas under Polgolla-Amban Ganga complex. The NCP canal will supply water for irrigation to the areas identified in the Mahaweli master plan, further North in the Dry Zone.

The capacity of the Moragahakanda reservoir is 570 million cubic meters (mcm) and the dam is being constructed across Amban Ganga.

The capacity of the Kalu Ganga reservoir is 250 mcm and the dam is being constructed across the Kalu Ganga.

These two reservoirs will add around 820-mcm additional water capacity to the existing Mahaweli system enabling added flexibility of water allocation and will help to reduce the adverse impact of climate change anticipated in the future.

As per the water balance studies there will be an excess of 100 mcm of water which could be transferred from Kalu Ganga reservoir to Moragahakanda to be used in other areas. This excess water in the Kalu Ganga reservoir will be transferred to Moraghakanda reservoir through a nine-kilometre long link tunnel.

Final phase of Mahaweli Development Scheme underway

The Mahaweli Authority of Sri Lanka (MASL) has planned to provide this water to Manankattiya - Mahakandarwa tanks which are in need of additional water as per the MDP. The total area expected to benefit from Moraghakanda and Kalu Ganga complex is about 93,122 hectares.

Water rights

There is a misunderstanding among some sectors that once the Moragahakanda and Kalu Ganga reservoir project are completed, the people in Polonnaruwa would be deprived of water rights due to the diversion of the Kaluganga and Ambanganga.

This is not true because water available in the two reservoirs with the diversion of the Mahaweli river through Polgolla is not sufficient to provide water beyond Mahakandarawa tank.

In the planning stage of the Kalu Ganga reservoir, the farmers in the Polonnaruwa area specially the farmers under Parakrama Samudra irrigation scheme who receive Kalu Ganga water at present through the Angamedilla diversion scheme protested regarding their water rights.

Accordingly, the Irrigation Department (ID) and Mahaweli Authority of Sri Lanka (MASL) and GA Polonnaruwa on behalf of the farmers signed a memorandum of understating that at times of water shortage, priority will be given to transfer water from either Moragahakanda or Kalu Ganga reservoirs to Parakrama Samudra and ensure their water rights in the future.

The NCP canal sub project is vital to address the plight of the farmers in most remote areas of Kebithigollewa, Horowpothana, Medawachchiya, Kahatagasdigiliya,

Rambewa and Mihintale in the NCP including Padaviya - Wahalkada and Pavattakulum schemes.

People in Vavuniya and Killinochchi in the Northern Province (NP) also suffer due to a severe water shortage. Further, an acute kidney disease is fast spreading in the NCP threatening the lives of the people.

The provision of safe drinking water has been identified as one of the measures to combat this disease.

According to areas recognised as Mahaweli areas by the government in 1979 all the people under MDP have an equal right to get their share of water.

The objectives of MDP are to divert the surplus water of Mahaweli river basin for irrigation of 365,000 ha to attain self-sufficiency in food, provision of land and job opportunities to landless people and hydro-power generation. However, by 2012, 44 years after the launch of the project, only 150,000 ha or 41 percent of the work has been completed.

Over time, the government has revised MDP accounting for socio-economic changes and national development priorities.

The government's present priorities for the irrigation and water resources sector focus on ensuring availability of water for irrigation and minimising variations in water availability by implementing trans-basin diversions to divert water to dry zone areas.

In November 2012 Government approved the Upper Elahera Canal from the Moragahakanda reservoir to launch the delayed NCP canal project.

NCP Canal area

As originally proposed in the MDP, Moragahakanda and Kalu Ganga are the main irrigation infrastructure needed for the development of NCP canal project area.

The Ministry of Irrigation and Water Resource Management (MIWRM) carried out a comprehensive water balance study and the study considered present environmental, social and technical constraints.

This study has identified two water sources for optimum use of water in the Mahaweli river and adjacent river basins.

One is the transfer of water from Randenigala reservoir augmented with Heen Ganga and Hasalaka reservoirs. The Heen Ganga and Hasalaka are two major tributaries in the left bank of the Mahaweli river and most of the water presently flows to the sea through Mahaweli river without being used.

Simultaneously it is proposed to divert lower Uma Oya water to Randenigala through Lower Uma Oya reservoir with the development of hydro power to compensate power loss due to transfer from Randenigala. This source will trap the present spillage amounting to about 900 mcm annually of Mahaweli water from the Minipe anicut located below Mahaweli major cascade Victoria, Randenigala and Rantambe.

Diversion

The Minipe anicut is the gravity water diversion point to Minipe scheme (system E) in the Mahaweli left bank and systems C and B under Maduru Oya reservoir in the Mahaweli right bank.

After allowing for environmental releases and the need of water for new development projects, it is proposed to divert about 550 mcm annually from Randenigala using spilling water over Minipe anicut with another 150 mcm from Heen Ganga and Hasalaka reservoirs to Kalu Ganga reservoir and will be used to augment the Moragahakanda reservoir.

This route will add additional effective storage (Victoria and Randenigala) to the Mahaweli system and open another water transfer route to Moragahakanda reservoir adding flexibility to existing water transfer systems in the Mahaweli-Amban Ganga complex to mitigate climate change effects witnessed today and resulting in greater flexibility to the Mahaweli system.

The second source needs, lifting of water from Mahaweli river at Kalinganuwara in the Mahaweli river, considered as another ancient water diversion point combined with Angamedilla in the Amban Ganga. In the original Mahaweli Master Plan lifting of about 800 mcm of water annually amounting to about 30% of water requirement of NCP canal development area is proposed from Angamedilla.

Dry year

Under the proposal, the quantity lift has been reduced to about 300 mcm of water annually to Moragahakanda system.

Even in a very dry year such as 2014 sufficient water is flowing in the Mahaweli river and part of this water if lifted could be used to minimise the drought conditions prevailing in the NCP.

This source also will add great flexibility in the operation of the Mahaweli system facilitating early commencement of cultivation in the Mahaweli system 'G' area and other existing major irrigation systems and will pave the way for optimum use of Maha rainfall in the NCP.

Supplementing Moragahakanda from the above two sources it is possible to provide approximately 1000 mcm from Moragahakanda to NCP Canal area including 70 mcm is allowed as drinking water. Thus, it should be clearly understood that full development of NCP canal is possible only with transfer of water through the above two sources to Moragahakanda reservoir complex.

Once additional water is transferred then it is possible to extend the NCP Canal beyond Mahakandarawa tank without affecting the Polonnaruwa irrigation system. An environment-friendly water diversion system is proposed from the NCP Canal to feed the minor tank cascade system.

This comprises about 1,000 tanks situated in the ancient settlement areas of which major part lies in NCP, north of Anuradhapura and the balance part in Northern province in an around Vavuniya town, fulfilling the dream of the farmers in the area.

Neither large-scale system development as done in the past nor new areas have been proposed for development. The existing forest areas will be linked to create large forest range areas for co-existence of wildlife minimising the human-elephant comflict in the area.

Another notable achievement in this project is paving the way for diversion of the Mahaweli to water scarce Hakwatuna Oya scheme in the upper Deduru Oya basin and upper Mi Oya irrigation system in the driest areas of the NWP in the Polpitigama, Galgamuwa and Ehetuwewa and Yapahuwa Pradeshiya sabah areas fulfilling the dreams of farmers in the area.

It is estimated that about 130 mcm of water could annually be transferred to this area through the existing Wemedilla-Dewahuwa water diversion system while stabilising the systems further.

Climate change

Today, the country is going through one of the severe droughts in recent times with no rains in some parts of the country for the past nine months.

The only way to fight future climate change effects, drought and floods in the NCP is to add storage capacity to the Mahaweli system. The proposed supplementary water diversions linking the existing and proposed irrigation infrastructure will minimise these effects in the future.

ANNEX 9
COMMUNICATION ACTIVITIES CONDUCTED DURING FEASIBILITY STUDIES
NWCP Area

DS Division	GN Division	Date of meeting	Venue of meeting	No of stakeholders present	No of officers present
Galewela	Pahalabambawa and Ranwediyawa	24/03/2014	Pahalabambawa Temple	27	9
Galewela	Danduyaya, Dambagolla and Nebadagahawatta	24/03/2014	Danduyaya Temple	22	10
Polpithigama	Polpithigama Bogolla	25/03/2014	Ds Office	25	13
Polpithigama	Amunukole Hathigamuwa	25/03/2014	Amunukole Temple	50	09
Polithigama	Bulnewa Moragllagama Moragllagama	26/03/2014	Bulnewa Temple	28	09
Galewela	Aluthwewa Nilagama Pibidunugama	27/03/2014	Aluthwewa Temple	42	09
Galewela	Hombawa	27/03/2014	Andagala Temple	26	07
Galewela	Koapotha	28/03/2014	Danduwagolla Temple	27	06
Polpithigama	Pallekele	28/03/2014	Sanasa Meeting hall	37	05
Dambulla	Pananmpitiya	01/04/2014	Parakum community hall	29	12
Dambulla	Lenadora North	01/04/2014	Lenadora Community Hall	31	13
Dambulla	Ethabedunuwewa	02/04/2014	Menikdena Community Hall	37	09
Dambulla	Welamitiyawa	02/04/2014	Welamitiyawa Temple	14	07
Mahawa	Mahawa	03/04/2014	Konwewa Temple	47	13

UEC Area

DS Division	GN Division	Date of meeting	Venue of meeting	No of stakeholders present	No of officers present
Galenbidunuwewa	Yakkalla	21/04/2014	Yakalla Community Hall	22	07
Elehera	Elehera		Elahera Community Hall	18	05

WATER RESOURCES DEVELOPMENT INVESTMENT PROGRAM

PROGRAM PREPARATORY TECHNICAL ASSISTANCE

TA-8633

DRAFT

APPENDIX 15

STRATEGIC COMMUNICATIONS PROGRAM

NOVEMBER 2014

ABBREVIATIONS

ADB	–	Asian Development Bank
DOI	–	Department of Irrigation
DCS	–	Development Communication Specialist
CBA	–	Communication-Based Assessment
CSOs	–	Civil Society Organizations
FGD	–	Focus Group Discussion
DPMU	–	District Program Management Communication Unit
DCC	–	District Coordinating Committee
DPD	–	District Program Director
DAC	–	District Agriculture Committee
DACM	–	Divisional Agriculture Committee Meeting
EDO	–	Economic Development Officer
GRC	–	Grievance Redress Committee
IEC	–	Information Education Campaign
KMTC	–	Kaluganga-Moragahakanda Transfer Canal
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Program
MRB	–	Mahaweli River Basin
MIWRM	–	Ministry of Irrigation and Water Resources Management
MLBCR	–	Minipe Left Bank Canal Rehabilitation
NCPCP	–	North Central Province Canal Program2
NWPC	–	North Western Province Canal
NGO	–	Non-Government Organization
PAP	–	Project Affected Person
PMDSC	–	Program Management, Design and Supervision Consultant
PMC	–	Program Management Committee
PMU	–	Program Management Unit
SCP	–	Strategic Communication Program
UEC	–	Upper Elahera Canal
YMBA	–	Young Mens' Buddhist Association

CONTENTS

ANNEXES

TABLES

I. OVERVIEW

A. Background

1. This report outlines a strategic communication program (SCP) for the WRDIP. Implementation of the SCP will engage and inform relevant stakeholders and sectors with timely, accurate, and comprehensive information about the investment program shared among stakeholders. Communication in this context is supposed to be a pre-requisite and an instrument of effective policy making and public participation from formulating a vision, negotiating and decision making, developing and implementing plans to monitoring impact.

2. Communication strategies are very prevalent, since all organizations have some sort of method to portray their core message to their stakeholders. Without having a strategy that effectively reaches the predetermined target audiences, there is no way that the organization with influence as many people. If the organization is going to spend the time to figure out their key messages it would be best to develop a strong communication strategy. Furthermore, this would guarantee the time was not wasted and the message will reach the all stakeholders in the easiest way.

B. Objectives of the Strategic Communication Plan

3. This SCP describes the communications principles and objectives of the WRDIP and is a guiding tool to plan and implement the knowledge management and information sharing tasks of Program Management Unit (PMU) and Program Implementation Units (PIUs). It also aims to support activities by the WRDIP's Steering Committee and other stakeholders. Strong communications throughout the program will help obtain better results by increasing awareness, fostering behavior changes, mobilizing support, and establishing partnerships in pursuit of common goals.

4. The investment program will maximize transparency by communicating relevant program information to stakeholders in various means with the objectives of:

- Ensure regular flow of reliable program information among the key stakeholders
- Establish two –way information sharing dialogue mechanism to the WRDIP

5. The SCP shall contribute to three main outputs of the WRDIP:

- Development of water conveyance infrastructure
- Developed systems for strengthening integrated water resources management and improving system efficiencies and water productivity
- Efficient multi-disciplinary investment program management

C. Methodology

6. The SCP was developed in close consultation with WRDIP Program Director and other stakeholders who were consulted during Stakeholder Analysis. The overall objective of the SCP is to enhance stakeholders' trust and ability to engage with the WRDIP activities.

7. The report is based on desk analysis, key informant interviews with stakeholders and focus group discussions (FGDs), when meetings were held with each stakeholder group and

site visits were conducted to the NWPC, MLBCR and UEC project areas. Based on the Stakeholder Analysis, a communications matrix was developed (refer to **Annex 1**).

D. Core Elements

8. Core elements of the SCP include:

(i) **A Communications Strategy** that will set the vision, identify challenges and risks, and elaborate a plan of action to achieve the communication objectives contributing to the successful implementation of the investment program.

(ii) **A Communications Action Plan** that will have specific communication objectives, internal and external audiences, messages, communication channels, type of media, frequency, evaluation, etc.

(iii) **A Communications Monitoring and Evaluation System** that will include opinion research, tracking systems, media monitoring, focus groups, and evaluation of major communication activities identified and listed in the Communications Action Plan.

(iv) **A Capacity-Building and Knowledge Management Plan** will describe the types of skills training, institutional arrangements, knowledge creation and sharing activities required to strengthen the capacity of key stakeholders, including key government agencies, to design and manage the implementation of the SCP.

E. Organization of the Report

9. The report is divided into eleven sections as follows.

1. Overview

10. This chapter provides an introduction to the investment program and the role and objectives of the SCP.

2. Principles and Approaches

11. Improving information management practices is not easy task and it should follow principles and approaches to achieve better results. This section introduces seven key principles and approaches to ensure that SCP activities are effective and successful.

3. Target Audiences and Key Messages

12. The main audiences are identified as those whose actions will influence achievement of the investment program's goals. These audiences are largely partner groups and require two-way communication efforts.

4. Implementation Strategy

13. The implementation strategy for the SCP is discussed in this section.

5. Communication Activities

14. Proposed communication activities for the investment program are discussed. Tactics and tools are recommended for each of the goals and sets of communications objectives and their associated audiences. The activities span a variety of approaches to engaging stakeholders, including IEC, public display / advertisement, material development, mass media, new technology and special event programs.

6. Capacity Building Plan

15. Communication capacity is one of the fundamental requirements for building good relationships with stakeholders and strengthening the bonds with citizens and their represent active organizations. It is necessary to develop capacity building for their stakeholders and proposed plan will be discussed in this section.

7. Monitoring and Evaluation Strategy

16. In this section the proposed monitoring and evaluation system for the SCP is described in detail. This includes the quantitative and qualitative indicators to measure impact of the SCP. Evaluation allows for determination of whether communications objectives have been met and offers feedback for adapting further communications to be more effective.

8. Budget

17. A budget estimate for the SCP has been prepared that identifies the key elements associated with initial and recurring costs in terms of the human resources, materials, equipment, and communication activities (both internal and external) to implement to the SCP..

9. Conclusions and Recommendations

18. The SCP will serves as an overall framework for communication activities within the WRDIP. Successful communication results from a committed effort from each PMU and PIU officer in using the channels and guidelines presented in this plan. Communication is regular and as needed to ensure that all audiences are aware of critical and important information on a timely basis. Seven recommendations are proposed to implement the SCP successfully.

II. PRINCIPLES AND APPROACHES

A. Principles

19. The SCP respects the following principles:

- This SCP is developed on the basis of a communication assessment and the result of the stakeholder analysis.
- The SCP is developed and implemented for most of the target groups of the investment program such as program affected people (PAPs), beneficiaries, government officials and policy makers, and secondary stakeholders.
- The elaboration and implementation of the SCP must be participatory to achieve its mission and vision.
- The activities are designed to increase knowledge skills and attitudes of the stakeholders.
- The SCP emphasizes communities including children youth and women's opportunities in participating to and benefiting from the program activities.
- Communication capacity building of the stakeholder should be increased.
- Monitoring and evaluation should be integrated in the SCP activities to ensure that the work plan is respected and success is achieved.

1. Vision

20. The vision statement of the SCP is: "*Make information accessible and transparent for all the stakeholders in WRDIP*."

2. Mission

21. The mission of the SCP is to empower WRDIP's stakeholders providing awareness, knowledge, and information in order to engage all stakeholders and the general public and provide capacity building.

3. Values

22. The values of the SCP include (i) being people-centric, (ii) transparency, (iii) integrity, (iv) accountable, and (v) responsive.

B. Approaches

23. There are five distinct approaches to communication that can be used for successful implementation of the WRDIP[1].

24. **Corporate communications** including media products that promote program activities, among key external audiences to strengthen the image of the institution and to build trust in its operations.

25. **Media relations** that strengthen ties with media institutions to identify opportunities for promoting program activities and outcomes, and to respond effectively to reputational risk posed by negative coverage.

26. **Internal communications** to promote information sharing and encourage consensus among internal stakeholders, including ADB, the MIWRM and implementing agencies, and other government bodies involved in program design and implementation.

27. **Advocacy communications** to build public support for an advocacy issue and raise issues at the level where action is taken.

28. **Development communications** to promote information sharing, behavior or social changes, and dialogue with program stakeholders by making information available to wide audiences including low literacy, hard to reach, or poor and vulnerable groups.

C. Key Areas of Communication Activities

29. The SCP will deal with external communication as well as internal communication. In this respect, it is therefore important to describe what the internal groups are and how the communication should flow in between these two groups. The SCP is developed base on three aspects including information disclosure policy, internal communication, and external communication.

D. Information Disclosure

30. The SCP implementation will engage and inform relevant WRDIP's stakeholders and sectors with timely, accurate, and comprehensive information shared among the stakeholders. Such information sharing will help to build consensus and ensure continuous stakeholder support throughout the program. The approach to stakeholder engagement takes place along a spread of increasing levels of participation depending on the stakeholder's "want to know" – which can vary from being informed through to being empowered depending on their roles and responsibilities:

31. The SCP will significantly increase stakeholder and community awareness of the WRDIP's strategy, construction activities and outputs in order to improve stakeholder engagement and to develop greater community support for the program proposals and the decision making process.

E. Internal Communications

32. Internal communications refer to the transmission of information between organizational members or parts of the organization. It takes place across all levels and organizational units of an organization.

33. The PMU has developed and expanded its internal communication activities in the investment program. Effective internal communication helps to create a common understanding among staff about management priorities and corporate issues. These include, circulation of management meeting minutes, messages to staff, office arrangement with communication materials and update regularly with program information. Video clips on the WRDIP and leaflets can be circulating to aware staff members.

F. External Communications

34. It is important to increase awareness of the WRDIP activities among the key stakeholders. These target groups have included primary stakeholders such as program affected people, program beneficiaries, government officials and policy makers and secondary stakeholders commercial media ,people in positions that convey influence, community leaders, civil society organizations, business, advocates, people with academic or research interests and community at large.

III. TARGET AUDIENCES AND KEY MESSAGES

A. Target Audiences

35. The SCP has different types of stakeholders according to the level of activities implementation .To be effective communications need to be directed at specific audiences or groups of audiences. That is to say messages should be designed for clearly defined target groups: those whom the information is aimed at. Following are the target audience of the WRDIP. Details list is attached as **Annex 2**.

B. Primary Stakeholders

- Program Affected People
- Program Beneficiaries
- Government Officials and Policy Makers

C. Secondary Stakeholders

- Commercial media
- People in positions that convey influence
- Community leaders
- Civil society organizations
- Business
- Advocates
- People with academic or research interests related to a targeted issue or population
- Community activists
- Community at large

D. Key Messages

36. Key messages are basically the messages that targeted audiences need to see or hear. For the message to be successful, it should follow the KISS AIDA principle that is often used in social marketing: keep it short and simple in order to catch the audience's attention raise its interest and instigate desire that will lead to action in relation with a desirable sustainable practice.

37. Key messages of the WRDIP are as follows.

- What is the investment program?
- Components
- Key program benefits
- Key program Impacts
- Program implementation process (Program Schedule)
- How stakeholders can get involved
- Program activities
- Resettlement and compensation
- Progress of the construction
- New livelihood activities
- Water management and environment conservation

IV. IMPLEMENTATION STRATERGY

A. Establishment of Media Units

38. A smoothly coordinating mechanism is needed to effectively implement the SCP. The SCP will maximize transparency by communicating relevant program information to stakeholders in various ways. A communications cell will be established in the PMU and each PIU. These cells should be equipped with necessary resources including adequate staff and budget. The proposed organization structure is attached in **Annex 3**. These cells will provide and coordinate all necessary information for the public as well as the institutions with the support and assistance of the Program Management, Design and Supervision (PMDSC) consultant.

39. The SCP underpins the annual communication plan, which describes the communication activities and knowledge products that the PMU will produce every year until 2020. Both communication strategies and plans will be reviewed during the annual review carried out by the PMU.

B. DOI Field Offices

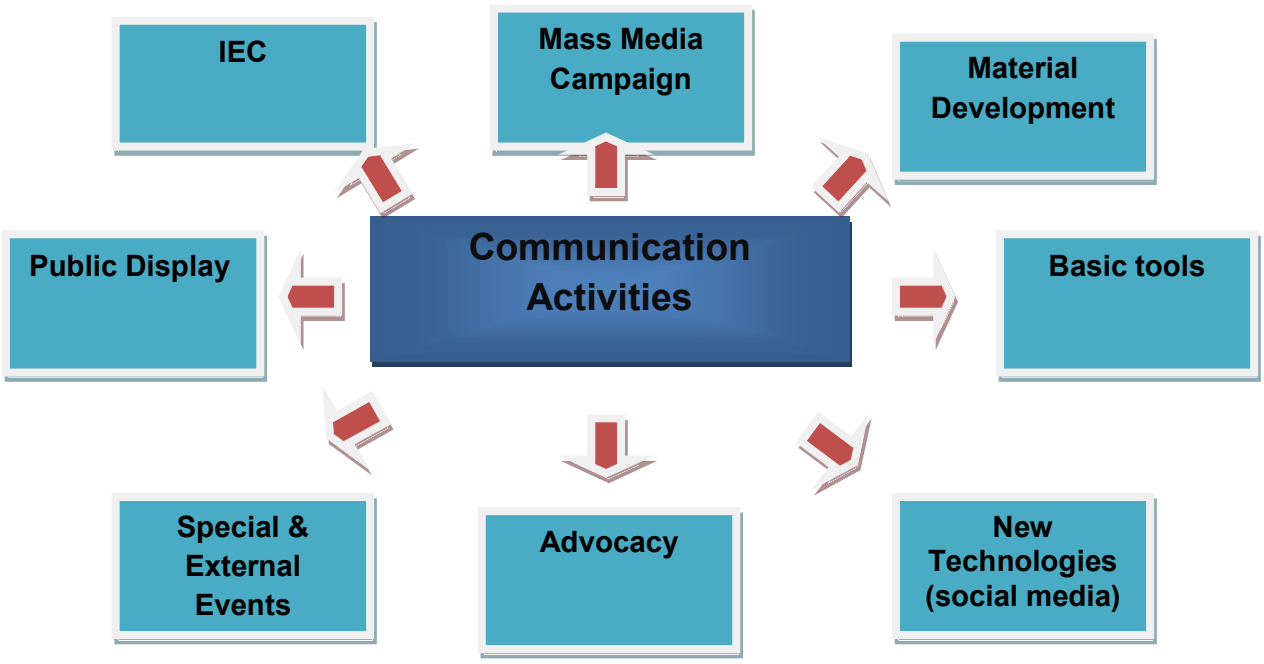
40. The DOI has established communications cells in field offices to enable communication with farmers in each irrigation scheme. These field offices should be equipped with necessary communication materials and tools on the investment program.

C. Appoint Strategic Communications Advisory Committee (SCAC)

41. A Strategic Communications Advisory Committee (SCAC) will be appointed at the PMU level and it will consist of The Program Director, Program Directors, as well as the communications and safeguards officers in the PMU. All reports and materials to be distributed externally should pass through an internal review process, which requires, for instance, all major documents to be peer reviewed then approved and commented on by the SCAC.

V. COMMUNICATION ACTIVITIES

42. Communication activities will take place both at internal and external communication activities tools and products. Proposed communication and engagement activities for the WRDIP are summarized below.



A. Information Education Communication Campaign (IEC)

43. An Information Education Campaign (IEC) should be conducted to raise awareness among all stakeholders. IEC materials should be developed by the PMU. It will be necessary to design, plan and implement an IEC to inform the affected persons particularly regarding:

- Benefits of the program
- Resettlement policies including compensation arrangements

44. The campaign will include measures such as the distribution of information booklets, leaflets, notices and other materials among the farmers/beneficiaries and field level officers, through community meetings, public announcements, and any other means necessary to provide information in a timely and effective manner.

45. The consultation with all affected persons will be an ongoing process throughout WRDIP planning and implementation. Affected persons will be fully informed of all steps in the planning and implementation of the process. All information including the entitlement matrix will be disclosed to affected persons in the local language. Local channels for information disclosure (through village level officers, PMC and FO meetings) will be planned and implemented as part of the information disclosure process. A grievance redress process will be implemented in respect of all activities under the WRDIP where resettlement actions are required. The grievance redress will be facilitated by the community and supported by

PIUs as required. The procedures for the grievance resolution process are based on the program implementation arrangements involving the PIU, PMU and DS and GA.

1. National Level

46. Provincial Secretaries of North Central, Central and North Western, District Secretaries of Polonnaruwa, Matale, Kandy, Kurunegala, Anuradhapura and Divisional Sectaries of Elahera, Medirigiriya, Galenbidunuwea, Palugaswewa, Dambulla, Galewela, Polpithigama, Mahawa, Ehetuwewa, Abanpola, Galgamuwa, Naula, Minipe, and Hasalaka should be briefed on the investment program well before implementation. It should be conduct by secretary of the MIWRM at the national level. In this stage resettlement and compensation information, grievance handling system should be briefed and necessary communication tools should be prepared.

2. Provincial, District Level and Divisional level and Field-level Officers

47. After conducting national level IEC program, provincial, district and divisional-level government officers should be briefed on the investment program; a DAC meeting can be used to make aware district-level government officers, field-level officers such as GN, EDO, DDO, and APA.

3. Farmer Leaders

48. Farmer leaders in the major irrigation systems should be briefed through the PMC and farmer leaders in minor irrigation systems should be briefed through a DAC meeting.

4. Village Level (Farmers, Women and Youth)

49. Farmers can be briefed through FO meetings conducted by every month.

5. Civil Society Organizations

50. The IEC campaign will be conducted for civil society organizations functioning in program areas such as YMBA, Lion's Club, Rotary Club, etc. Since these are the people who directly involved in community development activities, the PMU and PIU will develop appropriate communication tools to educate them in order to convey WRDIP message through them to the most vulnerable segments of the society and make use of some members of these organizations to help WRDIP to aware public at large.

6. Community at large

51. The general public is an important target group to reach but perhaps also one of the most important and difficult ones. Various communication tools can be used to aware them.

7. Journalists

52. Special awareness programs will be organized for selected media correspondents in national and district level. This program should be covered objectives, benefits, implementation arrangement, compensation and resettlement procedure, environment conservation of the investment program. Media directory should be prepared national level and district level.

8. Public Awareness Campaign during Design and Construction Phases

53. This activity is focused in addressing community issues during construction period. This activity will inform people that the program will solve the problem of water issues in dry zone and its impact on livelihood, public health, environment and economy. Activities of the construction period will be disseminated and community assistance by tolerating the temporary inconveniences will be sought. In addition, the activities take place within the areas and private properties during design period will be conveyed to the beneficiary HHs. Public addressing system can be used for it.

9. Orientation Programs

54. It is proposed to conduct three (3) orientation programs in all three program areas. The field level officers in DOI, IMD, officers in PMU and PIU will be given a wide knowledge on the core of the program and the benefits as well as ADB Policies on environment, safeguard, and communication. ADB Policies should be briefed with the help of Safeguard specialist, Environment specialist and Communication specialist in ADB. These programs will be organized as workshops so that PMU will be able to derive appropriate ideas to develop tools and materials for the orientation programs.

B. Advocacy – Influence People

55. Political support together with support from community leaders and religious leaders can give a campaign a powerful boost. Strategic networks and involvement of political, religious and local leaders are basic requirements for a successful IEC campaign. Contacting politicians or community leaders during IEC campaigns can stimulate their personal involvement. The involvement of leaders will increase public attention to the WRDIP and it will also influence social norms directly. There is a need to involve those leaders who are especially regarded as credible, trustworthy and popular among the public.

1. Religious Leaders

56. The Religious leaders of all religions respective program areas will be provided with knowledge of the WRDIP to educate their followers on the program activities, benefits and the temporary inconvenience that will be caused during the construction period. These awareness programs will be conducted with the blessings of the high priest, bishop and the other heads of all religions.

2. Politicians

57. Politicians are very important for political backing of the program and its issue to get the results/ achievements across. National, provincial and local government level politicians should be aware on WRDIP benefits, implementation arrangement and resettlement, compensation procedure.

C. Basic Tools

1. Slogan

58. The WRDIP will support the development and posting various communication tools of “hoarding, notice boards” (i.e. brochures, billboards) with a particular slogan, e.g. “water for all.” These kinds of slogans would be helpful to get the attention of stakeholders.

2. Color

59. Color is a communication tool which also works for co working spaces. Selection of color will be help to prepare communication tools. After deciding on the color for the program, it can be used all documents, advertising material and web site.

3. Program Logo

60. It is proposed design program logo it can be select through logo design competition. This can be an open competition to the general public and a paper advertisement shall be published in Sinhala, English and Tamil newspapers. It is proposed this approach of advertising in the newspaper for calling applications for the logo competition in order to give a wider publicity to the WRDIP and program benefits. The best artwork for the logo will be selected by the SCAC and an attractive cash prize can be given to the winner. After deciding on the logo for the program, all documents, advertising material and program vehicles will carry this logo.

4. Letterhead

61. The PMU will design letter head for the WRDIP and it will be used for external and internal communal.

5. File Folders

62. It is recommended to design specific file folder for the WRDIP and it can be used specific conference, meeting conduct by the PMU.

6. Large Size Stickers

63. A large sticker can contain a concise message, and can be placed on three wheelers, public transportation, and other sites with high visibility. It can be a good way for individuals to show their support and to serve as a visual reminder or prompt of key messages. It is proposed to produce 1000 number of large stickers to be pasted on vehicles if the authorities allow doing so.

7. Master PowerPoint Presentations

64. It should be develop and maintain a general power point presentation on the WRDIP and it should be regularly updated to reflect progress and other power point presentation relevant to the specific program. It should be developed and be updated regularly by the CBC officer of the PIUs with the support from the communication officer in PMU. 3D structure should be used to saw the final stage of the program. The power point can be available for government focal points, consultants, program managers to use on demand (at various workshops, conferences, meetings, etc.)

8. WRDIP Stands

65. Stands describing activities of the WRDIP can be produced. These stands can be used at exhibitions during various occasions and events e.g. World Water Day, Wari Desathiya, National level exhibition etc.

9. Creating Program Model

66. Creating a program model will enhance the interest of student, general public on the entire program. The model can be exhibited at popular exhibitions and trade fairs.

D. Public Display / Advertisement

1. Public Awareness and Involvement

67. Awareness regarding the need for water and environment conservation should be promoted involving all stakeholders including community group, political leader and farmers. Mass education through media, posters, and video tapes, public debate, T.V., radio, newspapers is found to be effective in motivating people to increase water usage and reduce water wastages.

2. Information Dissemination Using Public Address System

68. Mobile public address system can be used to convey important messages and to disseminate information prior to commencement of a phase activities of the program in an area and also requesting the public to bear the temporary inconvenience and to co-operate with the program staff to carry out the program activities uninterrupted.

3. Design Public Notice Boards – Installation and Updating

69. Public notice boards can be install as necessary in the places where people mostly gather such as bus stands -,PIU office , in prominent places in the city . Notice boards should update periodically so that the general public will know the activities that are taking place in those particular periods. The public will also be informed of the inconvenience that may be caused to them during these periods.

4. Erecting of Hoardings

70. Informative and eye catching hoarding can be erected in the places where people mostly gather such as public market, bus stand, and prominent places in the city Dambulla, Kandy and Kurunegala. The information given in the hoardings will be updated two times in the year (02) with the changes in the construction phases.

5. Digital Light Boards

71. Digital light boards can be fixed in places to disseminate brief information on the road blockage and the other construction activities that may cause inconvenience to the public especially to the residents. These boards will notify the alternate arrangements made for the convenience of the public due to those construction activities. These digital light boards also can be shifted to other appropriate locations as and when necessity arises.

6. Billboards

72. In be used to aware general public on WRDIP activities .Billboard that should be placed along a major highway of on the sides of buildings can effectively highlight a flagship species, an environmental threat, the adoption of a new behavior, or a simple message.

E. Material Development

73. Communication officer in the PMU should develop necessary materials on WRDIP to aware all stakeholders the core of the program and its benefits. Material development will be based on the basic educational theory of “from known to unknown”. It is proposed to obtain the subject knowledge from the experts from WRDIP and DOI to develop the tools and materials.

1. Posters

74. It is necessary to design, print and paste normal posters on awareness of GRC in all three languages. It should be posted public notice boards, notice board institutions, field level officers’ offices, etc. It will help notifying the program activities, benefits and the expected co-operation from the public.

2. Factsheets / Brochures

75. A factsheet or brochure can provide a lot of information in a graphically appealing format. It is proposed to design, print and circulate brochures on the WRDIP; specific program, GRC, compensation information.

3. Factsheet on Program Design Phase

76. A factsheet should be designed in all three languages to make potential beneficiaries aware on the co-operation expected from them during the design phase of the program. Fact sheet on resettlement and safeguard in all three languages will reinforce the messages of the media campaign and make the affected people, field level officers. Approximately 100,000 factsheets are proposed to distribute during the IEC campaign, meetings, during community interactions and through the volunteers to all the households in the service area.

77. Furthermore the factsheet should appeal to the households to allow the program staff access into their premises to take levels, estimate for cost of free service provided to them, assess damage involved in the property connection etc.

4. Booklets

78. It is proposed to publish 2000 booklets in all three languages, providing all details of the WRDIP. This booklet will contain the program plan; benefits, implementing arrangement of the program, features of the program, the importance and necessity to solve the prevailing water related problems in dry zone. This booklet will justify why this program should be protected and maintained.

79. This booklet can be distributed amongst all professional bodies, trade chambers, business associations, religious leaders, school teachers, and civil society organizations, and senior public servants, managers of private organizations, media personnel, and

relevant field officers and amongst the selected people who extend their support to assist the WRDIP on voluntary basis.

5. Reports

Monthly, Quarterly and Annual Reports

80. A number of formal and informal reports should be drafted on the progress of the scheme, where appropriate, these reports should be made available on the website. The Annual report requires making it more interesting to partners and stakeholders. The report should be more results-based, focusing on the effects of program work for the benefit of people in the program, and concentrating much less on internal procedures and planning meetings. One possible way to accomplish this would be to give each year a theme.

6. WRDIP Summary Report

81. This report summarizes the results of the work accomplished under the WRDIP Phase 1 and it can be circulate among all stakeholders in monthly basis to update progress of the program activities.

F. Modern Technologies

1. Social Media

82. It is proposed to use modern technologies and channels to disseminate WRDIP information. For example: a blog on WRDIP, web site, using social media e.g. Facebook, upload video clips to You Tube, Twitter for messaging, submitting a Wikipedia article, broadcasting program major activities online etc. It is proposed to use free-of charge communication solution such as Skype for conversation and chatting, making online calls and video conferences program activity calendar can be prepare using Google or Yahoo Calendar.

2. Frequently Asked Questions (FAQs)

83. A list of messages and FAQs is to be used to define important statements that explain the nature and purpose of the WRDIP. It should be used as a basis not only to formulate answers to specific questions posed by stakeholders and the media, but also to inform general and program communications. FAQs should be referred by program directors of the PMU and PIU staff whenever statements are needed in reports and when questions are asked by stakeholders. The list of questions and the answers are to be revisited regularly for addition or update, according to events and policy. The FAQs should be posted on the website.

3. Website

84. The PMU should set up a website as soon as possible of loan effectiveness and disclose all key WRDIP related information, including the scope, cost, and financial and institutional arrangements of the program, safeguard policies, grievance handling system, reports such as EIAs, compensation and resettlement plans, and program progress such as procurement, contract award and disbursement for general awareness and It should include FAQs. The WRDIP website acts as the main public window into the activities and objectives of the WRDIP, and as such it should offer a clear and comprehensive view into the work of

all investment program. It is proposed to develop it in all three languages Sinhala, Tamil and English.

85. Developing the intranet into a more effective tool for internal communication in PMU will be a top priority. It will help to staff members to get relevant information and it will be flat form to disseminate WRDIP information each other. It would become interactive and a forum for open communication that would help fosters a free and more transparent pattern of communication in the WRDIP.

4. Telemarketing

86. It can be used to aware public at large. Land and mobile telephone numbers can be obtained from the relevant companies and can disseminate recorded information through SMS and Voicemail. The PMU should come to an agreement with the companies to have a six month program in between the third month of the program to the fourth year.

5. Maintain Database relevant to the Resettlement and Compensation

87. The PMU should maintain databases on resettlement and compensation relevant to the program area as well as stakeholder engagement and consultation activities.

6. Video Documentaries

88. Several video documentaries should be produced on WRDIP and these can be displayed during village level meeting as well as it can be telecast and web cast.

G. Mass Media Campaign

89. The mass media will be a strong source of information for raising awareness, building knowledge and influencing public opinion. The following devices can be used national and local level seminar/workshop, electronic media, radio, television, video, film, and internet. print media, audio visual media can be used to disseminate information.

90. It will be organized with regular positive coverage in print and media in order to make the larger audience informed about the program and its progress. This will give a positive mindset that the WRDIP is essential for Sri Lanka and this scheme is the only the possible and appropriate one. This propaganda will be aimed at obtaining the public support for the program.

91. The above will be followed up with regular news updates to all news media regarding the progress of construction activities. It is necessary place advertisements in all media prior to the inconveniences caused due to the construction activities of the program

1. Print Media

92. The PMU should use all national newspapers, relevant magazines and local newsletters to educate the public on the program activities and the benefits that will be derived from the program.

2. Paper Supplements

93. Three (3) paper notices in three languages is to be inserted in highly circulated national newspapers on the day of launching the program. These supplements should be consisting of technical, educational and other informative articles. The purpose of this supplement is to make the people aware on the importance and essentials of the WRDIP to address and solve all prevailing water issues in dry zones and water related problems and its impact on public health, environment and economy.

3. Newsletters

94. It is proposed to design and publish quarterly newsletters to highlight the latest major events happening in the past four months by the WRDIP. This newsletter would serves as an updating material for all stakeholders to keep them abreast of all current events in the WRDIP. The newsletter can be disseminated every four months and can be circulated through national newspapers. The majority of the responds in program area used to read Sunday Lankadeepa newspaper. It is proposed to circulate newsletter through this newspaper.

4. Features – Articles

95. With the media relationships of the Communication Officer, the PMU should select suitable journalists to publish features articles to educate people on the core aspects of the program, progress and advantages. These articles could be published together with photographs to reinforce the matter included in the article. Different levels of language can be used in different articles to suit the level of the reader. A minimum of eight (8) such articles should be published in a year.

5. News Items

96. The PMU should develop a healthy working relationship with local journalists through their awareness programs and this relationship should be maintained by continuous dialogues and close links in order to ensure consistent information dissemination to people and to inform the public about the activities carried out prior to the commencement of the construction and the progress of the ongoing construction activities. At least twelve (12) news items and information on WRDIP should be disseminated through media.

6. Advertisements

97. Advertisements will be placed in the national newspapers, local newsletters, magazines etc. to develop a supportive mindset, and to encourage the public by showing the benefit of the WRDIP.

7. Magazine Articles

98. The PMU will request academics from the universities and professionals from the water, environment, communication, agriculture and irrigation and construction sectors to publish articles about the WRDIP and PMU can assure them that PMU would purchase a reasonable number of copies of these magazines from the relevant organizations who publish these magazines or publish an advertisement in those magazines. PMU will publish at least two articles in selected magazines during phase 01 of the program.

8. Advertorials

99. Advertorials will have more public acceptance than the advertisements. Therefore PMU should publish a minimum of three (3) advertorials for different target groups to be educative, to be supportive and to be motivated in connecting their water issues. These advertorials will be written by professionals or academics to suit each of the target group.

9. Radio Programs

100. The PMU should coordinate appropriate radio channels to develop radio programs and broadcast them to educate the public on the activities of the program and the disadvantage in the long delay in the program's fulfilment. To educate the public it will be useful also on radio to have discussions, jingles, news items, etc.

a. Jingles

101. Radio jingles will be arranged in order to keep the people aware of the WRDIP activities and the disadvantages of delaying the program implementation. PMU should make arrangements to broadcast at least 10 jingles in different themes on different construction phases.

b. Discussions

102. Radio discussions should organize with the participation of professionals of the DOI, a representative from the target community. Discussions can be arranged at every phase of the program construction. For this purpose, at least three (03) panel discussions should be arranged in year.

10. Disseminate Program Information

103. The PMU should disseminate the investment program information through news programs. These news items can be broadcast to educate the community at large on the program activities and the type of inconvenience which can occur to the public due to the program activities. The PMU and PIU should inform the public through special advertisements regarding the road blockage, alternate traffic arrangement and any other temporary inconvenience that may occur during the design phase and the construction phase.

11. Television Program

104. Telecasting of TV documentaries, strollers, advertisements and panel discussions will be organized by the PMU for the purpose of educating the public on the WRDIP, its benefits and the advantages of solution for water scarcity. The short advertisements and strollers can be telecast prior to the construction activities carried out on different zones and the inconvenience that will occur due to the construction.

a. Documentary

105. It is proposed to produce 30 minutes television documentaries using one of the best and well-experienced documentary producers in Sri Lanka .These documentaries will be dubbed in all three languages or will use two sub titles so that all ethnic groups can enjoy these documentaries.

b. Advertisements / Strollers

106. Advertisements / strollers should be arranged to be telecasted a day prior to the commencement of the construction and on the day of the activity of each phase.

12. Press (Media) Conference

107. To develop media relationships and to create a wide knowledge amongst the electronic and print media personnel, the PMU will organize media conferences prior to each phase of the program. The PMU should arrange four (4) media conferences during the first 4 years of the program period.

13. Radio and T/V News Bulletins

108. The PMU will organize television and radio news bulletins quarterly during the first five years of the program. The PMU shall make arrangements to telecast or broadcast news bulletin once a fortnight on popular channels. A minimum of four (4) bulletins should be providing the latest information with the visuals to the public in a year.

14. Media Tours

109. To obtain firsthand information and views from the persons concerned for the benefit of the media personnel, the PMU will organize one (1) media tour in a year for media persons to visit program sites.

15. Media Interviews

110. It is proposed the PMU will organize a minimum of three in a year (3) media interviews with administrative authorities, prominent political leaders, academics, engineers and communities. Interviewing with selected community members of the program area will be help to mitigate spreading of negative information about the program.

16. Panel Discussions on Television:

111. The PMU will arrange television panel discussions with the participation of a professional from the WRDIP and MIWRM, the EA and representative from the PMC leaders in program area. This will convey the unbiased and balance message to the broader audience. One (1) panel discussion in a year can be arranged prior to crucial phases of the program.

H. Special Event Programs

112. To highlight the program in the public's eye and encourage positive sentiment and provide occasions for news media coverage, special events can be arranged. The PMU and PIUs can emphasize that the WRDIP is the only available scheme to solve water problem in dry zones in these special events. The PMU can organize special events with help of the PIUs on the World Health Day, World Water Day, Earth Day and DOI Desathiya. Other than the above, several events can l be organized to draw the attraction of the different segments of the community.

1. Community-based Communication

113. A range of communication activities can be carried out using participatory and interpersonal communication tools. The success of this communication requires the active involvement of the participants in the communication development process. Informal discussion, meeting, FGDs and workshop with the particular stakeholder are proposed. Interpersonal communication tools and community media like radio, TV, video, digital storytelling, folk media, theatre, folk songs and different festivals can be used to aware the WRDIP.

a. Drama and Talk

114. Dramas can be conducted in the low income areas. These dramas can be performed either in open air or on a mobile stage and can be in Sinhala or Tamil languages depending on the language of communication in the respective area. These dramas can be produced in a manner that a few persons from the community also will be given an opportunity to take part in the dramas. A community leader can do a presentation to educate the community on the advantages of the WRDIP.

b. Cultural Shows/ Religious Activities

115. The PMU and PIU can guide the community to organize cultural activities, religious activities or variety shows in selected areas with the participation of the residents of the area. PMU can finance these events so that they can be conveying the message through those activities. These events can be organized after harvesting or special festival.

c. Shramadana

116. The PIUs will organize shramadana campaigns in project sites, as a part of a community service activity that has to be done by FOs, youth societies. These shramadana will be sponsored by the PMU.

2. Seminars on the World Water Day, Environment Day and World health Day

117. Seminars will be organized on the deferent days to educate the public on the importance of water management and the importance of keeping the water resources without polluting. The theme of this could be “Water for All,” “Safe Life”, “Go Green”, etc.

3. Music

118. Music will be used as a means to reach the local communities. The PMU will support the organization of “Peduru Sajje” musical concerts with community in different program areas. Concerts should have specific themes related to the water conservation and environment awareness and this kind of program would be organized in after harvesting and it will be good means of mass gathering and delivering a message relevant to the WRDIP. Certain funds could be allocated by PMU for organizing such programs every year.

119. Theme song relevant to the WRDIP can be produced and it should be sung by popular artist and this visual video can be used to branding the WRDIP.

4. School Children Awareness and Engagement Program

120. Schools can also provide an entry point to the community as a whole. Today's children will be, sooner or later, future use of water resources. Awareness and education can help the next generation with knowledge and attitudes and benefits of the WRDIP and that will promote the wise use of water resources. Several activities will be organized to aware on WRDIP to school community. It may be competition of drama, posters, quiz, photographic, and essay digital story production and oratorical contest.

a. Drama Competition

121. Drama competitions in all three languages amongst the schools in the program areas will be organized. The PMU can assist the schools by providing the requisite criteria for the competition, the theme for the drama, and any other assistance to develop a qualitative drama.

122. The competitions will be judged by reputed dramatist and certificates will be briefed to the children who have participated in these drama completions, as well as prizes with a substantial value to the winners and to their schools. The dramas performed by the school children will attract their family, and the public who love to watch dramas.

b. Poster Competition

123. The poster competition will be held in order to develop the aesthetics and the creativity of the children and to ascertain the level of awareness they have gained by the awareness programs and through the media campaign on WRDIP. A suitable theme should be given for this poster campaign so that to create an awareness amongst the public and to be supportive to the program. The selected best 3 posters can print and used for the branding of the WRDIP. The rewarding will be done on the same criteria adopted in the drama competition.

c. Quiz Competition

124. The school quiz competition will be held in all three languages to ascertain the knowledge gained from awareness program and also for the children to get a wide knowledge in water management, environment protection, and other general. This can be conducted on a tournament basis and the semi finals and finals will be telecast on a television channel with the sponsorship of a company involved in construction. The finalists and the runner ups should be briefed with valuable prizes and also the winning school should be given an award.

d. Photographic Competition

125. A school or general photographic competition under the theme of “Water for All” will be organized. It is proposed to advertise the competition in the newspapers to obtain attention of the general public and request education authorities to send a circular to schools to make it a formal activity in schools. The guild lines for the competition should be given in a workshop conducted prior to the competition. A reputed professional photographer should judge competition.

e. Essay Competition

126. Essay competitions will be conducted in all three languages. The subject of the essay completion may be ‘solutions for water scarcity in dry zones, improvement of health, and benefit of the WRDIP’. This competition will encourage the students to gather knowledge on water management from various sources and in the process the message will spread amongst a new segment of the society. The panel of judges should be consisting of academics. While rewarding the best three it is proposed to publish them in newspapers.

f. Oratorical Competition

127. Oratorical competitions will be held for the Sinhala, Tamil and English students. The theme of this competition will be on “Water Management”, its benefits, and how to mitigate the temporary hazards that occur due to the construction work of such programs. The winners will be rewarded as same as in the other school competitions. The best speech can be edited and publish in newspapers.

5. Digital Stories Production Competition:

128. The PMU will conduct a competition for digital story production competition by calling applications through a paper advertisement, giving details about the program, its benefits and the criteria of the competition. A reputed person from field of communication will be in the panel of judges and the winners will be rewarded. The best three (3) video clips can be telecast and web cast.

6. Production of Short Video Documents

129. Short video documentaries on WRDIP will be produced with the assistance of video documentary and feature producing directors who are associated with the DOI in producing informative and quality documentaries in the recent past. These documentaries will be telecast in popular channels dubbed in all three languages or with sub-titles.

7. External Events

130. The PMU will participate in external events, for example exhibitions, national and district-level exhibitions, conference and seminars relevant to the water and irrigation etc. It is advisable that the program is proactive in this and actively seeks for opportunities to go and promote itself. When participating in external events the program representatives have good opportunities to network with many interesting people and gain publicity for the program but also more active role can, and is recommended to be, taken in form of e.g. giving a presentation, show video documentary, etc.

8. Sponsoring Festivals

131. It is proposed to sponsor a maximum of 6 festivals of all ethnic and religious groups in a year. The sponsorship will be given to conduct these festivals only if they agree to convey the WRDIP messages through these events. In order to ensure this condition, it is recommended to have a discussion with the organizers prior to organizing the festival.

9. Demonstration Home Gardens

132. Demonstration home gardens will be an educational resource providing a number of benefits to the community. Benefits might be environmental, organic agriculture, new livelihood improvement activities showcasing water conservation, pollution prevention, energy savings, and reduced waste. It is recommend for the PIUs to facilitate the communities to build demonstration home gardens with the help of DOA.

10. Free Legal Clinics

133. Three free legal clinics can be conducted to the low income groups to advice on their legal issues before being present at the law courts. For these legal clinics it is recommend to get assistance from the bar council in Kandy, Kurunegala, Polonnaruwa.

11. Health Clinics

134. It is proposed to organize at least four health clinics in program areas. These health clinics should be conducted in three low income areas. Awareness programs on kidney disease and water borne diseases can be briefed among community.

12. Exhibition “Dayata Kirula”

135. Dayata Kirula is a national exhibition conducted every year by the government. The PMU should organize a special stall in the Dayata Kirula exhibition during the program period of five years, to make the public aware of the WRDIP.

13. Awards and Competitions

136. It is recommended to be proactive and use the opportunity to participate in competitions and awards, as this might help to both promote the program and strengthen networks. Alternatively, the WRDIP itself can organize a competition like writing or photo competition connected to the program theme.

VI. CAPACITY BUILDING IN COMMUNICATION

137. To achieve the goals of the investment program, the communications strategy needs to include capacity building activities for program stakeholders on: (i) human capacity building; (ii) institutional capacity building; and (iii) infrastructure capacity building.

138. **Human capacity building** refers to the education and training of individuals to be aware of, access, use and develop communication data and products.

139. Proposed activities include

- All staff members of the PMU and PIUs should be made aware on ADB policies for safeguards, resettlement, Information disclosure and the environment.
- Communication and Capacity Building officers should be trained on the IEC campaign strategy and way of conducting, as well as the GRC.
- Program Directors and other officers in the PMU and PIUs should be increased capacity of communication, presentation skills and participatory monitoring method.
- Building capacity of WRDIP staff use of new technology

A. Community Leaders

140. Build up the capacity of WRDIP communities and leaders of farmer organization so that they can manage their resources properly and are able to lead their communities well. Under this component, training and sensitization inputs would be provided to the farmer organization including women groups, youth groups and community based organizations.

141. These capacity building program should include leadership and management of the asset created under the programs, water management and conservation method, new livelihood activities, method of environment conservation and organic cultivation, program development and management; Irrigation and farming systems; improved agricultural practice methods ;leadership, facilitation and communication skills; natural resources management. Village level communication should be briefed and trained community media.

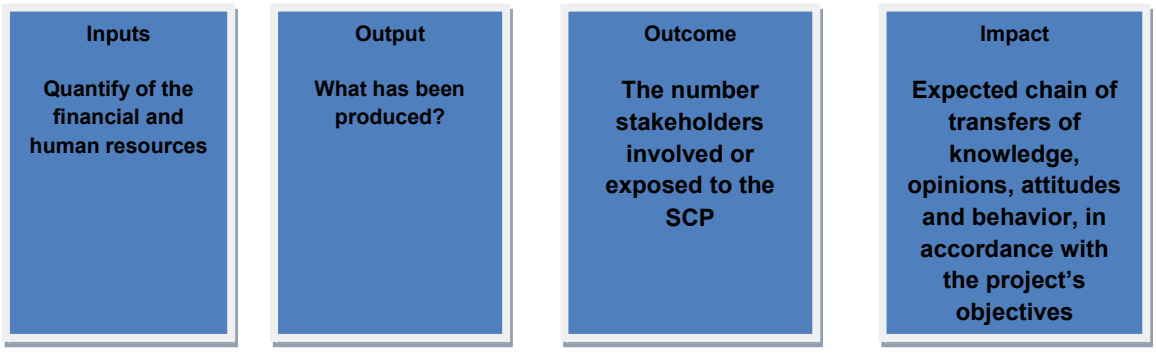
142. **Institutional capacity building** is focused on developing and fostering an environment for the use of communication tools to enhance WRDIP transparency and accountability of the programs.

143. **Infrastructure capacity building** is related to the hardware, software and other technology required to access.

VII. MONITORING AND EVALUATION

144. Effective communications strategies are supported and enhanced by good monitoring and evaluation efforts. Monitoring and evaluation is a critical and indispensable function of the SCP. The SCP will be evaluated quantitatively and qualitatively. Quantitative survey-based methodologies will be used to assess the impacts of the SCP. A participatory approach is recommended as an effective way of actively engaging key stakeholders in all stages of the evaluation of the SCP and strengthening evaluation capacities and ownership of the process. It is recommended to apply participatory monitoring and evaluation method to measure impact outcome of the SCP.

145. Monitoring and evaluation can be implemented with the usual approach that includes at least four logical sequential steps:



146. Monitoring of the activities will be continuously maintained to allow for timey adjustments as required to ensure achievement to reach the planned objectives. Simple evaluation will be made at appropriate time for each activity.

A. Key Performance Indicators

147. Performance evaluation measures variables such as the number of people interviewed, the number of programs conducted, the number of brochures distributed, or the number of products developed will be measured.

148. The performance indicators for quantitative monitoring and evaluation of the SCP are presented in **Table 1.**

Table 1: Quantitative Monitoring Indicators of the SCP

No.	Detailed	Performance Indicators	Sources of Verification
1	**IEC Campaign and Others**		
1.1	IEC Campaign	Number of IEC campaign conducted Number of participants including women, youth	Attendant sheet, photos
1.2	Public Awareness Campaign	Number of awareness programs conducted	Attendant sheet, photos
1.3	Conducting Orientation program	Number of orientation and Number of participants	Attendant sheet, photos
2	**Advocacy**	Number of advocate programs Number of people advocate	Participants list, photographs, meeting minutes
3	**Mass Media**		
3.1	Print Media - Paper Supplements	Number of paper supplements	Published paper supplements
3.2	Newsletters	Number of News Letters publish in a Year	News letter
3.3	Features – Articles	Number of feature –articles published	Feature articles
3.4	News Items	Number of News Items Published	Articles
3.5	Advertisements	Number of advertisement published ,telecast or broadcast	Advertisements
3.6	Radio Programs	Number of radio programs broadcast	Radio Programs
3.7	Jingles	Number of jingles produced and number of times broadcast	Jingles
3.8	Radio Discussions	Number of radio discussion broadcast	Radio discussion
3.9	Disseminate Program Information		
3.10	Television Documentary Press (Media) Conference	Number of TV documentary telecast Number of press conference conducted Number of Journalist participate in Number of articles published, number of news telecast or broadcast	Attendance list News articles
3.11	Radio and T/V News Bulletin	Number of news bulletin telecast or broadcast	News bulletin
3.12	Media Tours	Number of tour organized ,number of journalist participated	Attendance list Photographs
3.13	Media Interviews	Number of media interview conducted Number of administrative, political and community members participated	Media interviews
3.14	Articles for Magazines	Number of articles published	Published Articles
3.15	Advertorials	Number of advertorials published	Published advertorials
3.16	Panel Discussions on Television	Number of panel discussion telecast	Panel discussions

No.	Detailed	Performance Indicators	Sources of Verification
4	**Basic Tools**		
4.1	Letter head	Number of letter heads printed	
4.2	Large stickers	Number of stickers printed	Inventory check , stickers
4.3	File folders	Number of file folders printed	File folder
4.4	Master presentation	Number of master presentation	presentation
4.5	WRDIP Stand	Number of stands designed	Stand
4.6	Creating Program Model	Number of places exhibited	Number of people observed
5	**Public Display / Advertisement**		
5.1	Information Dissemination Using Public Address System Public notice boards	Number of time disseminate information through public address system Number of public notice board designed	Running chart of the vehicle, recorded message, notice board
5.2	Erecting of Hoardings	Number of places erected hoardings	Erected boarding, number of updated message
5.3	Digital Light Boards	Number of Digital Light Boards printed	Digital boards
5.4	Billboards	Number of Billboards placed	Billboard
6	**Material Development**		
6.1	Posters	Number of posters design and printed	Receiver feed back
6.2	Fact Sheets	Number of fact sheets designed and distributed	Printed fact sheet
6.3	Reports	Number of reports published	Finalized reports
6.4	Summery sheet	Number of summery sheet design and print	Printed summary report
7	**Modern technologies**		
7.1	Frequently Asked Questions (FAQs)	Number questions added	Upload web site
7.2	Website	Number of updated , Number of visited	Updated web site
7.3	Developing the intranet	Number of message sent, number of person use	Email address
7.4	Telemarketing	Number of time use tele marketing	Information sent
7.5	Maintain data base relevant to the resettlement and compensation		Complete data base
7.6	Video documentaries	Number of video documentaries produced	Complete video documentaries
8	**Special Event Programs**		
8.1	Drama and Talk	Number of drama and talk conducted	Number of Participants
8.2	Cultural Shows/ Religious Activities	Number of cultural shows and religious activities conducted	
8.3	Shramadana	Number of shramadana conducted	Attended net sheet
8.4	Seminar on the World Water Day	Number of seminars conducted	Seminar agenda
8.5	Music	Number of musical shows conducted	Video clips, photos

No.	Detailed	Performance Indicators	Sources of Verification
8.6	School children awareness and engagement program	Number of awareness programs conducted	
8.7	Poster Competition	Number of student attended for competition Number of competitions	Posters
8.8	Quiz Competition	Number of student participated	Student name list
8.9	Photographic Competition	Number of student participated	Student name list, photographs
8.10	Essay Competition	Number of essay received	Essay received
8.11	Oratorical Competition	Number of student participated	Student name list,
8.12	Digital Stories Production Competition	Number of Digital stories received	Digital stories
8.13	External events	Number of external events participated	Name list of the events
8.14	Sponsoring Festivals	Number of sponsorship given	Request letter, payment release letter
8.15	Demonstration home garden	Number of demonstration gardens established	Demonstration home garden
8.16	Free Legal Clinics	Number of legal clinics conducted	Number of participants
8.17	Health Clinics	Number of health clinics conducted Number of people participants	Number of people
8.18	Exhibition “Deyata Kirula”	Number of exhibitions participated	Photos of the exhibition
8.19	Awards and competitions	Number of awards given or number of competitions conducted	Photos of the awards and competitions
9	**Capacity building**		
9.1	Awareness program on ADB policies on safeguard, resettlement, Information disclosure, procurement and environment	Number of staff members participated	Participants list Training materials
9.2	Training program on communication capacity building officers how to conduct IEC campaign	Number IEC Programs conducted	IEC Materials
9.3	Training on “Communication skills” for the staff in the PIU and PMU	Training curriculum - Number of trainees (occupation, age, sex) - Trainees’ self-assessments	Training curriculum - Training report (with an analysis on trainees’ self-assessments) - Pictures of the training courses
9.4	Training programs for community capacity building	Training curriculum Number of training programs conducted Number of trainees	Training reports with trainees’ assessment

B. Impact Indicators

149. Qualitative research will be used to determine the effectiveness and impacts of the strategy's implementation on the knowledge, behavior, and attitude of the target groups. It will measure success or failure of the strategy. Impact evaluation measures variables such as level of participation, level of awareness, new knowledge taken will be measured. Outcome evaluation measures the change in behavior will be measured.

150. There will be two comprehensive evaluation missions (mid-term review and final evaluations) to review and assess the program activities and outputs were planned. Those evaluations should be conducted by the independent consultant teams. In those evaluations, the impacts of the communication activities should be assessed by the teams.

151. Evaluation method may be survey, interview, FGDs, case studies, direct observation, attitude, knowledge, skills and behavior changes. The impact indicators for communication activities in the strategy are presented in the **Table 2.**

Table 2: Impact Indicators for Communication Activities

No	Detailed activities	Impact Indicators	Source of Verification
1	Timely dissemination of information and knowledge about WRDIP implementation activities.	WDRIP implementation without delay	Mid-term and Final Evaluation reports by the independent consultants.
2	Strengthen participation of stakeholder in Implementation activities	Level of participation on the WRDIP activities	
3	Improve the awareness and information access of the participants regarding the WRDIP	Amount of the shift in perception about the WRDIP before and after the SCP.	

VIII. BUDGET

152. There are primarily two types of costs with regards to arranging and allocating funds for the SCP: (i) budget for human resources including design, management, and implementation of the program, and (ii) budget for communication activities. A summary of the proposed SCP budget is presented in **Table 3**.

Table 3: Summary of the Strategic Communication Plan's Budget (2015-2020)

No	Activities	Cost $US
1	Human Resources	153,611
2	Equipment	18,578
3	IEC Campaign	37,304
4	Advocacy	11,385
5	Basic Tools	32,667
6	Public Display / Advertisement	22,522
7	Material Development	239,463
8	Mass Media	114,252
9	New Technology	25,297
10	Special Event Programs	79,894
11	Transport cost for field visit	7,639
	Total	**742,616**

IX. CONCLUSIONS AND RECOMMENDATIONS

153. The officers and staff working in the WRDIP have to be alert in aligning their roles and strategies to address issues arising with their stakeholders. There is a stronger demand for promoting democracy and good governance, which requires strengthening transparency and accountability. To perform their strategic roles in enhancing public communication policy and good governance successfully, they should develop their institutional capacity including a professional unit and comprehensive strategies for internal and external communication.

154. Communication is one of the most essential tools for any organization in the achievement of its objectives. In the age of knowledge the key to accessing and harnessing knowledge lies in the ability to communicate. To achieve their objectives, the WRDIP's need to improve their communication capacities in order to build good relationships with their all stakeholders.

155. Effective communications with the primary and secondary stakeholders will enhance WRDIP's effectiveness and help respond to the challenge of ensuring transparency and accountability of public financial management. As the main tool for ensuring transparency and openness in the public sector, the WRDIP's should set up the PMU and PIUs, as accountable and transparent organizations under the framework of the SCP.

156. The SCP should be an integral part of any design procedure from the very beginning. It is a comprehensive and holistic vision of the communication activities needed for designing and implementing successful policies and programs. The SCP ensures that development policies are properly designed, with the participation of all stakeholders concerned, that their goals are, to some extent, shared by all the stakeholders and consequently that their implementation will most likely be successful.

157. The SCP should not be considered a cost, but rather a resource saving device which reduces the risk of less than optimal design, wrong measures, poor implementation, poor results, and even social unrest in the community.

A. Recommendation 1: Appoint Communication Staffs

158. As implementation of the SCP is an important component of the WRDIP a Communications Specialist has to be appointed to the PMU at the beginning of the program to help resolve the communication's problems of the beneficiaries, PAPs and other stakeholders due to implementation of the program activities.

159. Communication should have two main tasks: (i) to ensure that communication activities are properly planned and budgeted, and (ii) to ensure that proper communication activities are implemented during the program implementation, to ensure full, conscious participation of all likely stakeholders.

160. In addition to the communication expert, three Communication and Capacity Building officers have to be appointed in PIUs level to implement the SCP.

161. The position of the communication expert in PMU should be at Level C or above category as per the Circular number 33 which issued by the Department of Management Services of the General Treasury in 2007. Similarly, other three communication officers in PIUs should be placed at Level D as per the same circular mentioned above.

B. Recommendation 02: Appoint Strategic Communications Advisory Committee (SCAC)

162. A SCAC should be appointed and it should consist of the Program Director, three Project Directors, and Communication Officer in the PMU and Safeguard Specialist in the PMU. All reports and materials to be distributed externally should pass through the internal review process, which requires the document to be peer reviewed then approved and commented on by the SCAC. All media that is to be produced on a large scale should be pre-tested before being mass produced.

C. Recommendation 03: Specify a Communication Budget

163. The financial resources available for communication activities should be clearly established in the Facility Administration Memorandum (FAM), and the funds should be used accordingly.

D. Recommendation 04: Ensure Internal Communication

164. Knowledge management systems should be established to ensure that knowledge generated by the program is not lost. The flow of knowledge should be horizontal (between partner agencies), vertical (between the different levels of the same agency), diachronic (through time) and should contain feedback mechanisms.

E. Recommendation 05: Capacity Building for Communication

165. The SCP of the WRDIP should be briefed to the PMU and PIUs staff to make them aware of policies and approaches for information disclosure. Short training courses on communication skills and techniques should be organized for the higher level officials and for technical staff, including those who do not belong to the communication unit. Most of these people are conscious of the need for good communication, but they lack the necessary skills.

F. Recommendation 06: Establish Monitoring and Evaluation Procedures

166. Continuous monitoring and evaluation is fundamental for the effective management of any program. The impact of the communication activities should also be evaluated, via specific surveys, focus groups and opinion polls.

G. Recommendation 07: Ensure Technical Assistance for Communication

167. The PMU implementing the programs might need specialized support to design and implement the SCP. Provision for a communication expert in PMDSC should be made in the technical assistance budget as well as in the supervision missions and in the midterm review mission.

ANNEX 1
COMMUNICATIONS STRATEGY MATRIX

Communications Context: The WRDIP will assist the government complete outstanding water conveyance investments under the Mahaweli Development Program (MDP). The investment program will support the objectives of MDP to maximize the productivity of Mahaweli River Basin (MRB) water resources by transferring available water to Sri Lanka's northern dry zone areas for irrigation, drinking and commercial purposes. In addition, the program itself raises issues related to resettlement and safeguards and is expected to receive vocal opposition from NGOs. APs will also need special attention as there are expected to be significant compensation for them.

Program Objective: Secured access to water resources for agricultural and non - agricultural purposes in northern dry zone areas in Sri Lanka.

Strategic Elements							Work Plan Elements		Evaluation
Objectives	**Risks**	**Audiences/ Stakeholders**	**Current and Desired Attitudes/Behaviors**	**Messages/ Information**	**Activity/ Channels**	**Timing**	**Responsibility**	**Resources Needed**	**Expected Outcomes**
Ensure regular flow of reliable program information	Trust of information source Managing expectations	Primary and secondary stakeholders	**Current Status:** Main stakeholder groups are not well informed of WRDIP.APs are not aware of program benefits or safeguard issues ,resettlement and entitlements **Desired Status:** Stakeholders are aware of WRDIP and expected benefits and have an understanding of related safeguard and environment issues and know how/what channels to address issues	Key program benefits Main impacts (good and bad) Program implementation process Entitlements Compensation Resettlement procedure	Small groups Community Forums Mass media Local leaders Religious networks Print material (Brochures, etc.) FGDs Religious events Awareness meetings Face to face meeting Door-to-door community mobilizers IEC Special activities	From outset of program Regularly scheduled events to update on developments (every month)	Program implementation team PMU officers	Content development and publication/ dissemination costs Expenditure	Affected people support program or are neutral

			related to expected entitlement						
Establish two way information sharing dialog mechanism	Identifying valid community representatives Timing	Primary and secondary Stakeholders	**Current Status:** CSOs and other stakeholders not aware of how they can participate in or contribute to program design, implementation or monitoring **Desired Status:** APs and beneficiaries and other stakeholders are informed regarding the feedback process and willing to contribute ideas or get involved in program design or implementation	Importance of dialogue; incorporation of stakeholder views into WRDIP Explain feedback process and how feedback is used Identification of key issues to discuss	Existing CBOs NGOs, women's groups, water user groups, etc.) Local government mechanisms Local media Advisory groups/ committees	Regularly scheduled meetings/ workshops (every month)	Program implementation team PMU and PIUs officers	Content development and publication/ dissemination costs Logistical costs • Event costs	Program stakeholders are actively participate program activities

ANNEX 2
LIST OF STAKEHOLDERS

Primary Stakeholders
Program Affected People (PAP)
Program Beneficiaries
Government Officials and Policy Makers
Government of Sri Lanka (GOSL)

Cabinet Ministries
Ministry of Irrigation and Water Resources Management (MIWRM)
Ministry of Finance and Planning (MFP)
Ministry of Land and Land development (MLLD)
Ministry of Wild Life Resources Conservation (MWRC)
Ministry of National Heritage (MNH)
Ministry of Disaster Management (MDM)
Ministry of Power and Energy (MPE)

Departments
Department of Irrigation (ID)
Department of Forest Conservation (DFC)
Department of Wild Life Conservation (DWLC)
Department of National Planning (DNP)
Department of External Resources (ERD)
Department of Agrarian Development (DAD)
Department of Agriculture (DOA)

Authorities and Board
Central Environment Authority (CEA)
Mahaweli Authority of Sri Lanka (MASL)
Provincial Road Development Authority (PRDA)
National Livestock Development Board (NLDB)

Provincial Councils
North Western
North Central
Central

Local Government (Pradeshiya Saba)
Minipe, Mahawa, Polpihigama, Galewela, Dambulla, Elahera

Government Agent (GA)/ District Secretariat
Kandy, Anuradhapura, Polonnaruwa, Kurunegala, Matale

Divisional Secretariats (DSs)
Elahera, Medirigiriya, Galenbidunuwea, Palugaswewa, Dambulla, Galewela, Polpithigama, Mahawa, Ehetuwewa, Abanpola, Galgamuwa, Naula, Minipe, Hasalaka

Multilateral Agencies
Asian Development Bank (ADB)
Secondary Stakeholders

Commercial media (print, mass media, web sites, etc.)

People in positions that convey influence (e.g., clergy members)

Community leaders: These might be people who are respected because of their position of leadership in a particular community, or may be longtime or lifelong residents who have earned the community's trust over years of integrity and community service. (eg, Chairman of the Farmer Organization)

Civil society organizations: environment and wild life conservation

Business: The business community usually will recognize its interest in any effort that will provide it with more and better workers, or make it easier and more likely to make a profit. By the same token, it is likely to oppose efforts that it sees as costing it money or imposing regulations on it.

Advocates: Advocates may be active on either or both sides of the issue you're concerned with.

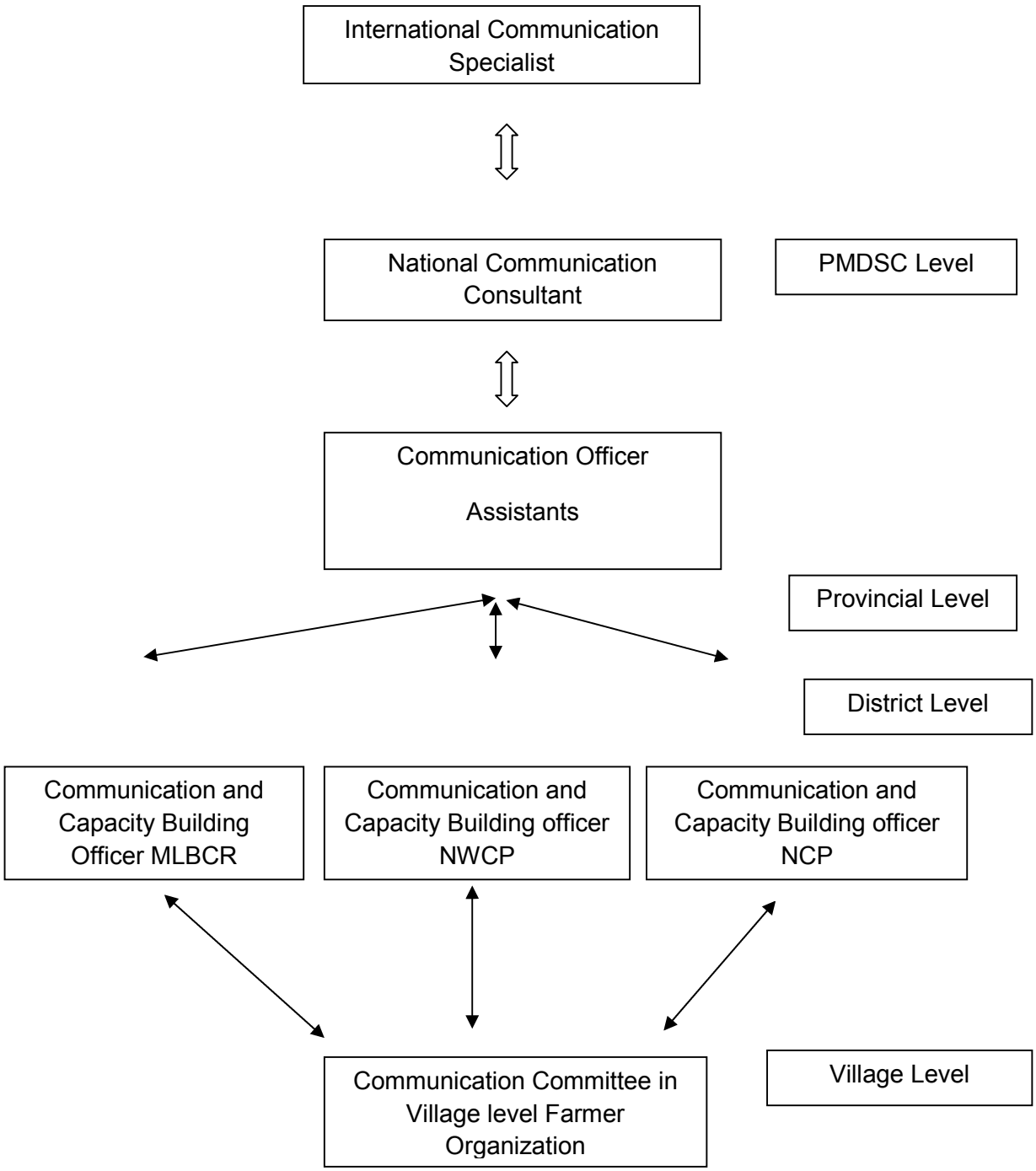
People with academic or research interests related to a targeted issue or population: Their work may have convinced them of the need for an intervention or initiative, or they may simply be sympathetic to the goals of the effort and understand them better than most.

Community activists: Organizations and individuals who have a philosophical or political interest in the issue or population that an effort involves may organize to support the effort or to defeat it.

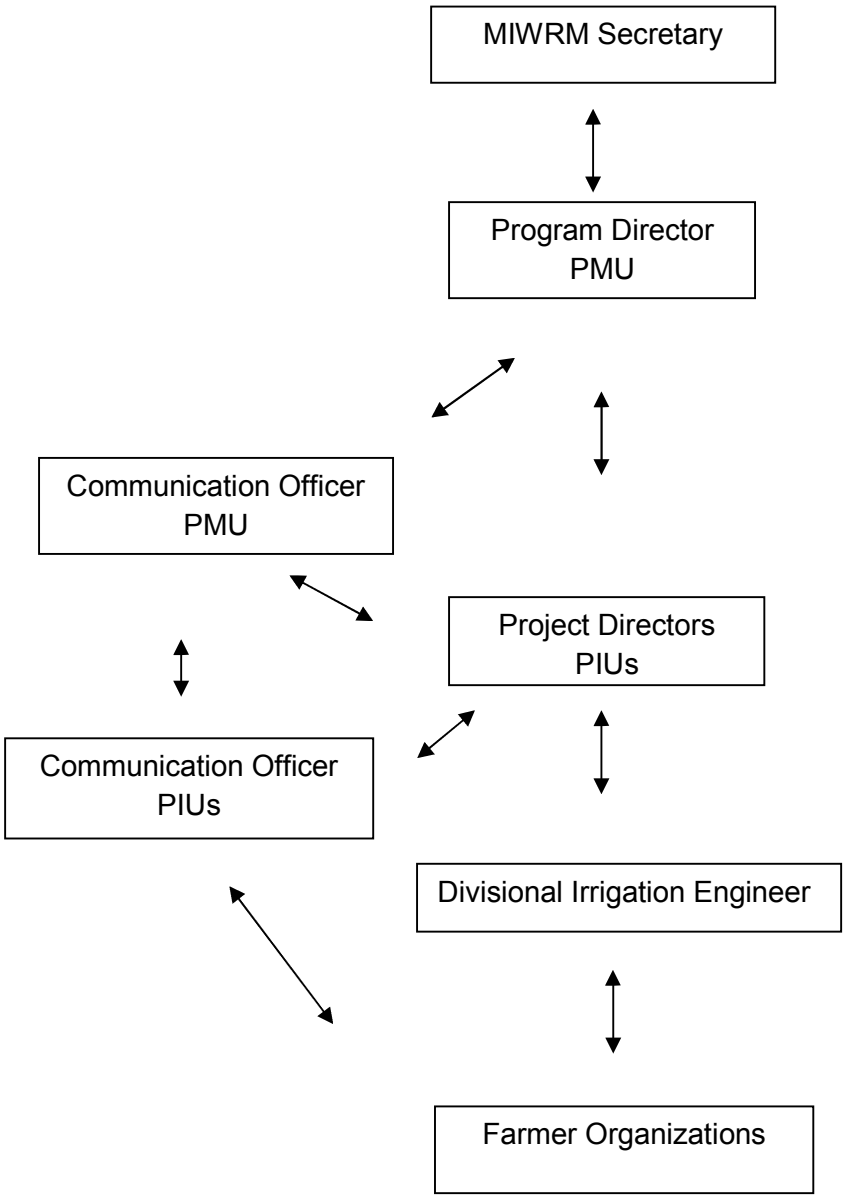
Community at large: When widespread community support is needed, the community as a whole may be the key stakeholder.

ANNEX 3

ORGANIZATIONAL STRUCTURE OF THE COMMUNICATIONS UNITS



Structure 2: Primary Information Flow for the WRDIP



ANNEX 4
DETAILED SCP BUDGET

Human Resources for PMU and PIUCs

	Designation	Number of Staff	Monthly Salary USD	Total
1	Communication officers	01	649.60	38,975.93
2	Communication and capacity building officers	03	343.91	61,902.95
3	Graphic designer and video editor	01	343.91	20,634.32
4	Information technology Officer	01	343.91	20,634.32
5	Management assistant /Data entry operator	01	191.06	11,463.51
	Total			**153,611.03**

Equipment

	Designation	Required Number	Unit Cost USD	Total
1	Laptops	04	764.23	3056.94
2	Digital Cameras	04	382.12	1528.47
3	Overhead projectors	04	764.23	3056.94
4	Photocopy Machine	01	2292.70	2292.70
5	Pen drives 16GB	06	7.64	45.85
6	Hard disk	01	191.06	191.06
7	Video Camera	01	3821.17	3821.17
8	Stationeries		764.23	3821.17
9	Software (Video editing, Photoshop, audio editing and MS Office)		764.23	764.23
	Total			**18,578.53**

IEC Campaign

No.	Program	No of Units/ Programs	Program/ Unit Cost USD	Total USD
1	National level Campaign	01	765	765
2	Provincial Level, District, Divisional level Officers	22	1836	1836
3	Farmer leaders	10	1530	1530
4	Village level (farmers, women and youth)	300	76.42	22927.02
5	Civil societies	10	1530	1530
6	Journalist	6	2295	2295
7	Public Awareness Campaign during Design, Construction	30	2294	2294
8	Orientation Programs	3	2294	2294
9	Participation Monthly Meetings in GA, DS Offices	120	15.28	1833.6
	Total			**37304.62**

Advocacy

No.	Program	No of Units/ Programs	Program/ Unit Cost USD	Total
1	Religious Leaders	3		3,253
2	Political Leaders	5		8,132
	Total			**11,385**

Basic Tools

No	Programs	No of Units/ Programs	Program/ Unit Cost USD	Total
1	Program Logo	1	813	813
2	Letter Heads	3000	8133	8133
3	File Folders	1000	813	813
4	Large Size Stickers	3000		
5	Master PowerPoint presentations 3D version	1	813	813
6	WRDIP Stands	20	9759	9759
7	Creating Program Model	1	8133	8133
8	Visiting cards	2000	382.12	382.12
9	Office arrangement	4	3821.17	3821.17
	Total			**32667.29**

Public Display/Advertisement

No.	Program	No of Units/ Programs	Program/ Unit Cost USD	Total
1	Design Public Notice Boards Boards-installation and updating	20	4590	4590
2	Erecting of Hoardings	3	2674.82	7642.34
3	Digital light boards	30	152.85	4560
4	Billboards display including the cost involved in updating information	15	382	5730
	Total			**22,522.34**

Material Development

No.	Program / Production	No of Units/ Programs	Program/ Unit Cost	Total cost USD
1	Posters (GRC)	10,000	0.15	1528.47
2	Fact sheet / Brochures (WRDIP,GRC)	500,000	0.38	190000
3	Fact Sheet on Program Design Phase	100,000	0.15	1528.47
4	Booklets	3,000	1.53	4585.40
5	Annual Reports	5	764.23	3821.17
5	WRDIP Summary Report	100,000	0.38	38000
	Total			**239,463.51**

Modern Technology

No.	Program / Production	No of Units/ Programs	Program/ Unit Cost	Total Cost USD
1	Website design, maintaining and updating	1	5350	5350
2	Telemarketing		76.42	76.42
3	Frequently Asked Questions (FAQs)		n/a	
4	Developing the intranet		n/a	
5	Social media		n/a	
6	Develop ,design, maintain data base	1	765	765
7	Video documentaries	4	3821.17	15284.68
8	Video coverage of construction stages			3821.17
	Total			**25297.27**

Mass Media Campaign

No.	Item	No. of Programs	Program/ Unit Cost	Total Cost USD
	Print Media			
1	Paper Supplements	3	764.23	2292.70
2	Newsletters (Sinhala, Tamil, English)	10 5000 circulations	0.38	19105.85
3	News Items	60	Free	
4	Features – Articles	40		1528.47
5	Advertisements	60	Free	
6	Articles for Magazines	05	76.42	382.1
7	Advertorials	15	Free	
	Radio			
8	Radio Programs- including cost of air time	48	382.12	22927.02
9	Jingles	10	382.12	3821.17
10	Discussions	10	382.12	3821.17
11	Disseminate program information	60	n/a	Free of charge
	TV Programs- including the production cost and airtime			
12	30 min TV documentary	08	6113.87	6113.87
13	TV Strollers & Adds.	30		3821.17
14	Press (Media) Conference National level	05	4585.40	22927.02
15	Radio and T/V News Bulletin	10		3821.17
16	Media Tours	5	2292.70	11463.51
17	Media Interview	10		Free of charge
18	Panel Discussions on Television	4	764.23	3056.94
19	District level media coordination	25	2292.70	57317.55
	Total Cost			**114,252.97**

Special Event Programs

No.	Program	No of Programs	Program/ Unit Cost	Total Cost USD
1	Community-based communication	6		1528.47
2	Drama +talk	03	382.2	1146.6
3	Cultural Shows/ Religious Activities	10	382.2	3821.17
4	Shramadana	30	Free	
5	World health day	15	382	5731.76
6	World water day	15	382	5731.76
7	Environment day	15	382	5731.76
8	School children awareness and engagement program	30	152.85	4585.40
9	Poster Competition	1	764.23	764.23
10	Drama competitions	1	764.23	764.23
11	Essay Competition	1	764.23	764.23
12	Photographic	1	764.23	764.23
13	Digital video production competitions	1	1528.47	1528.47
14	Production of Short Video Documents	2	1528.47	3056.94
15	External Events		3821.17	3821.17
16	Sponsoring Festivals	15	15.28	229.2
17	Demonstration Home Gardens	6	382.12	2292.72
18	Free Legal Clinics	3	191.06	573.18
19	Health Clinics	6	191.06	1146.36
20	Exhibition "Dayata Kirula"	5	3821.17	19105.85
21	Music Program and theme song	20		7639.42
22	Oratorical Competition	1		4583.65
23	Quiz Competition	1		4583.65
	Total			**79894.45**