Environmental Impact Assessment

December 2014

SRI: Water Resources Development Investment Program

Upper Elehara Canal (UEC)

Prepared by Mahaweli Consultancy Bureau (Pvt) Ltd. for the Asian Development Bank.

ENVIRONMENT IMPACT ASSESSMENT REPORT

MODIFICATIONS TO CONFIGURATIONS OF MORAGAHAKANDA-KALUGANGA PROJECTS PROPOSED UPPER ELEHARA CANAL (UEC), CANAL FROM MANNAKKATTIYA TANK TO MAHAKANADARAWA TANK AND KALUGANGA-MORAGAHAKANDA LINK CANAL PROJECT

DRAFT FINAL REPORT

MINISTRY OF IRRGATION AND WATER RESOURCES MANAGEMENT

GOVERNMENT OF SRI LANKA

Prepared by

DECEMBER 2014

Mahaweli Consultancy Bureau (Pvt) Ltd

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List of Abbreviations

Ac	- Acre
Acft	- Acre-Foot
ADB	- Asian Development Bank
AI	- Agriculture Instructor
AMDP	- Accelerated Mahaweli Development Programme
ASC	- Agrarian Service Centre
BCAP	- Biodiversity Conservation Action Plan
BOD	- Biological Oxygen Demand
CEA	- Central Environmental Authority
CECB	- Central Engineering Consultancy Bureau
CKDu	- Chronic Kidney Disease of unknown etiology
DMO	- District Medical Officer of Health
DO	- Dissolved Oxygen
DS	- Divisional Secretary
ECBA	- Extended Cost Benefit Analysis
EIA	- Environment Impact Assessment
EP	- Eastern Province
FAO	- Food & Agriculture Organization
GDP	- Gross Domestic Product
GND	- GramaNiladari Division
GOSL	- Government of Sri Lanka
GPS	- Global Positioning System
GRC	- Grievances Redress Committee
GTZ	- Germen Technical Cooperation Agency
Ha	- Hectare
HFL	- High Flood Level
ID	- Irrigation Department
IRR	- Internal Rate of Return
IUCN	- International Union for Conservation of Nature
JICA	- Japan International Co-operation Agency
KE	- Kalinga Ela

km	- Kilometers
KMTC	- Kaluganga-Moragahakanda Transfer Canal
LAA	- Land Acquisition Act -
LDI	- Livestock Development Instructor
m^3	- Cubic Meter
m^3/s	- Cubic Meters per Second
MASL	- Mahaweli Authority of Sri Lanka
MCB	- Mahaweli Consultancy Bureau (Pvt) Ltd.
MCM	- Million Cubic Meters
MDP	- Mahaweli Development Project
MIWRM	- Ministry of Irrigation and Water Resources Management
MIWRM	- Ministry of Irrigation and Water Resources Management
MLD	- Ministry of Land Development
MSL	- Mean Sea Level
MTS	- Minneriya Tank at Sluice
MW	- Mega Watts
NCP	- North Central Province
NCP	- North Central Province
NCPCP	- North Central Province Canal Project
NEDECO	- Netherlands Engineering Consultants
NIRP	- National Involunatary Settlement Policy
NP	- National Park
NP	- Northern Province
NPV	- Net Present Value
NWP	- North Western Province
NWSDB	- National Water Supply and Drainage Board
O&M	- Operation & Maintenance
OFC	- Other Field Crops
PEA	- Project Execution Agency
PHI	- Public Health Inspector
PMU	- Project Management Unit
RDA	- Road Development Authority

TBM	- Tunnel Boring Machine
TDS	- Total Dissolved Solids
ToR	- Term of Reference
UEC	- Upper Elahera Canal
UNDP	- United Nations Development Programme
WC	- Wildlife Corridor
WLS	- Wild Life Sanctuary
WPT	- Water Pressure Testing
WRB	- Water Resources Board

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EXECUTIVE SUMMARY

1 This report is the Environmental Impact Assessment Report (EIAR) required to be prepared according to the Terms of Reference provided by the Central Environmental Authority, Government of Sri Lanka under the provisions of Part IV C of the National Environment Act (NEA), No. 47 of 1980, as stipulated in Gazette (Extraordinary) No. 772/22 of 24th June 1993, for the project described below.

2 The project, Upper Elehara Canal (UEC), canal from Mannakkattiya Tank to Mahakanadarawa tank and Kaluganga-Moragahakanda Link Canal project is proposed by the Ministry of Irrigation and Water Resources Management, Government of Sri Lanka.

3 The UEC as it is commonly referred to, is part of the North Central Province Canal Project (NCPCP) which in turn is a component of the Accelerated Mahaweli Development Project (AMDP) of Sri Lanka. The main policy document of the Government of Sri Lanka, the *Mahinda Chintana Idiridakma* – Vision for the Future" (2012) includes the"North Central Province Canal" as a listed project under its National Development Program. The main objective of the NCP Canal Project is to transfer water to deficit areas in Northern Province (NP), North Western Province (NWP), the North Central Province (NCP), the Eastern Province (EP) along technically and environmentally feasible transfer route/routes in order to increase the cropping intensity of already cultivated lands. Other benefits are to provide domestic and industrial water, and to improve livelihoods of rural communities and greater environmental sustainability. The project has been justified by the socio-economic benefits it plans to deliver (MCB, 2012a).

4 The AMDP which was derived from the original Mahaweli Development Project was designed to address the most urgent irrigation and hydropower needs of the country at the time of the start of its implementation in the late 1970s. In response to the recurrent water shortages in the North Central Province (NCP) and the Eastern Province (EP), the Moragahakanda and Kaluganga reservoir projects were initiated in 2009. Increasing trends of industrialization, urbanization and more land being opened up for development after the improved security situation since 2009 have resulted in additional water demands from the Northern Province (NP), North Western Province (NWP) and the EP. In the past, several studies have been carried out to evaluate the available options for water transfer from Moragahakanda reservoir to the NCP which is now part of the NCCP.

5 The Upper Elehera Canal Project as described in this Environment Impact Assessment Report consists of the following three components:

i. Transfer tunnel/canal from Kaluganga reservoir to Moragahakanda Reservoir, referred to as the KMTC route
ii. Upper Elehera Canal (UEC) from Moragahakanda reservoir to Mannankattiya reservoir in the NCP
iii. Improvements to the existing water conveyance system consisting a combination of a canal and natural streams from Manankattiya to Mahakanadarawa via Eruwewa, located in the north-eastern parts of the NCP

6 The objectives of the EIA study commissioned for this project are:

a) Identify and evaluate the potential environmental impacts due to the construction, operation and maintenance of and all three components of the UEC

b) Recommend appropriate mitigation measures to avoid, minimize, remedy or compensate for the predicted negative impacts of the project

c) Highlight any cumulative/composite impacts due to other similar projects in the region

d) Provide a site-specific Environmental Monitoring Programme that will give adequate project options in terms of mitigation measures, project alternatives and a monitoring plan

e) Provide an environmental and management plan to achieve overall environmental sustainability of the project.

f) Analyze and discuss any alterations to the approved project as per the TORs.

7 The main guiding document for the EIA is the TOR provided by CEA. Environmental safeguard policy principles and procedures of ADB as stipulated in ADB's Safeguard Policy Statement (2009) are addressed as well. The EIA contains impact assessment on physical, biological, socio-economic, archaeological and physical cultural resources of the project area.

8 Studies to produce the report were conducted by a team of specialists numbering 13 supported by mapping and Geographical Information Systems specialists, through a combination of field surveys, desk reviews of past literature and interviews with a range of stakeholders including affected communities. 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.

9 The main findings of the environmental assessment are:

a. The long term impacts of the proposed project 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 phase and they can be minimized and mitigated with appropriate and timely interventions, with adequate supervision and monitoring by the project proponent and other stakeholders.

b. There is irreversible loss, fragmentation and degradation of natural habitats within two protected areas, traversed by the project, namely, Minneriya-Giritale Nature Reserve and Elehera-Giritale Sanctuary. The UEC travels as a tunnel along the border of Minneriya NP and also within the Hurulu Forest Reserve and the forested areas of the steep hills containing natural streams

traversed by the KMTC tunnels, and its aqueduct across Lel Oya, a natural stream. All these ecosystems provide functions that are vital for maintenance of natural cycles and biodiversity. None of the areas are considered as critical habitats.

c. The design and planning stage of the project has accommodated several major design and route changes to avoid any and/or minimize adverse impacts on protected areas. They are (i) decreased lengths of the UEC canal within protected areas and in steep hilly terrain; (ii) conversion of open canal sections to tunnels and cut and cover (buried) sections within legally protected areas, and changed the technology of tunnel creation to use of a Tunnel Boring Machine (TBM) that has less adverse environmental impacts than blasting construction technology. This change alone has increased project costs substantially but it has been accepted by the project proponent in view of the importance of the Minneriya National Park and the Hurulu Man and Biosphere Reserve.

d. In addition, provision of water for wildlife, inclusion of safe escapes for large animals that may fall into the open canal sections, provision of three existing tanks within the Elehera-Giritale Sanctuary as level crossings of the UEC, to maintain water levels especially within 50% of storage during dry seasons,to keep rest for wildlife are all very commendable avoidance and mitigation measures adopted early in the design and planning stage of this project by the proponent.

e. Long term residual adverse impacts on the four protected areas remain even after avoidance and mitigation measures. These residual impacts can be offset by implementation of the recommendations in the environment management plan to create offset areas with equivalent or higher biodiversity and conservation values as much as possible, and by the EMPs of the two associated facilities of the UEC, namely the Kaluganga Reservoir and Agricultural Extension Project (KRAEP) and Moragahankanda Agriculture Development Project (MADP).

f. The human-wildlife conflict is likely to be exacerbated by this project, unless adequate migratory routes/corridors are set aside and other mitigation measures are effectively implemented as recommended by this EIA and the EMPs of the KRAEP and MADP. The EMPs for these two projects are currently under implementation. Regular monitoring is undertaken.

g. While the project results in involuntary resettlement of families who affects their residences and/or property, this number (17) is very small compared to the area of project impact. The socio-economic survey has not encountered any opposition to the project by local communities along the project route. Details

of resettlement are outlined in the resettlement plans. Sites for relocation of displaced families have been identified. A Grievance Redress Mechanism has been developed and will be put into operation during the project. Further an information disclosure mechanism is also in place which has been used to make the community aware of the issues and their rights and responsibly.

h. There are beneficial impacts from the UEC to irrigated agriculture, provision of water for domestic and industrial purposes in areas of the North Central Province, and expected enhancement of the local and national economy in the long term. Provision of good quality potable water is of great importance given the rise of the Chronic Kidney Disease of unknown etiology in this region. The tourism industry which has shown a rapid rise since 2009 in this region is another economic activity that will benefit from the provision of water supply.

i. The cumulative impacts within the project area and of the entire proposed program have been examined. Cumulative Impact Assessment given in Annex VII.

j. Future impacts of climate change on this investment needs to be investigated in greater detail.

k. Full and strict compliance with the mitigation and monitoring measures in this report should be ensured to achieve a degree of environmental and social sustainability. This is particularly important to mitigate pollution of the water, air and soil that is anticipated to take place during the construction phase and to prevent further degradation and fragmentation of habitats.

l. Full and strict compliance with the mitigation and monitoring measures in this report should be ensured to achieve a degree of environmental and social sustainability. This is particularly important to mitigate pollution of the water, air and soil that is anticipated to take place during the construction phase.

m. The UEC project is therefore suitable for implementation, subject to approval by the Central Environmental Authority of Sri Lanka, ADB and other relevant agencies along with full and effective implementation of all mitigatory, monitoring and evaluation measures in its project phases

CHAPTER 1

1. INTRODUCTION

1.1 Background of the project

10 The Upper Elehera Canal was designed to address the current water shortages in the North Central and Northern Provinces. At present, both these provinces face water deficits for irrigation and drinking water. Although the Mahaweli Master Plan (1968) was designed to address these water shortages, some of the components were not implemented due to priority being shifted to the Accelerated Mahaweli Development Project in the late 1970s. In addition, the water demands, and related government policies have undergone significant changes. As such, a short description of the Mahaweli Master Plan, Accelerated Mahaweli Development Project and some relevant policies are given below.

11 **The Mahaweli Development Project and Accelerated Mahaweli Development Project:** This was conceived in late 1950s to augment water starved irrigation systems in Dry Zone of Sri Lanka in the North Central Province (NCP), Northern Province (NP) and Eastern Province (EP) and thereby improve the economic and living standards of agriculture based communities in those then under developed rural areas. Twelve distinct systems were identified under the Mahaweli Master Plan (1968) for development in the NCP, NP and EP including their corresponding benefit areas.

12 The project was planned to be implemented in 3 phases. The Phases I and II focused on meeting the irrigation demands in Mahaweli Basin, Kala Oya basin and in the MaduraOya Basin. The Phase III emphasized work in the remaining parts of NCP and to develop 131,000 ha (324,000acs) in six river basins, and construction of a North Central Province Canal (NCP Canal**)** as the main conveyance route. (Figure 1.1)

13 The Government of Sri Lanka (GOSL) commenced the 30 year implementation programme of the Mahaweli Development Programme (MDP) in 1970 starting with the Polgolla diversion encompassing the barrage, tunnel, Ukuwela power house, and followed by the Bowatenna regulation reservoir across the *Amban Ganga*. In 1977, the GOSL decided to accelerate the implementation of the MDP to fulfill increasing demands for agricultural and power needs to a much shorter period of 6 years. This was called the Accelerated Mahaweli Development Programme (AMDP), and it gave priority to;

(a) Construction of the regulatory reservoirs namely, *Kotmale*, *Victoria,Randenigala* and *Rantambe* in the Mahaweli cascade system

(b) Completion of Mahaweli Systems H, IH & MH including construction of DambuluOya reservoir and improving Kala Wewa reservoir,

(c) Improving irrigation infrastructure in Mahaweli Systems D1, D2& G,

(d) Completion of irrigation infrastructure in Mahaweli Systems B, C, and E including construction of the new reservoirs Ulhitiya, Ratkinda, and MaduruOya.

14 The direct benefits included establishing 665 MW of hydro power generation capacity and 214,000 ha (Cooke, 1982) of irrigated land all of which would contribute to the nationalGDP.

15 Thus the AMDP was designed to address the most urgent irrigation and hydropower needs of the country at the time of the start of its implementation (late 1970s). However, there were major imbalances in the areas identified for development under MDP due to non-inclusion of development of the Systems A, K, L, part of I, and M, and the related regulating reservoirs, namely Moragahakanda and Kalu Ganga, and the NCP canal. The total benefits achieved by the agriculture sector by implementation of the AMDP are about 41% of the originally envisaged under MDP (NCP-pre-feasibility Report, 2012).

16 In response to the recurrent water shortages in the NCP and EP, the Moragahakanda and Kaluganga Projects were initiated in 2009. Increasing trends of industrialization, urbanization and more land being opened up for development after the improved security situation since 2009 have resulted in additional water demands from the NCP, NP, NWP and EP. More recently, water transfers by the AMDP and those to be developed under Moragahakanda/Kaluganga projects were seen as failing to meet the growing water demands of NCP, NP and the EP as well as the new water demand areas in North Western Province (NWP). (NCP-Pre-feasibility Study Report 2012). In the NWP, river basins such as *DeduruOya*and*MiOya* have unmet water demands, despite recently completed in-basin water resources development.

17 The main policy document of the Government of Sri Lanka, the *MahindaChintanaIdiridakma* – Vision for Future" (Department of National Planning, 2010) includes the"North Central Province Canal" as a listed project under its National Development Program.

18 In the past, several studies have been carried out to evaluate the available options for water transfer from Moragahakanda reservoir to the NCP (NEDECO (1979), Lahmeyer International et al (1988) and JICA (1989)). The currently recommended NCP canal project will be implemented in two phases. Phase I will transfer water from the Mahaweli river basin to the North Central and North Western Provinces. Phase 2 will transfer water from the NCP reservoirs to existing reservoirs in the NP and would involve tapping additional water resources for this purpose.

19 The proposed water transfer system, referred to as NCP Canal Project (NCPCP), comprises of several water transfer routes (see Figure 1.2). They are:

a. Transfer tunnel/canal from Kaluganga reservoir to Moragahakanda Reservoir (Note: Kaluganga-Moragahakanda transfer route contains a tunnel section and a canal section, but is commonly called KMTC) (Phase 1)

b. Upper Elehera Canal (UEC) from Moragahakanda reservoir to turnout structure to feeder canal to Mannankattiya reservoir in the NCP (Phase 1).

c. NCP Canal from Mannankattiya feeder turnout structure to Chemamadukulam reservoir in the NP (Phase 2).

d. About 3.66m long feeder canal (sub surface) from the end of UEC to Mannankattiya tank (Phase 1).

e. Improvements to the existing conveyance system consisting a combination of a canal and natural streams from Manankattiya to Mahakanadarawa via Eruwewa, located in the north-eastern parts of the NCP – (Phase 2).

f. A NWP canal commencing downstream of Bowatenne reservoir and conveying water to water deficit areas in the NWP – Phase 1.

g. Pumping water from Kalinganuwara (located between MinipeAnicut and Ambanganga – Mahaweli confluence on the Mahaweli), to Angamedilla – (This is to be considered under Phase 2).

h. A canal transferring water from Randenigala reservoir to Kaluganga reservoir – (This is to be considered under Phase 2).

20 Out of the conveyance systems mentioned above, the project to be considered under this Environmental Impact Assessment (EIA) includes the following sections (Figure 1.3):

a. Transfer tunnel/canal from Kaluganga reservoir to Moragahakanda Reservoir- (KMTC).
b. Upper Elehera Canal (UEC) from Moragahakanda reservoir outlet to Mannankattiya reservoir in the NCP, while feeding Huruluwewa en-route, and the connecting route to Manankattiya from the UEC's outlet to Manankattiya.
c. Improvements to conveyance route from Manankattiya to Mahakanadarawa reservoir in the NCP.

21 The other component under Phase 1 – the NWP canal, is considered as a separate project and an EIA has been done to assess impacts of that project. Phase 2 is currently being developed and necessary environmental assessments will be carried out as more details of the project are available.

22 In addition to irrigation benefits, the NCP Canal Project will have a positive impact on drinking water supply water-related health. The priority given to these aspects at the national level are described below.

23 **Water Supply:** The tremendous importance attached to the provision of clean drinking water, sanitation and drainage is highlighted in numerous policies and programmes in Sri Lanka. This sector is of great relevance to this proposed project. The national policy on water supply and sanitation of 2002 has as one of its goals to provide access to sufficient and safe drinking water to 85% of the population of Sri Lanka by 2010 and 100% by 2025.

24 The national policy document on drinking water and the national policy for rural water supply and sanitation (2001) (http://www.waterboard.lk/scripts/ASP/Policies.asp) reinforces the commitment of the government to provide access to safe water supplies for the people of Sri Lanka. They also acknowledge disparities in service across the regions and the need to address the un-served populations.

25 **Health and water:** The importance of maintenance of water quality for human and other life forms cannot be emphasized enough as it has wide ranging impacts on life on this planet. Apart from past and current impacts from water borne diseases, poor sanitation and drainage, the current concern with the role played by drinking water quality in regions of Sri Lanka afflicted with the Kidney Disease of Unknown Etiology (CKDu) has reinforced the urgency with which access to clean water should be provided.

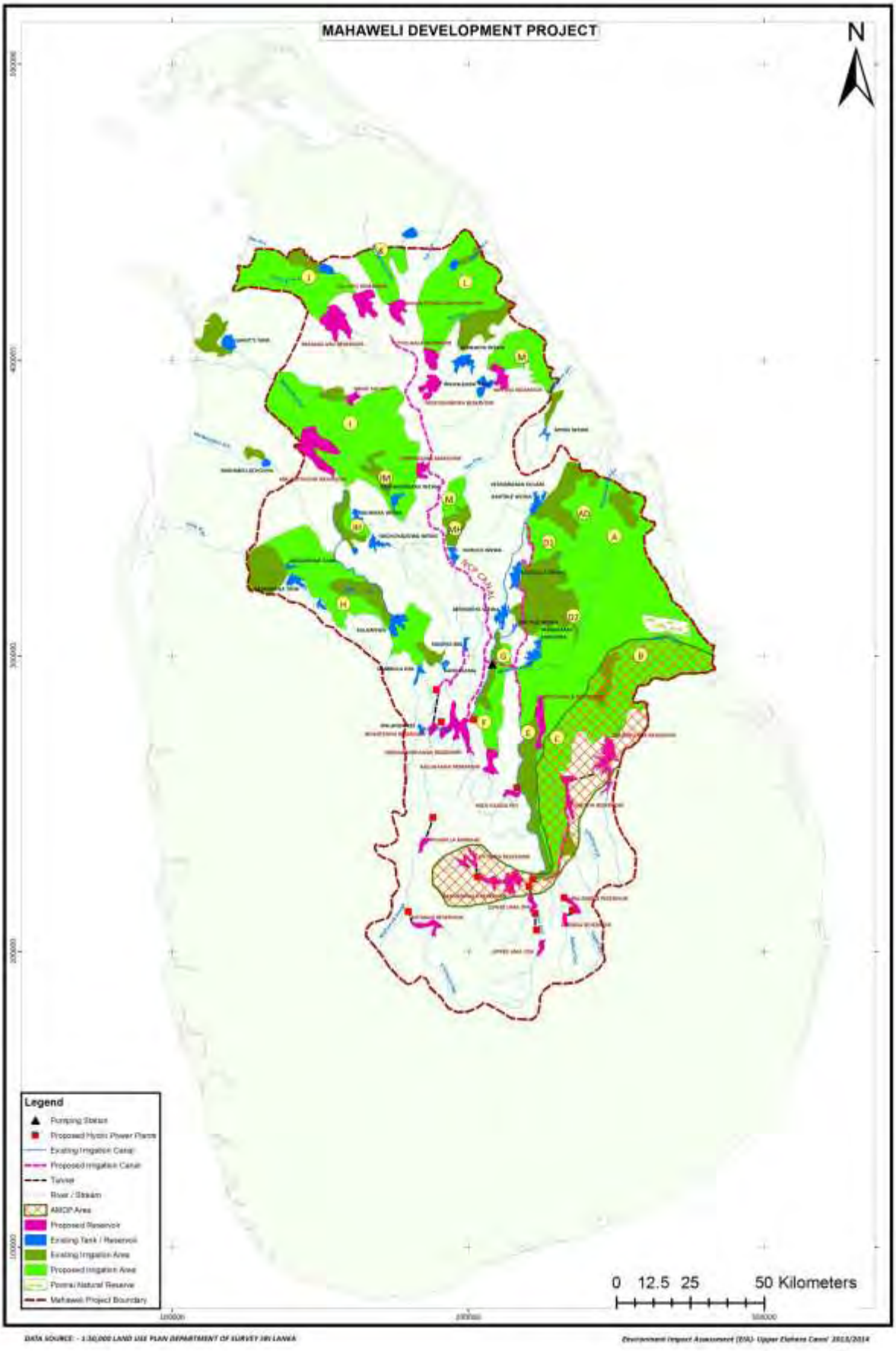


Figure 1.1- Country map with original Mahaweli Development Project areas

26 At particular risk are a large number of people in the Dry Zone of Sri Lanka from dental and skeletal fluorosis due to high fluoride levels in water (Dissanayake, 2005). High nitrate levels in water can cause blue baby syndrome, a condition found especially in infants and eutrophication of water bodies making them unsuitable as sources for drinking and other human and livestock related activities. High level of organic matter in water leads to a drop in dissolved oxygen (DO) level, which is harmful. As stated previously more recent and alarming rise of the Chronic Kidney Disease of Unknown Etiology (CKDu) (http://nas-srilanka.org/) has led to a renewed interest in the quality of drinking water especially in the North Central Province, the Uva Province and in the Eastern Province.

1.2 Objectives of the project

27 The Project is defined as the proposed constructions and modifications to existing structures under the KMTC, UEC and Manankattiya- Mahakanadarawa water conveyance route. Accordingly, the objective of the Project is to transfer water to deficit areas in the North Central Province, along technically and environmentally feasible routes in order to increase the cropping intensity from 1.2 to 1.80. Other objectives include provision of drinking water, improvement of livelihoods of rural communities and environmental sustainability. The KMTC and UEC will be designed with adequate capacity to cater for the envisaged benefits to the Northern Province in future phases of the NCPCP.

Location of the Project is given by Figure 1.3.

1.3 Justification for the proposed project

28 The current proposal for the UEC includes a wider scope of benefits than the previously approved project proposal for a similar water conveyance system under the Moragahakanda and Kaluganga Projects (MCB, 2012a and MCB, 2012b). The UEC is central to the several development activities of NCPCP mentioned in section 1.1. Therefore, in project justification, explanation is made with regard to how the project contributes to the components of NCPCP, which require UEC in place before implementation.

29 At present, all irrigation schemes in the northern part NCP and southern part of NP, *Upper Mi*Oya and *DeduruOya*basins in the NWP are facing severe shortages of water. The cropping intensities of some major and medium irrigation schemes are 1.2 and 1.0 respectively while it is less than 1.0 for minor schemes located in these areas. Major and medium irrigation schemes are designed for double cropping, the Maha (generally between November to March) and Yala (generally between April to August). The farmers of minor schemes generally cultivate one crop from irrigation water stored in the tanks. However, socio-economic changes, expansion of the cultivated area and population increase have made it necessary for farmers to receive more water and cultivate a part of their land in the Yala Season as well.

30 Evapo-transpiration exceeds annual rainfall in the Dry Zone of Sri Lanka thus requiring irrigation for livelihood sustenance. Study of topography and hydrology of the benefit areas coming under the proposed project shows that local water resources are not

capable of providing sufficient water for domestic irrigation and other needs during the dry season of the year. Water quality has shown to deteriorate during dry periods (Silva, 2004). Rapid spread of the Chronic Kidney Disease of unknown etiology (CKDu) partially attributed to poor quality drinking water by policy makers, scientists, health sector professionals and community level organizations (NAS 2013) is another more recent and urgent reason to improve the supply of water to the target provinces of this project.

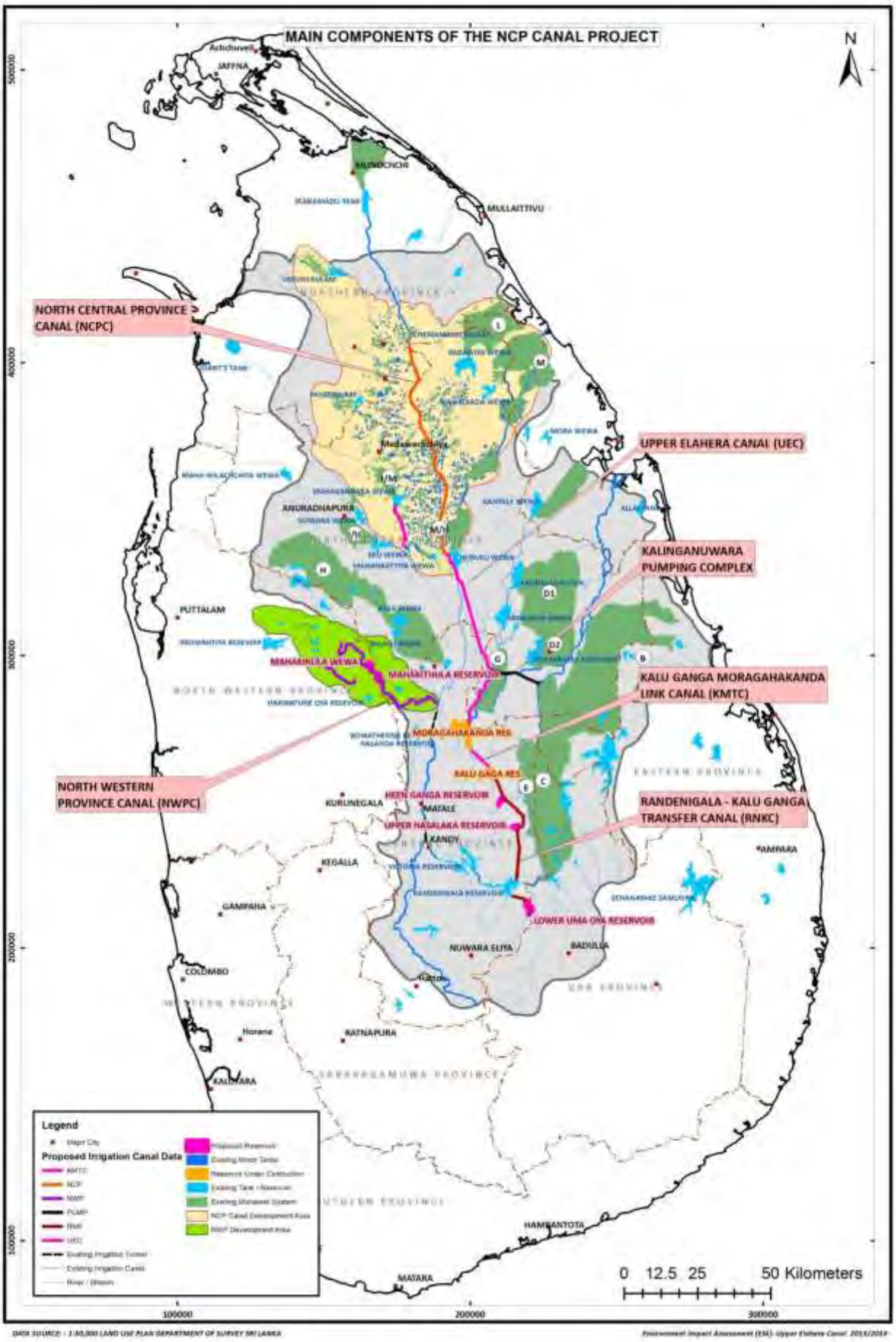


Figure 1.2-Main components of the NCP Canal Project

31 When Moragahakanda and Kaluganga reservoir projects were initiated in 2007, the associated development plans and feasibility studies did not include the NCP Canal. However, improved security situation in the north and east after 2009 has provided an opportunity for the government to modify the strategies to divert water to the dry zone. The proposed UEC, which is a part of the NCP Canal project, has the advantages over the previous development plans, in terms of flexibility of operation and the ability to cater for wider range of benefits. Diversion of water through UEC and extending the conveyance up to Manankattiya reservoir and Mahakanadarawa Reservoir (MalwathuOya Basin) and beyond HuruluWewa outlet is needed to address water scarcity problems in the target areas of the NCP.

32 The simulation study on water resources under the Water Balance Study revealed the feasibility of diverting 974 MCM to UEC with peak discharge of 44 m^3/s from December to March. There will be 617 MCM in Elahera – Minneriya Yoda Ela Canal (EMYE) (an existing canal, Figure 1.4 and 1.5) as per the simulations carried out for the UEC by design engineers. The EMYE Canal is taking off at 138 m MSL has a discharge capacity of 56 m^3/sec and the Upper Elahera Canal taking off at 143 m MSL has a discharge capacity of 40 m^3/sec, with provision for 10% overloading.

33 The current NCP Canal Project proposal envisages transfer of water from Randenigala to Kalu Ganga reservoir, tapping the water resources of *HasalakaOya* and *Heen Ganga* along the way. Water is to be transferred to the Moragahakanda reservoir from Kaluganga reservoir as part of this proposed project. Resulting additional water resources available in Moragahakanda reservoir will enable transfer of water to water deficit areas in NCP and NP via Upper Elehera Canal (UEC), especially Huruluwewa, Manankattiya and Mahakanadarawa areas. In the process, the demand downstream of Bowatenna reservoir is reduced, enabling transfer of water to NWP. This describes the difference between the initial Kaluganga-Moragahakanda project and the current NCP Canal Project.

34 Therefore, almost all the benefits to be achieved from the NCP Canal Project, including those in NWP, hinges on the successful completion of Upper Elehera Canal Project. The proposed NCP canal is catering for a much larger area harnessing the potential unutilized water resources of the MahaweliRiver and tributaries. To regulate water to a larger area along a lengthy canal it is required to have an assured irrigation water supply to the area. In this regard, the series of available reservoir storages (such as Victoria, Randenigala,) reservoirs under construction (Kalu Ganga and Moragahakanda) proposed reservoirs (Lower Uma Oya, Hasalaka and HeenGanga), and also the flexibility of the system is of paramount importance.

35 Considering the above, the Cabinet of Ministers of the Government of Sri Lanka decided to adopt Upper Elehera option (in the currently proposed NCP Canal Project) at the Cabinet meeting held on 31-10-2012.

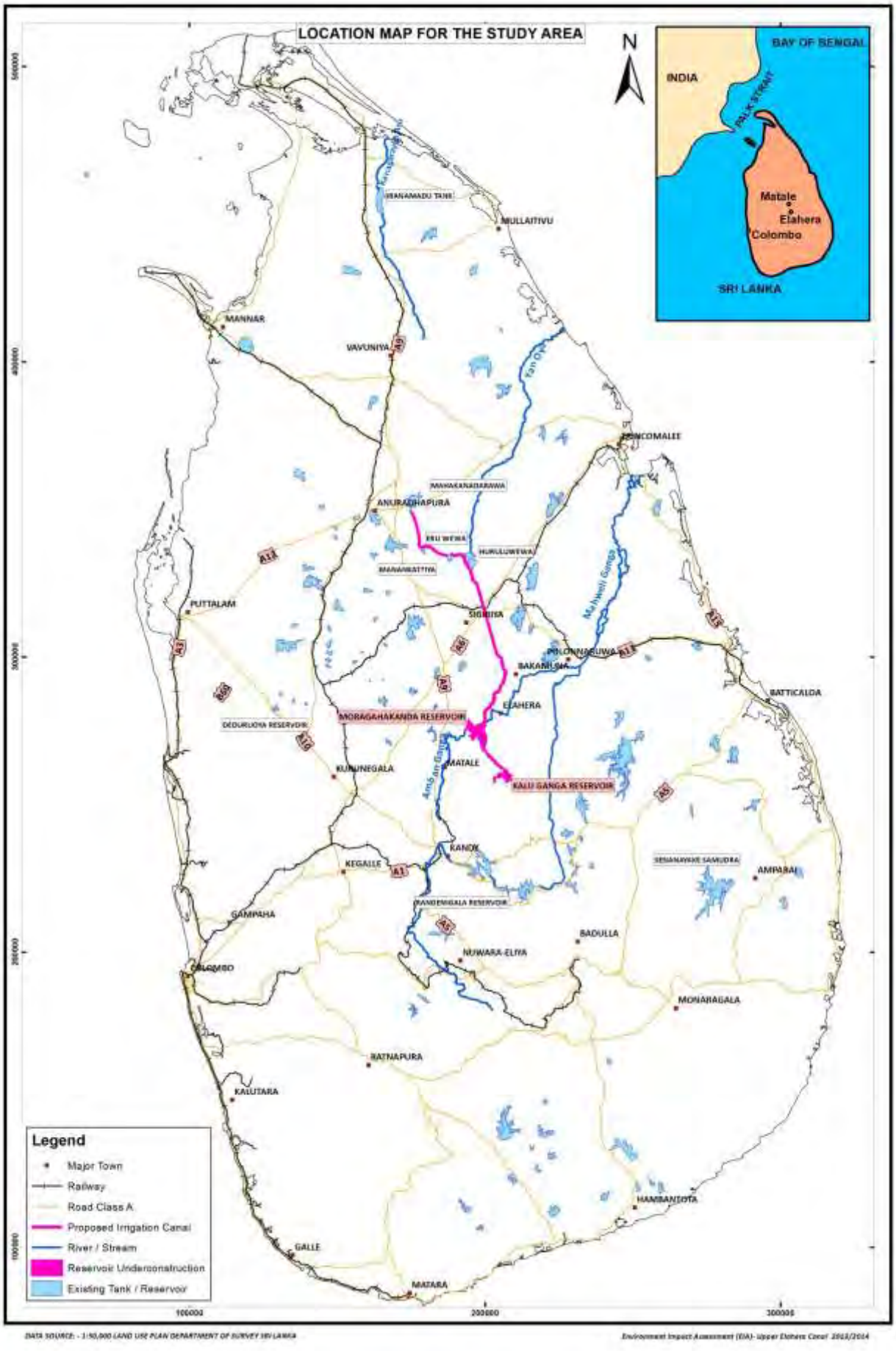


Figure 1.3-Location Map of Upper Elahera Canal

1.3.1 Irrigation benefits of the following are based on the cost-benefit analysis carried out for the NCP Canal Project:

- Cropping intensity of command areas under major tanks and minor tanks are to be increased from 1.3 to 1.8 and 0.9 to 1.8 respectively. Minor tank areas to be undertaken on Other Field Crops (OFC)/commercial crops
- Benefitted area include Manakkatiya-Eruwewa-Mahakanadarawa system, Huruluwewa and Yan Oya system and the revival of Kantale Sugar Plantation area
- Increase of paddy yields

1.3.2. Domestic water benefits

36 People in the irrigated areas generally get a part of their domestic needs fulfilled by irrigation facilities, and dug wells are regularly recharged by irrigation water. Enhanced water availability will be a benefit to the farmers under Manankattiya-Mahakanadarawa system and Huruluwewa and irrigation system under Yan Oyaanicuts.

37 At present the National Water Supply and Drainage Board (NWSDB) extracts water from the reservoirs in the Malwathuoya basin as follows.

i. ThuruwilaWewa - 21000 m3/d
ii. ThissaWewa - 4500 m3/d
iii. NuwaraWewa - 21000 m3/d
iv. Mahawilachchiya - 18900 m3/d

38 In addition to this, expecting augmentation of Mahakanadarawa Wewa by UEC the Irrigation Department has already granted approval for the NWS&DB to extract 39900 m^3/d from Mahakanadarawa.

Further NWSDB has requested from Irrigation Department to increase extraction of water following manner in 2033.

i. Thuruwila - 42000 m^3/d
ii. Thissawewa - 11500 m^3/s
iii. Nuwarawewa - 40000 m^3/d

39 This is possible only if the UEC canal is implemented.

40 Although NCP Canal-benefitted area is beyond the scope of this EIA study, provision of drinking water under that canal is enabled by the UEC. The NCP Canal plans to provide drinking water (70 MCM annually) in 12 towns in the NCP and NP situated along the NCP Canal route. The planned provision of drinking water under the NCP Canal Project is given in the Table 1.1 below and it is expected to benefit around 1,000,000 people.

Table 1.1 Planned provision of drinking and industrial water under NCP Canal Project

No.	Divisional Secretaries Divisions	Drinking Water Requirement (MCM/ Year) (2030)
A	**North Central Province**	
1	Rambewa&Mihintale	3.60
2	Kahatagasdigiliya&Ratmalgahawewa	3.60
3	Medawachchiya	4.50
4	Horowpatana	3.30
5	Kebithigollewa	2.00
6	GalenbidunuWewa	4.60
7	Future Expansion	12.00
	Sub Total for NCP	33.60
B	**North Province**	
1	Vavuniya	5.47
2	PulliyanKulama	1.46
3	ManKulam	1.82
4	Omanthai	1.82
5	Future Expansion – DS Divisions Mankulam and Jaffna Town	10.83 15.00
Sub Total For NP		36.40
Grand total for NCP & NP from NCP Canal		70.00
C	PaliAru (In Basin)	10.00
Total Drinking and Industrial Amount Supplied		**80.00**

1.4 Scope and objectives of the EIA

1.4.1 Scope of study for EIA

41 The area of study includes the following:

i. Proposed transfer route from Kaluganga reservoir to Moragahakanda reservoir,

ii. Proposed Upper Elehera Canal commencing from the downstream of Moragahakanda reservoir to Manankattiya reservoir,

iii. The water conveyance system from Manankattiya to Mahakanadarawa reservoir.

43 The study focused on 500 m on the canal trace and either side (on the left bank and right bank) of the proposed routes.

44 The environmental clearances for Kaluganga and Moragahakanda reservoir projects have been granted by the CEA previously. The most recent extensions to the environmental clearances granted have been made *vide* letters of the Central Environmental Authority No. 08/EIA/WATER/01/2006 dated 01-09-2011 for 3 years from the date of issuance of the letter for Kaluganga reservoir and No. 3/4/Mora/02 dated 11-11-2013 for 3 years from 26-10-2013for Moragahakanda Reservoir and these reservoirs are under construction now.

1.4.2 The objectives of the EIA study

(a) Identify and evaluate the potential environmental impacts due to the construction, operation and maintenance of:

i. Upper Elehera Canal (UEC)

ii. Manankattiya-Mahakanadarawa link canal

iii. Kaluganga- Moragahakanda transfer canal/tunnel

(b) Recommend appropriate mitigation measures to avoid, minimize, remedy or compensate for the predicted negative impacts of the project.

(c) Highlight any cumulative/composite impacts due to other similar projects in the region

(d) Provide a site-specific Environmental Monitoring Programme that will give adequate project options in terms of mitigation measures, project alternatives and a monitoring plan

(e) Provide an environmental and management plan to achieve overall environmental sustainability of the project.

(f) Analyze and discuss any alterations to the approved project as per the TORs.

45 The current project proposals consist of alternative routes for Kaluganga-Moragahakanda Transfer Canal and Upper Elehera Canal, which are shown in Figure 1.5and described in detail in the section 2.2.The total length of the UEC route is 66.9 km.

1.4.3 Relationship of the results of the EIA to project design and implementation

46 An examination of the initial designs of the UEC was carried out with a view to reduce its potentially negative environmental impacts. After consideration of the TORs issued by the Central Environmental Authority (CEA), and the professional knowledge of the consultants of the EIA and the designers of the UEC, the following amendments were carried out to address the concerns raised by the departments of Wildlife and Forests at stakeholder/scoping meetings of the UEC project. Such design modifications will also contribute towards greater ecological friendliness of the overall project.

Figure 1.5 that contains the Layout Plan of the UEC indicates the locations of some of these design modifications.

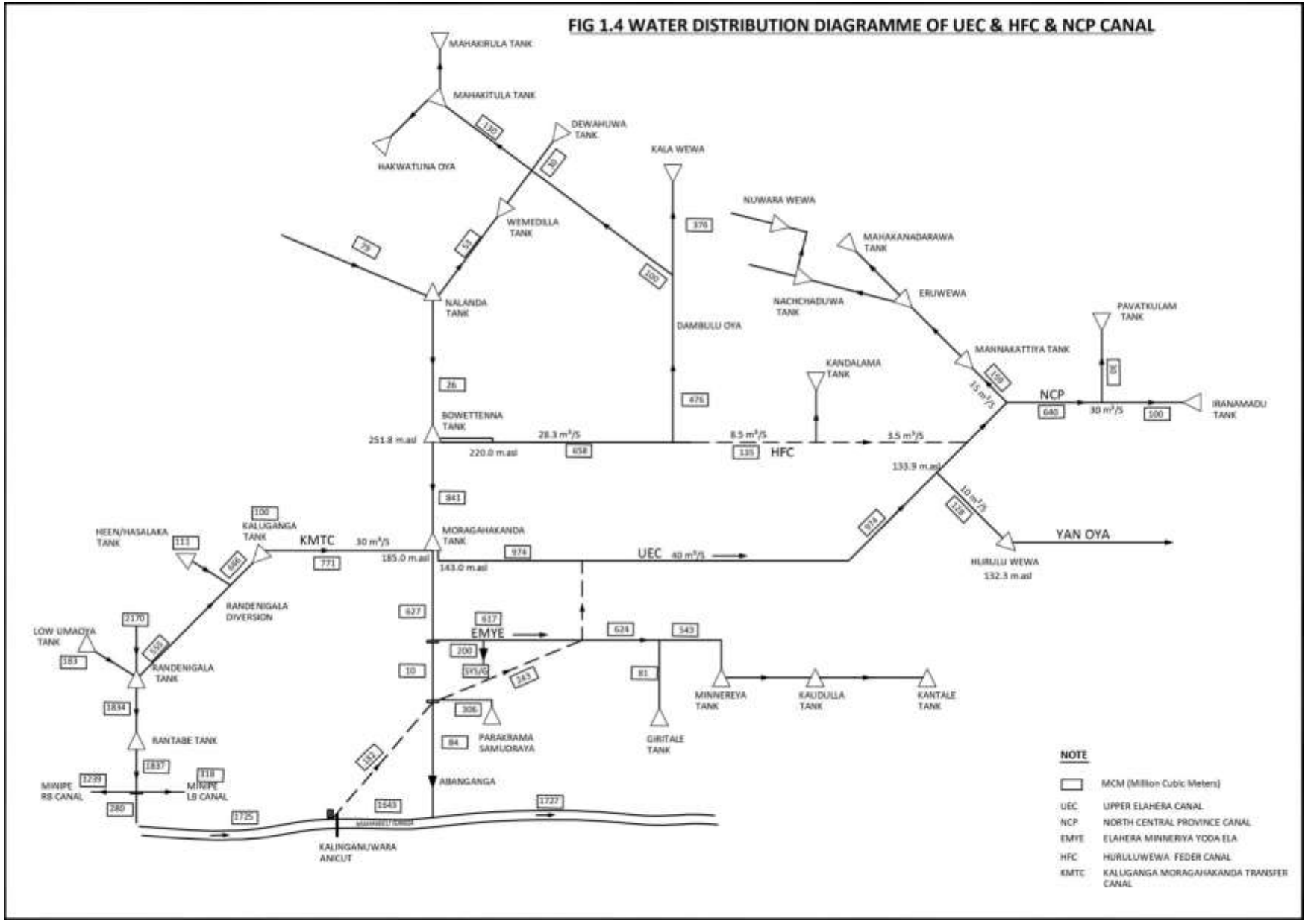


Figure 1.4- Water Distribution Diagram of UEC, HFC and NCP

Table1.2 Incorporation of the results of the EIA in designs

Issue and organization	Modifications to design/implementation phases
Drowning of wildlife especially small to medium sized animals in the canal - Department of Wildlife Conservation	Safe escapes for wild life in open canal reaches through modified trapezoidal concrete canal reaches to facilitate safe escapes to wild life (Figure 1.6)
Animals falling in and/or drowning in the canal- Department of Wildlife Conservation	Reduction of open canal sections as much as possible by having cut and covered conduits (single and double barrel) instead of open canal sections
Prevention and/reduction of locations at which animals, especially can cross the area containing the UEC, as it acts as a barrier- Department of Wildlife Conservation	Incorporation and establishment of corridors for wild life crossings, especially for elephants in the broader NCP Canal designs
Provision of drinking water for wildlife, especially for elephants and other large mammals- Department of Wildlife Conservation	Three existing reservoirs meant largely for provision of drinking water for wildlife, especially during the dry season, were incorporated as level crossings of the UEC. This will provide water from UEC into all three reservoirs and also improve the water table in the immediate vicinity of those reservoirs and allow riparian flows.
Habitat loss, fragmentation and degradation especially of forest and wildlife protected areas- Forest and Wildlife Conservation departments	Reduction of canal lengths through protected areas as much as possible
Habitat loss, fragmentation and degradation especially of forest and wildlife protected areas- Forest and Wildlife Conservation departments	Conversion of open canal or cut and cover section within protected areas into tunnels in some parts using a Tunnel Boring Machine (TBM)
Loss, fragmentation, degradation and increased risk of landslides in forested hill areas with high biodiversity- Forest and Wildlife Conservation departments	Tunnel reaches across hilly terrain to minimize conveyance system length through the forested areas, especially in the KMTC section
Loss, degradation of habitats and negative impacts on freshwater plants and animals in streams crossed by the UEC-Forest and Wildlife Conservation departments	An aqueduct across HeeratiOya, a natural stream

Disturbance to general flow pattern or the project area and existing hydrological patterns	The designs of the UEC through incorporation of several features, have taken precautions not to mix up the general flow pattern of the project area or the existing hydrology except for the three level crossings at “Kongetiyawewa”, “Bogahawewa” and “Madeththawawewa”

47 Details of some design modifications are given in Annex VI-Table 1.

48 Further mitigatory actions will be taken during the project implementation phase (construction and operation) to reduce impacts on wildlife and forests and sensitive areas.The Annex VI-Table 2 demonstrates the area of the UEC through protected areas and other types of land use.

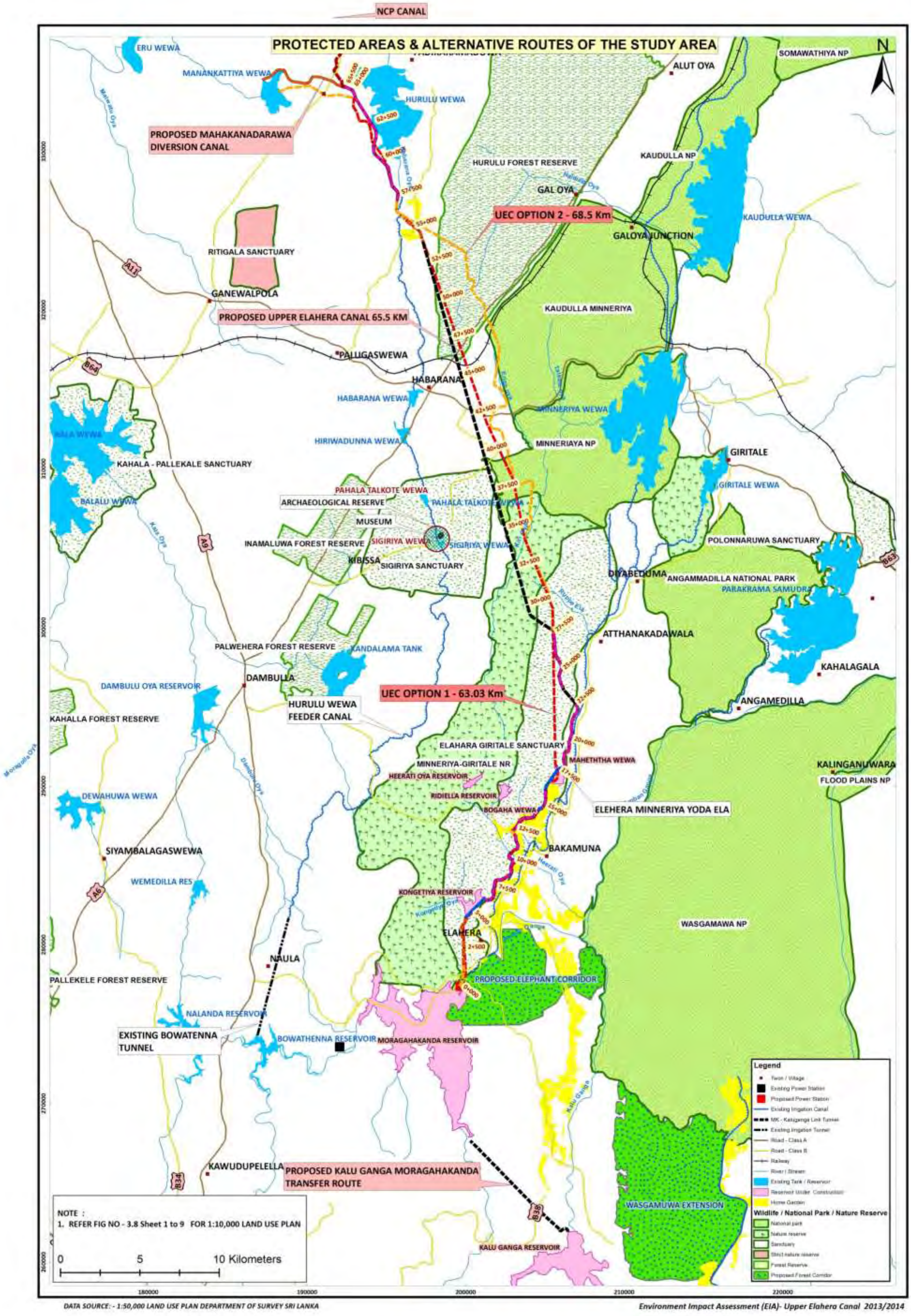
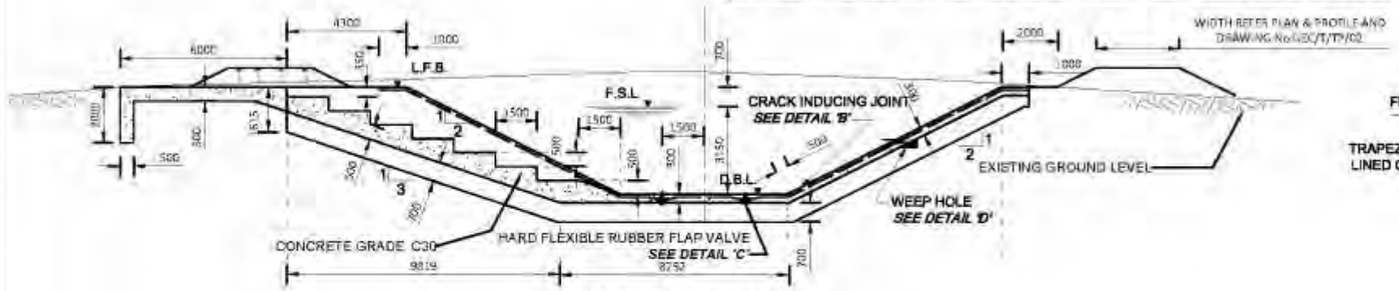
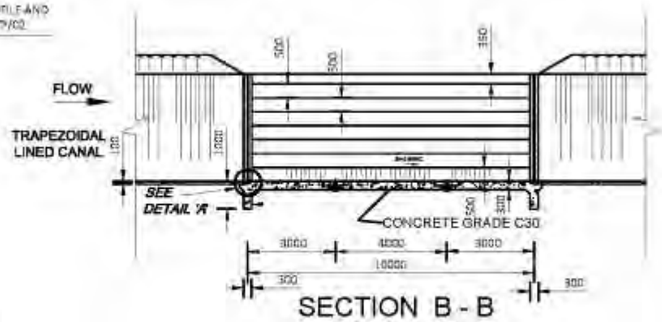


Figure 1.5- Upper Elahara Canal – Protected areas and Alternative Routes

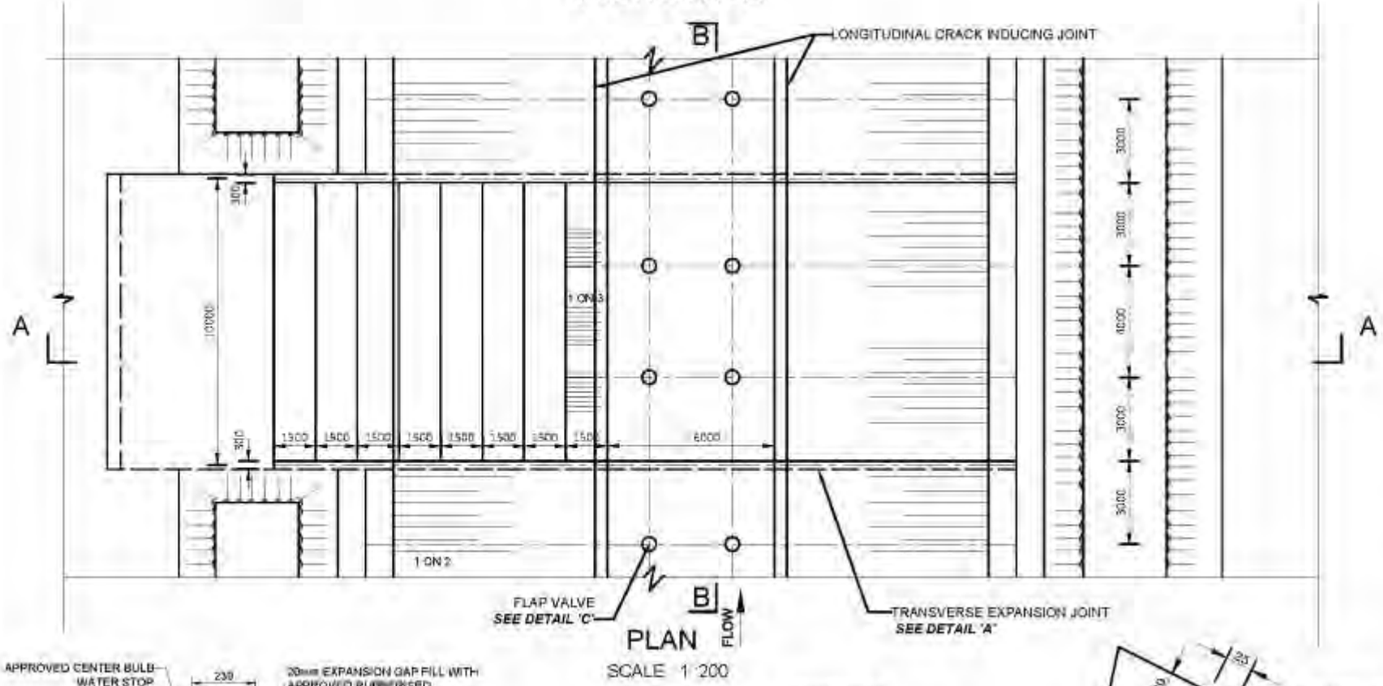
DETAILS OF WILD ANIMAL ACCESS /SAFE ESCAPE POINTS



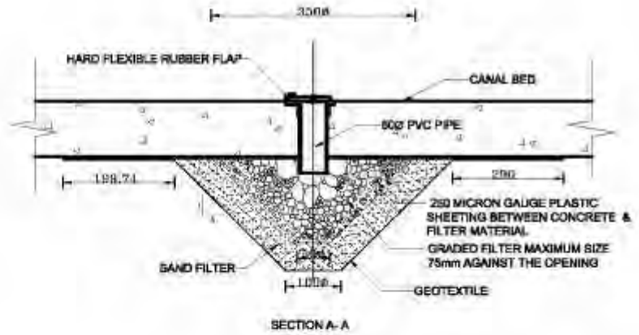
SECTION A - A



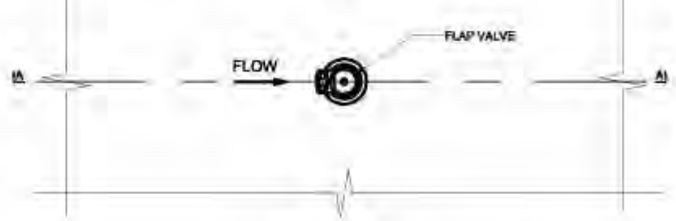
SECTION B - B
SCALE : 1:200



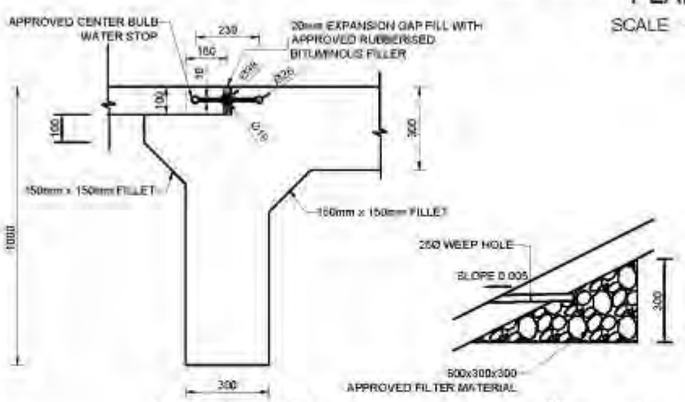
PLAN
SCALE : 1:200



SECTION A- A



PLAN
FLAP VALVE
DETAIL 'C'
SCALE:- 1 : 10

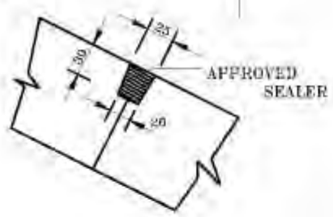


EXPANSION JOINT
DETAIL 'A'
SCALE : 1 :20

WEEP HOLE
DETAIL 'D'
SCALE :- 1 :20

TABLE 01
SUGGESTED LOCATIONS

No.	STATION (Km + m)	No.	STATION (Km + m)
1	6 + 510	15	14 + 210
2	6 + 850	16	15 + 010
3	7 + 210	17	15 + 610
4	7 + 610	18	17 + 805
5	8 + 010	19	18 + 605
6	8 + 410	20	19 + 005
7	9 + 010	21	19 + 405
8	9 + 560	22	19 + 805
9	9 + 810	23	20 + 205
10	10 + 310	24	20 + 605
11	10 + 910	25	21 + 005
12	11 + 510	26	21 + 405
13	11 + 810	27	21 + 805
14	13 + 810		



CRACK INDUCING JOINT
DETAIL 'B'
SCALE 1:5

NOTE
1. FOR STRUCTURAL GENERAL NOTES REFER DRAWING No. UEC/T/TP/01
2. ANIMAL ESCAPE STEPS SHALL BE PROVIDED ALTERNATIVELY ON EITHER SIDE INSIDE THE WILD LIFE RESERVE AREA

Figure 1.6 - Upper Elehara Canal-Details of Wild Animal Access / Safe Escape Points

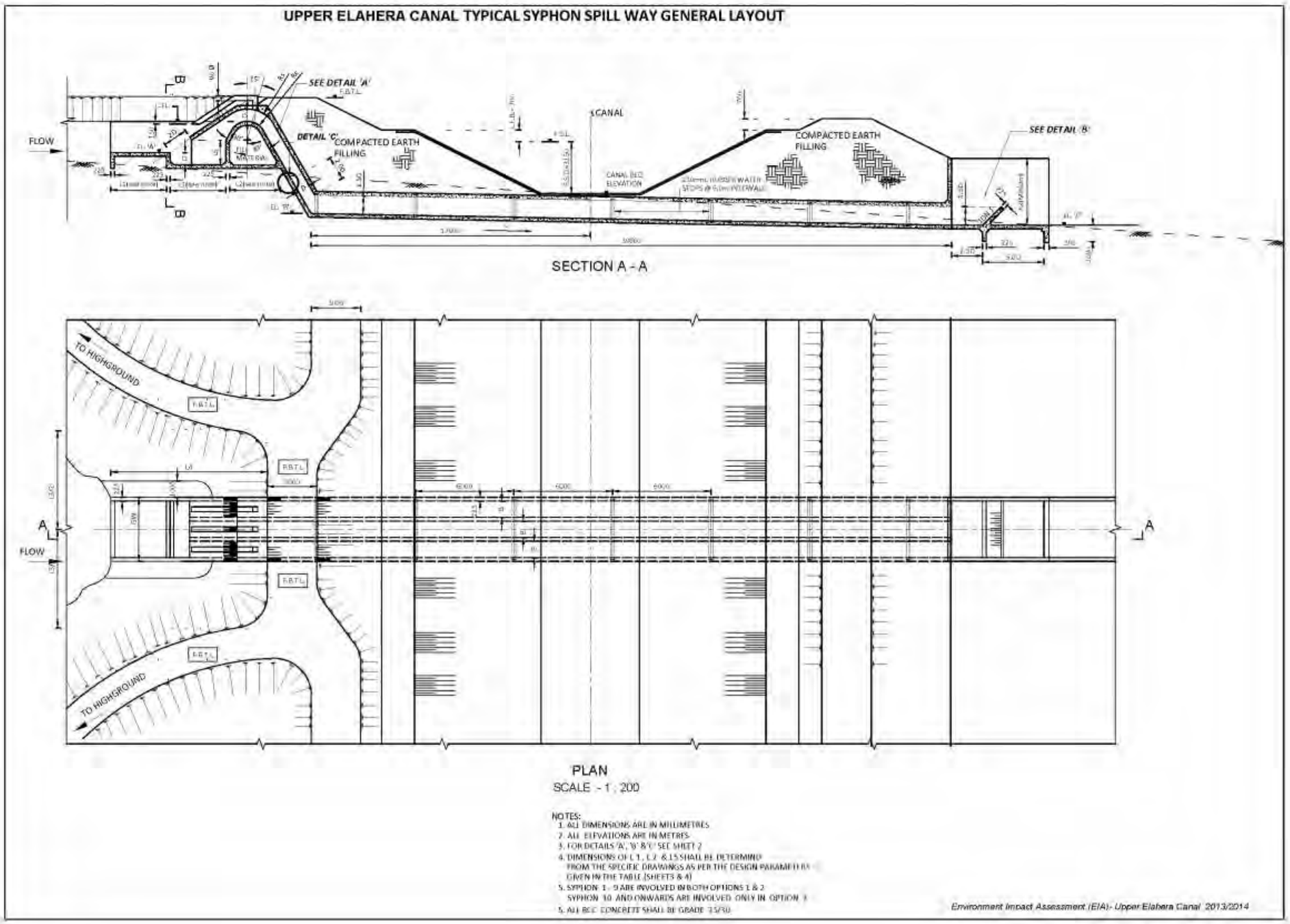


Figure 1.7- UEC – Typical Syphon Spillway General Layout

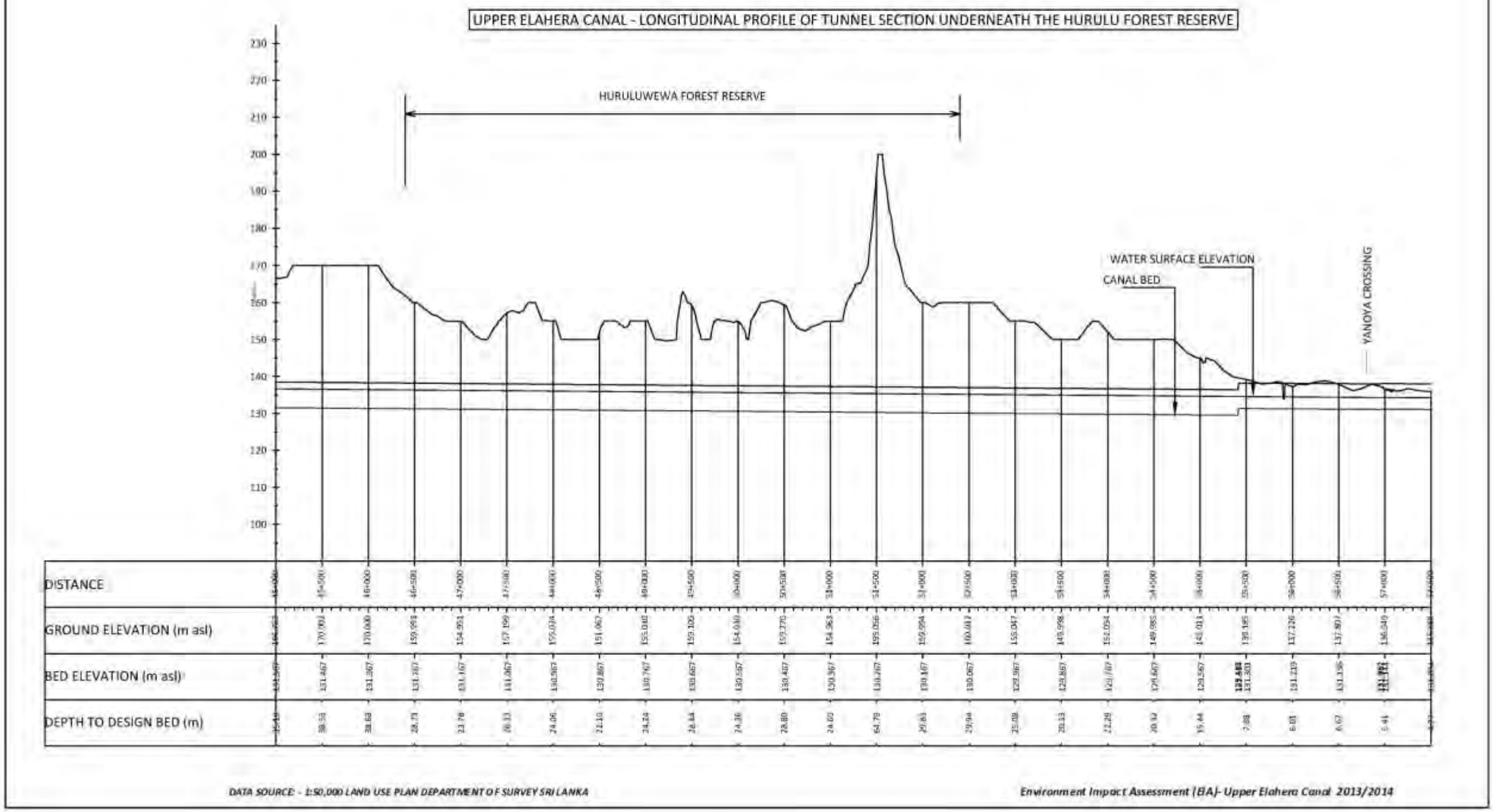


Figure 1.8- UEC – Longitudinal Profile of Tunnel Section Underneath the Hurulu Forest Reserve

LAYOUT PLAN FOR FAUNA-FLORA SAMPLING LOCATIONS OF UPPER ELAHERA CANAL & KALU GANGA MORAGAHAKANDA LINK CANAL

Fauna - Flora Sampling Locations				
	Local Coordinates		Global Coordinates	
No	Easting	Northing	Longitude	Latitude
1	200836	278281	80.7813	7.7087
2	199891	280318	80.7727	7.7271
3	199985	281790	80.7736	7.7404
4	201107	282949	80.7838	7.7509
5	204788	288612	80.8171	7.8021
6	205217	290217	80.8210	7.8166
7	206142	291194	80.8294	7.8255
8	206238	291221	80.8303	7.8257
9	206616	293062	80.8337	7.8424
10	206958	295183	80.8368	7.8615
11	206374	295886	80.8315	7.8679
12	205627	298910	80.8248	7.8953
13	205553	299707	80.8241	7.9025
14	201678	312577	80.7889	8.0188
15	200992	314335	80.7827	8.0347
16	199842	317493	80.7723	8.0633
17	197097	325006	80.7474	8.1312
18	195965	325990	80.7371	8.1401
19	206417	262073	80.8319	7.5621
20	206044	262000	80.8285	7.5615
21	205877	262035	80.8270	7.5618
22	204597	263370	80.8154	7.5739
23	204476	263392	80.8143	7.5741
24	204163	267864	80.8115	7.6145
25	200191	267790	80.7755	7.6138

Figure 1.9-Layout Plan for Flora and Fauna Sampling Locations of UEC and Moragahakanda Link Canal

1.5 Methodologies and Technologies adopted in EIA report preparation

1.5.1 Biological components

1.5.1.1 Objectives of the study of the biological environment

49 The study of the biological environment was conducted to fulfill the general objectives of the EIA in accordance with the TORs of the CEA and which are provided in Section 1.4.2. The considerations required in the ADB's Safeguard Policy Statement 2009 (www.adb.org) were also covered.

50 In accordance with the detailed TORs provided by the CEA, the specific objectives are to:

(i) Assess the status of the present biological environment and its major components.

(ii) Assess the impacts of the project on the biological environment and its components.

(iii) Propose mitigatory measures for all identified, significant impacts.

(iv) Develop a monitoring plan for implementation as part of the overall monitoring and management programme of the project.

1.5.1.2 General:

51 A desk review of information obtained through the literature with the findings of initial field visits along the entire project area was carried out to highlight the gaps in information and the areas where special attention should be paid during field surveys in March 2013. The surveys covered:

- Wildlife and Forest Department administered wildlife reserves, national parks, sanctuaries, elephant corridors, wetlands and forest reserves, riparian habitats, secondary/degraded habitats
- The entire route of the UEC including major and minor roads, home gardens, all major and minor tanks including sites of level crossings, associated canals, distribution channels, associated cascade systems, agricultural lands, burrow sites, disposal sites
- Assessment of the present ecological status of the study area including the aspects givenbelow;
    - Habitats and their ecological status: Major habitats of the study area and their distribution to be listed and ordered according to priority for conservation;
    - Habitats needing special attention by the project including any areas beyond the project sites, where there is potential for significant environmental impacts due to the project
    - Lists of species encountered in the UEC route
    - Lists of endemic/threatened or other species requiring special attention
    - Problems of Invasive Alien Species including locations needing special attention by the project, due to this threat

- Locations where ecosystem services are likely to be interrupted even temporarily due to the project

1.5.1.3 Methodologies of study of biodiversity and ecological resources

a) Methodology for study of flora and impacts on it including those from invasive plant species:

52 **S**urveys of habitats and flora was carried out to address the sections 3.2 (Biological Environment), 4 (Anticipated Environmental Impacts), 5 (Proposed Mitigatory Measures) and 9 (Environmental Monitoring Programme) of the TOR provided by the CEA. These included general and specific surveys to identify terrestrials and aquatic vegetation types/ major habitat types, floral diversity and distribution in the study area. The period of sampling was mostly in the dry season of 2013 (Jan-June), with some surveys being carried out during intermittent rain spells between the two monsoon periods as well.

53 The sampling locations were chosen based on the amount of disturbance that will be caused by the project. Accordingly, open channel sections, the cut and fill sections, aqueduct sections and the entry and exit points of the tunnel sections of the upper Elahera canal as well as the Kalu Ganga Moragahakanda link canal has been investigated in detail. Line transects (500m long) were carried out in each of these sections to identify the type of habitats that will be impacted and document the inventory of species present in these habitats. Altogether 25 line transects were carried out, 18 in the Upper Elehera canal and 7 in the Kaluganga-Moragahakanda link canal. The GPS coordinates of the starting point was recorded with a hand held GPS so that these transects can be repeated subsequently for monitoring purposes. The 25 flora fauna transects points are shown in figure 1.9.

54 The survey identified the major habitats / vegetation formations, populations and communities of flora (terrestrial and aquatic) along the Upper Elahera canal trace and possible impacts on habitats and flora due to the interventions of the proposed project were assessed. In addition a survey of habitats, flora and fauna was carried out of the areas indirectly affected by the project activities (e.g. quarries, refuse disposal areas, work camps, temporary access roads, etc.)

55 A greater emphasis was placed on sampling the area demarcated for the proposed canal construction due to the type and magnitude of potential impacts.

56 Plant species found in all habitats along the proposed canal were recorded by walking along transects to get a rapid assessment of the plant diversity. In addition several transects were marked in representative habitats and 5x100 m plots/ quadrats demarcated to enumerate flora/ populations and plant communities. Available land use maps (1:50,000 or 1:10,000) were be used as the base maps for the study.

57 All vascular plant species were recorded on a plot-by-plot basis (10 m x 5 m) within every quadrat (100 m x 5 m) of a transect. The number, estimated height (with the exception of climbers) and DBH (Diameter at Breast Height) of individuals exceeding 5 cm DBH was also recorded. If the felling of trees was required for project activities, a list

of species and their diameter (>30 cm DBH) would be prepared. Any herbaceous species within a quadrat was recorded as present (but individuals are not counted). The presence of additional species encountered along the transect, between quadrats, was recorded separately. Any other additional species encountered within the protected areas (Minneriya National Park, Elehera-Minneriya Sanctuary, Minneriya-Giritale Nature Reserve, Hurulu Forest Reserve etc.) were also recorded. Specimens of unidentifiable, previously unrecorded or otherwise notable species were collected, photographed and deposited in the Herbarium of the University of Sri jayawardenapura. Locations of all transect and sampling points of flora were geo-referenced.

58 The conservation status of the species was determined according to The National Red List Data (2012) of Sri Lanka, Biodiversity Secretariat, Ministry of Environment, and Governmentof Sri Lanka.

59 Name of the plant family, species name, local name of plant, life form, taxonomic status (Endemic, Indigenous, Introduced), and conservation status (threatened, endangered etc.) of species found in all habitats of the proposed project area was compiled. The observed flora species was identified by using published descriptions and taxonomic keys provided by Dassanayake and Fosberg- Handbook to the Flora of Ceylon (1980 - 1991), Dassanayake, Fosberg and Clayton (1994 - 1995), Dassanayake and Clayton (1996 - 2000), Dassanayake, Clayton and Shaffer-Fehre (2006. In addition rare species that were known from the general area of the project but was not found during these surveys were also noted.

60 The diversity and occurrence of invasive alien plant species in the study area was studied as well.

b) Methodology for study of fauna and impacts on it including those from invasive animal species

61 General and specific surveys to identify terrestrial and aquatic faunal assemblages, their major habitat types, faunal diversity, distributions etc. in the study area was carried out by the faunal specialist. The surveys included:

a) Elephants including human-elephant conflict issues; Human-animal conflicts.
b) Other vertebrates with special attention such as freshwater fish, amphibians, reptiles, birds and mammals.
c) Diversity and occurrence of invasive alien animals in the study area.

62 As in the case of flora, points samples were taken on identified major habitats. Both direct observations as well as verifiable indirect observations such as nests, droppings, footprints, and calls were recorded. When direct observation was possible the identity and number of individuals was recorded. Locations of each sampling transect/point was geo-referenced.

63 Aquatic fauna was surveyed using various sampling gear such as cast nets, fine meshed drag nets, hand nets and scoop nets. Furthermore, interviews were conducted with

the fishermen in the area in order to collect information on the species present. Aquatic amphibians and reptiles were recorded by direct observations. Aquatic birds were sampled using the point count method. Both direct observations and indirect observations such as existence of nests, droppings and calls were recorded.

64 The different types of natural habitats present in the study site were finally determined based on the observations recorded during the fauna and flora inventory.

c) Determination of conservation and taxonomic status:

65 The conservation status of the species was determined according to The National Red List Data (2012) of Sri Lanka, Biodiversity Secretariat, Ministry of Environment, and Government of Sri Lanka. The global conservation status was determined using IUCN 2014. The endemism, potential to become nuisance species such as invasive species and pests and those of commercial importance were determined based on the published information.

66 The animal classification, nomenclature, endemism and local names is in accordance with D'abrera (1998), Fonseka (1998), Pethiyagoda (1991), Dutta and Manamendra-Arachchi, (1996), De Silva (1996); Pethiyagoda&Manamendra-Arachchi, (1998), Inskipp*et al* (1996), and Corbet and Hill (1992).

1.5.2 Physical components

67 The physical environment to be considered under this study includes topography, geology and soils, climate and meteorology, surface and ground water hydrology, water quality including sources of water pollution and land use of the project area. This information was collected from a literature survey and information collected during field work.

1.5.2.1 Objectives of the study of the Physical Environment

68 The study of the physical environment was conducted to fulfill the general objectives of the EIA in accordance with the TORs of the CEA and which are provided in Section 1.4.2.

In accordance with the TORs provided by the CEA, the specific objectives are to:

(i) Assess the status of the present physical environment and its major components.
(ii) Assess the impacts of the project on the physical environment and its components.
(iii) Propose mitigatory measures for all identified, significant impacts.
(iv) Develop a monitoring plan for implementation as part of the overall monitoring and management programme of the project.

1.5.2.2 Methodologies for the study of the Physical Environment

69 ACRE's Reservoir Simulation Program (ARSP) and Irrigation Demand Model were used by the design engineers by taking 40 years data with present day irrigation

water requirement. Details are given in the Water Balance Study of NCP Canal Project under Method of Analysis (MCB, 2013). Additional reports including the Pre-Feasibility Report of the NCP Canal Project, engineering drawings, and previous studies were made available.

70 The methodology used to achieve the objectives of the TOR were as follows:

a. Reviewed the feasibility studies carried out for Moragahakanda and Kaluganga projects, land use patterns, water balance studies related to NCP Canal Project and all available hydrology related studies in the project area in order to assess the adequacy of hydrological studies. Studied the historical records of floods. The groundwater conditions were studied using the data available in the Water Resources Board (WRB)

b. The geological investigations carried out under the Project including water pressure tests, geological logging, soil data etc, all the available geological maps, topographical maps and other available geological reports and proposed blasting methods were studied.

c. Existing irrigation systems including major and minor systems, proposed canal and design assumptions, design criteria and used parameters were studied. The key physical parameters related to the irrigation structures under the Project are the open canal sections, tunnels, closed conduits and level crossings.

d. Proposed construction methodology of all the infrastructural developments, their impacts on the environment, and proposed measures for mitigation of the impacts in the designs were studied. Major construction sites were identified and their access routes, borrow areas, quarry sites, disposal methods of excavated material etc were noted. Need for service roads during the operation and maintenance phases and the possibility of using the existing roads for construction and O&M activities were investigated.

e. The Team visited the proposed canal/tunnel trace and made an assessment of the field conditions. Stream-crossing locations, proposed tunnel portals, conditions affecting slope stability and groundwater table, areas where soil erosion could take place due to project interventions were identified.

71 The outputs from the study of physical environment were:

a. Hydrological map showing the streams, water bodies, rainfall stations.

b. A detailed geological map for the study area, recommendations for essential drilling locations and additional drilling locations

c. Maps of proposed infrastructure, quarry sites and assessment of disposal requirements helping to identify disposal locations and methods of disposal

d. Identification of impacts on the environment including those on soils, slope stability, surface water and groundwater table.

e. Quantification of excavated material and its anticipated composition were quantified.

f. An assessment of the interactions/interdependence of project components with other irrigation developments of the area and impacts on the current irrigation users

g. An assessment of the proposed blasting methods and their impact on the general environment, groundwater resources, noise pollution, air pollution etc

h. Mitigatory measures for the impacts including precautionary methods to be adopted at the identified weak zones during construction,

1.5.3 Human settlements and land use (socio-cultural environment)

1.5.3.1 Scope of studying socio-cultural impacts:

72 The direct impact zone of the social – cultural environment for the proposed EIA includes following areas as defined by TOR:

1. Kalu Ganga - Moragahakanda transfer canal/tunnel
2. Upper Elahera canal route
3. Mannankattiya tank and Mahakandarawa tank link canal

73 Therefore, the study area was defined as the above-mentioned direct impact zone and any area with an anticipated significant social- cultural impact during construction, operation and maintenance phases of the proposed project.

1.5.3.2 Objectives of the social survey

74 The main objective of the social survey was to identify and evaluate the likelihood of impacts due to project interventions. This is in accordance with the TORs set by the CEA (section 1.4.2) for this aspect and the Social Safeguards mechanism of the Asian Development Bank. A separate social safeguard survey was conducted under the resettlement plan of affected households.

75 Secondary objectives are: To identify the positive and negative impacts of the proposed project interventions not limiting to the following aspects as mentioned in ToR document issued by the CEA.

a. Impact on present and future water users and limitations in sharing water and related issues especially in Amban Ganga basin.

b. Impacts due to increased cropping intensity of lands for agricultural purposes (if any)

c. Effects on existing and proposed settlements of the area including livelihoods.

d. Impact due to relocation of communities and loss of property including agricultural lands.

e. Impacts on safety of project affected persons, occupational health and safety, community health including sanitation.

f. Impacts on vulnerable groups.

g. Gender Issues

h. Impacts on indigenous communities (if any)

i. Impacts on occupational safety of project employees

76 Based on the information from the social survey and safeguards survey the following will be proposed in the EIA.

- Propose measures to mitigate the negative impacts and enhance the positive impacts.
- Develop an environmental monitoring programme to measure the social impact mitigation process.

77 In order to collect following specific information as per the ToR the following information was gathered.

a. Population characteristics, number and type of settlements, current water supply and water uses including existing irrigation schemes

b. Distribution of income and sources, goods and services

c. Cultural, historical. Protected resources and archeological aspects/considerations.

d. Existing health and infrastructure facilities

e. Existing environmental issues in the area.

f. Existing health issues in the area.

78 The details required to fulfill the social and cultural environment as specified in ToR were obtained through secondary data available with respective local authorities and through other stakeholder agencies. In addition a household questionnaire survey was used to understand the socio-economic profile of the affected community due to proposed project activities. The methodology adopted in EIA report preparation with respect to the Social Environment is summarized in the following sections;

a. Scoping and Reconnaissance

79 The project background, design and the study area was understood through the scoping meetings held with the Ministry of Irrigation and Water Resources Management and consultants of NCP and UEC canal projects. A reconnaissance visit was made to the project area to identify the direct and indirect impact zone of the project with respect to Social environment and GIS based maps prepared to identify land use and settlement areas.

b. Secondary data collection

80 Several stakeholder discussions and individual meetings were had with the respective Divisional Secretaries, GramaNiladharis, Agriculture officers, Samurdhi officers and other provincial and village levels government and non-government agents to obtain available socio-economic data of the study area.

c. Field social surveys

81 Two types of questionnaires developed to conduct rapid social surveys;

I. *GramaNiladhari*[1] *Questionnaire* - for GramaNiladhari's(GN) to obtain information of the socio-economic environment of the proposed project area.

II. *Household Survey Questionnaire* - for the affected community to obtain socio-economic profile and to find out their views on the proposed development and its impacts.

82 ***The field surveys were conducted in 3 stages;***

i. Visited 7 divisional secretariat divisions (DSDs) located in Matale, Polonnaruwa and Anuradhapura districts and met 20 GNsof the area to complete the GramaNiladhari Questionnaire and to collect all the relevant back ground information.

ii. Based on the information collected from each GramaNiladhari, walked along the canal trace giving special attention to the identified socio-economically sensitive areas. Where the project area lies within human settlements, commercial areas, religious places etc. such locations were geo-referenced and details obtained.

iii. Conducted the household questionnaire survey within 50 m either sides from the centre line of UEC canal trace and visited the proposed resettlement sites to observe the existing socio-economic conditions and their suitability from a sociological point of view.

83 (See Annex VI - Table 4 for administrative boundaries of the UEC recommended route.)

1.5.3.3. Methodology of the Socio-Economic Survey

84 The magnitude of the study area for the socio-economic surveys covers the 50 meter width area of the canal trace (25 meters each from the center line).The geographic locations for proposed development interventions and covers even areas beyond this for

[1] Grama Niladhari is the head of the lowest administrative division- grama niladhari division- in Sri Lanka

data collection where there are potential environmental impacts such as impacts on human settlements.

85 The geographical locations studied include:

- Fifty (50) meter vicinity of the proposed canal.
- Land identified for construction of the canal.
- Potential lands for resettlement

86. The survey methodology was developed within the framework of the involuntary resettlement guidelines according to the National Involuntary Resettlement policy (NIRP). Accordingly, data and information were collected under four steps.

1. A socio-economic survey was carried out covering all affected families within the area due to the project.
2. An additional impact measurement survey was carried out for the downstream community living in the close vicinity to measure the positive or negative impacts.
3. Further focus group discussions were held covering all the affected GN divisions of all DS divisions.
4. Collected data and information through government and other institution such as GN offices, DS offices, Agrarian Services, Agricultural Department and community leaders etc.

87. The topics covered under the general questionnaire are as follows;

- Significant improvements in livelihood
- Influenced family activities
- Influenced on Agriculture
- Influence on health, social life
- Negative impacts economically, socially and environmentally affects on other infrastructure facilities.

1.5.4 Methodology for the Archeological assessment

88. An analysis of the history of the project area (as defined by the TORs of this EIA) was carried out by searching the literature, study of old records, research in the museums, currentdocuments, study of folk stories maps, plans and photographs of currently known archeologically important sites.

89. Identification of the archaeologically important sites of the project area was mainly carried out through nondestructive methods such as study of aerial photographs, field walking, collection of samples, etc. All identified archeological remains were graphically and photographically recoded and presented by way of location maps with GPS coordinates, plans, sections, elevations, and detailed drawings where necessary. All artifacts were recorded to identify the location and analyzed the investigation methodology adopted in this survey was to evaluate a site in order to test for the extent and character of strata, assemblage, artefacts and ecology. During this survey investigations were carried

out also to identify and evaluate physical archaeological remains. The evaluation was carried out by surface field Surveys. The area was extensively investigated to identify all historical developments in the area as well as to identify the visible archaeological remains.

90. The method of systematic field walking was used to explore the entire project area. Collection of samples, establishment of marks, taking photographs, preparation of plans was carried out at the site during the survey. The maps, and plans among other equipment required for such a survey were used.

91. A set of mitigatory measures and a monitoring plan for conservation of sites of archaeological value in the project area is provided in the independently conducted archaeology assessment report. The set of recommendations from it are included in the mitigatory measures described in Chapter 5 and the monitoring aspects are dealt with in Chapter 9. The findings of the archaeological assessment have contributed to the overall conclusions of this EIA.

1.5.5 Proposed Mitigatory Measures

92. Each major impact of a sector has a set of associated mitigatory measures.

93. Each mitigatory measure will be cost in order to be included in the overall project cost.

1.6. Policy, Legal and Administrative Framework

94. There are numerous policies, legal instruments and administrative procedures governing the socio-economic and environmental aspects of the proposed project.

95. Given below is a brief description of the policy framework governing the irrigation and water resources management sector of the country.

A) Policy

1. The Constitution of the Democratic Socialist Republic of Sri Lanka of 1978 enshrines commitment for safeguarding the natural environment as seen from the following:

96. Under chapter VI Directive Principles of State policy and Fundamental duties in section 27-14,"The state shall protect, preserve and improve the environment for the benefit of the community."

97. Article 28 (f),"It is the duty of every person in Sri Lanka to protect nature and conserve its riches."

2. The development policy framework of the Government of Sri Lanka, *Mahinda Chintana Vision for the Future*, (Ministry of Finance and Planning 2010,http://www.treasury.gov.lk/publications/mahindaChintanaVision-2010full-eng.pdf)

98. Acknowledges that "Throughout the history of Sri Lanka, water has played akey role in development of the country and economic status of its people, and in shaping its culture and the tradition". Water resources development and management is listed as one

of five main drivers of the irrigation policy of Sri Lanka and will in turn be aimed to "harness the optimum use of surface and ground water resource…… While preserving the groundwater table and the environment". The NCP Canal is given high priority among the new projects to be undertaken and completed by 2018.

3, The Annual Report 2012 of the Ministry of Finance and Planning, Sri Lanka indicates the government policy towards trans-basin water diversions in the following manner:

99. "Trans-basin diversions of water is one of the solutions for water shortage, where such potential for water diversion exists. Positive impacts of such diversions were clearly seen during 2012 drought, from the work already done in the Hambantota District which includes *Mau Ara*, *Weli Oya* and *Weheragala* (*Menik Ganga*) diversions. Currently more such projects including the construction of *Uma Oya*, *Yan Oya* and *DeduruOya* to divert water across basins to water short areas are in progress and the feasibility studies of *Gin-Nilwala* diversion and North-Central Province (NCP) Canal Project are being explored."

4. Environmental Policy

4.1 The National Environment Act No. 47 of 1980 and its subsequent amendment by Act No. 56 of 1988 and Act No. 53 of 2000

100. This is the umbrella strategy for environmental protection in the country. This also established the Central Environmental Authority in 1980. The National Environmental (Amendment) Act No. 56 of 1988 introduced EIA, as a part of the strategy to achieve sustainable development for the entire country and the Central Environmental Authority was assigned regulatory functions (Central Environmental Authority of Sri Lanka http://www.cea.lk/web/index.php/en/law-policy-and-institutional-arrangement-for-eia-in-sri-lanka).

4.2 National Environment Policy 2003

101. Even though there has been polices and measures including institutional plans and programmes on the environment since the 1908s, these were insufficient to maintain environmental integrity and support sustainable development. Therefore a policy that will bind all organizations and individuals who use environmental resources or otherwise have an impact on the resources to exercise due care to avoid environmental degradation was required. This formed the basis for formulation of the National Environment Policy of 2003. This instrument is supported by many other policies, strategies and legislation in numerous other sectors.

102. The policy objectives are:

1. 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

2. To manage the environment by linking together the activities, interests and perspectives of all groups, including the people, non-government organizations and government at both the central and the local levels

3. To assure environmental accountability.

103. Principles of the policy are:

1. The guiding principles of environmental management will be "the polluter pays" and the need to reduce consumption, and recycle and reuse materials to the maximum extent possible.

2. 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.

3. When non-living resources are used, it will be ensured that such use is consistent with environmental best-practice, bearing in mind the need to provide also for future generations.

4. Traditional knowledge and practices will be respected in the development of environmental management systems.

5. Effective governance will be ensured through the decentralization of environmental management services to the maximum possible extent.

104. There are twelve (12) statements and explanation of key concepts/terms used in the policy.

105. There are outcomes provided for the three sectors of Land, Water, The Atmosphere and Biological Diversity, and environmental strategies for the six key economic sectors given below

- Forestry and Wildlife Conservation
- Agriculture, Plantations, Land development and Mining
- Fisheries, and Coastal and Marine Area Management
- Industry and Tourism
- Energy and Transport
- Health, Sanitation and Urban Development

106. Other policies of relevance to this EIA are:

- National Forestry Policy 1995
- National Policy on Wetlands 2005
- The National Policy on Wildlife Conservation 2000
- The National Policy on Solid Waste Management
- National Policy on Air Quality Management 2000
- National Policy on Sand as a Resource for the Construction Industry – 2006

B) Legal Framework

107. There are many other sectoral and cross cutting national legislative enactments are relevant this this project. Sri Lanka is also signatory to many multi-lateral environmental agreements that provide additional support to its national policy and legal instruments

108. The major acts and regulations of direct relevance to this project are:

- The Mahaweli Authority of Sri Lanka Act No. 23 of 1979
- Irrigation Ordinance No 32 of 1946, Act No. 1 of 1951, No. 48 of 1968, Law No. 37 of 1973, amendment Act No. 3 of 1994
- Soil Conservation Act No. 25 of 1951, amendments of Act No. 29 of 1953 and Act No. 24 of 1996
- Land acquisition Act of 1950 with subsequent amendments, latest in 1986
- Antiquities Ordinance (Act) No. 9 of 1940 and its subsequent amendments by Act No. 24 of 1998 and Act No. 12 of 2005. Related to this area is the Recovery of Government Possessions Act No. 7 of 1979.
- The National Environment Act (NEA) of 1980, amended by Act. 56 of 1988 and Act. 53 of 2000
- Fauna and Flora Protection Ordinance of 1938 and its amendment by Act No. 49 of 1993 and amendment by Act. 22 of 2009
- The Forest Ordinance No 16 of 1907 and its subsequent amendments, the most recent being in 2009
- Mines and Minerals Act of No. 33 of 1992
- Sri Lanka Electricity Act No. 20 of 2009
- Municipal Council Act No. 19 of 1987 and Urban Council Act No. 18 of 1987
- Urban Development Authority Act No. 41 of 1978, amendment by Act no. 36 of 2007

a) Legal and Administrative Framework for Environmental Impact Assessment

109. The National Environment Act introduced an internationally accepted process called Environmental Impact Assessment (EIA) as part of the strategy to achieve sustainable development. The legal framework for the EIA process in Sri Lanka has been laid down in the NEA.

110. "Part IV C of the amendment act of the NEA mandated that all "prescribed" development projects are required to be subjected to Environmental Impact Assessment. Only large scale development projects that are likely to have significant impacts on environment are listed as prescribed projects. In addition "prescribed projects" if located in "environmental sensitive areas" are required to undergo EIA irrespective of their magnitude. The prescribed projects are listed in the gazette No 772/22 of 24th June 1993, 859/14 of 23rd February 1995, 1104/22 of 5th November 1999 and 1108/1 of 29th November 1999 (Central Environmental Authority of Sri Lanka (http://www.cea.lk/web/index.php/en/law-policy-and-institutional-arrangement-for-eia-in-sri-lanka).

111. There are two levels of the EIA process- the Initial Environmental Examination (IEE), which is a relatively short and simple study. And if the potential impacts appear to be more significant, an Environmental Impact Assessment (EIA) which is a more detailed and comprehensive study of environmental impacts. Accordingly, in Sri Lanka, all the prescribed projects have to be provided with an Initial Environmental Examination Report or an Environmental Impact Assessment Report, as required by the Project Approving Agency. When such a report is prepared, a notice would be made in the gazette and news papers in three national languages, informing the place and time the report would be available for public inspection and inviting for comments.

112. The EIA process under the NEA is summarized below;

1. The project proponent needs to submit some preliminary information about the project to the CEA, in order to initiate the EIA / IEE process. This could be submitted through a Basic Information Questionnaire which could be obtained from the CEA
2. EIA process is implemented through designated "Project Approving Agencies (PAA)" led by the Central Environmental Authority (CEA). The PAAs are EIA administrative agencies that are responsible for guiding the EIA for projects and for issuing EIA approval or rejection. A single PAA is appointed as the appropriate PAA for each EIA by the CEA.
3. EIA / IEE process involves 6 major steps; (i) screening (ii) scoping (iii) preparation of the EIA / IEE report (iv) review of the report (by the public and the PAA) (v) approval with terms and conditions or rejection with reasons (vi) post approval monitoring. The step wise process has been defined in the EIA regulations which have been published in the Gazette No. 772/22 of 24.06.1993

4. The EIA reports are required to be open for public inspection and comment for a mandatory period of 30 days (excluding holidays), in all three national languages of Sri Lanka

5. The PAA is responsible for implementation of each step of the process except preparation of EIA / IEE reports. The project proponent or consultants hired by the project proponent is responsible for preparation of the EIA / IEE report.

6. The time allowed for the PAA for each step has been stipulated in the Gazette (as described above) provided that the information submitted by the project proponent is sufficient to proceed.

7. EIA regulations under the NEA are applicable only for projects which are located outside the coastal zone. The EIA process for projects located within the coastal zone is handled by the Coast Conservation Department.

113. As stated before, the CEA plays the pivotal role in environmental impact assessment. There are several other key national agencies with a mandate for environmental management and protection. The Forest Department, Department of Wildlife Conservation, Department of Archeology, Department of Coast Conservation, Disaster Management Center and Geological Survey and Mines Bureau are some of them and have their regional offices and staff to cater to and monitor the environmental safeguards. EIA aspects are also included in the Fauna and Flora Ordinance(Amended) Act No. 49 of 1993. Any development activity of any description what so ever proposed to be established within one mile from the boundary of a National Reserve, is required to be subject to EIA, and written approval should be obtained from the Director General, Department of Wild Life Conservation prior to implementation of such projects"

114. Provincial Councils and local authorities also have provisions under their respective acts to safeguard and maintain the environment for the benefit of the public in their respective areas. Further the respective local authorities have a mandate regionally to implement the project activities and monitor the progress of compliance work. The Municipal Council Act for example, covers public health, drainage, latrines, unhealthy buildings, conservancy and scavenging, nuisance etc.

115. **Strategic Environmental Assessment -** Even though EIA has been conducted at project level since 1993, it became apparent that cumulative impacts are not addressed through this alone and therefore inadequate for addressing sustainability of development. Therefore the CEA has initiated preliminary guidelines for Strategic Environmental Assessment (SEA). While SEA is yet not a mandatory requirement, implementation of SEA for policies, programmes and plans has been approved by the Cabinet of Ministers of the Government of Sri Lanka. The Government has carried out two strategic environmental assessments for the Mahaweli System and National Level Water Resources Planning prepared under MIWRM's Dam Safety and Water Resources Planning Project (2012).

b) Environmental Protection Licensing

i. Licensing by the CEA

116. The Environment Protection License (EPL) Scheme is a protective and regulatory tool enforceable by law under the provisions of the NEA. These are issued under the Order published under the Gazette Notification No. 1533/16 dated 25.01.2008 and National Environmental (Protection and Quality) Regulations,No. 1 of 2008. Licenses should be obtained prior to commencement of operations. The aim is to prevent and/or minimize pollution of water, atmosphere, soil and surface of the land and control of excessive noise, ensure emissions / discharges in accordance with national standards and to provide guidance on pollution management. Prescribed activities (activities which involve or result in discharging, depositing or emitting waste into the environment causing pollution) and requiring EPLs are provided in Order published under the Gazette Notification No. 1533/16 dated 25.01.2008. National Environmental (Protection & Quality) Regulations, No. 01 of 2008 published in Gazette Extraordinary No. 1534/18 of 01.02.2008set out the standards for different categories of activities

117. Regulations of the CEA on air, noise, waste management including municipal solid waste are available at http://www.cea.lk/web/index.php/en/acts-regulations. These are relevant to this project as there will be issues of air quality, noise and vibration, waste management due to project activities. The waste management licenses apply to Generator, Collector, Storer, Transporter, Recycler, Recoverer, and Disposer

ii. Licenses issued by the Geological Survey and Mines Bureau

118. Under the Mines & Minerals Act No. 33 of 1992, the GSMB issues three types of licenses, i.e., Exploration, Mining, Trading and Transport. Details of these licenses are as follows:

119. Exploration licenses (EL): An Exploration license grants the license-holder the exclusive right to explore for all mineral categories authorized by the license

120 Mining Licenses - Artisanal (AML) :Grants the license-holder the exclusive right to mine, process and trade in all minerals specified in the license within an area not exceeding ten hectares or to a depth not exceeding twenty five meters.

121 Category A - which shall include one or more of the under-mentioned conditions

- The depth of bore hole to be less than 1.5 meters;
- The production volume to be not less than 100 m3 and not more than 600 m3 per month;
- No machinery to be used

122 *Category B* - which shall include any one or more of the under mentioned conditions.

- The depth of the borehole to be less than 1.5 meters;

- Production volume to be not exceeding 100 m3 per month;
- No machinery to be used.

123 Source: Geological Survey and Mines Bureau

124http://www.gsmb.gov.lk/web/index.php?option=com_content&view=article&id=100%3Alicenses-a-procedures&catid=44%3Aservices&Itemid=68&lang=en

C) Other legal and administrative entities

125 Other legislation of relevance to this project is given below. They are administered through various institutions.

- Agrarian Services Act (58 of 1978), Agrarian Development Act no. 46 of 2000
- Water Resources Board No. 29 of 1964
- National Water Supply and Drainage Board Act No. 2 of 1974
- Plant Protection Act No. 35 of 1999
- Tourism Act (2005)
- The Flood Protection Ordinance Act No.22 of 1955
- Disaster Management Act No. 13 of 2005

D. Multilateral Environmental Agreements

126 Sri Lanka is signatory to many Multilateral Environmental Agreements (MEAs) that provide international support to its national policy and legal frameworks.

127 Those of most relevance are given in Table 1.3 below.

Table 1.3 International conventions, policies and treaties of relevance to the project

MEA	Date of Ratification
Air	
United Nations Framework Convention on Climate Change (1992)	23rd November 1993
Vienna Convention for the Protection of the Ozone Layer (1985)	15th December 1989
Montreal Protocol on Substances that deplete the Ozone Layer (1987)	12th December 1989
Kyoto Protocol	3rd October 2002
Biodiversity	
International Plant Protection Convention (1951)	12 February 1952
Plant Protection Agreement for Asia and the Pacific Region (1951)	27th February 1956
Ramsar Convention on Wetlands (1971)	

Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)- Man and Biosphere Programme	March 1987
Convention on International Trade in Endangered Species Of Wild Fauna and Flora (1973)	7th May 1979
Convention on Biological Diversity (1992)	23rd March 1994
Cartegena Protocal on Biosafety (2000)	23rd March 1994
Land	
United Nations Convention to Combat Desertification (1994)	28th April 2004
Chemicals	
Basel Convention on Control of Trans-Boundary Movements of Hazardous Wastes and their disposal (1989)	28th August 1992
Rotterdam Convention (1998)	19th January 2006
Stockholm convention on Persistent Organic Pollutants (POPs) (2001)	22nd December 2005

128 A list of legislations relevant to water resources management, environmental protection and therefore relevant to this EIA are given Annex VI - Table 3.

E) Law and Policies on Resettlement

i) Land Acquisition Act of 1950 with subsequent amendments, latest in 1986

129 The Land Acquisition Act (LAA) of 1950 governs land acquisition for a public purpose in Sri Lanka. It has been amended and revised several times, the latest being the version of 1986. The LAA sets out the procedures for acquiring land and for payment of compensation for the land to be acquired by the government for a public purpose. It provides for payment of compensation at market rates for land, structures, and crops. Chapter 416 of the LAA describes the land acquisition process as follows:

i. Preparation of acquisition proposal by the requesting agency and submission to the Ministry of Land and Land Development (MLD) (section 248);
ii. Registration of the proposal by MLD, posting of notices by the concerned divisional secretaries and conduct of advanced tracing by the survey superintendent (sections 2, 248, and 249);
iii. Investigation and calling for objections (4, 4.3, 4.4, 38a, 250, 251, and 252);

iv. Deciding to acquire land (sections 5, 6, 253, 254, and 255);
v. Inquiry into claims and payment of compensation (sections 7, 7.2, 9, 10.1a, 17, 255, 256, 257, 259, and 261);
vi. Taking over of possession after the acquisition (sections 38 in case of emergency acquisition and 262); and
vii. Vesting of certificates (sections 44.1 and 267)

ii) National Involuntary Resettlement Policy – 2001

130 To address the current gaps in the LAA in addressing key resettlement issues such as exploring alternative project options hat avoid or minimize impacts on [people, compensating those who do not have title to, but are currently using and dependent on land, or implementation of income restoration measures aimed at the social and economic rehabilitation of APs, the government of Sri Lanka (through its Cabinet of Ministers) adopted on 24 May, 2001 the national policy on Involuntary Resettlement (NIRP) . The NIRP also highlighted the need for AP consultation and participation. The Central Environmental Authority (CEA) was tasked to review and approve RAPs prepared by project executing agencies, and make plans publicly available.

131 The objectives of the NIRP are to;

i. Avoid, Minimize, and mitigate negative impacts of involuntary resettlement by facilitating the re-establishment of the APs on a productive and self-sustaining basis. The policy should also facilitate the development of the APs and the project;
ii. Ensure that APs are fully and promptly compensated and resettled. The livelihoods of any and all displaced persons should be reestablished and their standard of living improved;
iii. Ensure that no impoverishment of people shall result as a consequence of compulsory land acquisition for development purposes by the State;
iv. Assist APs in dealing with the psychological, cultural, social and other stresses caused by the land acquisition.
v. Make all APs aware of processes available for redress of grievances, which are easily accessible and immediately responsive; and
vi. Have any place a consultative, transparent and accountable involuntary resettlement process with a time frame agreed to by the project executing agency and APs.

132 Adhering to the forgoing objectives, the scope of the NIRP includes all development-induced land acquisition, or recovery of possession, by the state. The NIRP requires comprehensive plans be prepared where 20 or more families are affected. In cases where less than 20 families are affected, the NIRP still requires a plan but states that this can be prepared to a lesser level of detail. The NIRP applies to all projects regardless of the source of funding.

133 In line with the NIRP, Road Development Authority has developed an *ex-gratia* compensation package in 2005. This can be applied to the affected parties in this project with necessary amendments. The package includes compensation payment for non-title holders, compensation for affected structures, provision for livelihood restoration, and additional; assistance to vulnerable groups not covered under LAA.

134 **ADBs requirements:**ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories as per ADB's safeguard policy statement (2009):

135 **Category A**: Projects with potential for significant adverse environmental impacts which are irreversible, diverse, or unprecedented. An environmental impact assessment (EIA) is required to address significant impacts.

136 **Category B**: Projects judged to have some adverse environmental impacts, but of a lesser degree and or significance than those of category A projects. An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

137 **Category C**: Projects unlikely to have adverse environmental impacts. No EIA or "IEE is required, although environmental implications are still reviewed.

138 **Category F1**: Projects are classified as category F1, if they involve a credit line though a financial intermediary. The financial intermediary must apply on

environmental management system; otherwise all subprojects will result in insignificant impacts.

139 As per ADB's requirements this project is categorized as A.

1.7. Conditions laid down by state agencies in granting preliminary clearance for the project.

Table 1.4Conditions laid down by the State Agencies and their incorporation to the project design

Condition	Incorporation into design and implementation
Conditions laid down by the Department of Wildlife Conservation (ref: letter no. waji/6/1/1/252 dated 14-09-2012, for preliminary clearance are as follows:	
i. The open canal section parallel to the existing elephant fence and adjacent to Elehera Sanctuary: to enable elephants and wild animals to access water, build the bank on the jungle side with a mild slope and the other bank with a steep slope to prevent them from crossing over to the settlements	Incorporated into designs, see Figure1.6
ii. From the tanks located in the conservation area such as Kongetiya, Heerati oya, Madatthewa, water should be issued to only the authorized and currently cultivated agricultural lands and no water shall be issued to unauthorized lands (assistance of a DWC official is recommended to be obtained in water management activities).	These tanks are constructed independent of UEC. They will be operated according to conditions given by the DWC and incorporated into operational phase as a mitigation measure.
iii. Sluices of the above mentioned reservoirs are to be designed to release within 50% of active storage, allowing sufficient water to be retained from wildlife	Incorporated into the design stage such that 50% of water will be retained for wildlife
iv. Beyond Madetthewa (PuwakgahaUlpatha) and within Minneriya-Giritale Nature Reserve, Sigiriya Sanctuary, Minneriya National Park, and Hurulu Forest Reserve, the canal should be designed as a below-ground closed conduit (cut and close,	Incorporated into the design stage. The modified trace (the recommended trace) does not run through the Sigiriya Sanctuary. In all other places, the trace is conducted as a below ground closed conduit except for 8.4 km in the Elehera-Giritale Sanctuary (Figure 1.5),as the topography does not

double conduit or tunnel)	permit a below ground conduit. This open canal length consists of 6 segments separated by closed conduits where wildlife passage is possible. In addition, the design provides special arrangements for wildlife access to water
v. When the Pekkulama Tank located within Minneriya-Giritale Nature Reserve is rehabilitated, water should not be issued to unauthorized cultivators within the conservation area. The unauthorized cultivators may be evicted and suitable alternative lands may be given, while allowing the cultivated unauthorized land to be used by wildlife	Pekkulama Tank rehabilitation is not scheduled to be implemented in the near future. However, it will be recommended not to issue water for unauthorized cultivators as a mitigation measure.
vi. Tanks to be constructed within the conservation area may be constructed without sluices to prevent unauthorized	Incorporated as a recommended mitigation measure
vii. Restoration of the lands disturbed during construction activities, even when the conveyance route lies below the ground, when constructed through wild life conservation areas.	Incorporated as a recommended mitigation measure
viii. To compensate for the loss of wildlife habitats, adjacent forest lands, if any, may be declared as conservation areas and enrich the existing wildlife habitats within conservation areas.	Incorporated as a recommended mitigation measure
Conditions laid down by the Forest Department (Ref. letter No. EMD/EIA/MIWRM/ID/NCPCP/2012 of 11-10-2012) include	
ix. Preliminary clearance granted to construct the canal with minimum damage to forests when constructed through the Hurulu Man and Biosphere Reserve, other reserves and other state forests. The MASL and Project Proponent Agency and should take all necessary actions to prevent the forces likely to damage the forest by using the roads that have been used during the construction activities	Incorporated as a recommended mitigation measure

1.8 Conformity with other development plans in the area (present and planned)

140 According to the development –related information obtained from DS Divisions along the UEC route, the major economic development programmes conducted in the area are as follows:

a) "Gama Neguma" programme: the main activities are the improvement and rehabilitation of rural roads. In the Eppawala GN Division under Palugaswewa DS Division, a fertilizer store is constructed.

b) 1000 bridges and associated road development: Rehabilitation and construction of rural bridges, culverts and causeways.

c) "PalaththNeguma"- ("RajarataNavodaya"): Construction and rehabilitation of roads, bridges and culverts.

d) Minor irrigation and fallow paddy lands development: Rehabilitation of minor tanks, canals and anicuts.

e) Drinking water and sanitation projects, schools development, repairs to elephant fences, rural electrification and environmental conservation projects (sometimes overlapping with the above activities)

141 Under the UEC, the road crossings will be provided with appropriate bridges and culverts. The UEC will not interfere with the rehabilitation of minor tanks and anicuts, and only the three level crossings will be improved. Only reference to these level crossings in DSD level development plans is the proposed enhanced irrigation facilities to village irrigation systems in the villages such as Samagipura and Kudagama in Elehera GN Division.

CHAPTER 2

2. DESCRIPTION OF THE PROPOSED PROJECT AND REASONABLE ALTERNATIVES

2.1 Description of the proposed project

2.1.1 Main components

142 The descriptions below are for the three main components of the project with accompanying photographs of locations of these components.

a. Upper Elehera Canal (UEC)

143 Upper ElaheraCanal (UEC) route falls in the Central Province andNorthCentral Province and runs through three administrative districts Matale, Polonnaruwa and Anuradhapura, and 7 Divisional Secretary areas namely Naula, Dambulla, Hingurakgoda, Elahera, Kekirawa and Palugaswewa.

144 The unutilized average annual flow at Elahera and Minipe diversion points are 311 MCM and 910 MCM respectively as per last 05 year average annual values. It was also estimated that about 600 – 700 MCM would have been spilling and therefore being wasted during the same time at Angamedilla diversion weir. (MCB, 2012a).The proposed Moragahakande reservoir intends to capture a part of the Amban Ganga flows at Elehera, while the Kalu Ganga reservoir intends capturing Kalu Ganga flows spilling atAngamedilla, after it joins Amban Ganga.

145 UEC starts from the left bank sluice of Moragahakanda reservoir. Conveyance of water is by a combination of open canal, circular conduits, rectangular conduits, tunnels with conventional blasting, tunnels with TBM, aqueducts, and level crossings. The locations of these conveyance sections are given in Annex VI Table 2, and the Layout Plan (Section 2.1.4) shows the sections described.

146 A summary of the conveyance types is given in the Table 2.1

Table 2.1 Type of conveyance and land cover in the UEC

Type of conveyance	Type of land cover	Length (m)
Aqueduct (including Transitions)	River	258.00
Circular Conduit (Cut & Cover)	Forest /Elehera Giritale Sanctuary	4,785.00
Horse Shoe Shape Conduit (Cut & Cover)	Forest /Elehera Giritale Sanctuary	291.00
Rectangular Double Conduit (Cut & Cover)	Forest/ Elehera-Giritale Sanctuary	820.00

Tunnel (Controlled Blasting)	Forest/ Elehera-Giritale Sanctuary	760.00
Open Canal (Trapezoidal)	Forest/ Elehera-Giritale Sanctuary	15,010.00
Open Canal (Rectangular)	Forest/ Elehera-Giritale Sanctuary	600.00
Tank/Level crossing	Forest/ Elehera-Giritale Sanctuary	4,005.00
Rectangular Double Conduit	Scrub / other plantation	1,241.00
Open Canal (Rectangular)	Settlement	309.00
Open Canal (Trapezoidal)	Settlement / paddy / chena / other plantation	5,291.00
Open Canal (Trapezoidal)	Scrub	5,990.00
Inverted Siphon (Double Conduit)	Scrub	100.00
Tunnel (TBM)	Scrub / Forest /Settlement	26,040.00
Total Length		65,500.00

147 As explained in Chapter 1, the UEC is the only trans-basin diversion route available for transfer of Mahaweli water through Moragahakanda reservoir to river basins in NCP and NP. This conveyance route which goes through the environmentally sensitive areas such as Elahera- Giritale Sanctuary for approximately 22.5 km requires environmental mitigation measures. UEC passes through Minneriya-Giritale Nature Reserve, border of Minneriya National Park, and the Huruluwewa Man and Biosphere Reserve as a tunnel. (See Section 2.1.4, the Layout Plan of the UEC)

148 A separate new outlet from Moragahakanda Reservoir to the Upper Elahera Canal is proposed at an elevation about five meters higher than that of Elahera outlet to Amban Ganga. The water surface level at the commencement of UEC is fixed at (143.0 m msl) in order to feed the Huruluwewa and minor tank cascade systems on either side of the canal beyond Huruluwewa.

149 Initial field surveys carried out during the pre-feasibility stage show 87 families in 11 villages are within the project corridor. Affected families depend on farming as the main source of income and are subsidized by other sources. Most of the families have permanent houses and others have semi-permanent and temporary houses (MCB 2012 a) However, the canal trace was adjusted in response to environmental, social and engineering concerns and the number of affected families was substantially reduced to 17.

150 The concerns of the Department of Wildlife Conservation and of the Forest Department have been addressed at the design and planning stages (See section 1.7).

b. Mannakkattiya Tank and Mahakanadarawa Tank Link Canal

Manakkatiya Spillway

Eruwewa

Plate 1. Conveyance from EruWewa to Mahakanadarawa

Plate 1 Conveyance from Eruwewa to Mahakanadarawa

151 The Upper Elahera Canal will transfer water up to the Mannakkattiya outlet where it divides into two: the Manankattiya- Eruwewa - Mahakandarawa conveyance route and the end of UEC to Chemamadukulam canal (also known as the NCP Canal). The studies by MCB show that 281 MCM is intended to be transferred at Mannakkattiya outlet with 155 MCM to Mannakkattiya - Eruwewa - Mahakandarawa and 126 MCM to Huruluwewa (MCB, 2012 b). With these transfers, it is planned to increase the cropping intensity from around 1.2 to 1.8. (MCB, 2012a).

152 From UEC an open canal and a close conduit will enable discharge of water to MaminiyaOya (an existing stream), which will convey water to EruWewa. The length of this reach is about 9.5 km. From EruWewa, Eruwewa-Mahakanadarawa Feeder canal will convey water to Mahakandarawa Tank. The Eruwewa-Mahakanadarawa Feeder Canal requires to be improved to convey the additional discharge, and to address existing conveyance problems. The length of this reach is about 10.5 km.

c. Kaluganga – Moragahakanda Transfer Canal/tunnel

153 After evaluating the two available proposals (see section 2.2), the EIA Team recommended the proposal prepared by the MCB, basic features of which are describes as follows:

- The conveyance route consists of a short open canal, two tunnels combined by an aqueduct at *Lel-Oya*.
- Length of first tunnel section is 1.84 km and the second tunnel section is 6.0 km.
- The conveyance capacity of the conveyance structures is 35 m^3/s.

2.1.2 Present ownership of the Project Site

154 The Project area to be studied under this EIA will comprise the conveyance route from Kaluganga reservoir to Moragahakanda reservoir, UEC from Moragahakanda reservoir (outlet) to Manankattiya outlet and the conveyance route from Manankattiya outlet to Manankattiya reservoir, and the existing conveyance route from Manankattiya reservoir-Eruwewa-Mahakanadarawa.

155 Present ownership of the project area consists of government owned lands under the jurisdiction of the divisional secretaries, Department of Wildlife Conservation, Forest Department, Land Commissioner's Department, Ministry of Irrigation and Water Management, Mahaweli Authority of Sri Lanka and Road Development Authority, and private ownership.

156 The KMTC lies through an area classified as forest in the land use map.

157 The UEC travels through approximately 0 +000 to 10+600 km and 14+200 to 27+700 in Elehera-Giritale Sanctuary, 29+000 to 36+000 km in Minneriya-Girtale Nature Reserve (tunnel), 36+000 to 40+000 km along the border of Minneriya National Park (tunnel) and from 46+000 to 51+000 km in Hurulu Forest Reserve/ Man and Biosphere Reserve (MAB) (tunnel).

158 Please refer to Annex VITable 2 for details.

159 Final alignment of the trace was determined following discussions with the DWC, FD and initial field surveys of the EIA team and preliminary concurrence of these departments was obtained.

2.1.3 Description of the Project Components Relevant to the Proposed Project

a. New Constructions

160 The Irrigation Infrastructure Components for UEC recommended option are summarized below.

Table: 2.2 Project components of UEC

Item	Work Description	Recommended Option	
		No.	Length (Km)
1.0	Total Length		65.5
2.0	Open canal - rectangular & concrete lined	2	0.891
3.0	Open canal –trapezoidal & concrete lined	9	25.729
4.0	Cut and covered conduit sections – Rectangular Double Barrel	02	2.574
5.0	Cut and covered conduit section – Circular Single Barrel	3	5.599
6.0	Tunnel (conventional control blasting)	3	1.370
	Tunnel (TBM) – Circular	1	26.040
7.0	Structures		
7.1	Transitions	22	0.259
7.2	Aqueduct	1	0.24
7.3	Inverted Syphon	1	0.047
7.4	Bridges / Road Crossings (open canal and cover sections)	7	
7.5	Drainage under crossings	20	
7.6	Drainage over crossings	2	
7.7	Safe escapes for wildlife	33	0.33
7.8	Turnouts	2	
8.0	Level Crossings *(1)	3	
9.0	Minor reservoirs for wildlife	3	

Table 2.3 New Project Components for UEC (Recommended route by the EIA Study)

Section/Type	Discharge m^3/s	Bed slope	Bed width Or Diameter (m)	FSD (m)	Side Slopes	Free board (m)
Trapezoidal Open Canal	40	0.0001	6	3.15	1 on 2	0.7
Rectangular Open Canal	40	0.0001	12	3.08		0.32
Aqueduct	40	0.00011	2/5.475	3.79	-	0.31
Cut & Cover: Rectangular Double Conduit	40	0.00012	2/5.475	3.67	-	1.78

Tunnel / Cut & Cover: Horse Shaped Conduit	40	0.0002	6	4.68	-	3.32
Cut & Cover: Circular Conduit	40	0.00016	7	4.75	-	1.91
Tunnel: Circular	40	0.00018	7	4.77	-	1.89

Note: Aqueduct is an open double conduit

161 At the end of the UEC, a regulator cum turnout structure will transfer water to Manankattiya irrigation system. The first 140 m of the conveyance will be a rectangular, concrete lined, open canal varying in width from 5.8 m to 3.5 m. For the next 6.04 km, water will be conveyed through a rectangular closed conduit of 3.5 m wide and 3.25 m deep. This conveyance system will join the water pool downstream of Manankattiya main sluice and through the existing feeder canal to spill tail canal of Manankattiya, water will be transferred to Maminya Oya, then to Eru wewa and to Mahakanadarawa using the existing conveyance system.

162 There are no new structures proposed for the Manankattiya- Eru Wewa - Mahakanadarawa transfer route.

Table 2.4 Profile forKalu Ganga - Moragahakanda Transfer Route

Station (km)	Length (km)	Type of Structure	FSD (m)	Bed Width (m)
0.2915		Start at Transfer Canal Outlet *	2.560	
0.930	0.639	Canal	2.560	6.0
0.953	0.023	Transition	3.140	
1.160	0.207	Cut & Cover Conduit	3.140	6.0
2.800	1.640	Tunnel	3.140	6.0
2.835	0.035	Cut & Cover Conduit	3.140	6.0
2.845	0.010	Transition	2.800	
2.940	0.095	Lel Oya Aqueduct	2.800	2/4.0
2.950	0.010	Transition	2.930	
3.160	0.210	Cut & Cover Conduit	2.930	6.0
9.130	5.970	Tunnel	2.930	6.0
9.162	0.032	Cut & Cover Conduit	2.930	6.0

Source: UEC Design Office

163 KMTC tunnel emerges from the high ground at an elevation of 185.338 m msl, at a distance of about 30 m from the Moragahakanda reservoir. The FSL of Moragahakanda is at 185.00 m msl and therefore the tunnel outlet will be un-submerged even when Moragahakanda reservoir is at the FSL. When Moragahakanda reservoir is below the FSL, water discharging from the tunnel will flow along a series of steps to 182.338 m msl and then flow along a concrete apron for another 25 meters, followed by 300 mm random rubble pitching before flowing into the reservoir. The tunnel outlet is protected by a trash-rack (prevent human / animals entering to the tunnel).

b. Modifications to existing structures

164 The proposed conveyance system from the bifurcation at the UEC end to Mahakanadarawa Reservoir through Manankatiya and Eruwewa comprises of:

- A subsurface rectangular conduit concrete canal from the bifurcation at the UEC end to the water pool downstream of Manannkatiya main sluice.
- A Feeder Canal from Manankatiya to Eruwewa: *MaminiyaOya* which is an existing stream
- A Feeder Canal from *Eruwewa* to fall into *KanadaraOya* which leads to Mahakanadarawa reservoir

165 Bifurcation at the UEC would release a discharge of 12 cumec of water into the Manannkatiya Tank through the designated proposed subsurface conduit conveyance without any other utilization. From Manannkatiya, the water is conveyed through the Spill tail canal which ends with an anicut (Namely Manankatiya RB Anicut) then consequently falls into MaminiyaOya. Then the water is led to Eruwewa through the MaminiyaOya Stream having another pickup anicut at Thodamaduwa. Existing Feeder Canal from Eruwewa to KanadaraOya has originally been designed to convey 4 cumec of discharge and falls into KanadaraOya which leads to Mahakanadarawa Tank.

166 Required modifications are as follows:

Table2.5 Modifications to existing structures (Irrigation Structures)

System Components	Modifications Proposed
Confluence of Feeder Canal from UEC into Manankatiya RB Spill Tail Canal	New Turn Out Arrangements to Divert 0.25 cumec of Water through a new Closed Conduit (approximately 350m long) into the Existing Pond under the RB Sluice.
New Rectangular Conduit from the Confluence to the Pond in the D/S of RB Sluice of Manankatiya	New Construction of about 350m long Conduit Canal after detail investigation
D/S Pond System under the RB Sluice of Manankatiya	Providing Suitable overflow weir to maintain the Design FSL.

	Closing & Sealing the T.O Structure in the RB
	Improvements to the existing Center Sluice and LB Sluice
	Rehabilitation to the Existing Bund of the Pond and providing Slope protection
Overflow Weir (Anicut) at the Head end of Maminiya Oya (D/S along the Spill Tail Canal of Manankatiya)	Necessary Repairs to the Control Structure / Off take Structure feeding irrigation water to existing FC in RB of U/S of Anicut
	Improvements to the existing Vented Causeway in the immediate D/S of the Weir to cater the 15 cumec of Discharge without inundation.
Thodamaduwa Anicut across Maminiya Oya	Improvements to Head Works Components such as Side Off take Structures.
	Improvements to the over flow section to cater 15 Cumec of flow discharge.
Kuttikulama Anicut across Maminiya Oya	Improvements to Head Works Components such as Side Off take Structures.
	Improvements to the over flow section to cater 15 Cumec of flow discharge.
Eruwewa Head Works	Spillway and the Tail Canal to be improved to cater 16.5 Cumec of Flow Discharge
	Existing Inlet Structure to the Mahakanadara Feeder Canal to be improved (or demolished and reconstructed) to cater 5 Cumec of Flow Discharge
Existing Feeder Canal from Eruwewa to Kanadara Oya	Feeder Canal to be widen and improved to carry a design discharge of 5 Cumec flow.
Pallankulama - Existing Minor Tank intersects the Eruwewa Kanadara Oya Feeder Canal between 6Km+500m and 6Km+800m.	Strengthening the embankment and construction of new spillway to carry the feeder canal discharge of 5 Cumec flow.
Mudiruppuwa - Existing minor tank located along the LB of Eruwewa Kanadara Oya Feeder Canal near the canal reach of 7Km+800m to 8Km+200m.	Provide Off take Structure to release water from the feeder canal and strengthening the minor tank's head works.
Nochchikulamaa - Existing minor tank located along the LB of Eruwewa Kanadara Oya Feeder Canal near the canal reach of 9Km+200m to 9Km+700m.	Provide Off take Structure to release water from the feeder canal and strengthening the minor tank's head works.

167 Therefore improvements have to be done to accommodate this requirement and for a design discharge of 12 m^3/sup toEruwewa.

Bridges/ Road Crossings

Table 2.6 Modifications to existing roads: Road crossing locations at open canal routes

	Road & Class / Type	Location of crossing (Km + m)	Conveyance Type	Road Crossing Structure Provided
1	Village	10 + 520	Trapezoidal	2x14.5x3.5
2	Village	10 + 840	Trapezoidal	2x14.5x3.5
3	Dambulla - Bakamuna B Class	12 + 260	Rectangular Open	2x14.5x7
4	Village	12 + 620	Trapezoidal	2x14.5x3.5
5	Village	13 + 390	Trapezoidal	2x14.5x3.5
6	Village	13 + 810	Trapezoidal	2x14.5x3.5
7	Village	14 + 180	Trapezoidal	2x14.5x3.5
	Habarana - P'naruwa A Class	43 + 000	Tunnel	Not Provided
	Habarana – Galloya A Class	45 + 800	Tunnel	Not Provided
	Railway Track	46 + 000	Tunnel	Not Provided
	Polgaswewa - Galen BW B Class	55 + 020	Cut & Cover	Not Provided
8	Bendiwewa - Madawala: B Class	57 + 490	Trapezoidal	2x14.5x3.5
9	Village	59 + 040	Trapezoidal	2x14.5x3.5
10	Village	63 + 375	Trapezoidal	2x14.5x3.5

Note: Road Crossing Structures are Bridges with No of Span x Span Length (m) x Carriage Way(m)

c. Alterations to Approved Plans

168 The Kaluganga-Moragahakanda Transfer Route was studied under the Kaluganga EIA study and was approved. However, there is a new proposal by the MCB consultants (see section 2.13), which involves more tunnel sections. The EIA Team studied the options and recommended the most suitable route.

Table 2.7 Current and recommended designs by NCP Canal Project

Item	**Initial design**	**Recommended design**
Kaluganga-Moragahakanda Transfer Canal (KMTC) and	A power and bottom outlet KMTC: discharge 15	Capacity of the proposed outlet is sufficient KMTC: Required discharge has to

KalugangaHeadworks	m3/s	be increased to 35.0 m3/s. The canal section has to be modified accordingly
KMTC Route	Discussed separately in section 2.2	
MoragahakandaHeadworks and outlet from Moragahakanda Reservoir	Two Power Units each of 7.5 MW and an Irrigation by-pass in built into the spillway Tail race water surface elevation- 138.0 m msl. The tail race water to be picked up at ElaheraAnicut from where the existing Elahera - Minneriya Canal and the proposed Upper Elahera canal were to be fed.	With the additional inflow from Randenigala, annual outflow from Moragahakanda can be increased from 700 to 1,400 million m3. Upper Elehera canal should commence from 143 m msl (Huruluwewa FSL is 132.3 m msl). Additional outlet structure needed, at a higher of 143 m msl , on the left side of the currently proposed Outlet, together with an additional power unit. In addition, a new link canal has to be introduced from the tail race of this high level outlet to the start point of the Upper Elahera canal.

d. Associated facilities required for the Project

169 The disposal sites, the TBM site access roads to these area and quarries, given in Figures 2.1 and 2.2, showing their location and approximate size (area).

170 Access roads details are given in the table below:

Table 2.8 Access Roads Details

No	Description	Land Use Type	Road width	Road length (km)	From	To
Upper Elahara Canal						
1	Temporary Road	Forest (Elahera Giritale NP)	6	1.3	Madetthawa Bund	Proposed Tunnel at 18+000 km
2	Existing Road – To be extended to UEC	Settlement / Forest (Elahera Giritale NP)	6	1	16 km Post of Elahera Diyabeduma Rd	18+900 km of UEC
3	Existing Road – To be extended to UEC	Settlement / Forest / Paddy	6	4.5	Diyabeduma	27+500 km of UEC
4	Existing Road – To be widen	Settlement	6	1.6	Ganewalpola Palugaswewa Rd	55+900 km of UEC
5	Existing Road – To be widen	Settlement	6	1.5	Ganewalpola Palugaswewa Rd	57+300 km of UEC
KMTC Canal						
1	New Road	Scrub forest	1.7	6	Kambarawa – Nauala Rd	TBM launch
2	Existing Road		1.5	6	Haththota	Lel Oya

171 The site for location of the TBM was carefully selected in order not to create environmental damage to protected areas or other sensitive sites. Lands required for launching and retrieving TBMS given in Table 2.10.

172 Resettlement sites and associated details are given in Section 5.2.

173 Sites for worker campshavebeen identified at Bakamuna and near TBM entry point at 53 km. Both are private lands. The land is outside protected area. For the KMTC a worker camp location is identified at Haththota. Obtaining permission to use these land are been followed up.

174 **Other associated facilities**- One of the conditions laid down by the CEA during the approvals process for the Moragahakanda Agricultural Extension Project (MADP), and Kaluganga Reservoir and Agricultural Extension Project (KRAEP) (two projects associated with the UEC), is that the MASL should take steps to ensure that the biodiversity of the areas impacted by the MADP and the KREAP be investigated further and conserved adequately. There are memoranda of understanding on Wildlife Management Action Plan of the MADP, and the KRAEP between the MASL and the DWC.

175 Stemming from the biodiversity studies commissioned by the MASL, independent of the EIA reports conducted for the KREAP and approved by the CEA in 2010, a further Biodiversity Action Plan for the MADP and KREAP has been developed.

Table 2.9A comparison of excavated material with requirements of UEC

Total excavated material from UEC (1000*m3)				Required for Structures (1000*m3)		Required for backfilling(1000*m3)		
Earth	Soft Rock	Hard Rock	Rock Powder	Sand	Metal	Sand/ Rock powder	Earth	Gravel
5844	0	2209	0	272	456	7	825	17

176 A comparison of material excavated from the UEC, and the material requirements for structures and backfilling is made in the Table above. From the data, it can be seen that material requirement for structures and backfilling is less than the excavated material. As such, additional borrow areas will not be required. The excavated material in table 2.9 is produced within a period of approximately six years. The disposal sites including the permanent sites are designed to accommodate the excess material that is coming out periodically. This material has an economic value as they can be used for construction of roads and landfilling etc. Therefore they will be disposing to the individual or organizations that require such material; So that the space is retain for new excess material

177 Location of disposal areas and quarry sites is shown in Figure 2.1 and 2.2 respectively. The Table below gives the details of present status of the location and how it is planned to be used. Permission has been requested from the Department of Wildlife Conservation, Department of Forest and Road Development Authority, to use the selected degraded lands for disposal and rehabilitation of the existing land. The Ministry of Irrigation and Water Resources Management has requested and is proceeding with getting permission from the respective institutions for using these sites.

Table2.10Proposed disposal sites, present status of the location and intended usage

Site No	Location	Present status of location	Intended Usage& Area	Proposed Mitigation
A-Upper Elahera Canal				
1	At 1st km of UEC near 12th km of Naula-Elahera Road	Present Moragakanda Disposal Site	**Permanent** Disposal site 2 ha, capacity 29,500 m^3	Excavated material will be evenly spread and reforestation will be carried out with due attention given to prevent the introduction and spread of invasive species

2	Kongetiya Level crossing Near 6+50 km UEC	Near existing reservoir, earth excavated area	**Temporary**Disposal site- 2 ha, 24,500 m^3	Material will be used for Improvements of Reservoir to amalgamate with UEC Design & Canal bund formation
3	Madattewa Level Crossing FSL area near 17+00 km UEC	Near existing reservoir	**Temporary** Disposal site- 2 ha, 45,000 m^3	Material will be used for Improvements of Reservoir to amalgamate with UEC Design & Canal bund formation
4	Location for dismantling / exit of TBM near 27+500km UEC outside MinneriyaNP	UEC	**Temporary** site 200mX50m along the canal-1ha(Wildlife), 25,000 m^3	Additional area used will be reforested after removing TBM
5	Location near EMYE Diyabeduma	Abandoned Borrow area	**Permanent** Disposal site 1ha, 27,000 m^3	The abandoned borrow pits will be filled with excavated material, compacted and reinstated with reforestation
6	Location for assembly of TBM near 54+00km UEC	UEC	**Temporary** disposal site 200mX50m along the canal- 2 ha, 48,000 m^3 for 1 km length	Additional area used will be reforest
7	Namalpura near 60+00 UEC	Scrub Jungle	**Temporary** Disposal site- 2 ha, 50,000 m^3	Material will be used for Canal bund formation. Additional area used will be reforest
B- Kaluganga-Moragahakanda Transfer Canal				
Site No	**Location**	**Present status of**	**Intended usage**	**Proposed Mitigation**

		location		
1	1st km of KMTC Canal from Kaluganga outlet structure	Cleared	Permanent disposal site 2 ha	Excavated material will be evenly spread and reforestation.
2	1st km of KMTC, Tunnel portal (drill & blast)	cleared	Inlet portal, 0.5 ha	Area will be landscaped allowing for the portal
3	2+900 km of KMTC drill & blast tunnel	Forest	Outlet portal, 0.5 ha	Area will be landscaped allowing for the portal
4	Location for exit of Tunnel near 3+100 km of KMTC at Lel-OyaAqueduct	Forest	**Temporary** site 200mX50m- 1ha	Area used will be reinstated. Tunnel muck will be periodically removed.
5	3rd km of KMTC	Forest	Permanent, 1 ha	Excavated material will be evenly spread and reforestation.
6	Location for Tunnel portal Moragahakanda out let of KMTC(Reservoir bed)	Forest	**Temporary** disposal site, 1 ha	Area used will be reinstated.

178 Safe disposal of excavated material is discussed under mitigatory measures. Siting of disposal sites has been carried out to ensure that they do not lie on the environmentally sensitive areas. But, some areas belonging to the DWC & FD which are degraded due to borrowing earth etc. will be rehabilitated with suitable disposal materials upon approval from the two departments.

179 **Electricity Supply:** Provision of electricity supply is being discussed with the CEB. A layout will be provided by the CEB, which will provide the information regarding required associate infrastructure.

2.1.4 Layout Plan.

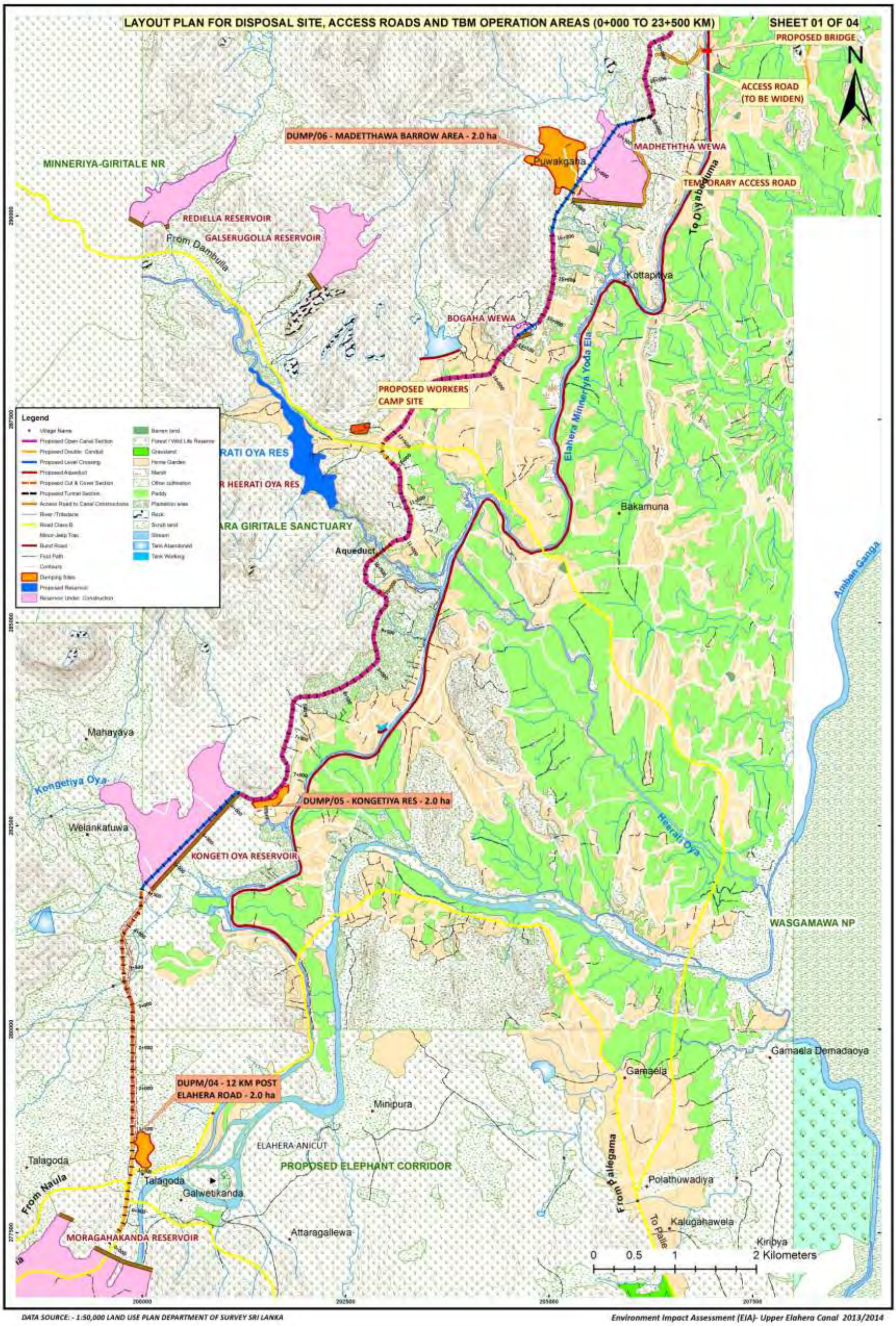
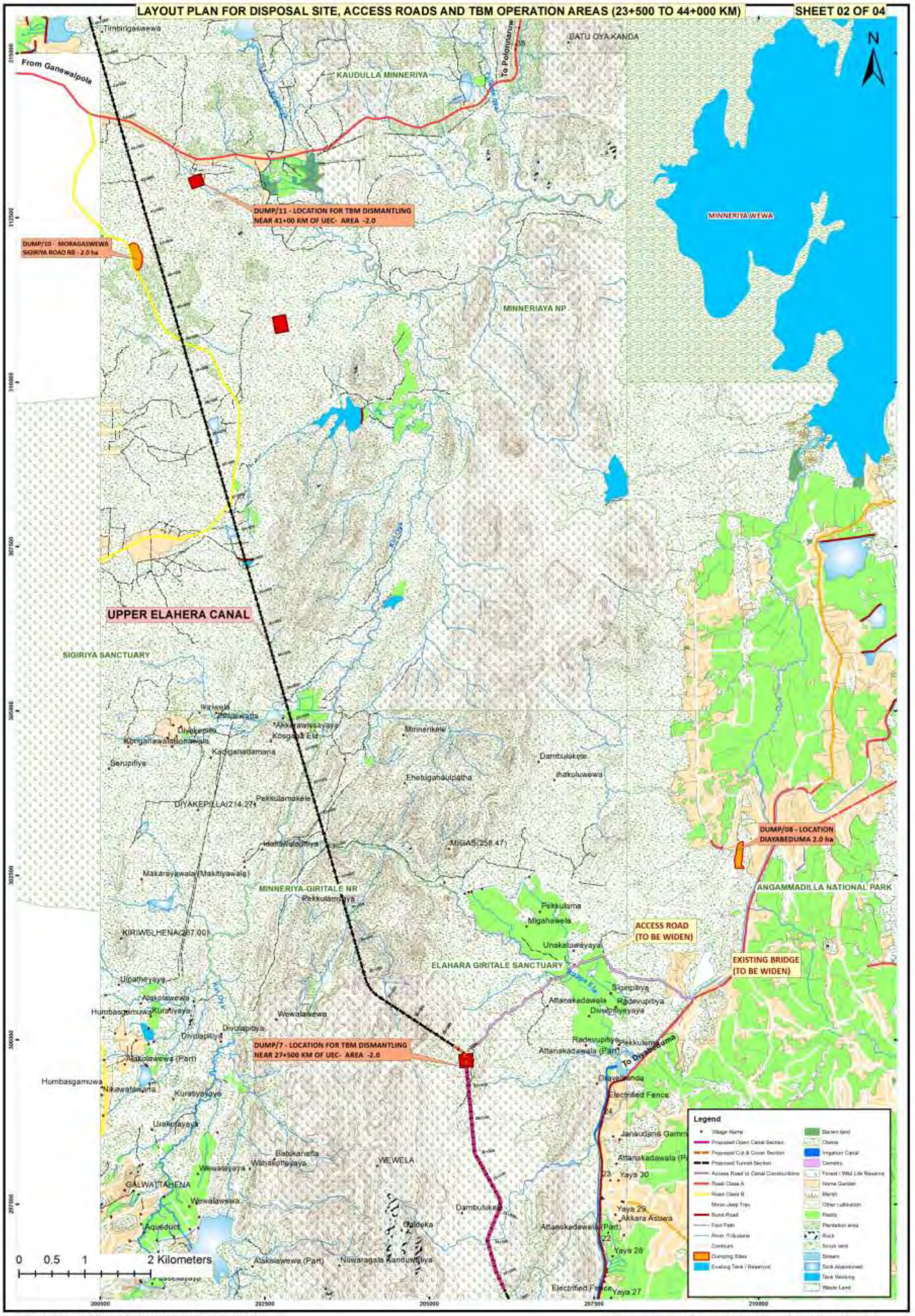


Figure 2.1- Layout for Disposal sites, Access Roads and TBM operation areas

LAYOUT PLAN FOR DISPOSAL SITE, ACCESS ROADS AND TBM OPERATION AREAS (23+500 TO 44+000 KM) SHEET 02 OF 04



DATA SOURCE: - 1:10,000 LAND USE PLAN DEPARTMENT OF SURVEY SRI LANKA

Environment Impact Assessment (EIA)- Upper Elahera Canal 2013/2014

LAYOUT PLAN FOR DISPOSAL SITE, ACCESS ROADS AND TBM OPERATION AREAS (42+500 TO 66+408 KM)

SHEET 03 OF 04

N

NCP Canal

Manankattiya Feeder Canal

YAKALLA WEWA

MANANKATTIYA WEWA

HURULU WEWA

From Gomadiyagala

DUMP/13 - NAMALPURA NEAR 60+00 KM OF UEC - 2.0 ha

ACCESS ROAD (TO BE WIDEN)

DUMP/12 - LOCATION FOR ASSEMBLY OF TBM NEAR 56+00 KM OF UEC - AREA 2.0 ha

PROPOSED WORKERS CAMP SITE

Mahamegaswewa

Kagala Gomadiyagala

Achchiyagama

Eppawala

Wanhathpalama

Moragaswewa

Habadivulwewa

Pusdivulwewa

Galapitagala

UPPER ELAHERA CANAL

To Trincomalee

To Galoya

Weragala

Kumbukwewa

TALBEMAKANDA

KAUDULLA MINNERIYA

Karandagaswewa

From Ganewalpola

From Kekirawa

Palugaswewa

Legend

Village Name
Access Road to Canal Constructions
Proposed Open Canal Section
Proposed Double Conduit
Proposed Aqueduct
Proposed Cut & Cover Section
Proposed Tunnel Section
Road Class A
Road Class B
Motor Jeep Trac
Bund Road
Foot Path
Rail Road
River / Tributaries
Contours
Dumping Sites
Existing Tank / Reservoir

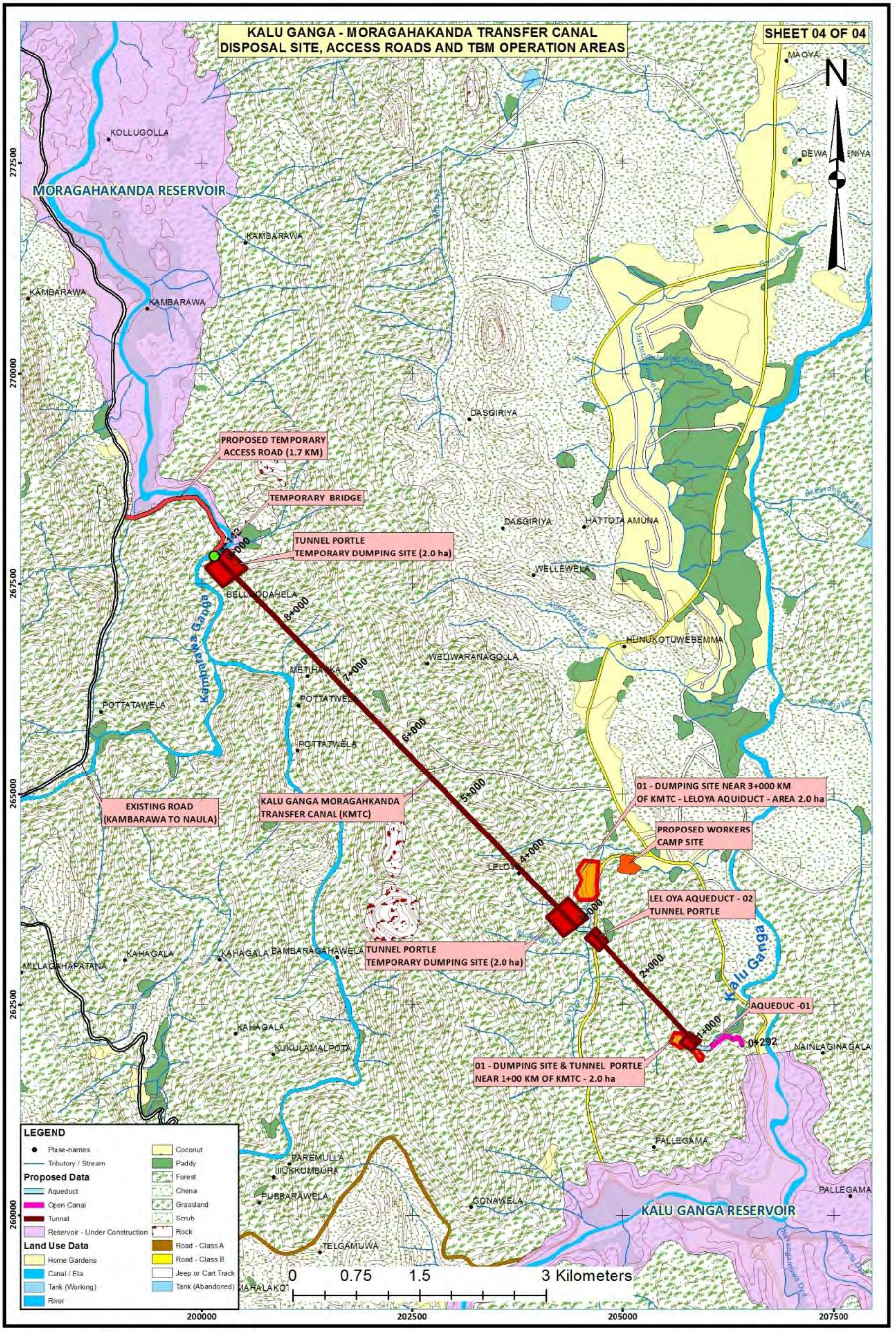
Barren land
Cocoma
Chena
Cemetery
Forest / Wild Life Reserve
Home Garden
Marsh
Other cultivation
Paddy
Plantation crops
Rock
Scrub land
Stream
Tank Abandoned
Tank Working
Unclassified Area

0 0.5 1 2 Kilometers

190000 192500 195000 197500 200000 202500

DATA SOURCE: - 1:10,000 LAND USE PLAN DEPARTMENT OF SURVEY SRI LANKA

Environment Impact Assessment (EIA)- Upper Elahera Canal 2013/2014



DATA SOURCE: - 1:50,000 LAND USE PLAN DEPARTMENT OF SURVEY SRI LANKA

Environment Impact Assessment (EIA)- Upper Elahera Canal 2013/2014

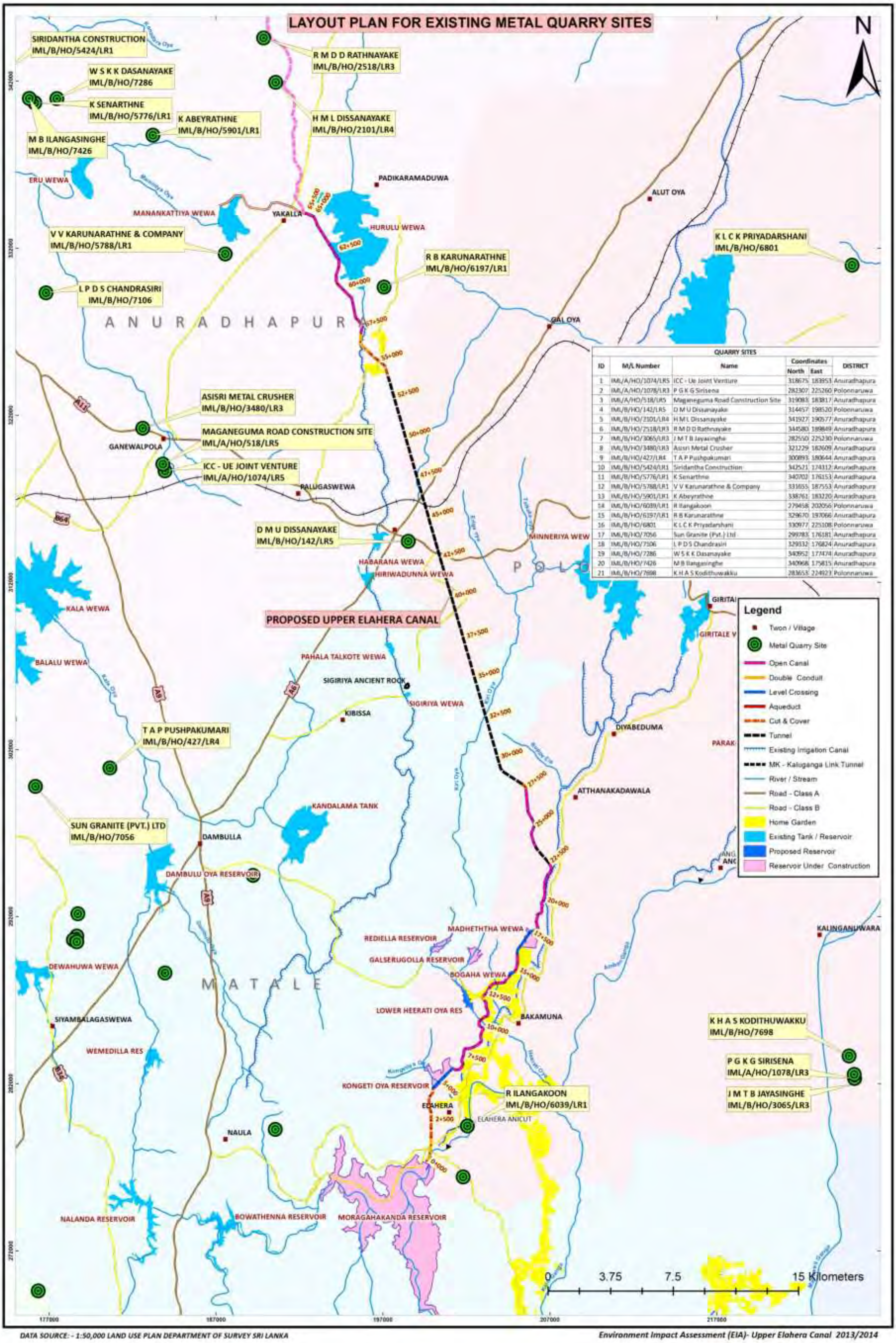


Figure 2.2- Layout Plan for Upper Elahera Canal – Existing Metal Quarry Sites

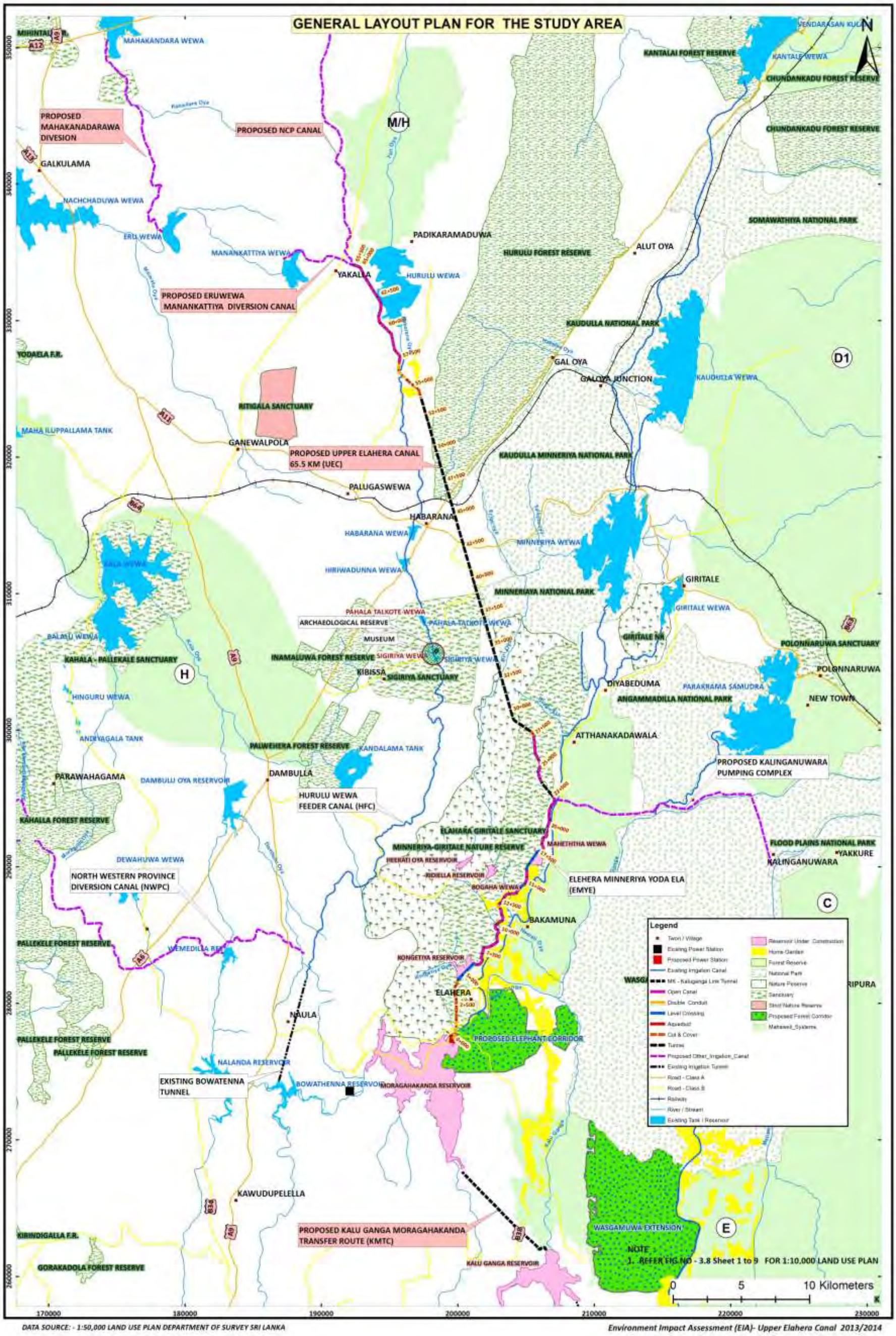


Figure 2.3- General Layout Plan for Upper Elahera Canal

180 Disposal sites, TBM operating sites and access roads are shown by the Figure 2.1 and Figure 2.2 shows the quarry sites. General layout of the Project is given by Figure 2.3

2.1.5 Pre construction activities and construction activities

Table 2.11 Construction and pre-construction activities

Pre-construction activities	Construction Activities
Resettlement Plan	Securing access
Environmental Approval	Land clearing
Detail Geological Investigations	Excavation
Preparation of Contract Packages and Tender Documents	Compaction
Tender Procedure and award of Contracts	Drilling and blasting
Mobilization of Contractors	Safe Removal and disposal of construction waste
	Construction of structures
	Tunnel excavation and grouting
	Construction of embankments
	Landscaping

2.1.6 Implementation schedule, staffing and support facilities and services

181 **Major Construction work components of the Project**

1. Construction of Kaluganga-Moragahakanda Transfer Canal & appurtenant structures
2. Upper Elahera Canal from Power tail race canal of power house no 2 of Moragahakanda reservoir to Mannakkattiya out let & appurtenant structures, and connection from the outlet to Manankattiya reservoir
3. Mannakkattiya to Mahakanadarawa Transfer Canal & appurtenant structures

182 **Funding arrangement and Contract packaging:** The components 1 and 2 are to be undertaken under Asian Development Bank (ADB) funding and the implementation program to be followed in line with present ADB funding program. The component 3 to be

undertaken under GOSL funding and implementation of this component also programmed to complete in par with completion of UEC. The Contract packaging as per the above funding arrangement is as follows.

- Traditional design section of UEC to be included in several contract packages to suit to ICB as agreed by MIWRM and ADB under ADB funding **(ADB-Project 1 & 3)**
- KMTC and Tunnel segments of UEC are to be in one Contract package under EPC basis under ADB funding **(ADB-Project 2)**
- Mannakkattiya-Mahakanadarawa transfer route to include in contract packages by MIWRM under GOSL funding and to complete implementation in par with UEC/KMTC implementation program

183 **Preconstruction, Construction activities, Phased implementation schedule staff and support facilities and services:** The following were prepared considering that the detailed designs will be completed by the MIWRM for all three components during the year 2014.

i). Following common preconstruction activities are envisages for ADB funded components of UEC and KMTC

- Resettlement Plan
- Environmental Approval
- Detailed Geological Investigations
- Preparation of Contract Packages and Tender Documents
- Tender Procedure and award of contracts
- Mobilization of Contractors

ii). Construction activities

184 The construction activities depend on the method of construction adopted

a) Traditional design sections of UEC Under ADB funding (ADB-Project 1 & 3)

185 The Construction method applied will be normal excavation by using earth moving machines and other activities involved are canal lining, formation of concrete cut and cover sections and construction of associated structures with ready mixed concrete. Controlled blasting techniques will be used in areas where rock excavations are involved. Disposal yards for excess excavated material are shown in Figure 2.1

b) KMTC and Tunnel segments of UEC under EPC basis on ADB funding (ADB-Project 2)

186 It is proposed to undertake and tunnel segments of UEC under EPC system engaging TBM where tunneling is to be done by mechanical means. It requires less labor compared to traditional method but need electric power to operate the machine and energy

to provide other services like water, ventilation etc. The tunnel muck will be transported to the sites identified for disposal. The TBM is assembled at the entry points to the tunnel segments at the locations identified in Figure 2.1

c) Mannakkattiya-Mahakanadarawa transfer route under GOSL Funding

187 The construction method applied will be normal excavation by using earth moving machines and other activities involved are canal lining, formation of concrete cut and cover sections and construction of associated structures with ready mixed concrete. Controlled blasting techniques will be used in areas where rock excavations are involved.

188 The Implementation program for the components under ADB funding and GOSL funding taking above into considerations is given in the Figure 2.4 as detailed below.

a) Traditional design sections of UEC under ADB funding (ADB-Project 1 & 3)
b) KMTC and Tunnel segments of UEC under EPC basis on ADB funding (ADB-Project 2)
c) Mannakkattiya-Mahakanadarawa transfer route under GOSL Funding

Designs by PPTA/MCB | Designs and Bid Documents by PMDSC
Bidding and Award | Other Tasks | Implementation

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)																																											
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%																								
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%																												

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)																																											
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%

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)																																											
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	Eru Wewa Mahakanadarawa Natural Stream																																33%				33%				33%				
UEC-ICB-6	NCPCP Water Management Software and Control Center																																											
CS	**Consulting Services**																																												
CS-3	PMDSC (Program Management, Design Supervison Consultant) Consulting Package																												20%				20%				20%				20%				
CS-4	Strengthening Integrated Water Resources Management (SIWRM)																																50%				50%								

Figure 2.4- Implementation Plan

2.1.7. Methodology of Operation of the Project Components

189 Existing irrigation schemes feeding from *Ambanganga* (river) downstream of Moragahakanda Reservoir are the Elahera Scheme, Minneriya, Giritale, Kaudulla, Kantale and Parakrama Samudra tanks. Except for the Elahera Scheme all others obtain their own reservoir augmenting balance water requirement from the *Ambanganga*. The Elahera Scheme does not have storage facility and is being fed by the Elahera Minneriya Yoda Ela (EMYE), a constructed canal.

Table2.12 Major Irrigation systems in the Ambanganga basin downstream of Moragahakanda reservoir

Serial No.	Name of Scheme	Reservoir Capacity MCM	Present Water Use Ha/ MCM	Future Water Use Ha/ MCM
01	Elahera	-	61	89
02	Minneriya	136	91.6	112
03	Girithale	23	77.8	112
04	Kaudulla	114	74	112
05	Kanthale	133	87.6	112
06	ParakcramaSamudra	116	77	86

190 Even though a water quantity of 970 MCM is diverted through UEC, sufficient water will be available for fulfilling the deficit requirement of above schemes with completion of the Moragahakanda reservoir as verified in the Water Balance Study (MCB, 2013).

191 Therefore with the additional storage facility in the Moragahakanda Reservoir and proper water management in this project, unnecessary water losses can be minimized and irrigation efficiency can be increased. Therefore greater agriculture productivity is possible and thus saved water will be available for all including the plants and wildlife of the region. In the water balance study carried out by MCB (2013), the present and future needs of water have been considered.

192 **Interactions with Other Irrigation Development Projects:** Interactions with the ongoing irrigation-related development projects relevant to Upper Elehera Canal are minimum due to the fact that UEC is designed not to intercept any stream flows. There are no proposed or ongoing irrigation projects in the Manankattiya-Eruwewa-Mahakanadarawa route and Kaluganga-Moragahakanda transfer route.

193 Minneriya-Elehera Yoda Ela bund road (Bakamoona-Elehera Road) is being widened by the Road Development Authority (RDA). However, the UEC has no impact on this road widening.

2.1.8 Project cost, Investment and Funding Sources

194 Two options were evaluated by the EIA team for the UEC. They are described in detail in section 2.2.

a. (Option) Route No. 1**:** The total estimated cost is LKR 35.16 billion.
b. (Option) Route No. 2:The total cost is LKR 27.6 billion.

195 The Total cost estimate of Upper Elahera Canal given above constitutes the construction cost.

c. Tentative Environmental Management Cost for UEC for Option 1 is estimated as Rs. 35.2 million and Rs. 27.6 million for Route No. 2.
d. Estimated Cost of assets of the affected families under UEC is Rs. 46.0 million for both Routes.

196 The summary is as follows:

Table 2.13Construction cost summary for alternate routes

No.	Item	Option 1 Rs. (billion)	Option 2 Rs. (billion)
1.	KMTC Construction	5.62	5.55
2.	UEC 2.1 Construction 2.2 Environmental Management Cost 2.3 Estimated cost of assets of the affected families under UEC	 35.16 0.035 0.046	 27.59 0.027 0.046
	UEC total	**35.241**	**27.66**

197 Despite the higher cost associated with option 1, the EIA study team recommended option 1, considering the reduced disturbance to environmentally sensitive areas. Several refinements to the design were effected subsequently, including the decision to employ a TBM and slight deviation of the route to have a continuous tunnel section. As a result, the cost further increased to Rs. 43 billion. Details are discussed under section 6.2.1. A summary of the costs (in Rs billion) are as follows:

i. Construction cost of KMTC = 5.550
ii. Construction cost of UEC (0.00 to 17.552 km) = 5.389
iii. Construction cost of UEC (17.552 to end) = 29.772
iv. Environmental management cost = 0.035

v. Loss of property value	= 0.144
vi. Infrastructure for water supply	= 2.0
Total	= 42.889

2.2 Evaluation of Alternatives

198 The EIA Team after field visits evaluated the following alternatives and made the following recommendations.

A. Proposed transfer routes from Kaluganga reservoir to Moragahakanda Reservoir

199 There are two proposals for the **Kaluganga-Moragahakanda Transfer Canal** KMTC. They include:

a. Lahmeyer proposal comprising a total length of 13.0 km with 8.2 km of open canal, 3.7 km of tunnel

200 The Transfer canal proposed by Lahmeyer has been already approved through previous EIA studies for Kaluganga Project. According to canal layouts proposed by the Kalu Ganga Design Consultants (Lahmeyer), transfer of water from Kalu Ganga to Moragahakanda has to be by means of a contour canal (approximately at elevation. 187.0) of length 9.32 km followed by a tunnel of length 3.74 km approximately. In the same design, the LB Main canal off Kalu Ganga reservoir also runs parallel to Transfer canal at a lower elevation(at 180.0 m msl) in its initial stretch of 8.740 km.

b. Modified proposal by the MCB with a total length of 9.16 km with 0.5 km of open canal, 7.85 km of tunnel

201 Augmentation of Moragahakanda from Kaluganga water has already been in the Lahmayer proposal for KMTC. The increase of capacity of KMTC was required later to cater for additional transfer from Randenigala under proposed NCP canal project, in response to the anticipated increased demands from benefitting areas in NCP, NP and NWP.

202 Following considerations were also made:

- Transfer canal and LB Main Canal of Kaluganga reservoir will run parallel to each other, with the LB Canal on a lower contour. Careful consideration has to be given to the inflows of lateral drainages. Transfer Canal will capture lateral drainages and it is likely to spill. Spill waters will flow to LB Canal, which has a lesser capacity than the Transfer Canal, thus requiring more canal safety measures.
- According to the given layout, the intermediate space between the corridors of the transfer canal and that of the LB Main canal will be about 30 to 50 m in width. However, with reference the ground slopes the ***normal section*** of the transfer canal and the LB Main canal will require a corridor of about 85 m and the ***deep cut section*** will require a corridor of about 75 m.

203 In view of above considerations, an alternative route is proposed by the MCB Consultants, which comprises of two sections of tunnels linked by an aqueduct located at 2

+ 850 Km en route (at *LelOya*, an existing large stream). The alternative route for the transfer canal has been proposed incorporating the following features:

i. Designed conveyance capacity of 35 m^3/s
ii. One open canal reach
iii. Three reaches of cut & cover conduits
iv. Two tunnels
v. An aqueduct across LelOya (2.85-2.94km) and another aqueduct at 0.89 km
vi. Four sections of bench flumes

Table 2.14 Two proposals for the KMTC

No.	Description	Unit	MCB Proposal	Lahmeyer Proposal
1	Total Length	km	9.16	13.0
2	Open Lined Trapezoidal Canal	km	0.480	8.2
3	Cut & Cover/double conduit	m	0.251	-
4	Tunnel	km	7.860	3.7
5	Steep slope canal	km	-	0.8
6	Bench flume	km	0.090	
7	Structures			
7.1	Drainage crossings	Nos	-	19.0
7.2	Aqueduct	Nos	2	1.0
7.3	Bridges	Nos	-	3.0
8	Access & Maintenance Road	km	0.64	10.96

204 The widening of KMTC to cater for increased discharge can have impacts from its close proximity to Kaluganga LB Canal and the steep terrain (please refer to Figure 3.1). The EIA team noted that above mentioned modifications were required to ensure the broader scope of benefits under NCP Canal Project (which include benefits to NWP, NP, EP) compared to the originally planned Moragahakanda-Kaluganga Project benefits. Further the open canal sections of the KMTC would run through good quality forest covered hill sides. Therefore negative impacts from open canal creations on these hills would have been greater than the currently proposed tunnels.

205 **The proposed amended trace of the conveyance system can shorten the total length, reduce open canal reaches and high maintenance costs in the steep hilly**

terrain,reduce environmental damage to forest and improve the safety of the conveyance route and structures. As such, the modified (MCB) trace can be recommended.

B. Proposed route from UEC

206 At the commencement of the EIA Study, the design engineers proposed two possible routes, as follows:

207 **Route No. 1:** The UEC Route No.1 has been designed as a free flow open canal to convey a discharge of 40 m^3/s from Moragahakanda reservoir. The total length of the route is 63.03 km with 21.6 km of tunnel, and the governing water surface elevations at commencement and the end of the canal are respectively 143.000 and 133.873m MSL. The total estimated cost is 35.2 billion.

208 **Route No. 2 :**The UEC Route No 2 also has been designed as a free flow open canal to convey a discharge of, 40 m^3/s from Moragahakanda reservoir. The total length of the route is 68.5 km with approximately 7.2 km of tunnel, and the governing water surface elevations at commencement and the end of the canal are respectively 143.000 and 134.807 m MSL. The water surface elevation at the end of UEC in route 2 is higher than that for route 1 due to reduced tunnel lengths with steeper gradient. The total cost is LKR 27.6 billion.

209 Option 1 involves longer length of tunnels and therefore would be more costly. In addition, a higher level of technology and machinery would be required.

210 In contrast, Option 2 would involve longer length of open canals and cut and cover sections. While this would make the cost less, there could be greater adverse impacts on the environment, especially in environmentally sensitive areas. In addition the route runs through rocky terrain, which may require blasting and associated work that entails greater impacts on the environment during the construction phase.

211 Subsequent to the initial field visit and literature survey, the EIA Team had discussions with the design engineers. The major outcome of the discussions was to recommend an **Option 3/route 3**, which is the combination of components of Route 1 and Route 2. The combination was made after carefully studying the environmental and technical concerns. These are listed in Table 2.13. This EIA was conducted for option 3 as the route to be constructed as the project.

Table 2.15 Recommended route of the UEC and the combination of Route 1 and 2

Reach	Route 1		Route 2		Route 3	
	From	To	From	To	From	To
1	0.0	17.5	0.0	17.5	No change	
2			17.5	27.5	17.5	27.5
3	26.5	32.5			27.5	33.5
4	32.5	35.8			33.5	36.8
5			38.8	43.0	36.8	41.0
6	40.3	63.0			41.0	63.7

212 It was noted that approximately 3 ½ km of the trace runs along the western border of the Minneriya National Park. As avoiding this was not possible tunneling was recommended for this section. See Annex VI - Table 1 and 2 which explain design stage changes done to accommodate the concerns expressed by the Department of Wildlife and the Forest Department.

C. No action alternative

213 Without the Project, the cropping intensities of small tank cascades in the NCP, NP and NWP will remain at around 0.9-1.1. Water shortages in the major reservoirs in the NCP, NP and NWP will remain the same. This will give rise to severe socio-economic problems in the area. It is to be noted that there are water-sharing issues among the farmers already. Examples are the issues between farmers under Huruluwewa feeder canal and Huruluwewa reservoir. Without the UEC, these problems would further increase.

214 In addition, there are serious water quality concerns in the NCP, NWP and NP at present. It is known that water quality deteriorates, and pollution concentration rises in the dry periods. Without augmentation, these water quality problems will increase in the future.

215 With the cessation of the conflict in 2009, the townships in the target areas are rapidly developing and expanding. Tourism especially as a regionally very important industry has expanded very rapidly. Minneriya NP, Sigiriya cultural sites, Dambulla religious and cultural sites are hubs of tourism in this region. Thus with such expansion, water demands from drinking, sanitation and industrial sectors will increase. The NWSDB has already identified its water requirements, and local water resources are incapable in providing these needs during dry periods. Moreover, any attempt to extract water from agriculture sector under present conditions will create serious water sharing issues among its current users. While there is a rapid development in roads and other infrastructure, residents of the area will not be able to make optimum utilization of those benefits without the removal of the water constraint.As such, no action alternative is considered unacceptable.

CHAPTER 3

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 Physical Environment

3.1.1 Topography

216 The Figure3.1 depicts the topography of the project area.

a) UEC Route

217 The UEC is located almost entirely in the upland area. The terrain is more flat when compared to the KMTC transfer route, but the upstream reach conveys through some steep areas. The Agro-ecological map of the Department of Agriculture designates this area under DL1b and DL1c, where the topography is described as undulating.

218 Annex VI –Table 1shows the profile of the UEC along with the approximate lengths traversed through each type of land use.

219 Paddy tracts of Pekulam breached tank lie on the left side of canal in the above mentioned reach. In the same reach two dominant folds rising to 215M MSL & 255 M MSL exist.

220 After 42+200 the route goes through limbs of several folds rising to maximum 200m msl and reaches end of tunnel section at 53+7400km. The maximum rise above the tunnel would be 110m near Pekulam.

221 The canal trace travels below the Yan Oya close to 47+500km and then reaches Mannakkatiya bifurcation at 65+500 km. Link canal to Mannakkatiya and NCP canal bifurcate at this location.

b) Manankattiya Tank- Mahakanadarawa Tank Link Canal

222 From Manankattiya Tank, a new sluice structure will enable discharge of water to Maminiya Oya (stream), which will convey water to Eru Wewa. The length of this reach is about 10 km. From Eru Wewa, (Eruwewa Mahakanadarawa Feeder Canal) will convey water to Kanadara oya which leads to Mahakandarawa Tank, and requires to be improved to convey the additional discharge, and to address existing conveyance problems. The length of this reach is about 11.5 km.

223 The Manankattiya-Eruwewa link canal passes few kilometers over an almost flat terrain before falling onto existing Eruwewa.

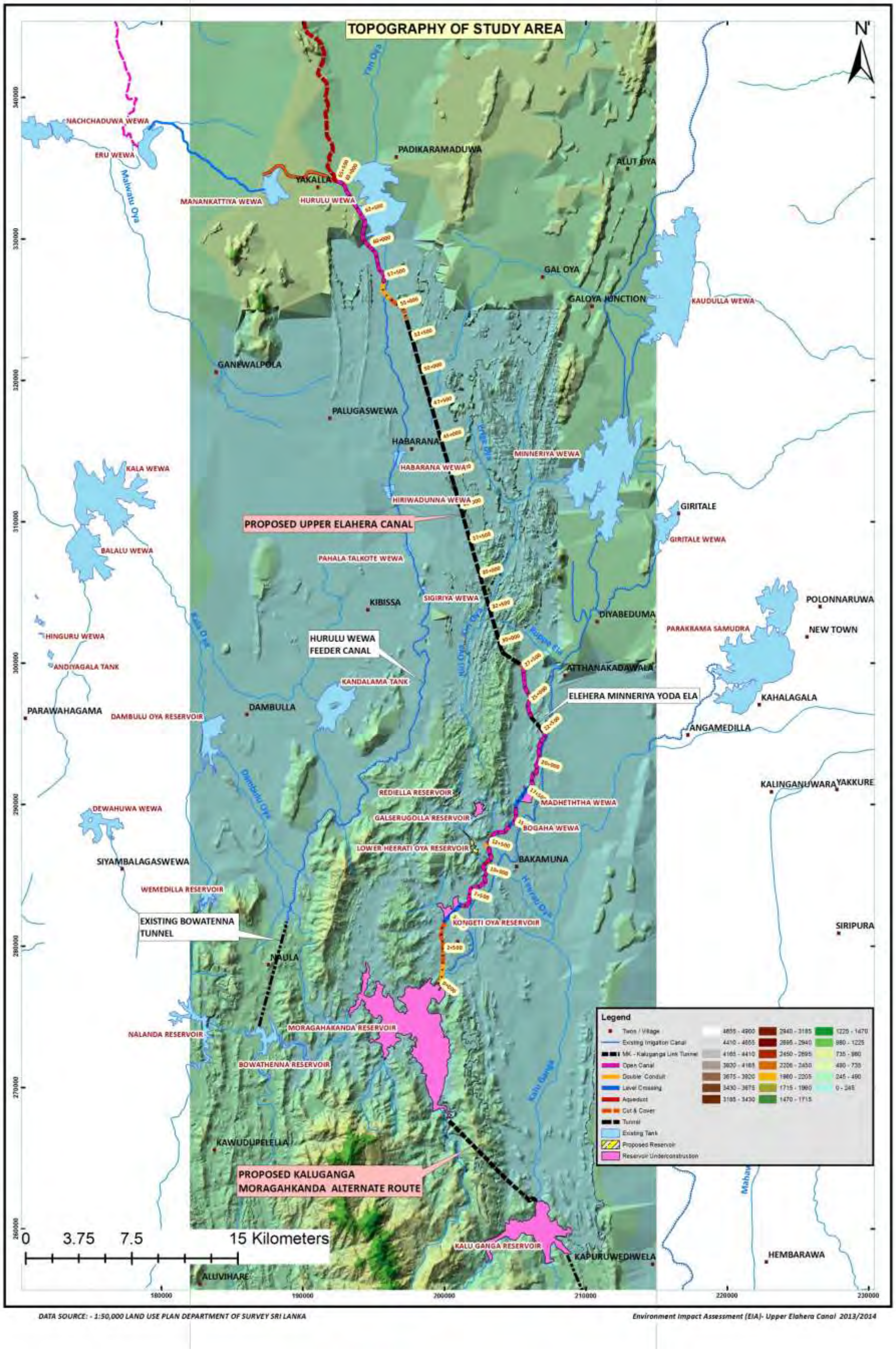


Figure 3.1- Topography of the project area

224 **(**Note: The Figure 3.1 is based on 1:50,000 topographical maps of the Survey Department. It was noted that the contours created by 1:10,000 topographical maps do not make an exact match with the former, but the latter does not cover the entire study area. As such, the **Figure 3.1 is used** for comparison of the terrain and slopes only.)

225 Eruwewa- Mahakanadarawa Transfer Route comprises of a natural stream (a branch of *Maminiya Oya*) at the beginning and an irrigation canal which falls in to a natural stream *Kanadara Oya* which then leads to Mahakanadarawa tank. The irrigation canal runs through a rocky terrain which require enlargement to send the required discharge.

c.) KMTC Route

226 Kaluganga- Moragahakanda transfer route goes through highland areas for a small section,but is mostly located in the upland area. The concentration of contours shows that KL-MK route is running through very steep terrain.

227 Kaluganga - Moragahakanda transfer canal has to pass through two steep high hill ranges and also a stream called *Lel Oya*located in between.

228 An aqueduct will convey water across *Lel Oya*, and on either side tunnel sections are proposed to be incorporated.

Plate 3.1 Lel Oya and approximate aqueduct location

3.1.2 Geology

229 Figure 3.2describes the geology of thestudy area

230 The UEC, starting just downstream of Moragahakanda reservoir, traverses about 67 km to the Manankattiaya outlet.

231 Some geological investigations have already been done for tunnel sections and aqueducts in the Kaluganga-Moragahakanda transfer route. It is necessary to carry out detailed geological investigation especially to locate inlet portals and outside portals and also drill a few more bore holes in between in order to ascertain the actual geological situation of this area. Currently a tunneling expert is reviewing the arrangements for detail investigations and these investigations will be completed before construction commences. The portals have been identified and the required investigations are being carried out to determine the required type of support etc. As far as Core Recovery (CR) and Rock Quality Designation (RQD) are concerned, the geological situation of the rock appears to be suitable.

232 In the initial stretch of 17.5 km of UEC, sufficient investigation has been done including geophysical surveys, auguring and Standard Penetration Test (S. P. T.) tests. There are three level crossings namely Kongetiya oya, Bogahawewa and existing Madeththa wewa. Geologically the UEC project area has undergone metamorphism and folding lithological variation coupled with tropical weathering. This has given rise to a strongly featured topography of ridges and valleys generally striking North-South alignment, often associated with large scale folds within meta sediments. Quarz being the most resistant to weathering, ridge forming rocks depend on the percentage of quartz with quartzite, quartz rich layer parallel pegmatites and quartz rich granatoids.

233 The Precambrian crystalline complex of Sri Lanka is sub divided into three major units' namely Highland complex, Vijayan complex and Wanni complex based on the rock types and structure present in them.The entire canal trace falls within the Highland complex where the oldest rocks are much dominant. The Highland complex is composed of Khondalite group of Meta sediments and charnokytes and it occupies a broad belt running across the center of the island from south West to North East. Highland complex mostly covers hill country of Sri Lanka.

234 It is important to note that there were no major faults encountered in the canal trace in all sections. However Calcic gneiss exists in the last stretch of UEC. This necessitates detailed geological investigation to ascertain the actual geological situation of the area for the construction of tunnels. The required investigations are being carried out.

235 In the initial stretch of the tunnel (27+500 to 54+000Km) Marble exists over 5 Km which is a major concern. This necessitates detailed Geological investigation for tunnel to ascertain the actual geological situation of the area concerned

236 The rock types intercepted by the canal & tunnel trace are as follows:

Table 3.1 Summary of Rock Types along UEC Route 3

Calc Gneiss 0 - 2+000 Km 11+500 - 12+300Km 16+500 -17+600Km 23+000 -25+200Km 32+200-32+800Km 33+300-34+000Km 39+000 – 47+600Km	**Garnet- biotte- sillimanite Gneiss** 9+500 – 10+000Km 10+500 – 11+500Km 12+400 -12+600Km 12+800 – 16+500Km 17+600 – 23+000Km 31+100-31+500Km 31+700 – 32+000Km 34+100 - 39+000Km
Quartzo feldpathic Gneiss 50+900 - 54+900Km	**Biotite hornblende Gneiss** 55+000 – 58+400Km 59+600 – 60+200Km 62+200 - 64+408Km
Charnokitic biotite Hornblende Gneiss 30+200 -30+500Km	
Marble 39+100 – 47+500Km 42+200 – 47+5000Km	**Quartzite** 18+700 – 19+100Km 22+000 – 22+300Km 30+400 – 30+700Km 30+900 – 31+100Km 32+800 – 33+000Km

Plate 3.2 Drill hole location at 17+770km - above Madatta wewa

237 **Mannakattiya - Eruwewa Mahkandarawewa Link canal:** Geologically this link canal intercepts northern end of an overturned Antiform (axis N-S oriented) passing biotite Gneissic layer and Quartzitic layer and again the same lithological unit of Biotite Gneissic layer, Hornblende biotite Gneissic layer before opening onto Eruwewa.

238 **Mannakattiya wewa- Mahakanadarawewa Link Canal:** Upper Elehera Canal ends at Manakattiya outlet and the link canal To Mannakattiya wewa and NCP canal bifurcates from this location. Geologically the link canal originates in Biotite-hornblende Gneissic area and then crosses Charnokite-biotite Gneissic area passing a patch of quartzite again enters Charnokite-biotite Gneissic area and falls into Mannakattiya irrigation system. From Mannakattiyawewa system water goes through a canal which already exists. Eruwewa –Mahakanadarawewa link canal already exists and has to be augmented at some locations to divert water to Mahakanadarawewa .After crossing Galkulama- Yakalla road the canal goes through a deep cut in weathered rock where widening and & deepening may be required. Soft rock excavation may be possible in that stretch. There does not appear to be serious geological and environmental issues as this link canal is already functional.

239 **Kaluganga - Moragahakanda transfer canal/ tunnel:** Some geological investigation has already been done for tunnel sections and aqueducts. It would be necessary to carry out detailed geological investigation especially to locate inlet portals and outside portals properly and also few more bore holes in between already drilled locations in order to ascertain the actual Geological situation of the area concerned. In first section of the tunnel of KMTC, geological investigation carried out at inlet portal [1+160 km] indicate favorable geological condition from the elevation 220.5m MSL to a depth 11.30 m. Slightly weathered quartzo feldspathic rock and followed by fresh charnoritic gneiss, which can reach 100% core recovery (CR) values & Rock Quality Designation (RQD) values are found way down to the canal bed level. This charnoritic gneiss has low or no fracture at this level and proves ideal conditions for a tunnel... However, as stated

earlier few more bore holes with rock permeability tests and other relevant tests would be necessary to determine the treatments and strengthening measures of tunnels.

240 In the KMTC geological investigation carried out revealed the geological situation from the elevation 206.0m to a depth 3.0m thick clay layer and completely weathered rock at 3.75m depth and slightly weathered rock level at 6.30m which is Chranokitic gneiss. At 9.00m depth fresh charnokitic gneiss occurs indicating very good CR and RQD values and continues the same situation way down tunnel bed level.

Plate 3.3 Heerati Oya Core Sample Location and core samples

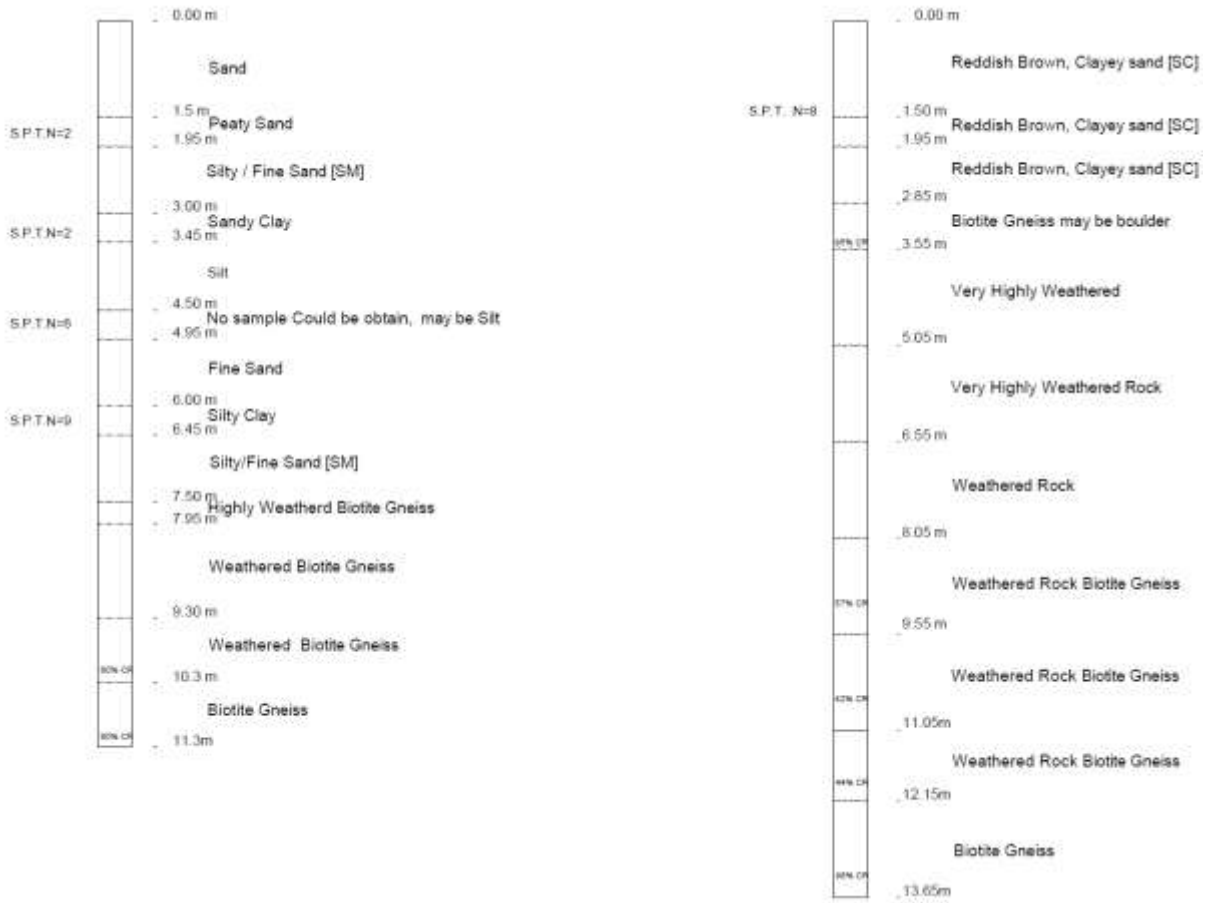


Plate 3.4 Heerati Oya Core Logs at 10+460 km (left) and 10+560 km

Plate 3.5 Heerati Oya - Core sample 10+560 km (left) and Pan Sample/Quartzitic Gravel 10+375 km

Rock Level 0.5m below ground level

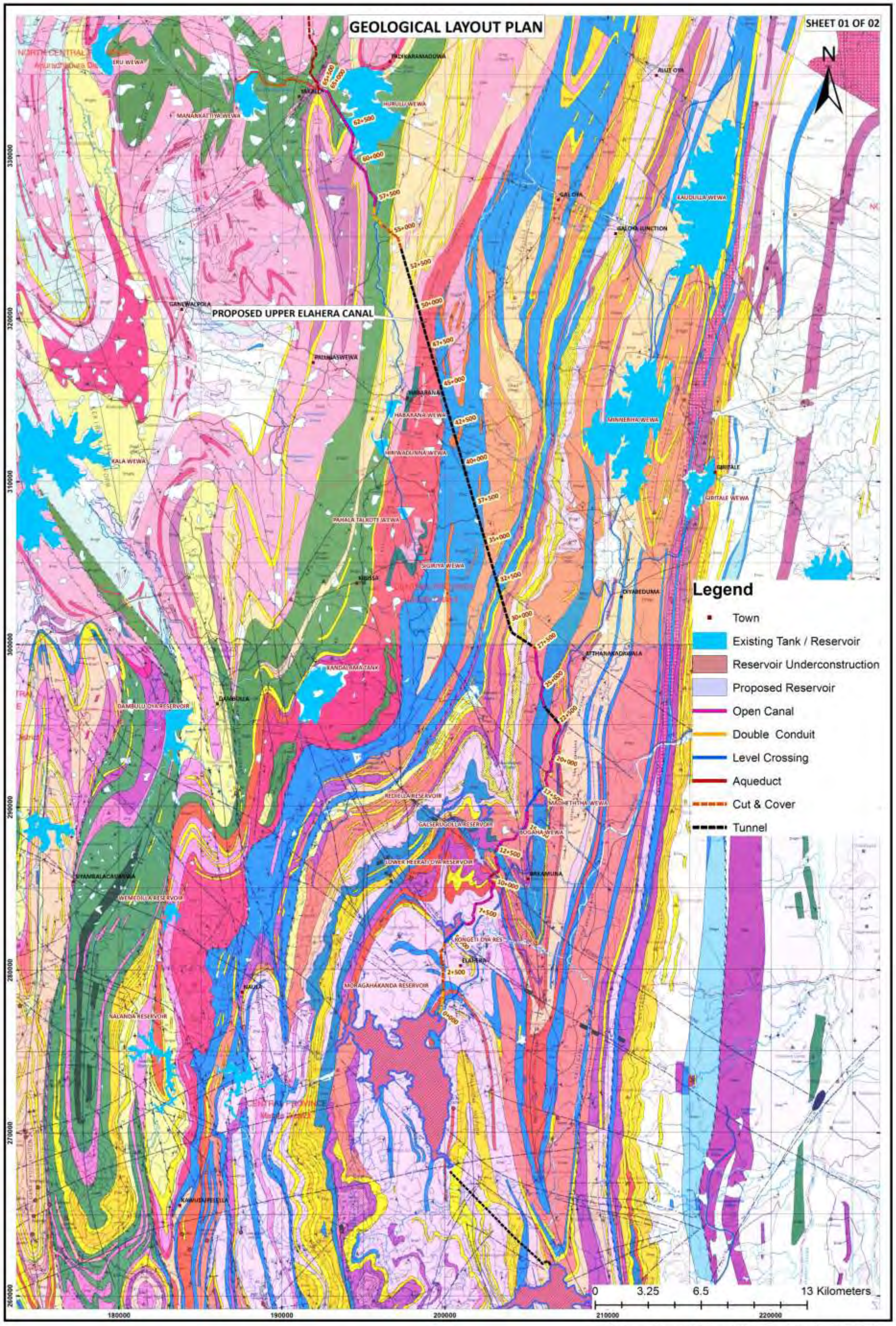


Figure 3.2- Geological Layout Plan

GEOLOGICAL LAYOUT PLAN

PROTEROZOIC METAMORPHIC ROCKS
(no stratigraphic order implied)

Lithologies principally (but not exclusively) of the Vijayan Complex

Microcline gneiss: fine-grained, quartz-rich, massive gneisses (alkali feldspar granite composition); with biotite only; characteristically with myrmekite textures (the 'Welikande-Dambane' gneisses)

Granodioritic gneiss: massive to weakly layered rocks with quartz, plagioclase; biotite > hornblende

Lithologies principally (but not exclusively) of the Wanni Complex and associated Kadugannuwa Complex

Granite gneiss: massive leucrocratic quartzo-feldspathic gneisses, quartz >20%, few mafics

Pegmatitic granitoid gneiss: distinctive quartz-rich, leucocratic, white or pink, pegmatite-layered gneiss produced by deformation, usually ridge-forming

Hornblende-biotite gneiss: massive to compositionally layered grey gneiss with quartz >20% plagioclase and garnet < *ca* 10%; tonalite composition

Hornblende-biotite migmatite: compositionally layered grey gneiss typically with white pegmatoid leucosomes

Biotite-hornblende gneiss: medium to dark grey gneiss, plagioclase > K-feldspar; quartz <15%; quartz monzodiorite to leucodiorite composition

Biotite-hornblende migmatites: medium to dark grey migmatite; plagioclase > K-feldspar; often white pegmatoid leucosomes; quartz <15%

Hornblende gneiss or amphibolite: mafic orthogneisses and schists, quartz generally =<10% plagioclase <20%; diorite to gabbro composition (may contain small amounts of garnet and clino- and orthopyroxene)

Metagabbro: includes two pyroxene granulites and other dense mafic orthogneisses, garnet often present

Lithologies principally (but not exclusively) of the Highland Complex

Quartzofeldspathic gneiss: leucocratic, gneiss weakly compositionally layered, granoblastic, CI <10; may include both para- and orthogneisses

Quartzites: pure coarse-grained ridge-forming quartzites locally with <5% each of sillimanite, kaolinised feldspar or biotite

Impure quartzites and quartz schists: with sillimanite, ± magnetite, ± garnet, often interlayered with biotite-bearing quartz-rich quartzofeldspathic gneisses

Garnetiferous quartzofeldspathic gneiss (formerly 'garnet granulite'): leucocratic quartz-feldspar gneiss with abundant pink garnets, often >20%; weathers to iron-rich residual deposits

Garnet-sillimanite-biotite gneiss ± graphite: pelitic schist or gneiss

Garnet-silimanite-biotite gneiss ± graphite with up to 30% large (1-3 cm) red garnet, formerly 'khondalite'

Tectonically layered charnockitised biotite-hornblende gneiss with thin quartzites

Marble, usually coarse-grained and dolomitic, locally high calcite marble present

Calc-gneisses and / or granulites: calc-silicate gneisses with very variable mineralogy

Cordierite gneiss: granoblastic, with cordierite >15%, and K-feldspar, biotite, quartz, ± sillimanite, garnet usually present

Undifferentiated calc-gneisses: variable sequences of well layered gneisses with interlayers of biotite gneiss or quartzofeldspathic gneiss

Biotite gneiss: massive or compositionally layered, pale grey gneiss; contains quartz, feldspar and >10% biotite; generally granodioritic to quartz-monzonitic in composition; biotite rich (>20%) variants generally paragneisses

Dambulla-Habarana migmatitic gneisses: tectonically interlayered garnet- sillimanite-biotite paragneiss and biotite-hornblende (±) opx. orthogneiss. Variably migmatised with abundant potash melts in paragneissic lithologies

Undifferentiated charnockitic biotite gneisses: extensive sequences of charnockitic-looking grey gneisses usually lacking hypersthene, though commonly with boudinaged orthopyroxene- bearing mafic layers; but may include some paragneisses

Polonnaruws-Mahiyangana gneisses: extensive suite of variably migmatised and charnockitised black & white layered (TTG) orthogneisses, mainly tonalite-quartzdiorite composition; charnockitic biotite-gneisses and garnet, biotite-hornblende gneisses most abundant with late monzogranitic pegmatite veins common

Charnockitic gneisses: restricted outcrops, often ridge-forming, typically coarse-grained with characteristic brown or green greasy lustre; may lack hypersthene. Includes patchy *in situ* charnockites as well as partially retrogressed, bleached 'ex-charnockites', stipple indicates local charnockitisation

Undifferentiated paragneisses: well-layered, extensive and compositionally variable gneisses, locally containing garnet, biotite, sillimanite, ± cordierite

Late-stage intrusives (in general younger than 550 Ma)

Quartz-syenite pegmatite: very large (up to 30 cm), ovoid, microcline or perthite, with granular feldspar mantle; quartz <10% (except on intrusion margins) with hornblende and biotite, and accessory zircon and apatite (formerly 'augen gneiss')

Pegmatites: simple quartz-feldspar pegmatites with magnetite and/or allanite

Serpentinite: pale green altered ultramafics (mainly dunite from east of Mahaweli river)

Dolerite: quartz-normative tholeiites (K-Ar ages *ca*152 and 143 Ma)

Vein quartz: usually transparent to milky, high-purity, massive to lenticular

EXPLANATION OF LINE AND STRUCTURAL SYMBOLS

- Approximate or inferred geological boundary or contact
- Geological boundary, between superficial deposits and solid formations
- Geological boundary, concealed
- Fault, inferred from air photographs (tick shows downthrow side)
- Shear zone, inferred from air photographs (arrows denote shear sense where known)
- Axial trace of antiform, and plunge
- Axial trace of synform, and plunge
- Overturned antiform
- Overturned synform
- 65 Strike and dip of foliation (generally parallel to compositional layering)
- 230 / 15 Azimuth and plunge of lineation
- Azimuth and plunge of minor fold
- Plunge of minor antiform
- Plunge of minor synform
- Structure, form or trend lines, from air photographs
- Fault, fracture or major joint, from air photographs
- Thrust or shear with thrust sense probable
- Thrust inferred
- Mineral occurrence
- Extent of mineral resource, i.e. silica sand, principal gemming area, gravel (or limits of patchy gravel spread)
- Mine, abandoned

TES ON MAP COMPILATION AND NOMENCLATURE

ps have been compiled using point data and original lithological scriptions from unpublished mapping of the Geological Survey of ylon/Sri Lanka. The original linework has been completely revised, dified by photogeological and satellite image interpretation. ited fieldwork (see reliability diagram) has been undertaken to ck and substantiate new linework. Satellite images show clearly extreme lateral lithological continuity particularly of lower-crustal iss units, and hence small though significant occurrences of ticular lithologies have been enhanced in size where they aid ity to the linework.

ar zones, faults, fractures and major joints are also interpreted inly from air photos and satellite imagery. Upright shears and ts appear as lineaments, many following the limbs of D_3 folds. across-strike extent of such linear features indicates that at st some must represent significant crustal-scale discontinuities. spite pervasive high-strain fabrics throughout the gneisses, field cking has shown that upright shears are characterised by even ve intense fabrics. Because of a lack of expression on the photos

3.1.3 Soils of the project area

241 **Agricultural properties of soils**: The area beyond Pekkulama Tract towards the downstream of the canal trace consists of well-draining Reddish Brown Earths (RBEs) and associated soils (Rhodustalfs)Figure 3.3.The depth of the soils is likely to be from 60 cm to 90 cm in most of the area. The quartz impervious layer situated at various depths in different locations is the primary obstacle to crop cultivation. The narrow range of water holding capacity, low organic matter content and reduced workability when dry are other concerns that may affect the growth and yield of crops in these areas. These factors will equally affect both annual and perennial crops. The natural vegetation of shrub jungle and dry evergreen short statured forestry is an indicator of the shallow depth of the soils.

242 However, a considerable area upwards from Pekkulama up to Elahera, including Pekkulama Tract, as well as Heerati Oya command area consists of sandy to clayey alluvials and mountain regosols of varying drainage capabilities. The effective soil depth is likely to be more than 90 cm while it could be deeper to even 150 cm in the valley plateau. The Draft Final Report on Modifications to Configuration of Moragahakanda-Kalu Ganga (M-K) Project also confirms this fact. Surveys and Investigations adds Kongeti Oya and Bogahalanda areas as also having similar soil characteristics. These soils are agriculturally very productive owing to their good drainage as well as the nutrient status. Flooding brings in a tremendous amount of nutrients from the mountain slopes and deposits them on the valleys which is the main reason for the high productivity. Infact, the farmers of Pekkulama reported that they are getting 150 bu/ac (7.5t/ha) both Maha and Yala seasons even without the recommended rate of fertilize application, and this was confirmed by the Department of Agriculture and Department of Agrarian Development/Bakamuna and Divisional Secretary /Elahera. Not only rice and other field crops but perennial crops such as coconut and recant will perform extremely well on these soils**.** Therefore a careful consideration has to be given for using these soils for increased agricultural production wherever possible with irrigation supply, while ensuring environmental sustainability.

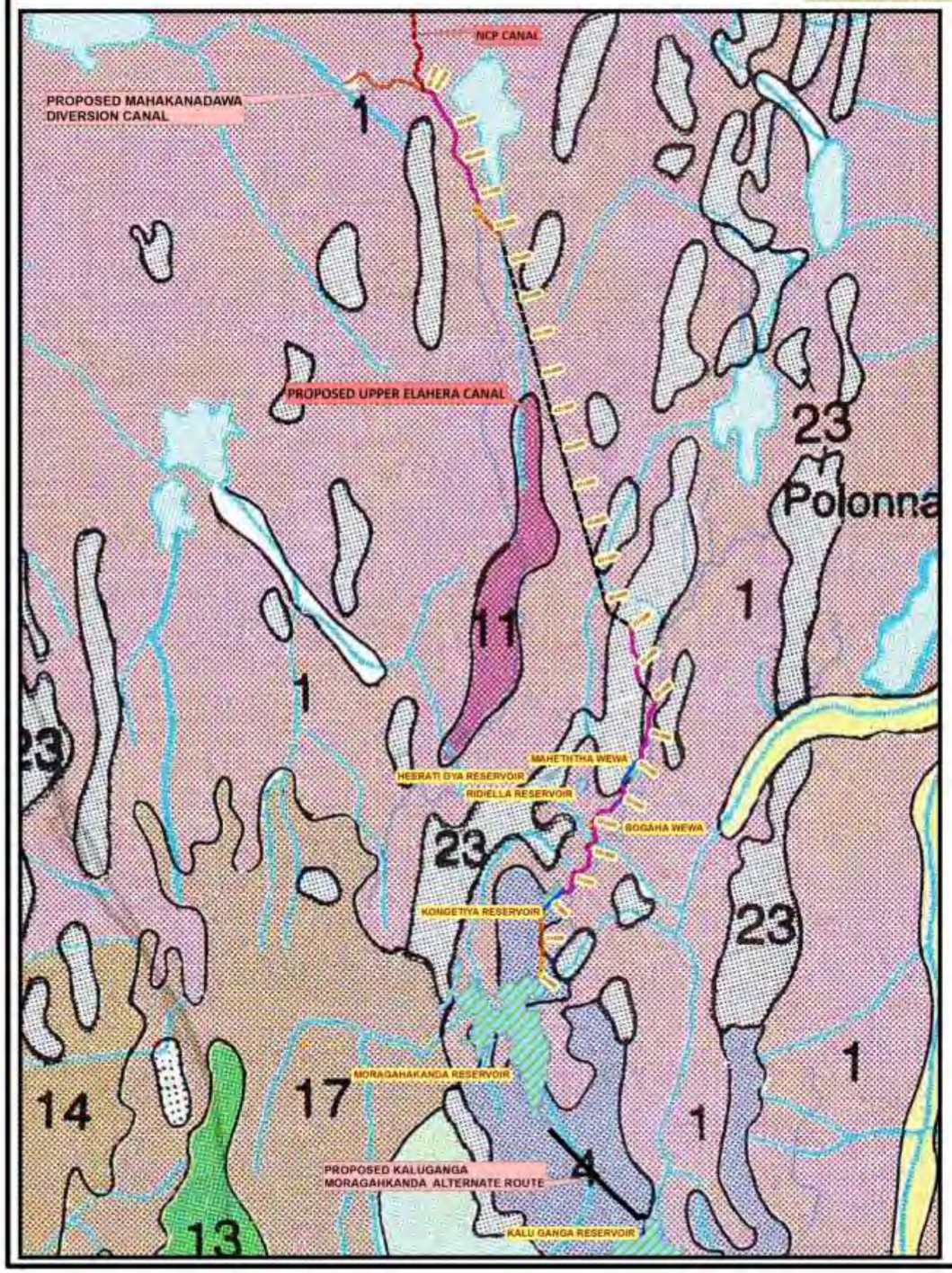
243 A narrow strip of sandy alluvials with similar production potential is seen around Siyambaladamana- Halmillewa area, downstream of UEC, along the Yan Oya which is reported to be cultivated with short-term field crops such as maize, vegetables, chillies and onions mainly during Yala season with pump-lift irrigation. This area is not cultivated during the Maha season owing to riverine floods.

244 **Engineering properties of soils**: Soil investigations carried out at Kongetiyaoya Level crossing, Heeratioya aqueduct and Bogahawewa Level crossing shows the soil profile where top layer is a 1m-2m thick silt layer underlain by 1-2 thick Sandy clay overlying 0.5m-1m thick Gravelly silty clay material. Below that, it is completely weathered rock. According to unified soil classification silt is classified as ML, sandy clay material as CH, clayey Sand material as SC,silty sand as SM and clayey gravel as GC. The above soils are typical weathering profile that could be anticipated with the exception of sandy alluvium and Alluvial soil that may be encountered in stream section and flood plains.It is to be noted that a 2.85m thick layer of Reddish Brown Clayey Sand overlying

weathered Biotite Gneissic rock at 10+560 km location onthe LB of Heeratioya. The same material is observed at Madettawewa Spill overlying weathered rock.

245 Most of the material coming out from the canal excavation containing SC, CH & SM can be used for the formation of bunds on either side of the Canal. GC Material with high bearing capacity can be used at the top as wearing surface. A similar soil profile can be expected up to Pekkulam, and beyond that the material becomes more permeable lacking clay content. Again Sandy Alluvial soils exist in the most downstream reach where Yanoya flows in the close vicinity of UEC.

SOILS OF THE STUDY AREA



SOILS

LEGEND

Soils of the Dry Zone and Semi-Dry Intermediate Zone

1 Reddish Brown Earths and Low Humic Gley Soils: undulating terrain
2 Non Calcic Brown Solis and Low Humic Gley Soils: undulating terrain
3 Soils on Old Alluviam; undulating terrian
4 Reddish Brown Earths and Immature Brown Loams; rolling and hilly terrain
5 Red-Yellow Latosols; gently undulating terrain
6 Calcic Red -Yellow Latosols; flat terrain
7 Grumosols; flat terrain
8 Solodized Solonetz, Solonchaks and Soils on recent marine calcareous sediments flat terrain
9 Alluvial soils of variable texture and drainage; flat terrain
10 Regosols on recent beach and dune sands; flat terrain
11 Rendzina Soils; undulating to rolling terrain

Soils of the Wet Zone and Semi-Wet Intermediate Zone

12 Red-Yellow Podzolic Soils and Mountain Regosols; Mountainous
13 Red-Yellow Podzolic Soils; steeply dissected, hilly and rolling terrain
14 Red-Yellow Podzolic Soils with strongly mottled sub-soil and Low Humic Gley soils; undulating terrain
15 Red-Yellow Podzolic Soils with soft or hard laterite;rolling and undulating terrain
16 Red-Yellow Podzolic Soil with prominent A1 or semi-prominent A1 horizons and Red-Yellow Podzolic Soils with dark B horizon; hilly and rolling terrain
17 Reddish Brown Latosolic Soils; dissected, hilly and rolling terrain
18 Immature Brown Loams, dissected, hilly and rolling terrain
19 Bog and Half-bog Soils; flat terrain
20 Latosols and Regosols on old red and yellow sands; flat terrain
21 Alluvial Soils of variable texture and drainage; flat terrain
22 Regosols on recent beach sands; flat terrain.

Miscellaneous land units

23 Erosional remnants. steep rock land and various lithosols

Environment Impact Assessment (EIA)- Upper Elahera Canal 2013/2014

Figure 3.3- Soils of the Project area

3.1.4 Climate, Meteorology and Agro-ecology

246 The Figure 3.4 explains the agro-ecological status of the study area.

247 The Agro-Ecological Regions Map prepared by the Department of Agriculture describes the properties of relevant Agro-Ecological Regions (AER) as follows:

Table 3.2 Agro-ecological zones and characteristics of the study area

AER	Terrain	Major Soil Groups	Land Use
IM2	Hilly rolling and undulating	Reddish Brown Earth, Reddish Brown Latosolic, Low Humic Gley, Mountain Regosol and Lithosol soils	Natural forest, mixed home gardens, paddy and grasslands
IL2	Rolling, hilly and undulating	Reddish Brown Earth, Low Humic Gley and Reddish Brown Latosolic soils	Mixed home gardens, paddy, rainfed upland crops, scrub, sugar cane, citrus
DL1c	undulating	Reddish Brown Earth, Low Humic Gley	Rainfed upland crops, paddy, scrub, Mixed home gardens, Forest plantations
DL1b	undulating	Reddish Brown Earth, Low Humic Gley	Rainfed upland crops, paddy, scrub, natural forest, forest plantations, sugar cane

248 **Agro-Ecological Potential of the affected area**: Around 20% of the canal length situated proximally to Moragahakanda Reservoir is within the Agro-ecological Region (AER) of Intermediate Low (IL2) while around 80% of the canal length away from the Moragahakanda Reservoir is situated within Dry Low AER (DL1c)Figure 3.4. The Annual 75% Rainfall Probability of IL2 is more than 1600 mm with around 1000 mm during Maha and 600 mm during Yala while for DL1c it is around 900 mm with 650 mm during Maha and 250 mm during Yala. This shows that only the area coming under IL2 can support a crop of paddy without supplementary irrigation and that also, only during the Maha season. However, most other field crops (OFC) of less than 90 days, could be grown under rainfed conditions if the rainfall distribution and soil conditions are favorable even in DL1c. The Yala rainfall is not adequate for rice in both these AERs but it is somewhat sufficient for short-term field crops in IL2. Also, it is possible to grow short-term legumes such as green gram during yala in DL1c, if well-timed with the onset of season. However, there is a possibility to cultivate a considerable extent with supplementary lift irrigation from agro-wells or small streams.

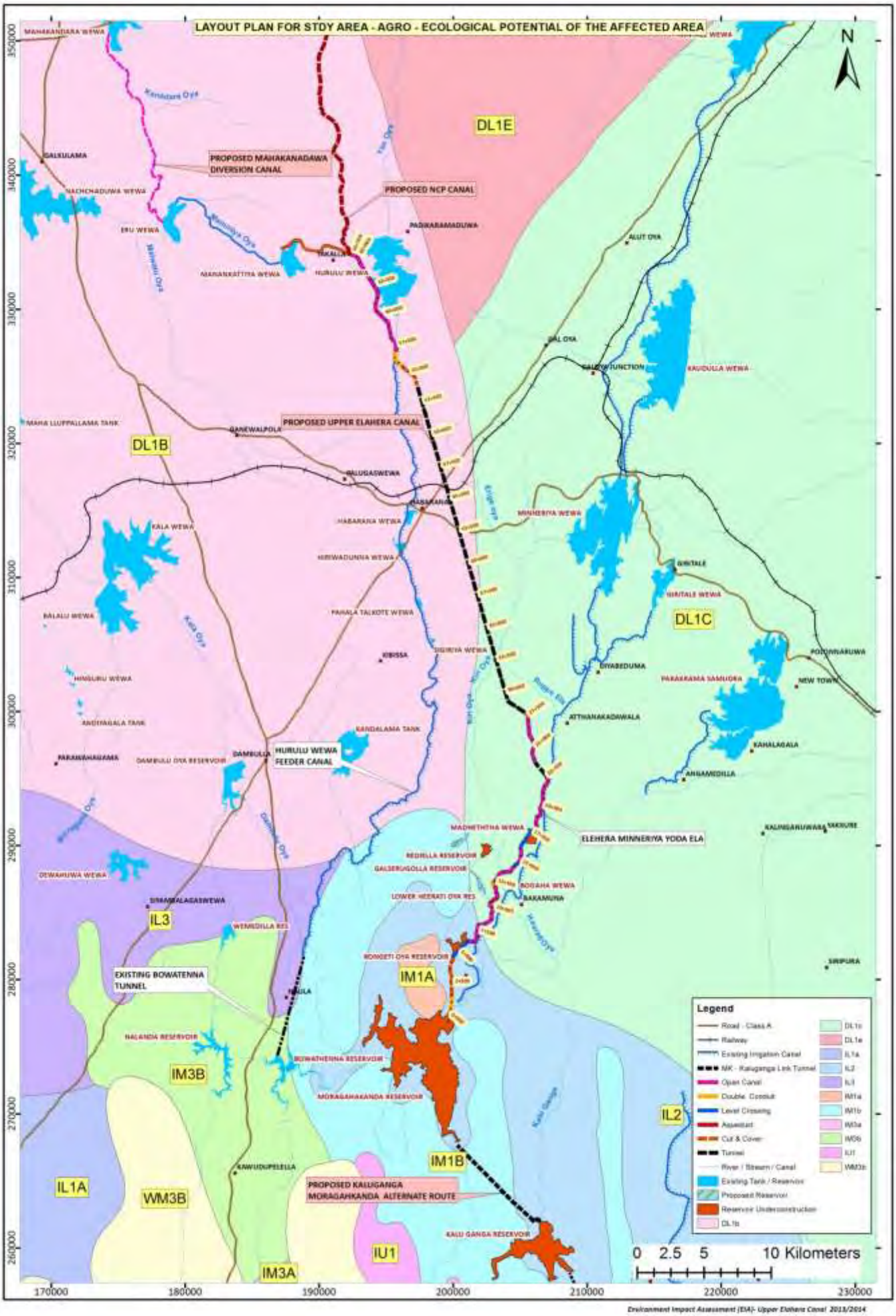


Figure 3.4-Agro ecology of the Project area

249 The figures below demonstrates the annual long-term rainfall status, based on the records from 1971-2000 at three meteorological stations within the study area. Out of the three stations, Katugastota receives an annual rainfall of 1,805 mm. It can be seen that the rainfall is generally uniformly distributed with a peak in November-December and low values from January to March. Mahailluppallama located around the center of the study area and Anuradhapura in the tail end receive about 62% of the annual rainfall during the second inter-monsoon and north-eastern monsoon periods (October to February). Rainfall peaks in October-December period, while low values are recorded from June to August.

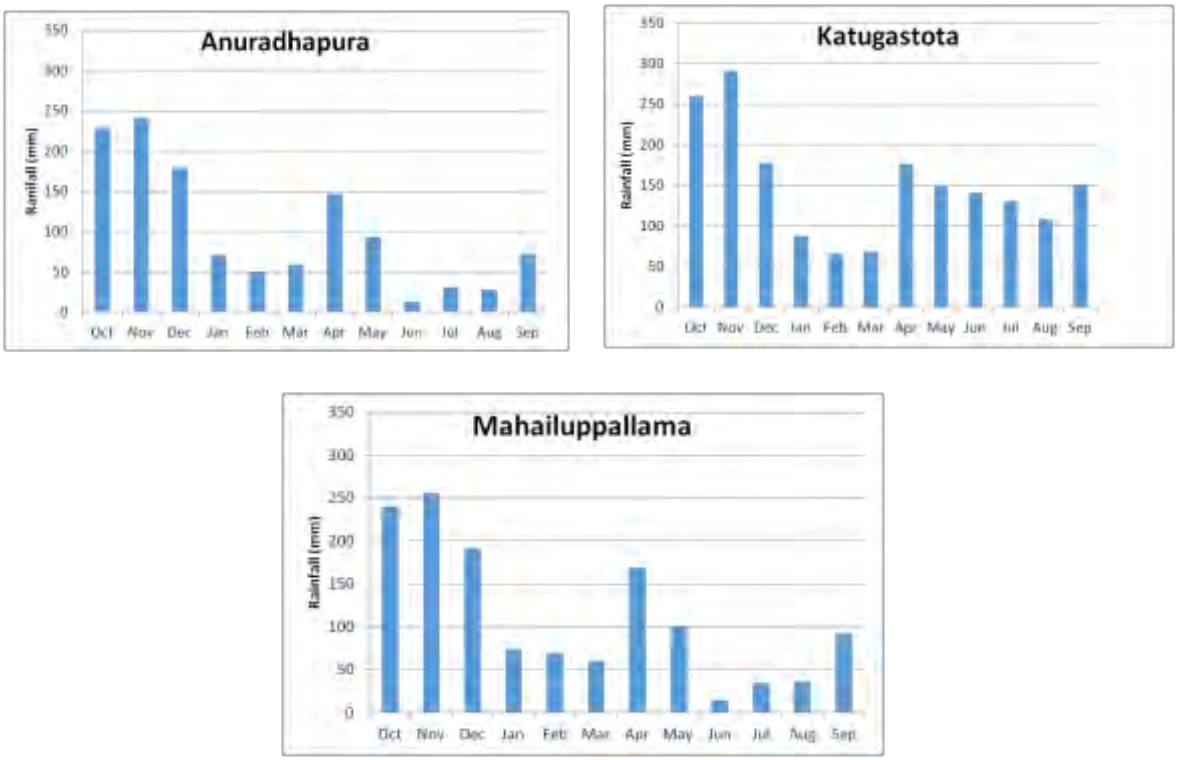


Figure3.5- Current rainfall pattern of the study area

250 **Methodologies adopted by the MCB Consultants to assess rainfall**: Rainfall time series used for the study consists of monthly data from 1949 up to 2010 with the update done by the Water Management Secretariat (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 developed byUS 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 Netherlands Engineering Consultants (NEDECO) in 1979 and Electricity Master Plan Study (Lahmeyer International.1987) in 1987 too.

251 The study to optimise the use of available water and other natural resources in Mahaweli and the selected 5 basins including technically feasible transfer routes and power generation had been conducted in detail adopting the following computer models, time tested and proven to be satisfactory over last 2 decades. (MIWRM, 2013)

(a) Acre's Reservoir Simulation Programme (ARSP) for multipurpose and multi-reservoir water balance studies developed by ACRES International, Canada and

(b) Acre's Irrigation Demand Model (AIDM) (developed by ACRES International, Canada) for irrigation demands for all committed irrigation systems receiving Mahaweli waters.

252 MCB had conducted several simulation studies, to cater the demands for water in all systems under original MDP including NCP canal and areas in NWP, adopting the above model for optimizing water resources in Mahaweli and adjoin basins, for different options involving diversions, increasing storage capacities, maximizing power generation

253 Consequently this proposal recommends a water resources distribution plan and an infrastructure arrangement to achieve the objective of maximizing the use of water resources without major changes to the existing infrastructure in Mahaweli basin, with only minor amendments to proposed infrastructure developments in the adjoining basins, and including pumping for irrigation from the lower reaches of Mahaweli River.

3.1.5 Hydrology

254 **Hydrology of the Upper Elahera Canal (UEC):** Upper Elahera Canal (UEC) is the first stretch of water conveyance from Moragahakanda Reservoir to the NCP canal which provides water to the topmost Huruluwewa Reservoir in Yan Oya and Manankattiya reservoir in Malwathu Oya basins.

255 After Kongetiya level crossing, there are a few streams crossing the path of UEC. The major streams are Heerati Oya and Kiri Oya. Their natural flow is not affected by the UEC, as the latter bypasses the streams. There is an aqueduct over Heerati Oya and at Kiri Oya where the UEC water will be conveyed by a tunnel. (See Figure 3.6)

256 In addition, there are level crossings proposed at Kongetiya Tank, Bogahawewa Tank and Madetthewa Tank.

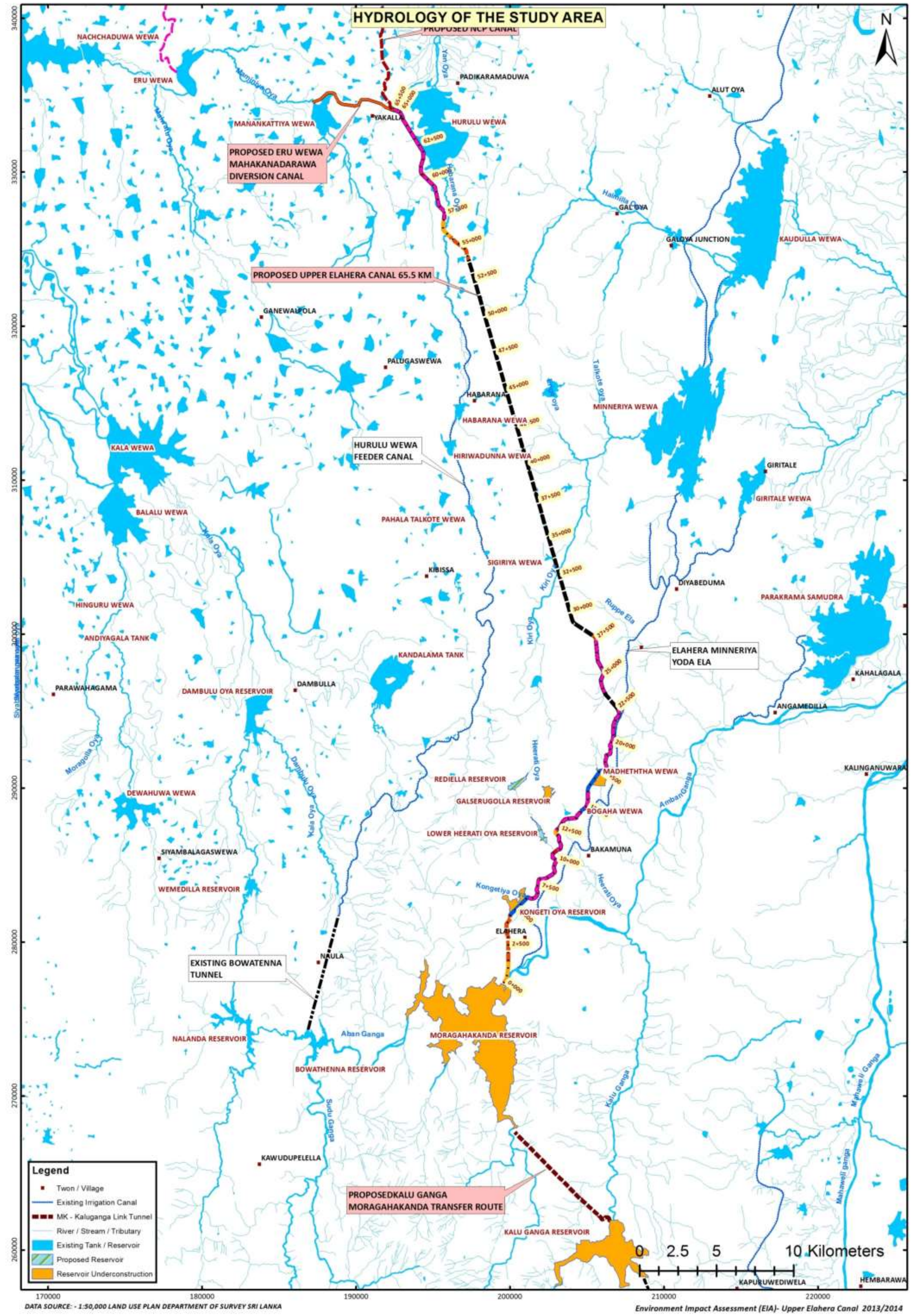


Figure 3.6-Hydrology of the Study Area

257 **Kalu Ganga – Moragahakanda Transfer Canal:** Kalu Ganga is a major right bank tributary of Amban Ganga, starting at an elevation of about 1,800 m MSL. The southern part of the watershed contains some of the high peaks of the Knuckles Mountain Range, such as "Kalupahana" and "Lakegala". It joins Amban Ganga about 14 km downstream of Elahera. In its upper reaches, the Kalu Ganga is known as "Kuda Oya". The "Halmini Oya" and "Nikawatura Oya" are two right bank tributaries of Kalu Ganga. The riverbed slopes are very steep in the initial reaches, with a slope of about 23% in the initial 6 km, and reducing to 2% in the next 9 km. Subsequently the river slopes are relatively flat, averaging around 0.3% between Pallegama and Hattota Amuna.

258 The catchment area of the Kalu Ganga at the Pallegama dam site (which will form the Kaluganga reservoir) is 128 km^2. The gauging site at Pallegama is located about one kilometer downstream of this site. The annual rainfall received in the upper Kalu Ganga catchment varies from 2300 mm to 3300 mm. The upper Kalu Ganga basin, receives a higher annual rainfall, compared to the other sections of Amban Ganga catchment. Annual rainfall received in the areas north of Pallegama reduces from about 2300 mm at Pallegama to about 1800 mm near the confluence with Amban Ganga. The major part of the rainfall at Pallegama is received during the NE monsoon from October to January.The main features of KMTC are:

- The route starts from the left bank sluice of proposed Kalu ganga reservoir.
- In the reaches where the mode of water conveyance is open canal, drainage under crossings are proposed to ensure no mixing up of Kalu Ganga water and water from local catchment is possible. From 1.00 Km to 2.85 Km is a tunnel through steep hills
- At 2.85Km, canal crosses Lel Oya by an aqueduct structure of about 200 m in length. The aqueduct is running 4 m above the high flood level of Lel Oyaat 100 year return period.
- From there the canal runs up to 9.087Km as a tunnel through hills.
- The route runs as an open canal for about 500 meters after this tunnel and falls in to a tributary of Moragahakanda, called Kabarawa Oya

259 Therefore no change in the existing hydrology is expected except for minor regulations at drainage under crossings.

260 **Conveyance system from Manankattiya to Mahakanadarawa:** The conveyance system from Mannankattiya to Mahakanadarawa comprises of existing canals, an underground conduit and a small section of open canal. The proposed improvements do not have an impact on the existing hydrology.

261 **Groundwater status in the UEC affected area:** The Kaluganga – Moragahakanda link route and the Upper Elahera Canal passes through or passes close to the Divisional Secretary's areas of Elahera, Bakamoona, Naula, Dambulla, Palugaswewa, Kekirawa, Galenbindunuwewa and Hingurakgoda.

262 According to the Ground Water data collected by the Water Resources Board through the deep wells of diameter 112.5 mm constructed for a considerable period, following observations can be made (See Figure 3.8 for locations).

Table 3.3 Groundwater observations

Information	Minimum	Maximum	Average
Water Level – mbelow ground level	0.4	21.0	5.6
Yield – lpm	5.0	1000	106.3

263 **Flooding:** In the UEC maximum precautions have been taken not to alter the general flow pattern of the project area with the canal flow except for level crossings at "Kongetiya wewa", "Bogaha wewa" and "Madettawa wewa". Adverse flooding situations have not been recorded in the case of Kongeti Oya, and the Puwakgaha Ulpotha across which the Madettawa wewa is constructed except for some back water effects at the confluence with EMYE (Elahera Minneriya Yoda Ela). Due to introduction of additional tanks, more favourable situation than the existing situation with regard to flooding in the area is expected.

264 Spillway structures for these tanks have to be selected and designed carefully so that this condition is fulfilled.

265 There has been no severe floods or flood disasters in this area, however villagers undergo nuisances due to local drainage problems during heavy rains. Such villages with flood issues include Elahera and Karadagolla villages, Thunwana piyawara and Puwakgaha Ulpotha villages, and Mahadiwulwewa.

266 An analysis of flood and drought records in the Divisional Secretary Divisions in the Project area for the 30 year period from 1983 to 2012 provides the following results:

Table 3.4 Flood and drought situation in the study area

Divisional Secretary Division	Number of drought years per 30 years	Number of flood years per 30 years
Dambulla	4	4
Laggala-Pallegama	5	4
Naula	5	3
Elehera	1	8
Hingurakgoda	4	5
Kekirawa	4	3

Galenbindunuwewa	6	1
Mihintale	6	0

Source: *www.desinventar.lk*

267 It can be seen that droughts are more frequent in the benefitted area in the north and north east of UEC. This emphasizes the benefits of water transfer to these drought affected villages. Elehera DS Division in the UEC path has a higher frequency of floods. This agrees with the findings of the social survey, which cites flood issues in Elehera, Karadagola, Thunwana Piyawara and Puwakgaha Ulpotha villages in the Elehera DS Division. In addition, the social survey found flood issues in the Mahadiwulwewa GN Division in Kekirawa DS Division. The construction of UEC does not affect these floods because water of the streams is not intercepted by the UEC. However, the three level crossings are located in this DS Division and the design engineers have provided spills with adequate capacity.

268 **Environmental Flow:** As there is no disturbance to the existing hydrology, releasing of environmental water issue is not expected. The bottom sluices of the above mentioned 03 tanks (level crossings) have to be operated suitably to fulfill this condition. The three streams generally go dry during some months of the year. But due to two season cultivation under these tanks after the operation of theUEC, drainage water will collect to the original stream improving the current situation.

3.1.6 Water quality and sources of water pollution

269 Sources of water pollution include:

i. Soil erosion, especially during the start of rainy season is a cause for high sediment loads.

ii. Main contributor to fecal coliform counts in water is the poor sanitation practices including overflowing septic tanks of the population of the area. Animal bathing in rivers and tanks could be another reason.

iii. Many different types of human activities that increase turbidity, change pH, add heavy metals and other types of pollutants including agrochemicals, fertilizer run offs, oils, solid waste etc.

iv. Activities of the construction phase of the UECincluding construction waste, oil spilling of machineries, solid disposal etc.

270 **Water quality at Elehera Anicut:** Considering that UEC will commence near Elehera Anicut, a water quality assessment study was carried out by MCB Consultants through the Environmental Engineering Department/Engineering Designs Center of University of Peradeniya in 2012 at that location(EDC, 2012) (see Figure 3.7 for locations). The results are as follows:

Table 3.5 Water quality at Elehera Anicut

	Drinking* +	Bathing +	Irrigation +	May	June	July	August	October	December
Color (PtCo units)	200	NA	NA	52	51	22	1	42	7
Turbidity (NTU)	NA	NA	NA	2.3	3.01	2.5	10.5	17.5	33.1
pH	6.0-9.0	6.0-9.0	6.0-8.5	7.85	8.08	7.99	8.58	6.92	7.66
Temperature (^{0}C)	NA	NA	NA	28.2	28.4	30	28.5	26.8	25.1
Electrical Conductivity (µS/cm)	NA	NA	0.7	238	194.1	222	174	131	191
Hardness / (mg/L)	NA	NA	NA	92	177	90	65	48	61
Nitrate as NO_3 -N / (mg/L)	5	5	5	0.7	0.3	0.9	1.3	0.8	8.6
Phosphate as PO_4-P / (mg/L)	0.7	0.7	0.7	0.29	0	0.01	0.07	0.45	0.04
Fluoride/ (mg/L)	1.5	NA	NA	0.51	0.28	0.51	0.09	0.12	0.33
Manganese/ (mg/L)	NA	NA	NA	0.1	0.6	0.1	0.1	0.2	0.031
Aluminium/ (mg/L)	NA	NA	NA	0.55	0.35	0.01	0.71	0.36	0.48
BOD_5/ (mg/L)	5	4	5	<1	<1	<1	<1	1.02	2.5
Suspended Solids/ (mg/L)	NA	NA	NA	32	26	2.2	15	43	25
Total Coliform at 35^{o}C/ 100ml	5000	1000	1000	1000	1550	710	4000	1050	1860
Fecal Coliform at 44^{o}C/ 100ml	0	50	0	600	1100	260	120	560	1660

Notes; C.G - Carpet Growth (too many to count)

+ Ambient water quality guideline level /

* Source water for drinking water for conventional treatment

271 Guideline levels/standards are according to the Sri Lankan Ambient Water Quality Guidelines for Bathing, Drinking Water with Conventional Treatment and Irrigation and Agriculture use, proposed by the Sri Lanka Standard Institute (SLS)

272 In the above table, drinking water standard requirements are the minimum water quality standards to be maintained before treatment. It can be seen that all the parameters are within the acceptable levels for drinking and irrigation. In addition, the rise of Fecal Coliform during December, with the onset of rains, suggests that the sources of Fecal Coliform are local, and comes from the nearby urban area.(EDC,2013)

273 The situation can be considered to improve with the construction of Moragahakanda reservoir and its augmentation by Kaluganga reservoir. When the variation of water quality parameters with time is studied, it can be seen that water quality goes down during the dry months such as August. With the construction of Moragahakanda reservoir and with good catchment management practices incorporated to its design, better water quality than current levels at Elehera can be expected from the Moragahakanda reservoir. In addition, when the water flows over to reservoirs and water levels are maintained at high levels due to augmentation, further dilution of pollutants can be expected.

274 The above mentioned measurements were taken during an extreme dry season and it can be expected that these measurements represent an extreme situation (base flow dominant). It can be expected that there will be high dilution of pollutants with higher water levels (Surface water dominant). Furthermore, it was found that waters at Elehera show better water quality in terms of suspended solids and electrical conductivity compared to downstream locations. The Fluoride content, hardness, Nitrate-N and Phosphate contents are within the acceptable limits.

275 **Groundwater Quality**: The Table below describes the quality of groundwater in the UEC general area. Theinformation was obtained from the data base of Water Resources Board, and the readings have been obtained in different time periods.

Table 3.6 Quality of groundwater in the general area of UEC

Information	Minimum	Maximum	Average
Turbidity	0.4	130	8.07
pH	6.3	8.2	7.46
Electrical Conductivity	114.5	7320	801.44
Aluminium	82.6	614	328.56
Total Dissolved Solids	123	4831	534.37
Calcium	8	483	44.44
Magnesium	4.8	377	42.67
Ferrous	0.01	10.1	1.19

Chlorine	10.1	2797	113.58
Sulphate	0.7	233	28.64
Fluoride	0.01	1.9	0.61
Salinity	0.1	4	0.4
Nitrate	0.1	5.4	1.24

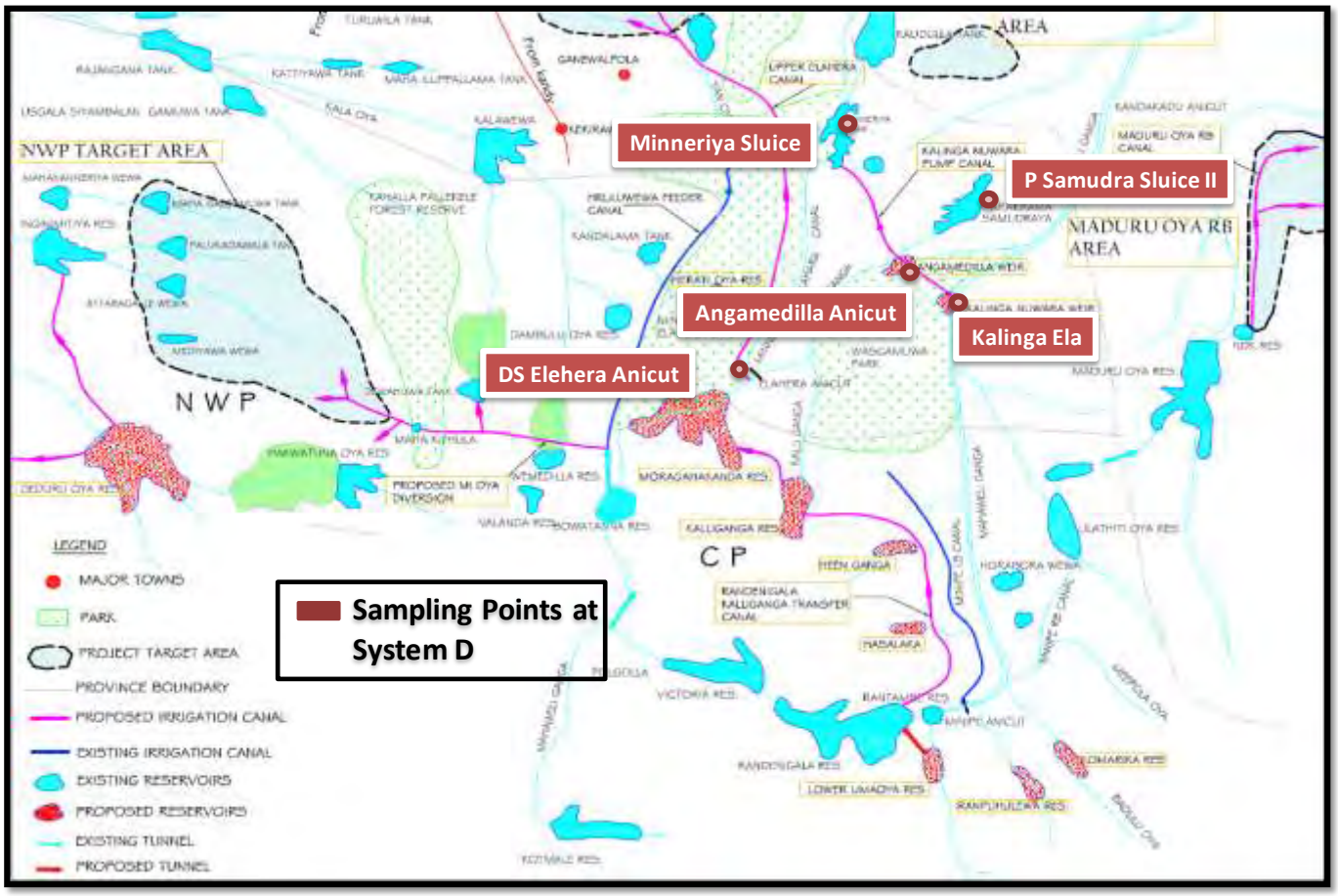


Figure 3.7- Location of water quality measurement sites

3.1.7. Irrigation Aspects:

276 The major existing irrigation schemes located in the study area and their current agricultural potential in the major schemes are listed below:

Table 3.7 Major irrigation systems in the Study Area

Name of Scheme	Storage MCM	Present Irrigable Area, Ha	Cropping Intensity (last 05 years)
Huruluwewa	67.8	4300	1.69
Mannankattiya	6.1	607	1.64
Eruwewa	4.32	85	2.0
Mahakanadarawa	44.8	2526	1.62
Nachchaduwa	55.7	2834	1.71

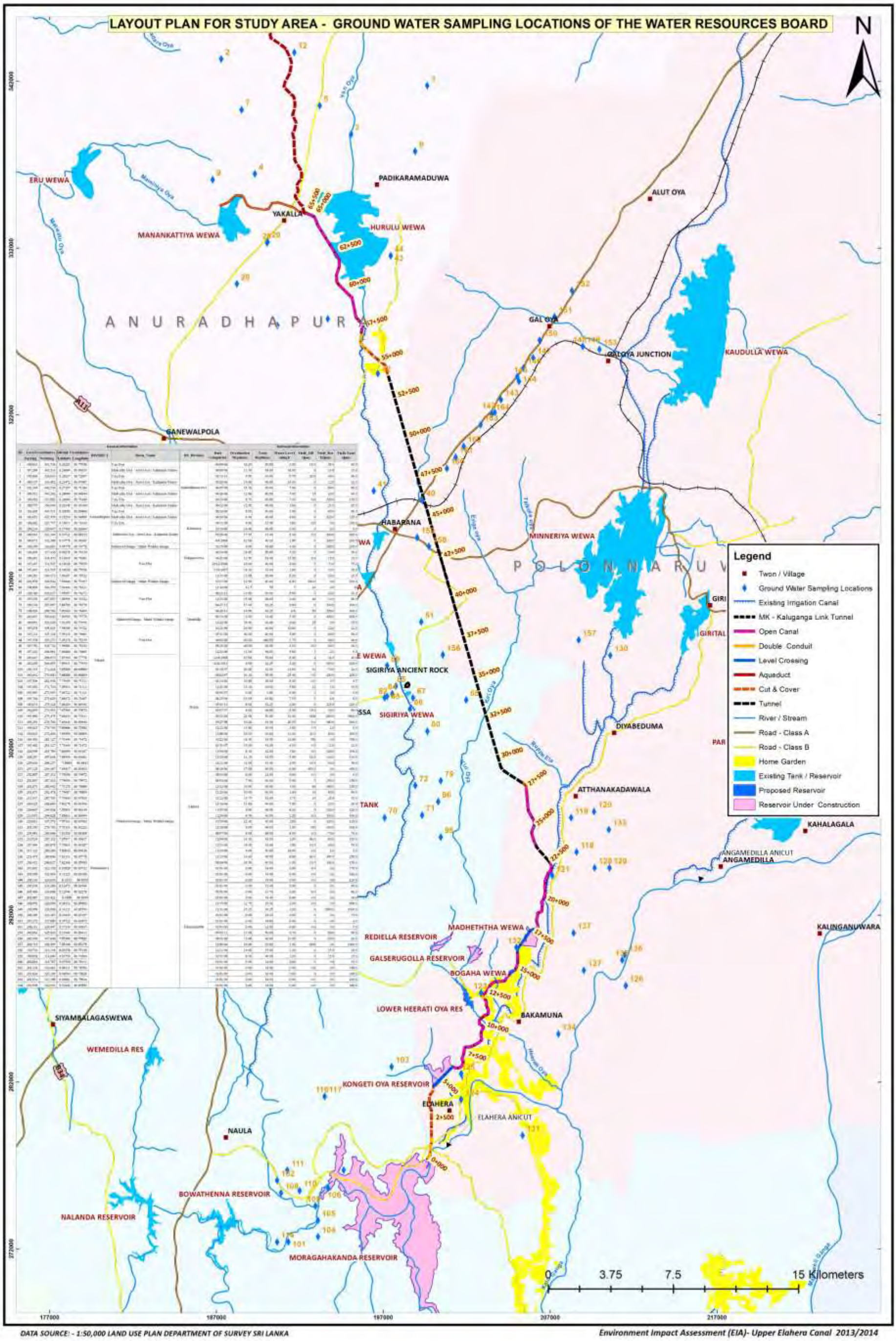


Figure 3.8- Layout Plan for Ground Water Sampling Locations of the Water Resources Board

277 Some of the existing irrigation systems in the area practices lift irrigation systems. In addition there are agro wells developed in the area to do high land crops. Table 3.8 gives the information about irrigation schemes in the respective GNDs and other sources of water use for their cultivation.

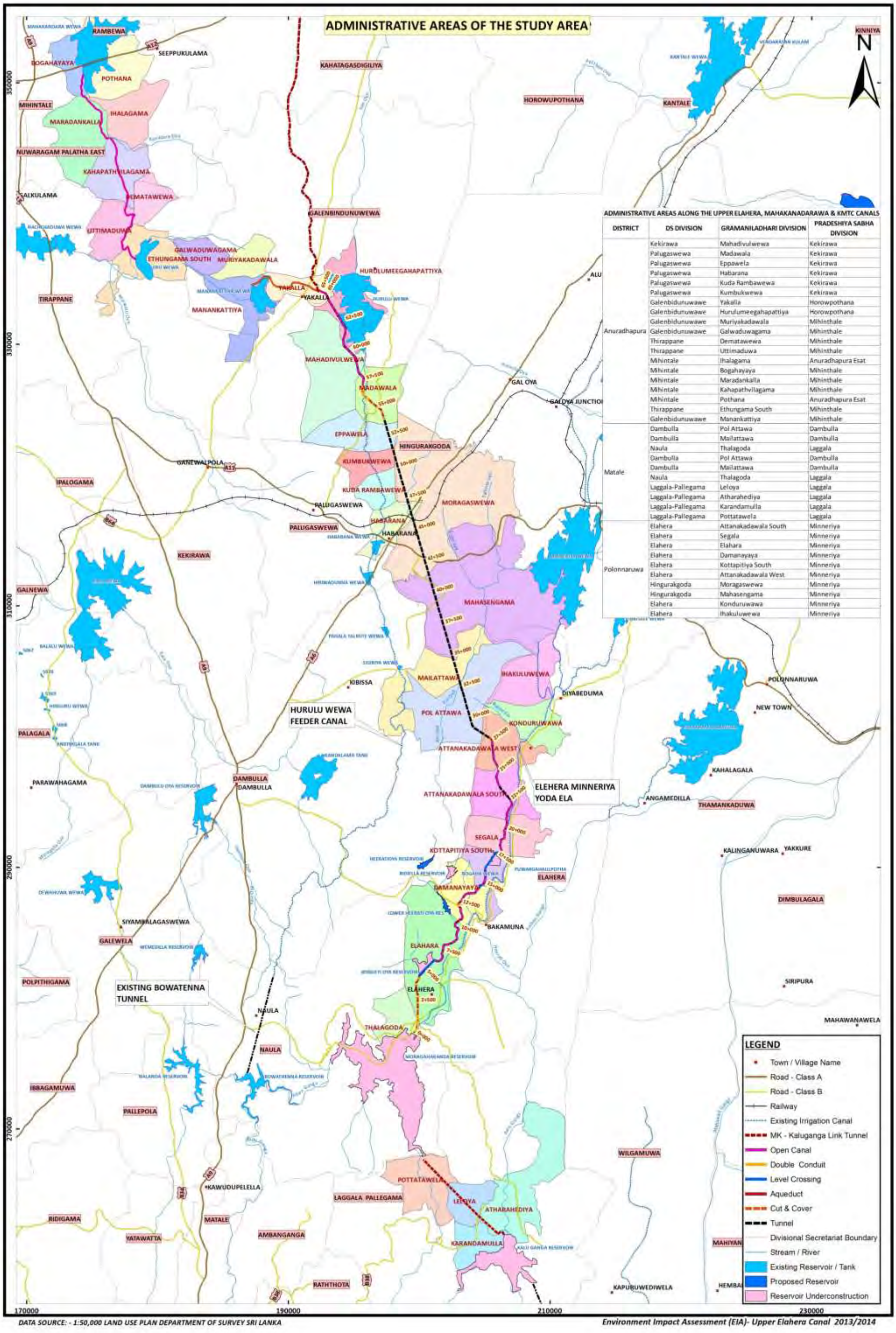
Table 3.8 Irrigation schemes in the respective GNDs located in UEC trace

DSD	**GND**	**Existing irrigation schemes and other resources**
Naula	Thalagoda	Thalagoda and Amban ganga anicut to cultivate about 278 acres of paddy lands. In addition there are 5 agro wells to cultivate 80 acres of lands.
Elahera	Elahera	1 minor irrigation scheme. Yoda ela is the main source of water for their cultivation and cultivate only during Maha season.
	Damanayaya	About 22 ha of highland cultivation are used 45 agro wells in the area. Heerati oya scheme and bakamuna pathaha tank are the main minor irrigation schemes in Damanayaya and Dampuragama areas of GND. The lift irrigation scheme is abandoned in Tharuna govi wyaparaya at present.
	Kottapitiya – south	Elahera irrigation scheme supply water to cultivate about 350 acres of paddy. Nikapitiya and Mahadetta tanks are the other water resources used in the area.
	Segala	There is no proper irrigation system to this area. The people cultivate using water of Yoda ela sub channel and 16 agro wells. But, these water sources not available for Dambulukelegama village where UEC is proposed.
	Attanakadawala-south	Yoda ela is the only source of water for cultivation and no agro wells or other minor irrigation system. People face difficulties during dry season.

DSD	GND	Existing irrigation schemes and other resources
	Attanakadawala-west	There is no proper irrigation system to this area.
Dambulla	Polattawa	Polattawa and Alakolawewa upper and lower tanks supply water. The people in the area has no any other irrigation system for their cultivation
	Maillattawa	Hurulu feeder canal
Hingurakgoda	Mahasengama	The main source is rain water which fills the tanks of Eirige oya, galen bindunu wewa, Gallinda, Angulana, Gallinda kuda tank and Purana wewa. The cultivation restrict to maha season due to water deficiency in the area
	Moragaswewa	There are 6 minor irrigation schemes of Moragaswewa, Thimbirigaswewa, Kadahatha tank, Dehiattawala, Unagolla tank and Karandagaswewa tank which cultivate about 194 acres during Maha season. In addition there 32 agro wells to cultivate OFCs.
Palugaswewa	Habarana	Habrana tank controlled under Mahweli has a command area of 150 acres.
	Eppawela	There are 6 minor irrigation schemes fed by rain water which are Ikiri wewa, Bogahakotuwa wewa, Ambagaswewa, Asirigama wewa, Gambirisgaswewa and Habadiwulwewa with a total command area of about 230 acres paddy during maha season
	Madawala	Six minor irrigation schemes fed by rain water. They are Ihalamadawala wewa, Siyambaladamana wewa, Kirimetiya wewa, Pahalamadawala wewa, Meegaswewa and Madugahawewa with a command area of

DSD	GND	Existing irrigation schemes and other resources
		490 acres paddy during Maha season.
Kekirawa	Mahadiwulwewa	Mahadiwul wewa and Konwea minor irrigation schemes cultivate 150ha during maha and 100ha during yala seasons.
Galenbindunuwea	Hurulumeegahapattiya	Huruluwewa major irrigation scheme
	Yakalla	Karambegama and Samagiwewa minor irrigation schemes with a command area of 43 acres during maha season. In addition, Iluppukanniya mahawewa, Iluppukanniya pahala wewa and Yabarawewa cultivate 58 acres paddy
	Mannankattiya	Galketiyawa minor irrigation scheme to cultivate 46 acres and Manankattiya which is a medium scale irrigation tank which cultivate 1050 acres paddy during Maha season

(Source: 2011 & 2012 data from relevant DSDs and GNDs)



ADMINISTRATIVE AREAS ALONG THE UPPER ELAHERA, MAHAKANADARAWA & KMTC CANALS

DISTRICT	DS DIVISION	GRAMANILADHARI DIVISION	PRADESHIYA SABHA DIVISION
Anuradhapura	Kekirawa	Mahadivulwewa	Kekirawa
	Palugaswewa	Madawala	Kekirawa
	Palugaswewa	Eppawela	Kekirawa
	Palugaswewa	Habarana	Kekirawa
	Palugaswewa	Kuda Rambawewa	Kekirawa
	Palugaswewa	Kumbukwewa	Kekirawa
	Galenbidunuwawe	Yakalla	Horowpothana
	Galenbidunuwawe	Hurulumeegahapattiya	Horowpothana
	Galenbidunuwawe	Muriyakadawala	Mihinthale
	Galenbidunuwawe	Galwaduwagama	Mihinthale
	Thirappane	Dematawewa	Mihinthale
	Thirappane	Uttimaduwa	Mihinthale
	Mihintale	Ihalagama	Anuradhapura Esat
	Mihintale	Bogahayaya	Mihinthale
	Mihintale	Maradankalla	Mihinthale
	Mihintale	Kahapathvillagama	Mihinthale
	Mihintale	Pothana	Anuradhapura Esat
	Thirappane	Ethungama South	Mihinthale
	Galenbidunuwawe	Manankattiya	Mihinthale
Matale	Dambulla	Pol Attawa	Dambulla
	Dambulla	Mailattawa	Dambulla
	Naula	Thalagoda	Laggala
	Dambulla	Pol Attawa	Dambulla
	Dambulla	Mailattawa	Dambulla
	Naula	Thalagoda	Laggala
	Laggala-Pallegama	Leloya	Laggala
	Laggala-Pallegama	Atharahediya	Laggala
	Laggala-Pallegama	Karandamulla	Laggala
	Laggala-Pallegama	Pottatawela	Laggala
Polonnaruwa	Elahera	Attanakadawala South	Minneriya
	Elahera	Segala	Minneriya
	Elahera	Elahara	Minneriya
	Elahera	Damanayaya	Minneriya
	Elahera	Kottapitiya South	Minneriya
	Elahera	Attanakadawala West	Minneriya
	Hingurakgoda	Moragaswewa	Minneriya
	Hingurakgoda	Mahasengama	Minneriya
	Elahera	Konduruwawa	Minneriya
	Elahera	Ihakuluwewa	Minneriya

Figure 3.9- Administrative Boundaries – Upper Elahera Canal

Plate 3.6 Agricultural activities in the proximity of the Canal Trace

278 **Availability and accessibility to inputs and services:** The discussions with farmers revealed that there is no dearth of new technology as per agriculture. The farmers of Pekkulama area reported that they cultivate 90 day rice variety (Bg 300) and they complained that they are allocated subsidized fertilizer at the rate for rainfed rice though they irrigate and obtain extremely good yields. This shows that they are even aware of the fertilizer rate due for them though provided less. Land preparation and harvesting is conducted with machinery use. The farmers of other areas are also aware of new agricultural technology because of their relative proximity to Agrarian Services Centres of Bakamuna, Giritale, Palugaswewa and Yakalle. The interactions between DO and Agrarian Research and Productivity Assistants (ARPA) and farmers seem to be strong as they report about the existence and operations of Framer Organizations (FO). Even maize, onion and vegetable seeds they use are either new improved or hybrid varieties. Well-established trellis cultivations of cucurbits in some areas are indicative of the concerns to obtain high productivity and better income. **Therefore, it can be noted that agricultural extension and other services are adequately available and accessible to the farmers of affected areas as well as beneficial areas.**

279 **Crops cultivated in the affected areas in 2011 and estimated production:** Crops cultivated in the affected areas are mainly short-term and seasonal due to their fully rainfed nature. However, perennial crops such as coconut, lime etc. could be found in home gardens to a lesser extent. As some inhabitants have been living in this area for last 30 to 40 years, it is inevitable that such perennial crops are cultivated for self sufficiency

of families, so that they do not have to face wild animal attacks while travelling to townships to procure daily needs, such as coconut and lime. What is given in the following Tables are of the extents and crops affected by the UEC based on the data from the Socio-Economic Survey.

280 The main crop grown is paddy under rainfed conditions with 15 ha (38 acres) in Maha (2010/11) and 8 acs. in Yala (2011). Out of affected 73 families, 50 families reportedly engaged in agriculture, and only 29 and 11 farmers are cultivating paddy during maha and Yala respectively. Paddy cultivation is successful only during Maha season in Damanayaya which is under agro-eco region, IL2, and the paddy in the rest of the affected area are deemed to fail even during Maha seasons, as there is no supplementary irrigation source.

281 The other major crops grown are vegetables, maize and ground nut which apparently are grown with supplementary irrigation, especially during Yala season.

282 A moderate estimate of the annual income that will be generated during 2013 from the reported cultivated extent of affected area during 2011 is around Rs.M. 6.3 for 50 families practicing agriculture out of 73 families. The extent cultivated is considered as fixed since the farmers can not extend the land area cultivated within the Reserves. The calculations were based on moderate yields and current farm-gate prices of the crops reported. Also, the total extent and income include the extent and income of perennial crops reported. It is likely that the production and value of the products are higher than estimated owing to the favorable agricultural and marketing practices adopted.

3.2 Biological Environment

3.2.1 Wildlife Reserves, National Parks, Sanctuaries, Elephant Corridors, Wetlands and Forest Reserves

283 Figure 1.5 shows all protected areas, elephant corridors and forest reserves within the project area and through which the UEC traverses. These aspects have been already referred to in Chapter 2 in relation to the changes to the design and planning of this project according to the findings of the EIA.Overall, the flora and fauna of the new UEC sections required detailed surveys through field visits. Field visits were made in June, August and September 2013.

3.2.2. Presence of Protected Areas (PA)

284 The proposed Upper Elahera canal, 66.58 km in length, passes through a complex of protected areas (PAs) that includes Elahera- Giritale Sanctuary, Minneriya- Giritale Nature Reserve (Block III), border of Minneriya National Park, and Hurulu Forest Reserve (FR (the last two as tunnels and not as surface structures). Nearly 40 km (60% of the total length) of the proposed canal is located within or along the above three PAs and Hurulu FR. Other PAs in close proximity to the proposed canal are Minneriya- Giritale Nature Reserve(Blocks I & II), Kaudulla- Minneriya National Park, Kaudulla National Park,

Angamedilla National Park (former Block I of Minneriya-Giritale Nature Reserve), Sigiriya Sanctuary and Wasgamuwa National Park.

285 **Forest Classification of Sri Lanka:** The Forest Ordinance of 1907 has been amended by Act numbers 13 of 1966, 56 of 1979, 13 of 1982, 84 of 1988, 23 of 1995 and 65 of 2009. It is cited as the 'Forest Conservation Ordinance' according to the Act No. 65 of 2009. The four categories of forests protected by the Forest Conservation Ordinance are Conservation Forest, Reserved Forest, Village Forest and Other forests.

Conservation forest is any specified area of state land declared by an Order published under section 3A of the Ordinance in the Gazette by the Minister in charge of the subject.

286 Reserved forest is any specified area of state lands declared by an Order published under section 3 of the Ordinance in the Gazette by the Minister in charge of the subject. According to the interpretation under section 78 "reserved forest" includes forest plantations and chenas with planted trees. Apart from that any forest declared as a reserved forest under any law before the enactment of the Forest Ordinance No. 16 of 1907 is considered to be a reserved forest.

287 Village forest is a specified area of state land declared by an Order published under section 3 of the Ordinance in the Gazette by the Minister in charge of the subject for the benefit of any village community or a group of village communities.

288 Other forest (except for conservation, reserved, and village forests) need not be declared with specified boundaries, and they are all other state forests which have not been declared as conservation forests, reserved forests or village forests and therefore several interpretations have to be associated to better understand an 'other forest'.

289 Conservation forests, reserved forests and village forests can be declared under the Forest Ordinance. Provisions to protect and manage them and 'other forests' (not declared under the Forest Ordinance) 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.Punishments, if found guilty before the courts of law, for doing such things, are also indicated in the Forest Ordinance.

290 Protected Areas types under the Department of Wildlife Conservation are as follows:

291 National Reserve shall be-

a) Strict Natural Reserve
b) National Park
c) Nature Reserve
d) Jungle Corridor
e) Refuge
f) Marine Reserve
g) Buffer Zone
h) Sanctuary

292 Details of activities permitted / prohibited in each of these protected area categories is given in Annex VI – Table 06

293 All of these PAs were established with different but complimentary goals. The Nature Reserve protects the catchment of the three ancient irrigation tanks (Minneriya tank, Giritale tank and Parakrama Samudraya). Sigiriya sanctuary safeguards the natural environment of the ancient ruins while Minneriya, Kaudulla, Angamedilla, Wasgamuwa National Parks were established for biodiversity conservation under the Accelerated Mahaweli development programme. Therefore, this complex of protected areas is one of the most important habitats in the Mahaweli region for the long-term conservation of the elephant and associated flora and fauna. Furthermore, it is contiguous with Riverine Nature Reserve, Floodplain National Park and Somawathiya National Park, providing opportunities for conservation in the dry zone at a landscape level. Table 3.10show the extent and year of declaration of Protected Areas in the surroundings of proposed Upper Elahera Canal and the length of canal sections in each PA.

Table 3.9 The canal sections located in Protected Areas and Hurulu Forest Reserve with common habitats

Protected Area	**Canal chainage (km + m)**	**Type of Canal Construction**	**Length (km)**	**Habitats**
Elahera-Giritale Sanctuary	00 to 10+570 and 14+220 to 27+740	Open Canal& Open Canal/ Tunnel/ Cut & Cover	10.57 13.52 Total: 24.09	Scrublands, Dry-mixed evergreen forest (undisturbed and degraded), riverine forest, marshes, rock outcrop vegetation, grasslands
Minneriya-Giritale Nature Reserve, Block III	30+000 to 35+ 920	Tunnel	5.920	Dry-mixed evergreen forest (undisturbed and degraded), scrublands, riverine forest, marshes, rock outcrop vegetation
Minneriya National Park	35+920 to 38+610	Tunnel	2.690	Dry-mixed evergreen forest (undisturbed and degraded), scrublands, riverine forest, marshes, rock outcrop vegetation riverine forest, marshes, rock outcrop vegetation,
Hurulu Forest Reserve	45+750 to 51+000	Tunnel	5.250	Dry-mixed evergreen forest (undisturbed and degraded), scrublands, riverine forest, marshes, rock outcrop vegetation
	Total length		**37.26**	**Located within 3 PAs and Hurulu FR**

Table 3.10 Protected areas found along the proposed UEC canal and surrounding areas

Protected Area/ Forest Reserve	Extent (ha)	Year
Elahera- Giritale Sanctuary (chainage of canal- **00 to 10+560** km and **14+220 to 27+740** km)	14,035	2000
Minneriya- Giritale Nature Reserve Block II (outside the canal trace)	1,924	1993
Minneriya- Giritale Nature Reserve Block III (chainage **30+000 to 35+ 920** km)	4745	1995
Minneriya- Giritale Nature Reserve Block IV	8336	1997
Minneriya National Park (this includes former Minneriya- Giritale Sanctuary, 6,693.5 ha declared in 1938) (Border of the national park)	8,889	1997
Kaudulla National Park (outside the canal trace)	6,900	2002
Hurulu Forest Reserve (chainage **45+750 to 51+000**)	25,000	1942
Angamedilla National Park (former Block I of Minneriya- Giritale Nature Reserve, outside the canal trace)	7,529	2006
Wasgamuwa National Park (outside the canal trace)	37,063	1984
Sigiriya Sanctuary (outside the canal trace)	5,099	1990

294 **Elahera Giritale Sanctuary:** The Upper Elahera Canal sections, chainage 0 to 10+570 and 14+220 to 27+740, a total length of 24+100 km, are located within the Elahera- Giritale Sanctuary. It was declared as a sanctuary in 2000 and the extent is about 14,035 ha. The lowest eastern part of the sanctuary connects to the Wasgamuwa National Park and the northern boundary adjoins the Minneriya National Park. The length of the sanctuary is about 35 km. The eastern boundary is found towards Elahera- Minneriya Yoda Ela and the western boundary is the Blocks III & IV of Minneriya Giritale Nature Reserve. The natural habitats found in the sanctuary are dry-mixed evergreen forest, riverine forest, scrublands, grasslands, marshes, rock outcrops and associated vegetation. Man made habitats such as home gardens, paddy lands, agricultural lands, and shifting cultivation lands are also found in the sanctuary towards the eastern border along Elahera-Minneriya Yoda Ela.

295 **Minneriya Giritale Nature Reserve:** The Nature Reserve traversed by the UEC consists of four blocks, named as Blocks I- IV and declared between 1993 and 1997. The Block I designated in 2006 as Angamedilla National Park (7,529 ha). The Block II (1,924 ha) connects the Minneriya and Angamedilla National Parks and Blocks III (4,745 ha) and IV (8,336 ha) found along the western boundary of Elahera- Giritale sanctuary. The southern boundary of the Block IV is the dam of Moragahakanda reservoir. The northern boundary of Block III is Minneriya National Park. The natural habitats found in the nature reserve are dry-mixed evergreen forest, scrublands, riverine forest, grasslands, marshes, rock outcrops and associated vegetation.

296 **Minneriya National Park:** The Upper Elahera canal also travels along the border of this national park as a tunnel. The habitats found in this section are dry-mixed evergreen forest, scrublands, and grasslands. Minneriya National Park is situated in Polonnaruwa district, North Central Province of Sri Lanka between latitudes 7.5^0 – 8.5^0 North and longitudes 80.5^0- 81^0 East. The boundaries of the park are Habarana -Polonnaruwa main road in the North, Katukeliyawa -Minneriya road in the East, Matale District boundary in South and Moragaswewa - Sigiriya road in the West. The general elevation ranges from 60 – 500 m above mean sea level. Major part of the reserve is within the lower peneplain. In this undulating landform rock massifs rise to about 500m, the dominant Sudukanda ridge and number of minor ridges are present.

297 Distinct rock knobs or mountains such as Sigiriya, and Pidurangala are visible landmarks close to the Park. Number of small streams namely Batuoya, Erigeoya, Thalkoteoya and Kirioya converge to Minneriya reservoir; however, it is mainly fed by Mahaweli irrigation scheme through Yodha ela. This area was declared as a sanctuary in 1938. In order to provide continued protection to the fauna and flora in the sanctuary with Minneriya tank, this area was declared as a National Park (8,889 ha including Minneriya tank) on 12th August 1997 by gazette notification No. 988/4 and opened for visitors in May 1998.

298 The dry-mixed evergreen forest is the dominant vegetation formation in the Park. The dominant family in the Park is Euphorbiaceae due to the presence of common sub-canopy species *Drypetes sepiaria.* Ebenaceae, Sapotaceae and Tiliaceae could be regarded as co-dominant families. Plant communities recorded in different areas of the Park are; *Vitex-Manilkara- Berrya* community in Batuoya area, *Berrya- Drypetes- Diospyros-Manilkara* community in Digamadulla area, *Berrya- Drypetes- Manilkara – Diospyros* community in Kirioya area, *Diospyros- Drypetes- Diplodiscus* community in Thalkoteoya area and *Diplodiscus- Vitex- Drypetes- Diospyros* community in Thalgasduwa-Rambawila area. *Glycosmis pentaphylla, Croton* species, *Ochna* and *Premna* species are common in the understory.

299 The average rainfall is about 1500mm in the northern end, it gradually increases towards the south and at the southern end of the Park the annual rainfall is about 2000 mm. The main rainfall months are October to January. Temperatures remain relatively uniform throughout the year. The annual average temperature is about 28^0 C. The Relative Humidity remains around 59 – 97%. The monthly average wind speed is between 3.3 – 9.6

km/hr. During the months of May – August wind speeds tend to be high coinciding with the South West monsoon. According to the soil map of Sri Lanka the soils of the Park are classified as Reddish Brown Latosolic soils, Reddish Brown Earths, Low Humic Gley soils, Mountain Regosols and Alluvial soils of variable texture and drainage.

300 **Hurulu Forest Reserve:** The UEC travels through the Hurulu forest reserve as a tunnel section, 21 to 64 m below the surface. This forest is named after the ancient Huruluwewa tank was declared as a forest reserve in 1942. The total area of the Hurulu Forest Reserve is around 25,000 ha. The forest is in the dry zone of Sri Lanka and spans over the Polonnaruwa and Anuradhapura districts. Part of Hurulu Forest Reserve, an extent of 512 ha was declared as an International Man and Biosphere Reserve in 1977. A stretch of 1000 ha land in the reserve was declared opened as an eco- park in 2007 by the Forest Department. The main habitats found in the reserve are dry-mixed evergreen forest (undisturbed and degraded), scrublands, grasslands, riverine forest, vegetation associated with rock outcrops.

301 **Diversion of UEC to immediate catchment of Huruluwewa**

302 **Existing Environment:** A part of canal trace is found within the immediate catchment of Huruluwewa and runs along the strip of vegetation surrounding the FSL of this tank. The main habitats found in the canal path from 61+000 to 65+480 are chena/ shifting cultivation lands, scrublands, paddy fields, home gardens, and secondary forest patches (Plates 1-12). Forest Department has planted *Khaya senegalensis* (Kaya) in the areas previously used for chena/shifting cultivation with the participation of farmers. A Teak plantation is also found close to the canal trace. Plant species such as *Terminalia arjuna* (Kumbuk), *Mitragyna parvifolia* (Helamba), *Bauhinia racemosa* (Maila), *Limonia acidissima (Divul), Ziziphus oenoplia* (Eraminiya), *Pterospermum canescens* (Welan), *Manilkara hexandra* (Palu), *Memecylon angustifolium*, *Vitex leucoxylon* (Nebada) are common to the area close to Hurulu wewa.

Photographs of the habitats from 61+000 to 65+480 of the deviated canal trace

Plate 1- UEC canal passes through chena lands between chainage 61+000 and 62+000, west of Hurulu wewa

Plate 2 - Chena land- Preparation for a new crop

Plate 3 - Teak plantation established by the Forest Department is seen in the background

Plate 4 - Degraded/ secondary forest patches are found from 62+000 to 63+100

Plate 5 - Scrublands and secondary forest

Plate 6 - Secondary vegetation along the access road

	
Plate 7 - Habitats in the FSL of Hurulu wewa, close to the proposed canal	Plate 8- The canal crosses Ulpotha road within the FSL of Hurulu wewa
	
Plate 9 - The canal crosses the road at 63+380m	Plate 10 - The canal passes through an open area from 63+500 to 64+700 m
	
Plate 11 Yakalla Ulpotha road, canal is about 250 m from the road towards east	Plate 12 Open area/ paddy fields at 64+000 m

	
Plate 13 – Canal at Chainage 63+360	Plate 14 - cultivation areas
	
Plate 15- View of Huruluwewa	Plate 16 - Canal at Chainage 62+700
	
Plate 17 - Trees Planted by the Forest Department	Plate 18 - Government Lands Cleared for encroachment cultivation

3.2.3 Assessment of present ecological status of the area

303 The existing habitats of Kalu Ganga dam site, proposed tunnel trace to Moragahakanda reservoir and along the finalized path of the Upper Elahera canal up to 56 km at Siyambaladamana, the points of outlets from Kaluganga to Moragahakanda and aqueduct across Lel Oya were observed during the field visits. Observations were also made of the rest of the project area such as Mannankattiya Tank, link canals including Mamini Oya and Eruwewa and Mahakanadarawa Tank and their surrounding habitats.

304 Kaluganga-Moragahakanda Transfer Canal runs through steep terrain mostly and consists of cut and cover sections, tunnels, an aqueduct and an outlet to Kabarawa Oya.

305 The habitats and the flora around the Kaluganga reservoir and dam are available in the Kaluganga EIA and subsequent biodiversity assessments of the area surrounding the reservoir. But that data is now old (3-4 yrs) and significant development activity has taken place since then. Therefore they were updated and verified.

306 The existing habitats of Kalu Ganga and Moragahakanda dam sites, proposed tunnel trace from Kaluganga to Moragahakanda reservoir and the finalized path of the Upper Elahera canal from Moragahakanda to Manankattiya wewa have been enumerated in several field visits to the project area. The main habitats found in the canal path are scrublands, dry-mixed evergreen forests (mostly degraded and few undisturbed forest areas), rock associated vegetation, grasslands, marsh and riverine areas, paddy fields, home gardens, chena lands and lands with other agricultural crops.

307 The trapezoidal open canal sections, rectangular open canal sections, and trapezoidal cut-and –cover sections of the UEC were considered as having impact on the forests and the species. The open canal sections are having a bed width of 6 m and side slopes of 1 vertical to 2 horizontal, a full supply depth of 3.15 m, a lined free board of 0.7m, a 3 m wide road and a 2 m wide berm on the either side.

308 Depending on the topography, at the sections where canal has to be excavated on the high ground, further land has to be cleared to get a stable slope. Therefore, the top width of the canal depends on the topography. Considering the maneuvering of the vehicles and other possible disturbances, the impacted width was considered as 50 m wide in the open canal sections.

309 The rectangular cut and cover sections are designed for a total width of 12.2 m and the sides have to be excavated at a slope of 2 vertical to 1 horizontal. Including the working space etc., the excavated width would be around 23 m. Accordingly, the impacted width was taken as 30 m.

310 A 30 m width which will be impacted by the constructionof the cut and cover sections of the canal will be filled. Therefore adverse impacts on terrestrial fauna would be reduced. The natural habitats found in this area are scrublands, grasslands and degraded dry-mixed evergreen forest.

311 A 50 m width of the forest within the Elehara Girithale sanctuary is expected to be impacted by the construction of an open canal. The main habitat is the relatively

undisturbed dry-mixed evergreen forest. Then the canal passes through an aqueduct (240 m) in Heerati Oya. Next the canal goes through a settlement area (Samagipura) and the habitats are home gardens, agricultural lands, paddy lands, scrublands and small patches of degraded forest. The type of conveyance in the settlement area is an open canal and 50 m width is required for the construction..

312 The Elehera-Giritale sanctuary has as its main habitats dry-mixed evergreen forest and scrublands. The proposed canal runs close to the existing Yoda ela in this section.

313 After the tunnel there will be a double conduit section passing through scrublands and the immediate catchment of Huruluwewa as an open canal. Then an open canal passes through scrublands and paddy lands. Then the UEC crosses a settlement area and the final section of the canal passes through home gardens and agricultural lands

3.2.4 Habitat Types

314 The habitat types found in the canal trace are undisturbed and degraded dry-mixed evergreen forest, scrublands including abandoned chena, riverine forests, and vegetation associated with rock outcrops, grasslands, home gardens, paddy lands, abandoned chena, other agricultural lands and teak plantations. Table 3.11 shows the sections of the canal and dominant habitat types.

Table 3.11 Main habitat types in different sections of the UEC canal

Chainage (km)	Length (km) Approx.	Habitats
0-10	10	Scrublands, degraded dry-mixed evergreen forest, grasslands
10- 14	4	Home gardens, scrublands, degraded forest patches, paddy lands, other agricultural lands, riverine vegetation along Heerati oya
14-39	25	Dry- mixed evergreen forest (undisturbed and degraded), scrublands, riverine forest, rock outcrop habitats, grasslands, marshes
39- 67	28	Scrublands, grasslands, abandoned chena, home gardens, teak plantations, paddy lands
Total length	67	

315 **Undisturbed Dry-mixed Evergreen Forest:** The undisturbed forest found along the canal path has the general appearance of a closed canopy forest and the height of the canopy is about 30 m. The canopy consists of trees such as– *Manilkara* (Palu), *Drypetes* (Wira), *Chloroxylon* (Burutha), *Alseodaphne* (Wewarana), *Berrya* (Halmilla),

Diospyros(Kaluwara), *Schleichera oleosa* (Kon), *Pterospermum canescens* (Welan), and *Vitex altissima* (Milla). *Drypetes* (Wira) forms the sub-canopy of these forests. The understory vegetation includes medium sized trees such as *Diospyros ovalifolia, D. ferrea, Feronia acidissima, Xylopia nigricans, Nothopegiabeddomei, Pleiospermium alatum, Cassia fistula*, *Bauhinia racemosa*and shrubs such as *Ochna lanceolata, Tarenna asiatica, Memecylon angustifolium, M. capitellatum, M. umbellatum, Mallotus resinosus, Croton laccifer,* and *Dimorphocalyx glabellus.*

316 Some degraded forest patches are also found within undisturbed forest and these areas could be regarded as successional stages after the natural and manmade degradation to the dry-mixed evergreen forest ecosystem.

317 **Scrublands:** Scrub vegetation forms in places where chena (shifting cultivation) have been abandoned. Soon after the chena plot is left fallow, various herbaceous pioneer species begin to appear followed by woody species in a series of succession leading to the appearance of a secondary forest. It is found in areas where the climax forest/ dry-mixed evergreen forest is degraded. The degraded areas are not converted back to the closed - canopy forests through natural succession and these could be regarded as scrublands. Species such as *Azadirachta indica, Bauhinia racemosa, Carissa spinarum, Catunaregam spinosa, Dichrostachys cinerea, Flueggea leucopyrus, Gmelina asiatica, Grewia orientalis, Hugonia mystax, Ichnocarpus frutescens, Lantana camara, Limonia acidissima, Memecylon umbellatum, Phyllanthus polyphyllus, Scutia myrtina, Syzygium cumini, Toddalia asiatica and Ziziphus oenoplia* recorded from the scrubland.

318 **Riverine Forest:** These are narrow strips of tall forests found along the banks of streams found in the canal trace. *Terminalia arjuna* (Kumbuk) is the most common riverine species. Other species such as *Polyalthia longifolia, Madhuca longifolia, Diospyros malabaricum, Nauclea orientalis, Mangifera zeylanica, Nothopegia beddomei, Garcinia spicata, Diospyros ferrea, Diospyros montana, Diospyros ovalifolia, Homonoia riparia, Cynometra zeylanica, Pongamia pinnata, Hydnocarpus venenata, Barringtonia acutangula,* and *Vitex leucoxylon,* are found in these forests. *Dimorphocalyx glabellus* (Thenkuttiya/ Weliwenna) is a common understorey species of the riverine forests.

319 The typical riverine vegetation is found on the banks ofKambarawaOya, at the tunnel outlet of Kaluganga reservoir to Moragahakanda reservoir. In this area river bank vegetation is confined to a narrow strip and beyond that the land is used for paddy cultivation, other agricultural crops, chena cultivation, and home gardens. The most common tree species found on the river banks are *Terminalia arjuna* (Kumbuk) *Mangifera zeylanica* (Etamba) *Polyalthia longifolia* (Owila), *Madhuca longifolia* (Mee), *Diospyros malabaricum* (Timbiri), *Nauclea orientalis* (Bakmi), *Pongamia pinnata* (Karanda),and*Hydnocarpus venenata* (Makulla). In most places riverbank vegetation in the Thelgamuwa oya is intact and very little disturbances or degradation can be seen. Field visits carried out during the rainy season to Thelgamuwa oya and Pottatawela area showed that clear water in Thelgamuwa oya and this may be mainly due to the closed canopy forest along both banks of the river that prevent the soil erosion.

320 **Grasslands:** The grasslands found in the proposed canal path are established in land abandoned after shifting/ chena cultivation. *Panicum miximum* (Guinea grass) is the dominant grass species in the grassland with some scattered shrubs and isolated trees.

321 **Rockoutcrops and associated vegetation:** Rock outcrops and associated vegetation is found in several areas close to the canal trace. Tree species associated with rock out crops are *Commiphora caudata, Ficus arnottiana, Ficus mollis, Givotia moluccana, Lannea coromandelica, Memecylon petiolatum, Euphorbia antiquorum, Bambusa bambos, Sapium insigne and Wrightia angustifolia.* Shrub species such as *Carmona retusa, Croton laccifer, Mundulea sericea, Ochna lanceolata, Osbeckia aspera* are also found in this habitat.

322 **Flora in the project area:** A total of 174 plant species including 10 endemic, 154indigenous and 10 introduced species were recorded in all habitats in the project area. Four plant species recorded during the field survey are listed as Nationally Threatened species (see Table 3.12). However, none of the recorded plant species are unique or restricted to the project area. A detailed list of plant species recorded in the project area during the study is given in Annex VI –Table 05

Table 3.12 Summary of the plant species recorded during the study

No of Species	Endemic Species	Indigenous species	Exotic Species	Nationally Threatened
174	10	154	10	EN- 02, VU- 02

EN- Endangered, VU- Vulnerable

323 **Threatened and Endemic Flora:** Out of 174 recoded species four are Nationally Threatened (02 endangered and 02- Vulnerable species). Also 10 endemic plant species were recorded in the project area (Table 3.13). All recorded endemic and threatened flora species are not unique or restricted to the project area.

Table 3.13 Endemic and Threatened plant species recorded from the UEC canal project area

Family	Species	Local Name	HA	TS	CS
Apocynaceae	*Wrightia angustifolia*		T	E	
Asteraceae	*Vernonia zeylanica*	Pupula	C	E	
Ebenaceae	*Diospyros ebenum*	Kaluwara	T	In	EN
Euphorbiaceae	*Margaritaria indicus*	Karaw	T	In	VU
Euphorbiaceae	*Cleistanthus pallidus*		T	E	

Fabaceae	*Derris parviflora*	Sudu Kala Wel	C	E	
Flacourtiaceae	*Hydnocarpus venenata*	Makulla	T	E	
Loganiaceae	*Strychnos benthamii*		C	E	
Melastomataceae	*Memecylon capitellatum*		T	E	
Meliaceae	*Munronia pinnata*	Bin Kohomba	H	In	EN
Sapindaceae	*Glenniea unijuga*		T	E	
Sapotaceae	*Manilkara hexandra*	Palu	T	In	VU
Tiliaceae	*Diplodiscus verrucosus*	Dikwenna	T	E	
Vitaceae	*Cissus heyneana*		C	E	

(HA – Habit, **T** – Tree, **C** – Climber or Creeper, Ep- Epiphyte, **TS** – Taxonomic Status, **E** – Endemic,**In**– Indigenous, **CS** – Conservation Status, **EN**- Endangered, **VU** – Vulnerable) H- Herb

3.2.5 Faunal inventory of the project site

324 Total number of 240 faunal species was recorded in the project area representing butterflies, dragonflies, inland fishes, amphibians, reptiles, birds and mammals (Table 3.14). This included 17 species that are endemic to Sri Lanka (See table 3.15 for the detailed list). Further, the faunal assemblage included eight species that are listed as Nationally Threatened species (one Nationally Endangered species and seven Nationally Vulnerable species). A further eleven species that are listed as Nationally Near Threatened (MOE, 2012) was also observed in the study area (see table 3.16 for the detailed list). The faunal assemblage also included six species that are listed as Globally Threatened (four Endangered species and two Vulnerable species) and eight species that are listed as Globally Near Threatened (IUCN, 2013). The faunal assemblage recorded in the project area also included one exotic fish species and 16 species of migrant birds that inhabit forest habitats.

Table 3.14 Summary information of the fauna observed during the survey.

Taxonomic Group	Total	Endemic	Migrant	Exotic	CR	EN	VU	NT
Dragon flies	**9**						**1**	**1**
Butterflies	**48**	**1**						**1**
Fish	**16**	**3**		**1**		**0 (1)**	**1**	
Amphibians	**9**	**1**						

Reptiles	**19**	**2**					**0 (1)**	**3**
Birds	**123**	**8**	**16**				**2**	**4 (4)**
Mammals	**16**	**2**				**1 (3)**	**3 (1)**	**2 (4)**
Total	**240**	**17**	**16**	**1**	**0**	**1 (4)**	**7 (2)**	**11 (8)**

Abbreviations: * - Proposed endemic species, CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near Threatened, Numbers in parenthesis are globally threatened species.

325 **Dragonflies:** Total number of 9 species of dragonflies and damselflies were recorded. None of the species observed are endemic to Sri Lanka. One species *Trithemis festiva* (Indigo Dropwing) is listed as a Nationally threatened species.

326 **Butterflies**: Total number of 48 butterfly species was recorded. This included one species that is endemic to Sri Lanka. All the species observed are commonly occurring species in the dry zone and intermediate zone of Sri Lanka including the endemic species *Appias paulina* (Sri Lanka Lesser albatross). None of the butterfly species recorded at the project sites are listed as nationally or globally threatened species.

327 **Freshwater Fishes:** Total of sixteen species of freshwater fish including three endemic species and one exotic species were recorded from the aquatic habitats present within the direct impact zone of the project. The freshwater fish recorded include One Nationally Vulnerable species *Garra ceylonensis* (Stone sucker) that is also listed as a globally endangered species.

328 **Amphibians**: Total of nine amphibian species were recorded including one species that is endemic to Sri Lanka. All nine species are commonly occurring species in human dominated landscapes. None of the species observed are listed as Nationally or Globally threatened species.

329 **Reptiles:** Altogether19 species of reptiles including two endemic species were recorded. All the species recorded are commonly occurring species in the dry zone. One of the reptile species recorded *Crocodylus palustris* (Marsh crocodile) is listed as Globally Vulnerable species.

330 **Birds:** A total number of 123 bird species were recorded including eight endemic species. Further, sixteen migratory species of birds that inhabit mainly forest habitats were also observed. The bird species recorded include two species listed as Nationally Vulnerable. However it should be noted that both of these species are represented by a small breeding resident population that is boosted by migrants during the migrant season. Therefore, bot species are represented by large numbers during the migrant season. Only the breeding resident population is listed as Nationally Vulnerable. However, neither of these two species is known to breed in the project area.

331 **Mammals:** A total number of 16 mammal species including two endemic species were recorded. Most number of threatened species was observed among the mammals,

including one Nationally Endangered and three Nationally Vulnerable species (MOE, 2012). Most of these endangered species were observed within the protected areas. Further, the mammals observed in the study area included four species that are listed as Globally Threatened (IUCN, 2013).

332 **Identification of Rare, Threatened, Endemic or Commercially Important Species:** Most of the species observed in and around the sites identified for the proposed project activities are commonly encountered species in the dry and intermediate zone of Sri Lanka. A total of 17 endemic species of fauna were recorded from the study area (Table 3.16). Many of the endemic species observed in the project area are common species showing an island wide distribution. None of the endemic species observed are restricted to the study area. Observed lack of endemism in the project area is not an unusual phenomenon given the fact that dry and intermediate zone habitats support lesser number of endemics compared to the wet zone off Sri Lanka. None of these endemic species will be significantly affected by the project as only a small proportion of their population occur in the area that will be directly impacted by the proposed project.

Table 3.15 List of endemic fauna observed during the survey.

Family	**Scientific Name**	**English Name**	**TS**
Pieridae	*Appias galena*	Lesser albatross	E
Cyprinidae	*Esomus thermoicos*	Flying barb	E
Cyprinidae	*Garra ceylonensis*	Stone sucker	E
Cyprinidae	*Puntius singhala*	Filamented Barb	E
Rhacophoridae	*Polypedates cruciger*	Common hour-glass tree frog	E
Agamidae	*Otocryptis nigristigma*	Black spotted kangaroo lizard	E
Colubridae	*Dendrelaphis bifrenalis*	Boulenger's bronze back	E
Bucerotidae	*Ocyceros gingalensis*	Sri Lanka Grey Hornbill	E
Campephagidae	*Tephrodornis pondicerianus*	Common Woodshrike	E
Columbidae	*Treron pompadora*	Pompadour Green-pigeon	E
Hirundinidae	*Hirundo daurica*	Red-rumped Swallow	E
Phasianidae	*Gallus lafayetii*	Sri Lanka Junglefowl	E
Pycnonotidae	*Pycnonotus melanicterus*	Black-crested Bulbul	E

Family	Scientific Name	English Name	TS
Ramphastidae	*Megalaima rubricapilla*	Crimson-fronted Barbet	E
Timalidae	*Pellorneum fuscocapillum*	Sri Lanka Brown-capped Babbler	E
Cercopithecidae	*Macaca sinica*	Sri Lanka toque monkey	E
Tragulidae	*Moschiola meminna*	Sri Lanka mouse-deer	E

333 Eight Nationally and six Globally Threatened species of fauna were recorded from the study area. In addition, six Nationally and 9 Globally Near Threatened species were also recorded in the various habitats present in the direct impact zone of the project site (Table 3.16). As in the case of endemic species number of threatened species was also found to be low in the immediate impact zone of the project. This is usually the case in the dry zone as most of the threatened species are restricted to the wet zone of Sri Lanka.

334 Further, none of the threatened species are restricted to this area since all of these species show relatively wide distributions in Sri Lanka albeit being listed as threatened due to number of threats that operate on these species. None of the faunal species observed are exploited at a commercial scale in the region. Some of the fish and mammal species are consumed by the villagers as a source of food.

Table 3.16 List of threatened fauna observed during the survey

Family	Scientific Name	English Name	TS	NCS	GCS
Hesperiidae	*Hasora taminatus*	White banded Awl	N	NT	NE
Libellulidae	*Orthetrum pruinosum*	Pink Skimmer	N	NT	LC
Libellulidae	*Trithemis festiva*	Indigo Dropwing	N	VU	LC
Cyprinidae	*Garra ceylonensis*	Stone sucker	E	VU	NE
Colubridae	*Boiga forsteni*	Forsten's cat snake	N	NT	LC
Colubridae	*Dendrelaphis bifrenalis*	Boulenger's bronze back	E	NT	LC
Crocodylidae	*Crocodylus palustris*	Marsh Crocodile	N	NT	VU
Accipitridae	*Ichthyophaga ichthyaetus*	Grey-headed Fish-eagle	N	NT	NT
Alcedinidae	*Ceyx erithacus*	Oriental Dwarf Kingfisher	N	NT	LC

Family	Scientific Name	English Name	TS	NCS	GCS
Anhingidae	*Anhinga melanogaster*	Darter	N	LC	NT
Charadriidae	*Charadrius alexandrinus*	Kentish Plover	N/M	VU	LC
Charadriidae	*Charadrius dubius*	Little Ringed Plover	N/M	VU	LC
Ciconiidae	*Ciconia episcopus*	Woolly-necked Stork	N	NT	LC
Cuculidae	*Cacomantis sonneratii*	Banded Bay Cuckoo	N	NT	LC
Cercopithecidae	*Macaca sinica*	Sri Lanka toque monkey	E	LC	EN
Cercopithecidae	*Semnopithecus priam*	Grey langur	N	LC	NT
Cervidae	*Cervus unicolor*	Sambur	N	NT	VU
Cervidae	*Muntiacus muntjak*	Barking deer	N	NT	NE
Elephantidae	*Elephas maximus*	Elephant	N	VU	EN
Felidae	*Panthera pardus*	Leopard	N	VU	NT
Felidae	*Prionailurus viverrinus*	Fishing cat	N	EN	EN
Mustelidae	*Lutra lutra*	Otter	N	VU	NT

Abbreviations: **GCS** - Global Conservation Status; **NCS** - National Conservation Status; E – Endemic, N - Native, EN - Endangered, VU - Vulnerable, NT - Near Threatened;

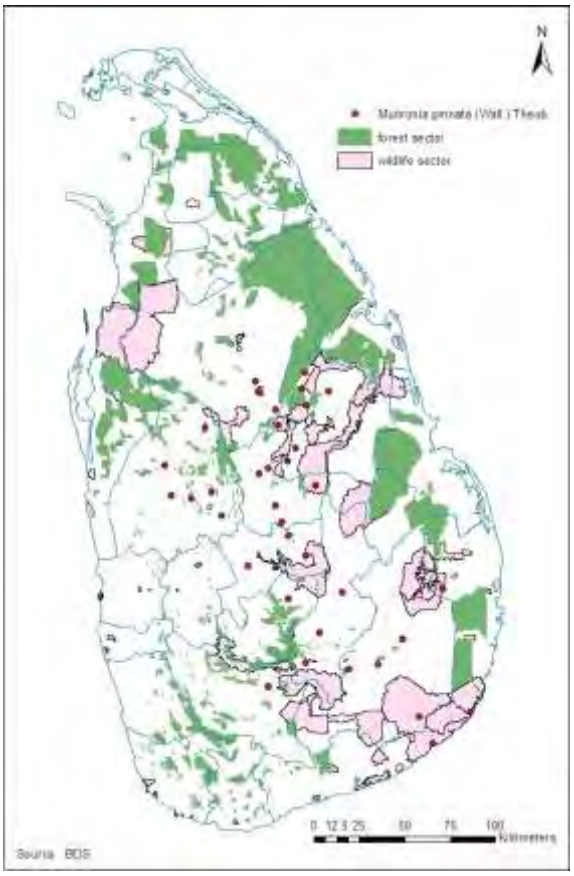
3.2.6 Further analysis of the project impacts on the species listed as Nationally or Globally Endangered (EN):

335 ***Diospyros ebenum***(Kaluwara in Sinhala, Karunkali in Tamil; Indigenous Tree)

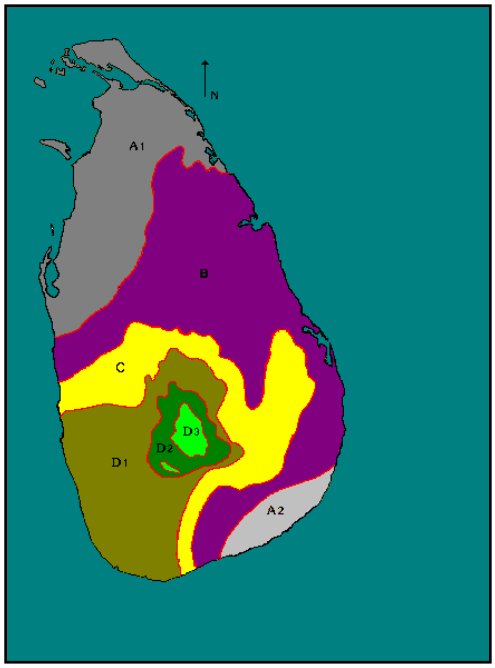
336 *Diospyros ebenum* is an indigenous tree found in Sri Lanka predominantly in the dry and intermediate zone of the country. It is not a rare plant species, yet they are found in low densities at any given locality. It is distributed throughout the dry and intermediate zone districts (Anuradhapura, Vavunia, Mannar, Kilinochchi, Mulathivu, Plonnaruwa, Puttalama, Kurunegala, Trincomalee, Hambanthota, Monaragala, Badulla and Matale). However it has a scattered distribution within forest habitats and has a slow growth rate. Even though it has good distribution within the country, it is listed as an Endangered (EN) species in 2007 as well as 2012 national Redlist, mainly due to the high exploitation levels of the tree for its high timber value (Ebony).

337 During this project no trees belonging to this species will be affected as it was not recorded in the direct impact zone. However, it was recorded in some of the protected areas through which the canal will pass and hence included in the species list.

338 ***Munronia pinnata*** (Bin Kohomba in Sinhala; Indigenous Herb or Shrublet)
Munronia pinnata is an indigenous herbaceous plant species found in dry and intermediate zone of the country. Sometimes it grows as a shrublet up to about 65 cm in height. It is a rather uncommon plant found in seasonal forests, scrublands and vegetation associated with rock outcrops in the dry and intermediate zones. It is recorded mainly in Anuradhapura, Kurunegala, Matale, Badulla, Ampara, Monaragala, Ratnapura and Hambanthota districts. It is listed as an endangered (EN) species in 2012 national Redlist mainly due to high levels of exploitation due to its medicinal value. During this project no trees belonging to this species will be affected as it was not recorded in the direct impact zone. However, it was recorded in some of the protected areas through which the canal will pass and hence included in the species list.

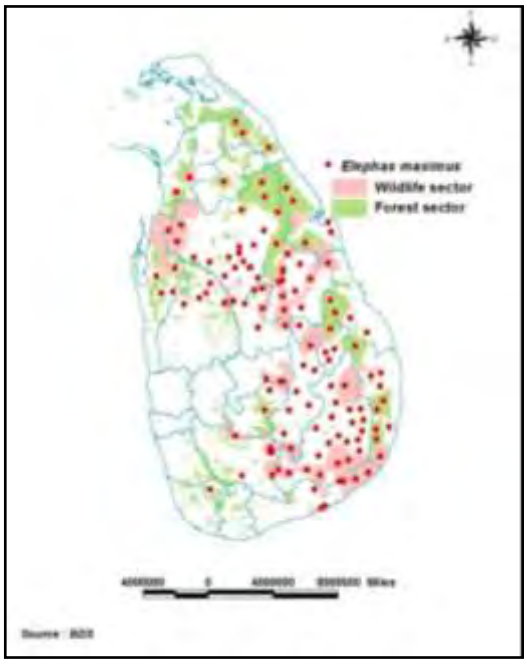


339 ***Macaca sinica*** (Toque Monkey and Rilawa in Sinhala): *Macaca sinica* is an endemic primate that is distributed in forest and non forest habitats throughout Sri Lanka. Thus far it has been reported from over 500 locations in Puttalama, Kurunegala, Anuradhapura, Pollonaruwa, Ratnapura, Badulla, Kandy, Matale, Matara, Galle, Hambanthota, Kalutara, Colombo, Gampaha, Kegalle, Nuwara Eliya, Trincomalee, Mannar, Mullaittivu and Vavunia districts. Even though this species shows a wide distribution in Sri Lanka (Area of Occupancy more than 1500 km^2) its habitat is lost at a rapid rate. Three sub species has been recognized in Sri Lanka, *Macaca sinica sinica* (zones A, B and C in the attached map), *Macaca sinica aurifrons* (zones D1 and D2 of the attached map) and *Macaca sinica opithomelas* (zone D3 of the attached map). According to the IUCN 2012 assessment all three sub species has been listed as Endangered species. However, according to the National Redlist 2012 (where assessment is only carried out at species level) *Macaca sinica* has been listed as a least concern (LC) species as the species is not in danger of becoming extinct. However, it should be noted that the two sub species *Macaca sinica aurifrons* and *Macaca sinica opithomelas* have smaller populations and are subjected to significantly high levels of habitat loss compared to *Macaca sinica sinica* (the sub species that is present in the project affected area) which has a large population size. The project will not have a significant affect on this species as only a small proportion of its habitat is affected by the project activities.

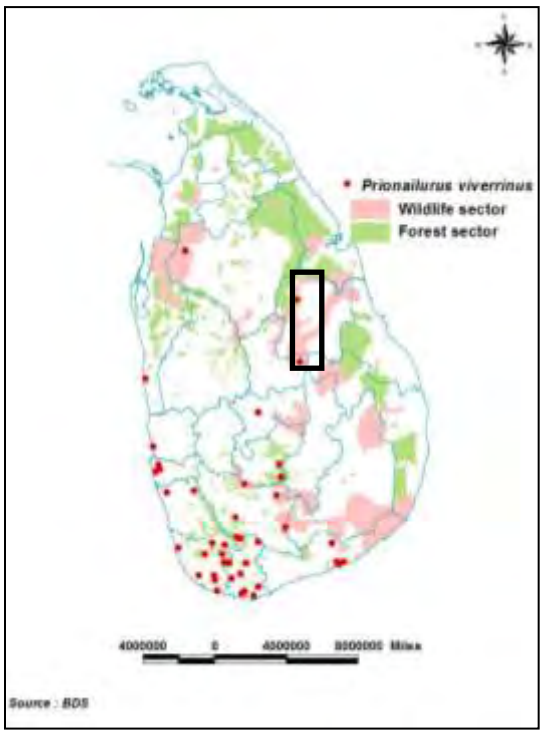


340 ***Elephas maximus*** (Asian Elephant, Aliya in Sinhala)

Elephas maximus is a native megaherbivore that is distributed mainly in forest and non forest habitats in the intermediate and dry zones of Sri Lanka. Few small isolated populations occur in the wet zone. Thus far it has been reported from over 500 locations in Ratnapura, Puttalama, Kurunegala, Anuradhapura, Pollonaruwa, Badulla, Matale, Hambanthota, Moneragala, Trincomalee, Baticaloa, Mannar, Mullaittivu and Vavunia districts. Even though this species shows a wide distribution in Sri Lanka



(Area of Occupancy more than 15000 km^2) its habitat is lost at a rapid rate due to development activities resulting a population reduction. Further, it has been extirpated from much of its original range. Each year more than 200 elephants die due to the human elephant conflict and it has also undergone nearly a 50% reduction in its population over the past 100 years. A similar situation is found globally where it has undergone a drastic range reduction and is high mortality rates are recorded across all its range states owing to human-elephant conflict. Therefore, it has been listed as an Endangered (EN) species in 2012 National Redlist as well as the Global list of Threatened Species (www.redlist.org).



341 ***Prionailurus viverrinus***(Fishing cat, Handun Divia in Sinhala)*: Prionailurus viverrinus* is a native medium sized carnivore that is distributed mainly in forest and non forest habitats in the wet, intermediate and dry zones of Sri Lanka. Thus far it has been reported from over 100 locations in Ratnapura, Puttalama, Kurunegala, Anuradhapura, Pollonaruwa, Badulla, Matale, Galle, Matara, Hambanthota, Moneragala, Trincomalee, Colombo, Gampaha, Kalutara, Kegalle, Batticaloa, Mannar, Mullaittivu and Vavunia districts. Even though this species shows a wide distribution in Sri Lanka (Area of Occupancy more than 5000 km^2) its habitat is lost at a rapid rate resulting in a population reduction. Further, it has been extirpated from much of its original range. Each year many fishing cats are killed due to road accidents and deliberate hunting Therefore, it has been listed as an Endangered (EN) species in 2012 National Redlist and Global list of Threatened Species (www.redlist.org). This species has been recorded during the survey in the riverine forests and tank catchments both within and outside the area affected by the project. However, the impact on its habitat is insignificant as much of its range in Sri Lanka falls outside the project affected area (boxed area) as can be seen in the attached map.

342 **Recognized animal movement pathways and their significance**: Based on direct and indirect observations it indicates that the area, which is identified for establishment of the Upper Elehera Canal supports a rich faunal diversity. There was evidence to indicate frequent animal movements within the project area, especially the four protected areas. However, during the survey period no specific migratory paths or routes were identified within the project area. The area is also utilized by migratory bird species, especially the forest habitats. However, based on the information available on migratory paths used by

the migrant birds, it can be concluded that the area proposed for the development of the canal does not function as an important flyway for migratory birds. Therefore, while the proposed project will impair animal movements in the project area, it will not be a significant impact as it does not block any known critical animal migration paths.

343 **Summary of project activities within protected areas:** Much of the project activities (ca. 68%) will take place within four protected areas, namely, Elahera-Giritale Sanctuary, Minneriya-Giritale Nature Reserve (Block III), Minneriya National Park and Hurulu Forest Reserve (Table 3.9). Out of these four protected areas the one that is most affected will be the Elahera-Giritale Sanctuary where nearly 40% of the canal will be located either above or below ground. However, as can be seen in the table Annex VI Table 2 the overall impact of the project on each of the protected areas is relatively small and in many cases the impact on the surface habitats is near zero in the case where the canal section will pass as a tunnel, especially in the Minneriya-Giritale Nature Reserve (Block III) and Hurulu Forest Reserve. However, since the project activities will take place mainly within protected areas it is important that during the construction period all efforts are taken to minimize the negative impacts on fauna and flora inhabiting these protected areas.

344 **Existing Environmental considerations/ problems/ issues in the area:** The sites identified for the project falls in to three main categories Areas managed by Department of Wildlife Conservation (Elahera-Giritale Sanctuary, Minneriya-Giritale Nature Reserve (Block III), and Minneriya National Park), areas managed by the Forest Department (Hurulu Forest Reserve) and areas managed by local communities (home gardens, permanently cultivated lands, and seasonally cultivated lands). Much of the project activities take place within protected areas. This fact is amply reflected by the habitats and species assemblages recorded during the survey. Minneriya NP has a management plan.

345 The main existing environmental problems include habitat conversion for agriculture, overuse of agrochemicals causing loss of habitat quality, especially aquatic habitats, illegal extraction of timber trees and destructive harvesting of non timber forest products and hunting which takes place at a low incidence.

346 Further, human wildlife conflict, especially due to the presence of wild elephants that cause damage to crops and property as well as death and injury to villagers was identified as another significant issue in the area during the field visit. Implementation of the project will result in further loss of habitat for elephants as well as other fauna that can lead to further aggravation of the human-wildlife conflict. Also it was observed during the field study that some sections of the Elahera-Giritale Sanctuary is encroached by villagers for farming, resulting in a loss of habitat for species that inhabit the area.

347 The area identified for development does not contain any critical habitats or restricted or highly endangered species. Thus the project will not have serious adverse impacts on the environment. Only Minneriya national park (which is not traversed by the UEC) has a management plan. Elehara Giritale Sanctuary and Minneriya Giritale Nature Reserve do not have management plans. However a number of environmental impacts that will arise due to the proposed project which will be discussed in Chapter 4.

Plate 3.8 Kabarawa oya

Plate 3.9 Moist Mixed Evergreen Forest (natural forest) along Kabarawa oyatowards Beligoda village

Plate 3.10 Kaluganga tunnel outlet habitat

Plate 3.11 Kaluganga tunnel outlet habitat

Plate 3.12Habitats along Kambarawa Oya close to canal discharge point of

Kaluganga Transfer Canal

Plate 3.13 Landscape view of the Kaluganga tunnel outlet above Kabarawaa Oya (Beligoda village)

3.3. Human settlement and land use

3.3.1. Socio-economic environment of the affected families in the project area

348**: Diversity of Population:** The lands of the inundation area belong to 18 GN divisions but the affected people come from 5 GN divisions only. The affected GN divisions are Damanayaya, Kottapitiya-south, Elahera, Yakalla and Madawala. There were no affected families among the surveyed families in Moragaswewa and Mahasengama GN divisions. All families are ethnically Sinhalese and religiously Buddhist. The householder distributions for the five affected GN Divisions are listed in the table below.

Table 3.17 Families in the Project Area

Divisional Secretariat	**GND**	**Village**	**Number of affected families**	%
Elahera	Damanayaya	Dampuragama	12	13.8
		Nuwaralagama	9	10.3
		Damanayaya	18	20.7
	Kottapitiya-south	Thunwana-Piyawara	12	13.8
	Elahera	Samagipura	8	9.2
Galenbindunuwewa	Yakalla	Ulpathpara	6	6.9
		Mahasenpura	6	6.9
Palugaswewa	Madawala	Madawala	3	3.4
		Siyambaladamana	4	4.6
Hingurakgoda	Moragaswewa	Moragaswewa	3	3.4
	Mahasengama	Eirige oya	6	6.9
Total affected houses under UEC			**87**	100.0

Social Baseline Survey -2014, MCB Consultants

349 The survey data reveals that among the surveyed families, the total population among surveyed families is 326, with 163 males and 163 females. Male female ratio is 50:50. When the population is divided into main age groups, 70 (21%) are in 0 – 14, age group, 229(70%) are in 15 - 59 age group and 27 (9%) are in 60+ age group. The table below shows details. The dependency ratio is 30:70.

Table 3.18 Age group of the surveyed families

DSD	**GND**	**Age**			**Total Population**
		0-14	15-59	Over 60 Years	
Elahera	Damanayaya	35	102	14	151
	Kottapitiya-south	9	34	3	46
	Elahera	2	17	5	24

Total Elahera DSD		**46**	**153**	**22**	**221**
Galenbindunuwewa	Yakalla	12	31	2	45
Total Galenbidunuwewa DSD		**12**	**31**	**2**	**45**
Palugaswewa	Madawala	7	24	-	31
Total Palugaswewa DSD		**7**	**24**	**0**	**31**
Hingurakgoda	Moragaswewa	3	5	2	10
	Mahasengama	2	16	1	19
Total Hingurakgoda DSD		**5**	**21**	**3**	**29**
TOTAL		**70**	**229**	**27**	**326**

Social Baseline Survey -2014, MCB Consultants

350 **Marital Status:** Considering the Marital Status, 66 (76.5%) are married 13 (14.7%) are widows. In addition there are 5 divorces and 3 separated.

Table 3.19 Marital status

Civil Status	No. of HH	%
Married	67	76.5
Widowed	13	14.7
Divorced	5	5.9
Separated	**3**	**2.9**
Total	**87**	**100**

Social Baseline Survey -2014, MCB Consultants

351 **Disability: No persons with disabilities were identified in the survey.**

352 **Education Level:** The literacy rate in this area is high (97%). Attainment to higher education (degree or above) is 1%. Out of the total population, 18(6%) has passed GCE (A/L), 45(13%) passed O/L and 211 (64%) are in up to grade 9. More details are given below.

Table 3.20 Education Level of the surveyed families

DSD	GND	Total Population	Education level								
			Preschool	Below school age	Grade 1-5	Grade 6 - O/L	O/L passed	A/L passed	Graduate	Never school attend	Other
Elahera	Damanayaya	151	4	11	39	55	21	9	3	4	5
	Kottapitiya-south	46	2	3	14	15	7	-	-	5	-

	Elahera	24	-	-	8	10	4	1	-	1	-
Total Elahera DSD		**221**	**6**	**14**	**61**	**80**	**32**	**10**	**3**	**10**	**5**
Galenbindunuwewa	Yakalla	45	2	4	12	19	4	2	-	1	1
Total Galenbidunuwewa DSD		**45**	**2**	**4**	**12**	**19**	**4**	**2**	**0**	**1**	**1**
Palugaswewa	Madawala	31	1	1	5	14	5	3	-	-	2
Total Palugaswewa DSD		**31**	**1**	**1**	**5**	**14**	**5**	**3**	**0**	**0**	**2**
Hingurakgoda	Moragaswewa	10	-	-	2	5	-	2	-	-	1
	Mahasengama	19	-	1	4	9	4	1	-	-	-
Total Hingurakgoda DSD		**29**	**0**	**1**	**6**	**14**	**4**	**3**	**0**	**0**	**1**
Grand total		**326**	**9**	**20**	**84**	**127**	**45**	**18**	**3**	**11**	**9**

Social Baseline Survey -2014, MCB Consultants

353 **Labor Force, Employment and Unemployment:** The total labor force in the project area is 229 with 152 employed and 19 unemployed. When these figures are categorized according to the main activities, the results are as follows. The employed personal among the labor force is 88%, and it is 41.5% out of the total population. The survey data reveals unemployment level of the area is 12%. Normally unemployment calculates to the labor force.

Table 3.21 Labor force of the surveyed families

Activity	No.	%
Employment	152	47
Unemployment	19	6
Housewife	58	18
Student	57	17
Retired	3	1
Elderly	11	3
Children	26	8
Total	326	**100**

Social Baseline Survey -2014, MCB Consultants

354 **Details of Occupation:** When considering the employed persons, much of them work as wage agricultural laborers. Agricultural labors accounts for 53(35%) The second highest occupational group is farmers 49 (32%). However 67% of the employees are engage in agricultural sector. The survey reveals that 22 persons engaged in government sector. Other significant employments are foreign employment and business which is accounts for 5% each. Othercategories are insignificant. The details of the occupation are given in the table below.

Table 3.22 Distribution of surveyed community based on employment categories

DSD	GND	Number of employed in each category										
		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
Total Elahera DSD		**3**	**1**	**3**	**32**	**0**	**6**	**12**	**7**	**1**	**43**	108
Galenbindunuwewa	Yakalla	-	-	-	10	1	-	1	-	-	5	17
Total Galenbindunuwewa DSD		**0**	**0**	**0**	**10**	**1**	**0**	**1**	**0**	**0**	**5**	17
Palugaswewa	Madawala	-	-	1	7	-	1	1	-	-	5	15
Total Palugaswewa DSD		**0**	**0**	**1**	**7**	**0**	**1**	**1**	**0**	**0**	**5**	15
Hingurakgoda	Moragaswewa	-	-	-	-	-	-	-	1	-	2	3
	Mahasengama	-	-	-	1	-	-	-	1	-	7	9
Total Hingurakgoda DSD		**0**	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**9**	12
Grand total		**3**	**1**	**4**	**49**	**1**	**7**	**14**	**7**	**1**	**53**	**152**

Social Baseline Survey -2014, MCB Consultants

355 Considering about the location of employment 67% (102 persons) of the people is employed within the village. 33% (50 persons) work outside the area. Thus, certain issues are likely to arise in relocating the persons whose current employment is situated within the village; they may find it difficult to find other employment and may face adverse consequences to their livelihood; this consequence needs to be taken into account.

Table 3.23 Employment percentage, status, sector and location based on GND

DSD	GND	Total employed	Location			
			Within GND / resident area	% of within GND	Outside the resident area	% of outside GND
Elahera	Damanayaya	72	42	58.3	30	41.7
	Kottapitiya-south	23	16	69.6	7	30.4
	Elahera	13	11	84.6	2	15.4
Total Elahera DSD		**108**	**69**	**63.9**	**39**	**36.1**
Galenbindunuwewa	Yakalla	17	15	88.2	2	11.8
Total Galenbindunuwewa DSD		**17**	**15**	**88.2**	**2**	**11.8**
Palugaswewa	Madawala	15	8	53.3	7	46.7
Total Palugaswewa DSD		**15**	**8**	**53.3**	**7**	**46.7**
Hingurakgoda	Moragaswewa	3	3	100.0	-	
	Mahasengama	9	7	77.8	2	22.2
Total Hingurakgoda DSD		**12**	**10**	**83.3**	**2**	**16.7**
Grand Total		**152**	**102**	**67.1**	**50**	**32.9**

Social Baseline Survey -2014, MCB Consultants

Table 3.24 Income level of the surveyed families

Income(Rs.)	No. of Families	%	Cumulative Number	Cumulative %
<10,000	5	5.7	5	5.7
10,001 -20,000	10	11.5	15	17.2
20,001 -30,000	33	37.9	48	55.2
30,001 -50,000	25	28.7	73	83.9
50,001-100,000	8	9.1	81	93.1
100,000 <	6	6.9	87	100.0
	87	100.0		

Social Baseline Survey -2014, MCB Consultants

356 **Existing health issues of the project site:** Based on the field surveys, meetings with government officials, community leaders and members of CBOs, the major health problems are:

- Inadequate supplies of potable water and for other purposes causing residents to use sources of water that are likely to be unsuitable
- Increase of persons suffering from Chronic Kidney Disease of Unknown Etyology
- Increase of non communicable diseases including respiratory problems
- Unsafe levels of agrochemicals

357 As the project is intended to improve economic status including livelihoods of people and contribute to regional development, it should make attempts to highlight its contribution to improving good quality water supplies for domestic and industrial uses, at local and regional levels during its implementation.

3.3.2. Land Use

3.3.2.1 Land use patterns in the project site

358. Most of the project site is covered by lands owned to the forest and wildlife departments. In the settlement area agricultural productions are the dominant product output in the area. Cultivations such as paddy, OFC, vegetables fruits and coconut are also significant. Timber trees such as Teak, Burutha, and Halmilla etc. are also perceptible to a significant extent. Along the UEC and KMTC trace, the major land use types are forest land, scrub land, other plantations, paddy, irrigation tanks and settlements. Existing land use pattern of upper elahara canal is given in Figure 3.10 (Sheet 1 to 9) and Annex VI – table 2gives a detailed description of the lengths which is traversed by the UEC in each land use type.

3.3.2.2. Land ownership

359. 183 acres which is identified as private property are owned by affected households, 139 are highlands and the balances of 43 acres are paddy lands. 139 acres of highlands in the project site are the private property which is owned to the affected families. Out of the total number of 139 acres, 125 acres has legal titles. 72 (52%) acres were given under land development ordinance (LDO) grants and 26.9 acres under LDO permits. These lands were given subject to the provisions of the Land Development Ordinance as amended by the Act, No: 16, 1969 and Act No: 27 of 1981 and the conditions set out in the schedule. The details are given below.

Table 3.25 Highland ownership

	No. of HH	%	Acres	%
LDO grants	48	55.2	72.3	52.0
Permits	20	23.0	37.	26.9
Sole owner	9	10.3	14.8	10.7
Leased	5	5.7	4.5	3.2
Encroached	5	5.7	10	7.2
	87	100.0	139.0	100.0

Social Baseline Survey -2014, MCB Consultants

360 Considering about the ownership of the lands 16 families have less than 1 acre of homesteads. 39 (45%) of families are having less than 2 acres. The following table shows the land distribution among the families.

Table 3.26 Land extent of the surveyed families

Size of plots (Acres)	Highland plots	Extent (Acres)	Paddy land plots	Extent (Acres)
> 1	16	9.0	6	3.5
1 >2	39	45.5	21	26.75
2 >3	25	55.8	7	17.25
3 >4	5	18.8	3	9
4 >6	2	10	4	18
	87	139.1	40	74.5

Social Baseline Survey -2014, MCB Consultants

361 Considering about the land ownership out of 139 acres of highlands 37.4 acres are included to the sole owner category. Majority of the lands72.3 (52%) Acres are in the LDO grants category. Second largest category is permit holders. The following table shows the details.

Table 3.27 Number of Households and extent according to the type of deeds

Type of deeds	Households		Extent	
	No:	%	Acres	%
LDO grants	48	55.2	72.3	52.0
Permits	20	23.0	37.4	26.9
Sole owner	9	10.3	14.8	10.7
Leased	5	5.7	4.5	3.2
Encroached	5	5.7	10	7.2
	87	100.0	139	100.0

Social Baseline Survey -2014, MCB Consultants

3.3.2.3. Condition of Houses/Buildings

362 According to the socio-economic survey of the project area, there are 78 buildings including houses. In viewing the category of buildings, 58 (87%) are permanent houses, 15 semi permanents and 5 are temporary. In addition there is 1 commercial venture.

Table 3.28 Condition of the houses

DSD	**GND**	Total houses	House		
			Permanent	Semi-permanent	Temporary
Elahera	Damanayaya	39	36	3	-
	Kottapitiya-south	12	4	5	3
	Elahera	8	5	2	1
Total Elahera DSD		**59**	**45**	**10**	**4**

Galenbindunuwewa	Yakalla	3	1	2	-
Total Galenbidunuwewa DSD		**3**	**1**	**2**	**0**
Palugaswewa	Madawala	7	5	2	-
Total Palugaswewa DSD		**7**	**5**	**2**	**0**
Hingurakgoda	Moragaswewa	3	3	-	-
	Mahasengama	6	4	1	1
Total Hingurakgoda DSD		**9**	**7**	**1**	**1**
Grand Total		**78**	**58**	**15**	**5**

Social Baseline Survey -2014, MCB Consultants

363 **Access to other facilities:** According to the socio economic survey, 60 (69%) of the houses have electricity. 22% of the houses have telephone landlines, though virtually all use mobile phones. 92% have toilet facilities out of which 72% are water sealed. 61% of families are having access to pipe born while other use stream water or dug wells.

Table 3.29 Source of drinking water

DSD	GND	Water supply		
		Pipe born	Well	Other
Elahera	Damanayaya	32	7	-
	Kottapitiya-south	6	6	-
	Elahera	-	8	-
Total Elahera DSD		**38**	**21**	
Galenbindunuwewa	Yakalla	-	5	6
Total Galenbidunuwewa DSD		**0**	**5**	**6**
Palugaswewa	Madawala	6	1	-
Total Palugaswewa DSD		**6**	**1**	**0**
Hingurakgoda	Moragaswewa	3	-	-
	Mahasengama	6	-	-
Total Hingurakgoda DSD		**9**	**0**	**0**
Grand Total		**53**	**27**	**6**

Social Baseline Survey -2014, MCB Consultants

3.4. Description of the archaeological remains within the study area

364 According to studies carried out within the project area, 16 archeologically important sites have been identified (see figure 3.11). Descriptions of the sites are given below.

1. <u>Shyila Gangaramaya Temple</u>

365 An ancient temple with different cut marks in a rock surface was identified within a distance of about 1500 meters from the right side of the Canal near Elahera Junction. It is situated in the North Central Province, Polonnaruwa District, Elehera Divisional Secretariat Division, Elehera GS Division at GPS Point 07^0N 44' 3.259" and 80^0E 47' 17.590".

2. Welan Katuwa Ancient Tank

366 Damaged Welankatuwa Ancient Tank about 200 meters from the right side of the Canal was identified. The tank is now destroyed and not being used. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Elehera GS Division at GPS Point 07^0N 43' 52.322" and 80^0E 46' 27.460".

3. Athikampitiya Ruins near Wadi Ela

367 Ruined Structure with lime stones was identified about 245 meters from the left side of the Canal. Stone pillars and stone blocks used for wall were identified within the area. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Elehera GS Division at GPS Point 07^0N 43' 45.713" and 80^0E 46' 13.491"

4. Thanthiriglala Ruins

368 An area with stone blocks belongs to a ruined structure was identified in an area within a distance of about 1400 meters from the left side of the Canal. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Elehera GS Division at GPS Point 07^0N 45' 18.363" and 80^0E 46' 16.722".

5. Orumendi Siymalawa

369 Ancient mound belongs to an ancient stupa was identified near the Elehera Minneriya Yoda Ela by the side of the road was identified about 615 meters from the right side of the Canal. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Heeratiya GS Division at GPS Point 07^0N 45' 42.449" and 80^0E 48' 16.573".

6. Puwakgha Ulpatha

370 Ancient Spring named Puwakgaha Ulpatha was identified within a distance of about 800 meters from the left side of the Canal. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Kottapitiya GS Division at GPS Point 07^0N 49' 23.682" and 80^0E 49' 9.344".

7. Damanayaya Walsge

371 A cave with ancient bricks named as Damayaya Walsge was identified with in a distance of about 300 m from the left side of the Canal. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Damanayaya GS Division at GPS Point 07^0N 46' 58.920" and 80^0E 48' 0.194".

8. Ruins at Dambulukele – No. 1

372 Ancient structure which has been excavated by treasure hunters was identified within Dambulukele within a distance of 100 meters from the right side of the Canal. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Segala GS Division at GPS Point 07^0N 50' 33.015" and 80^0E 50' 5.371".

9. Ruins at Dambulukele – No. 2

373 Ancient structure which has been excavated by treasure hunters was identified within Dambulukele within a distance of 12 meters from the right side of the Canal. Stone pillers and tiles were identified within the area. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Attanakadawala South GS Division at GPS Point 07^0N 51' 7.425" and 80^0E 50' 5.442".

10. Ruins at Dambulukele – No. 3

374 Ancient structure with stone retaining walls was identified within Dambulukele on the Canal Path. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Attanakadawala South GS Division at GPS Point 07^0N 51' 6.546" and 80^0E 50' 4.756".

11. Archaeological Ruins at Pekkulama

375 Ancient structure with stone blocks, stone pillars, tiles and potsherds was identified within a distance of about 250 meters from the right side of the Canal. This is belongs to an ancient settlement. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Konduruwewa GS Division at GPS Point 07^0N 55' 26.724"and 80^0E 49' 24.927".

12. Rock Out Crop with Cut Marks

376 Rock out crop with cut marks was identified within a distance of 400 meters from the left side of the Canal. It is situated in the Central Province, Matale District, Dambualla Divisional Secretariat Division, Polwatta GS Division at GPS Point 07^0N 55' 50.361" and 80^0E 48' 53.747".

13. Ancient Tank Bund of the Beegahawela Ancient Tank

377 Ruined ancient tank bund of the Beegahawela Ancient Tank was identified within a distance of about 236 meters from the right side of the Canal. It is situated in the North Central Province, Polonnaruva District, Elehera Divisional Secretariat Division, Konduruwewa GS Division at GPS Point 07^0N 55' 31.932" and 80^0E 49' 24.014".

14. Archaeological Ruins near Beegahawela Ancient Tank by the side of Ruppe Ela

378 Ancient structure which has been excavated by treasure hunters was identified within a distance of about 453 meters from the right side of the Canal. Stone pillars and stone retaining walls could be identified with in the area. It is situated in the Central Province, Matale District, Dambualla Divisional Secretariat Division, Polwatta GS Division at GPS Point 07^0N 55' 50.361" and 80^0E 48' 53.747".

15. Gallinda Ancient Mahasen Devalaya

379 Gallinda Ancient Mahasen Devalaya is situated within a distance of about 769 meters from the left side of the Canal. It is situated in the North Central Province, Polonnaruva District, Hingurakgoda Divisional Secretariat Division, Mahasengama GS Division at GPS Point 07^0N 41.338" and 80^0E 47' 34.871".

16. Gallinda

380 Ancient Gallinda is situated within a distance of about 762 meters from the left side of the Canal. It is situated in the North Central Province, Polonnaruva District, Hingurakgoda Divisional Secretariat Division, Mahasengama GS Division at GPS Point 07^0N 59' 35.088"and 80^0E 47' 36.340".

381 While this report provides a summary of the recommendations of the independent archaeological impact assessment report developed by Department of Archaeology for the Upper Elehara Canal project the full report (in Sinhala language) of the archaeological impact assessment is available in MIWRM.

LAND USE PLAN OF UPPER ELAHERA CANAL 00+000 Km to 08+000 Km

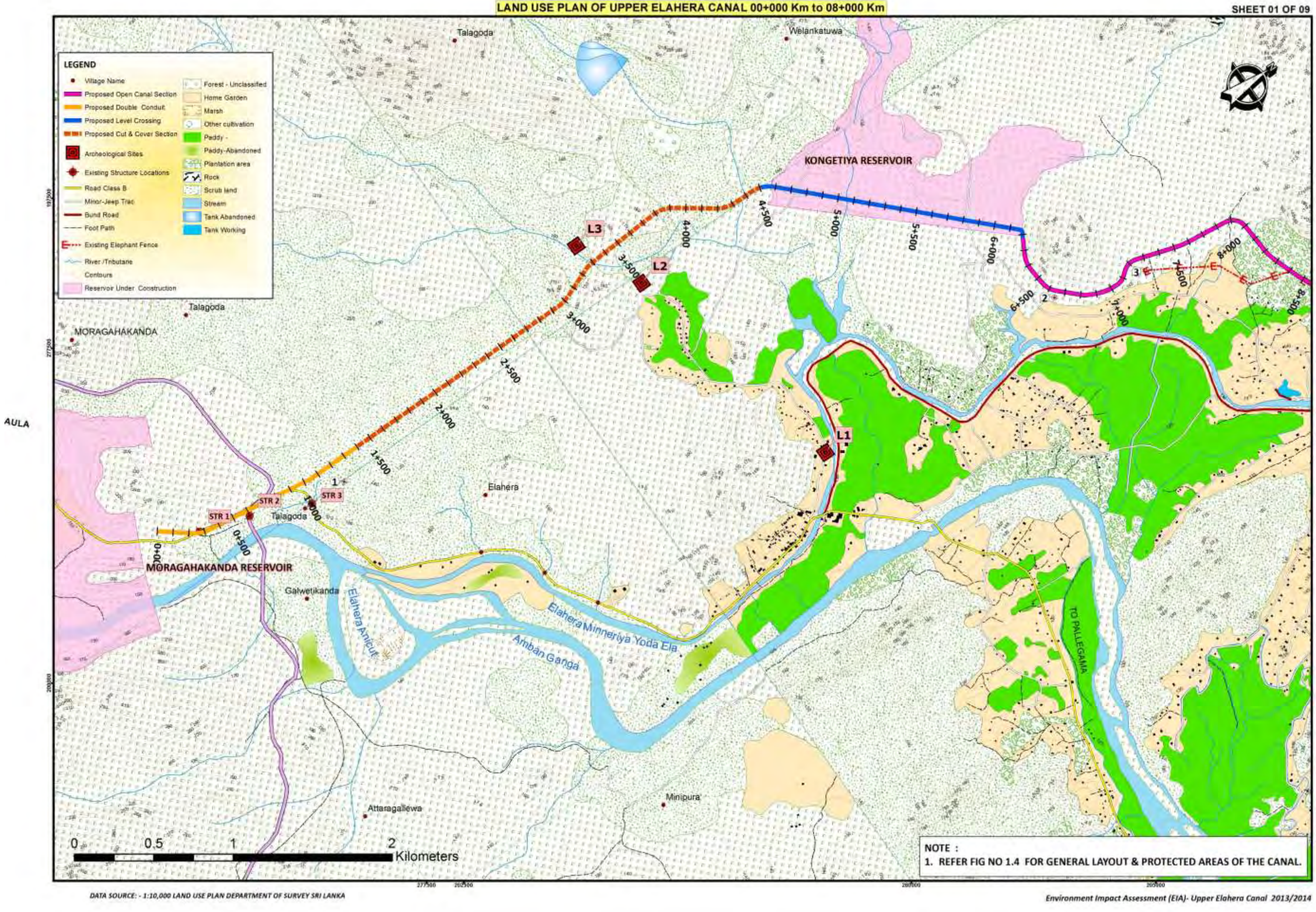


Figure 3.10- Existing land use pattern – Upper Elahara Canal. Sheet 1 of 9

LAND USE PLAN OF UPPER ELAHERA CANAL 08+000 Km to 16+000 Km

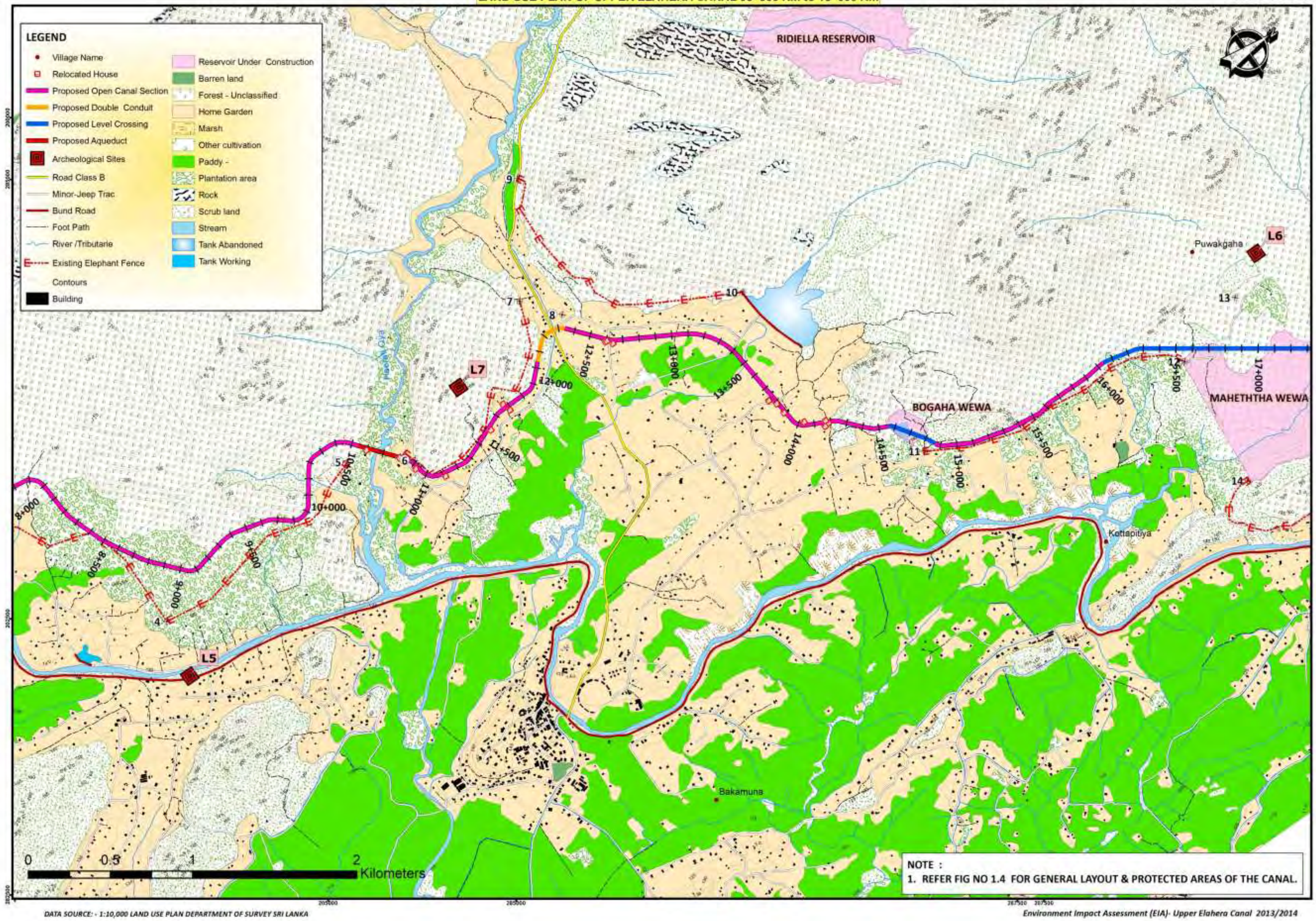


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 2 of 9

LAND USE PLAN OF UPPER ELAHERA CANAL 16+000 Km to 24+000 Km

SHEET 03 OF 09

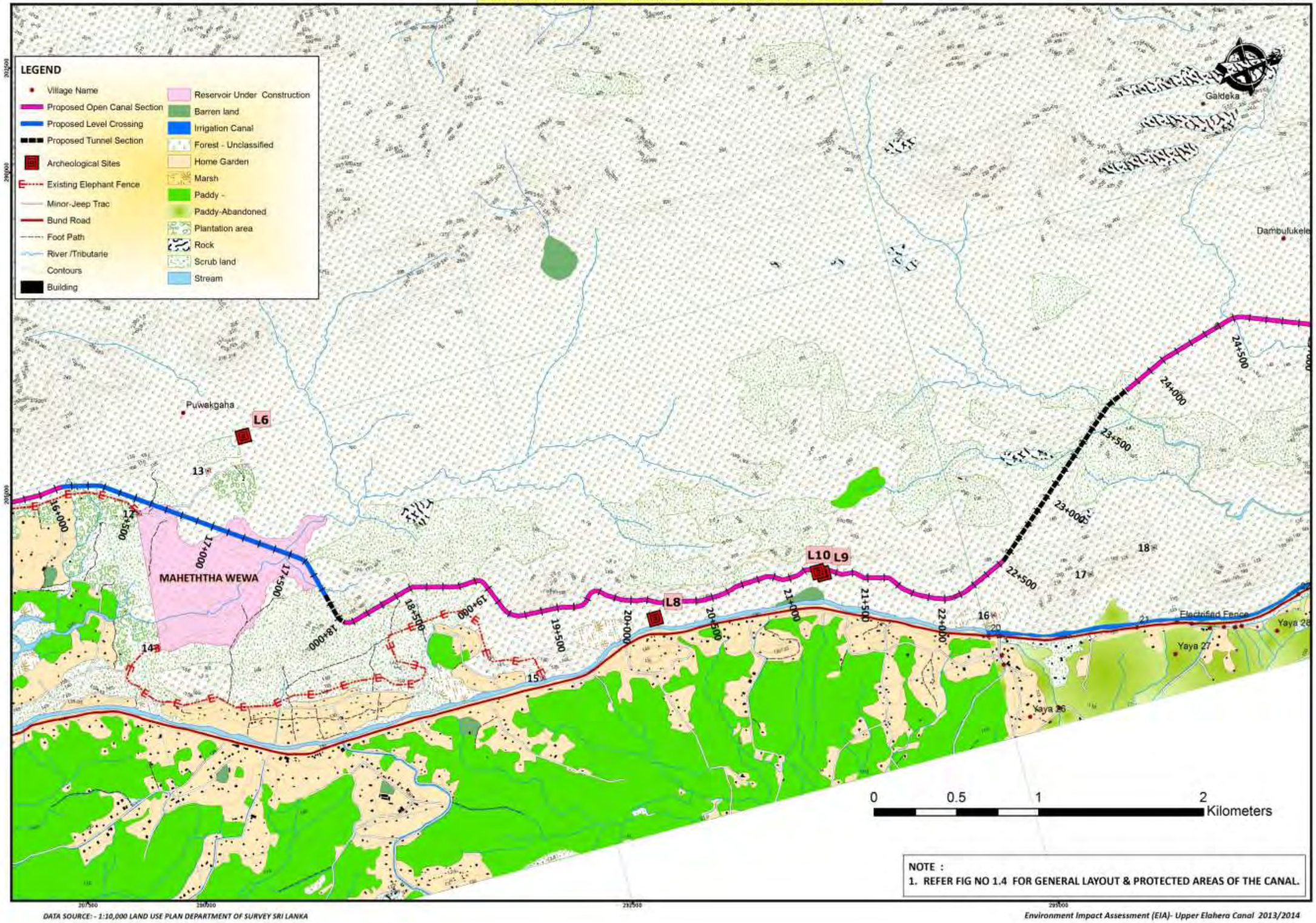


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 3 of 9

LAND USE PLAN OF UPPER ELAHERA CANAL 24+000 Km to 32+000 Km

SHEET 04 OF 09

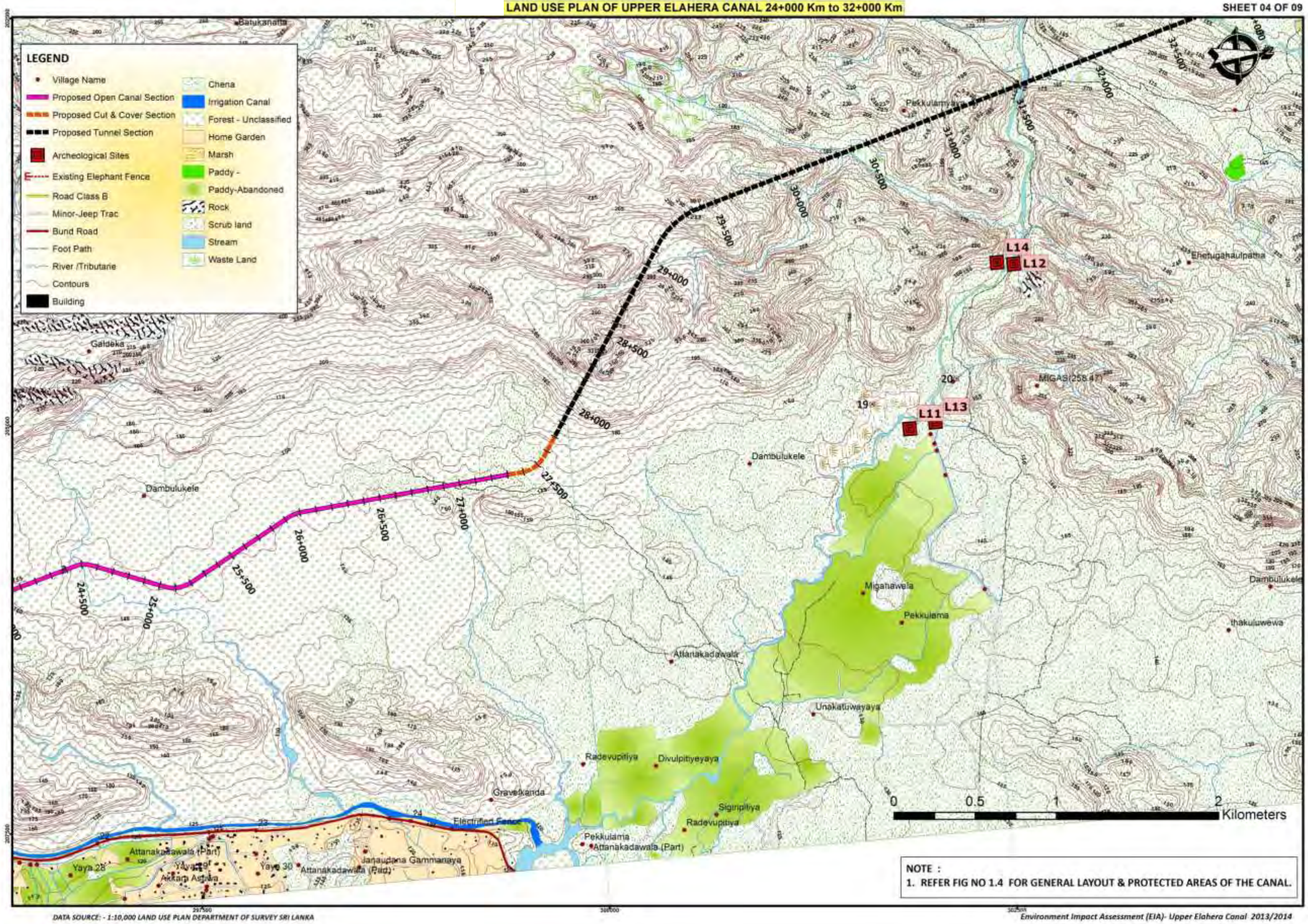


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 4 of 9

LAND USE PLAN OF UPPER ELAHERA CANAL 32+000 Km to 40+000 Km

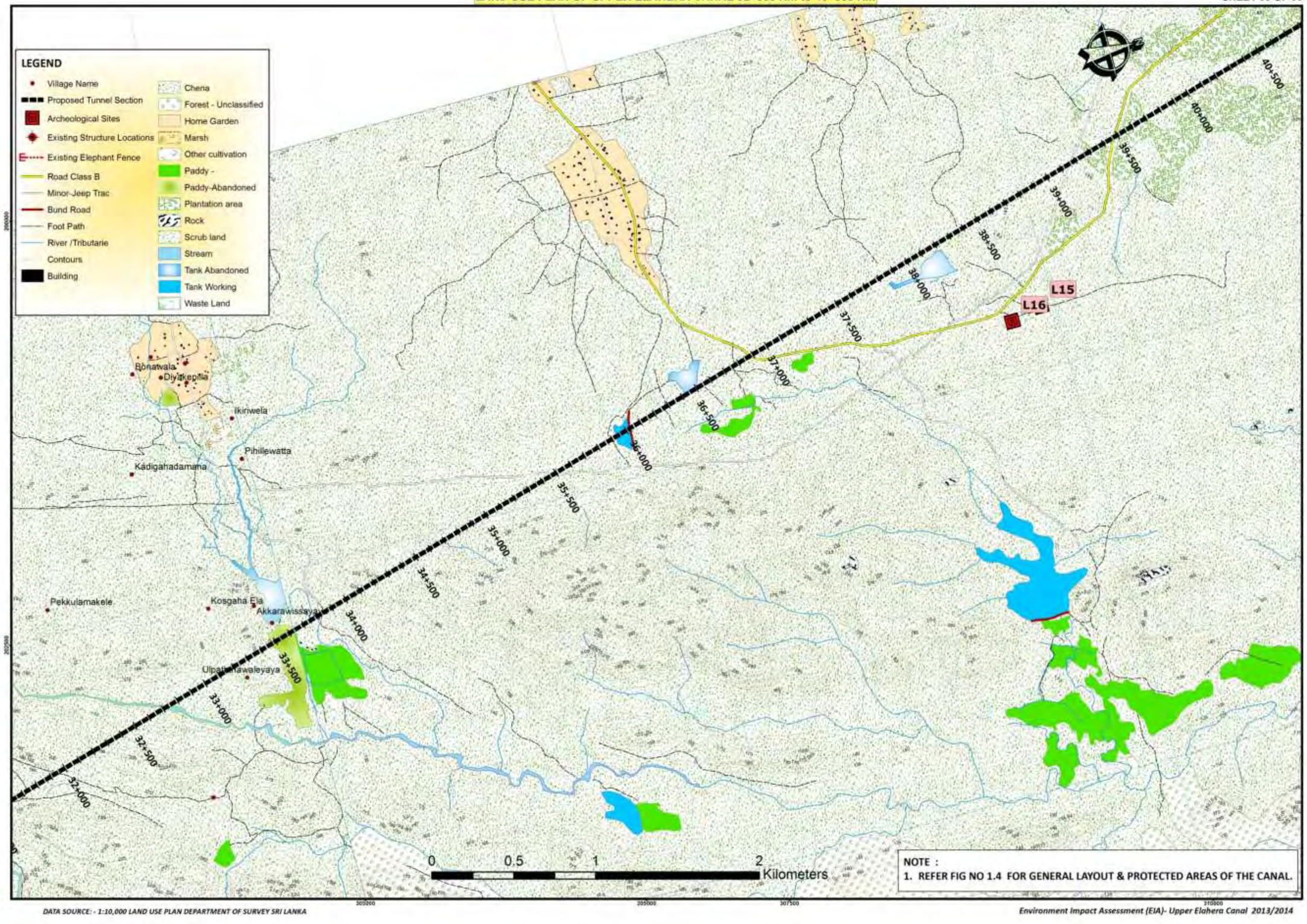


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 5 of 9

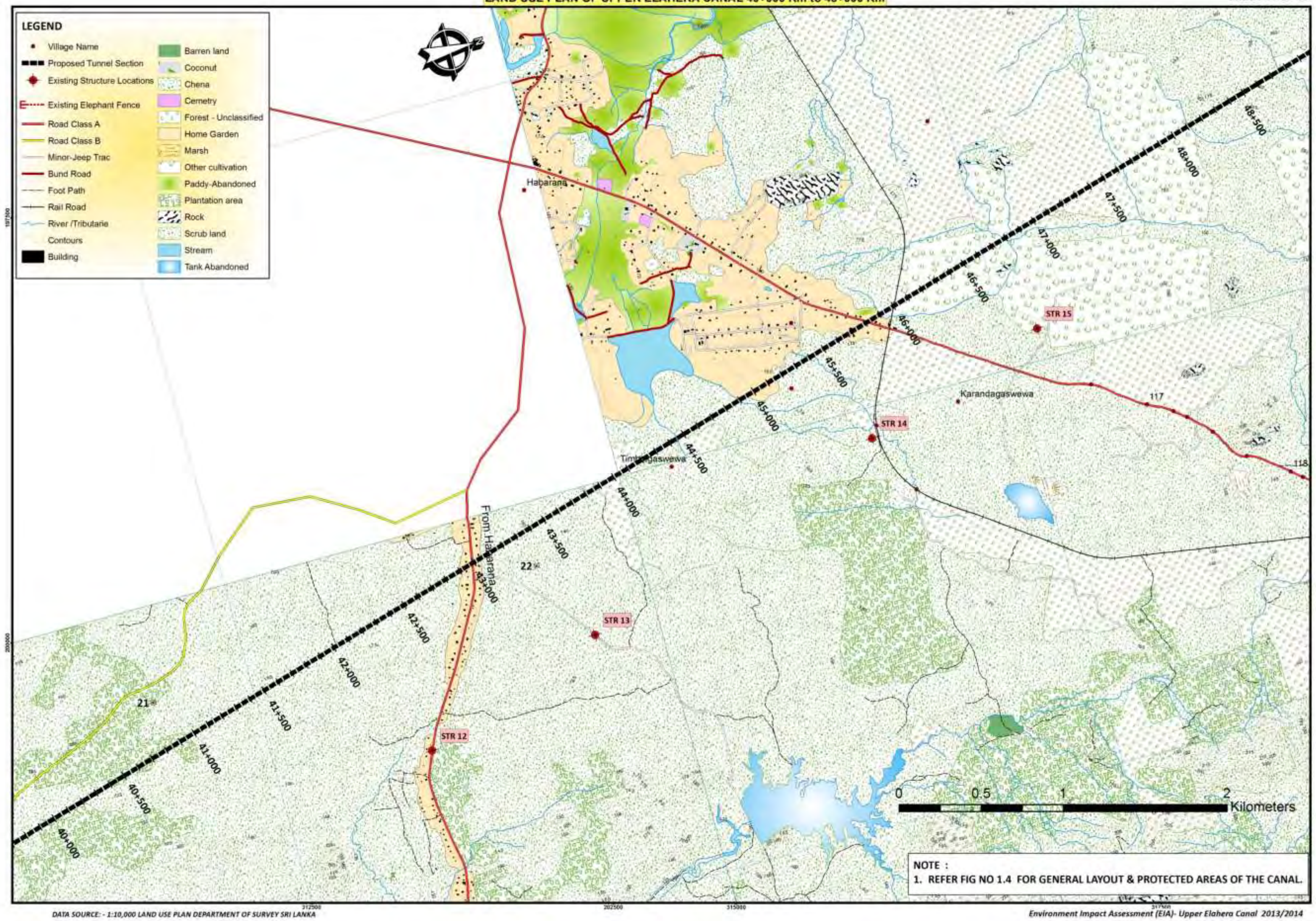


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 6 of 9

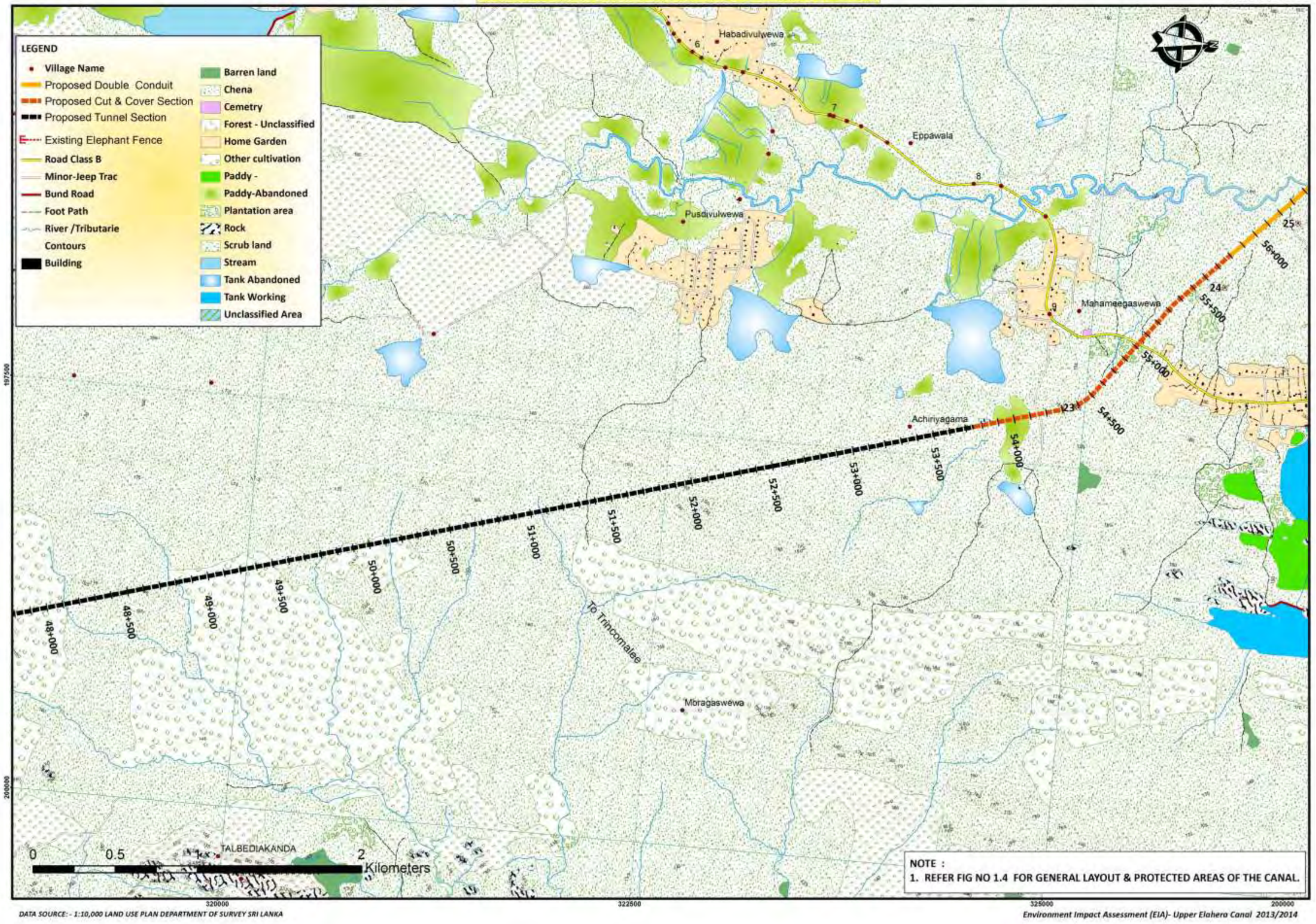


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 7 of 9

LAND USE PLAN OF UPPER ELAHERA CANAL 56+000 Km to 65+000 Km

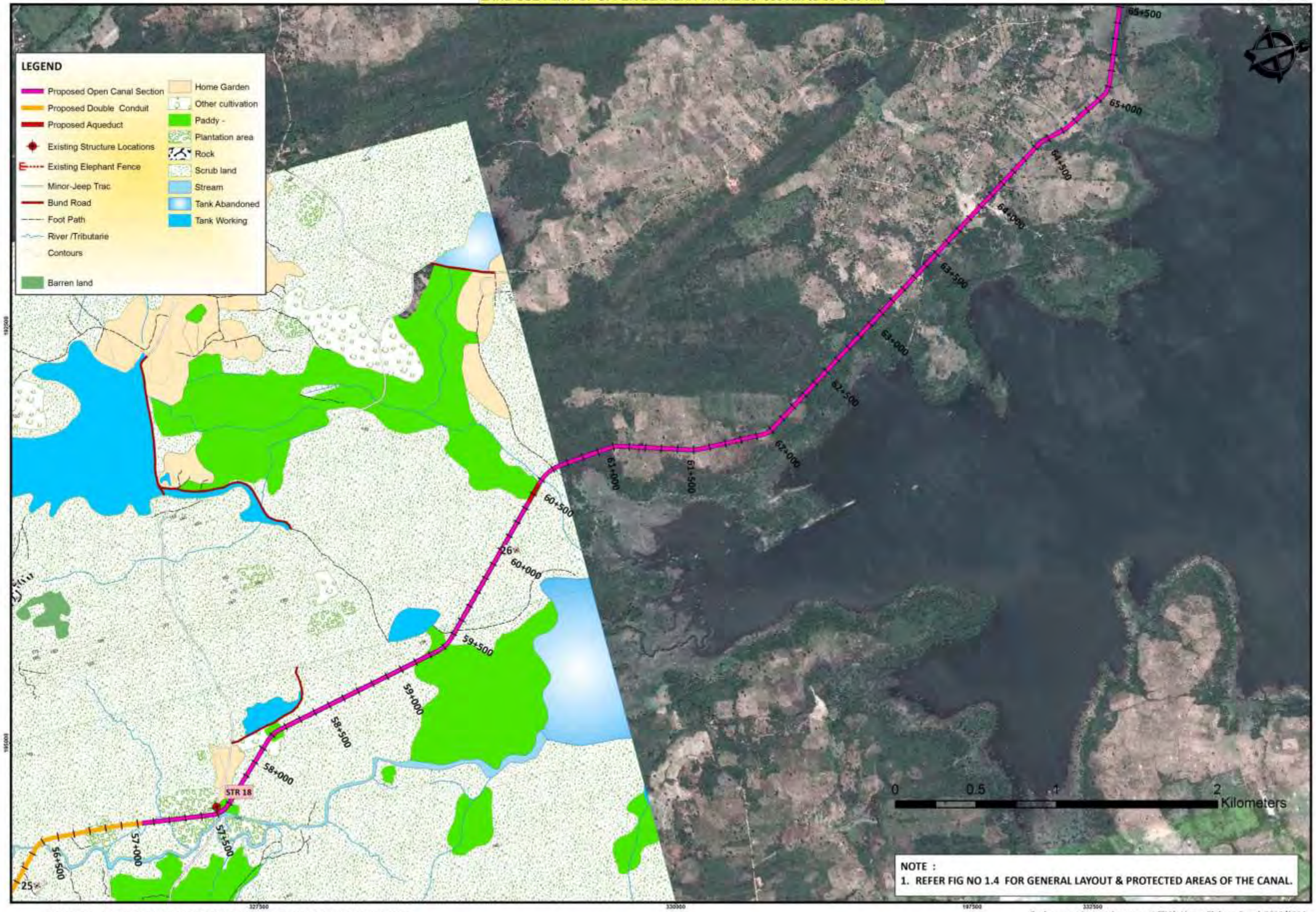


Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 8 of 9

LAND USE PLAN OF UPPER ELAHERA CANAL 62+000 Km to 65+500 Km

DATA SOURCE: - 1:10,000 LAND USE PLAN DEPARTMENT OF SURVEY SRI LANKA & GOOGLE SATELLITE IMAGE

Figure 3.10-Existing land use pattern – Upper Elahara Canal. Sheet 9 of 9

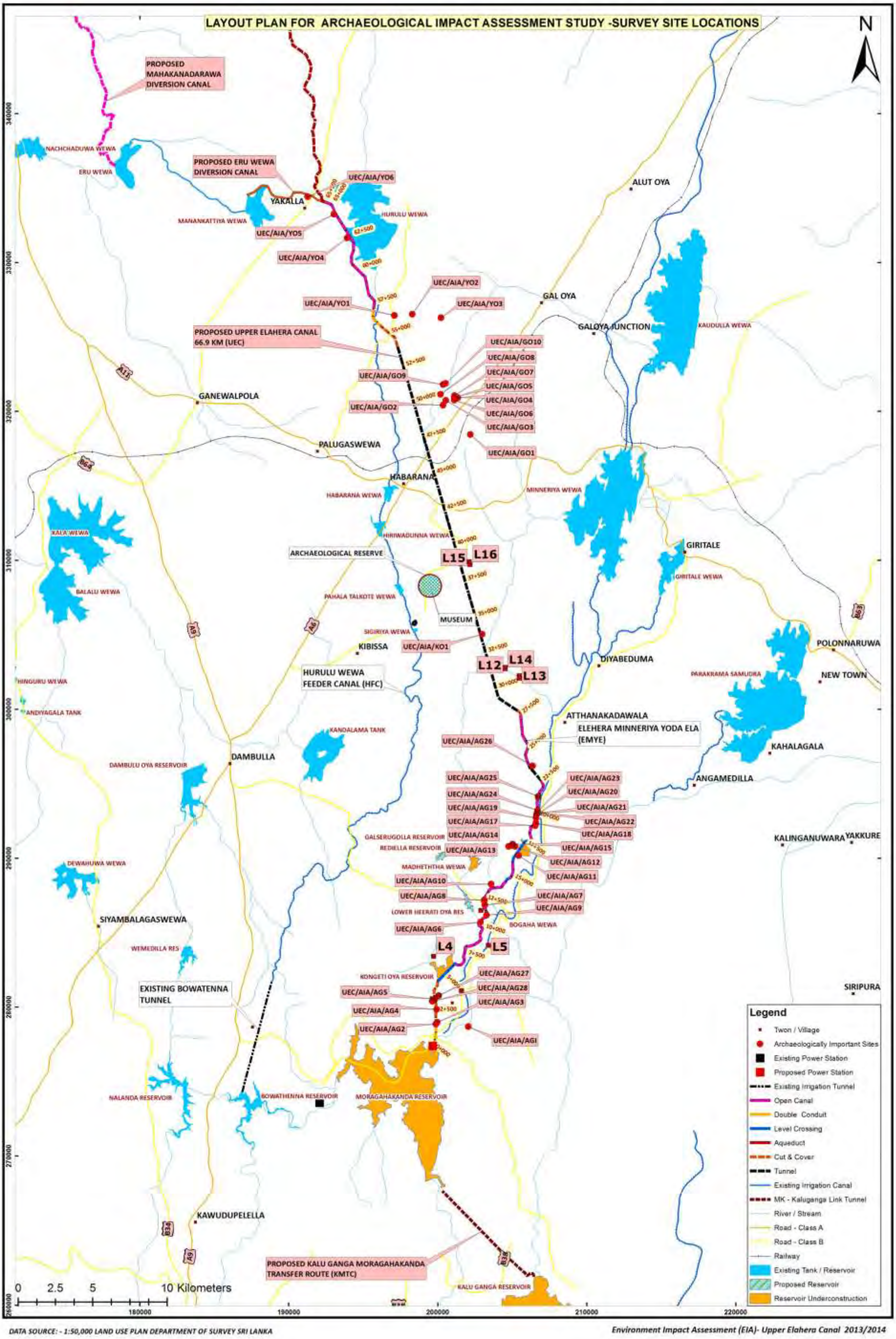


Figure 3.11- Layout Plan for Upper Elahera Canal with Archeological Sites

CHAPTER 4

4. ANTICIPATED ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

4.1 Scope of the analysis

382 This report chapter presents the results of the impacts of the proposed project activities on the environment and socio-economic aspects. Impacts identification has been based on the TORs and guidelines provided by the CEA (the PAA) in accordance with the laws and regulations governing the EIA process in Sri Lanka. The requirements under Safeguard Policy Statement (2009) of the ADB have been considered (since its inclusion in the EIA in February 2014) in environmental impacts. The beneficial irrigation and agricultural impacts from the proposed project are set out in Chapter 1 as the justification of the project. There are other benefits that need to be specified.

383 Direct, indirect, irreversible and reversible, long term, short term impacts on and risks to physical, biological, socioeconomic, and physical cultural resources were taken into consideration to determine their significance and scope, as much as possible

384 The impact identification covered the design and planning, construction, operational and decommissioning phases. The EIA process was conducted in such a manner that impacts were identified early in the project cycle. Initial field surveys and stakeholder consultations indicated the major aspects and locations where there was a need to avoid, minimize, mitigate, or compensate for potential adverse impacts. This enabled decision makers to modify designs and route locations to avoid/minimize some impacts, and to draw up plans to mitigate and/compensate for other impacts. Engineering and location modifications were done to the general layout and designs of the UEC to avoid/ minimize some major environmental impacts. See chapters 1 and 2 for the processes that led to such modifications and details of those modifications.

385 All identified adverse impacts will be addressed through avoidance/minimization and/or mitigation and/or offset/compensation strategies to be made ready for implementation during the project cycle.

A) Beneficial Impacts from the project

386 Chapters 1 and 2 provide descriptions of the irrigation and agricultural improvements in the recipient regions from this project. The fundamental basis of the UEC is as a 'water investment' in Sri Lanka. It anticipates providing the following benefits:

a) Mainly improve water security in the currently water deficit irrigation systems in Dry Zone of Sri Lanka in the North Central Province (NCP), and once the second phase of the project which will include the NCP canal is implemented, Northern Province (NP) and Eastern Province (EP) and thereby improve the economic and living standards of agriculture based communities in those under developed areas.

b) Irrigated agriculture benefits

387 Cropping intensity of command areas under major tanks and minor tanks are to be increased from 1.3 to 1.8 and 0.9 to 1.8 respectively. Minor tank areas to be undertaken on Other Field Crops (OFC)/commercial crops. In addition, paddy yield is expected to increase from 5.0 Tons/ha to 6.2 Tons/ha. About 5,200 ha under Sugar cultivation in Kantale area will be benefited with irrigation as well. Other crops including banana, green gram, ground nut, big onion chilies and vegetables will be cultivated in 60 to 80% of the irrigable land in the Yala season, benefiting the farmers further.

388 Benefitted area includes Manakkatiya-Eruwewa-Mahakanadarawa system, Huruluwewa and Yan Oya system and the revival of Kantale Sugar Plantation area. The total benefited area will be 17,664 ha.

c) Domestic and industrial water benefits. This is of paramount importance due to the emergence of the Chronic Kidney Disease of unknown etiology that has become a major national health issue but is centered in the NCP, EP and NWP. This benefit from the UEC needs to be emphasized more than when the project was initially developed. Further provision of good quality drinking water supplies reduced burden of gastrointestinal diseases, especially in children and other vulnerable groups such as the elderly groups.

d) Benefits to wildlife such as through provision of water bodies; ponding areas created by level crossings incorporated into the UEC and permitting drinking from the canal itself by design modifications that enable large animals to climb down into the canal from the side of the protected area and/or reservation but preventing them from climbing out from the side of the village/settlement, creation of small reservoirs for wildlife at drainage streams along the route are design features that will improve access to water for wild life. Water provision is especially important during the dry season.

e) The UEC, at some points, acts as a barrier to wild animals crossing into human settlement areas thereby removing the need to maintain electric fences at those locations.

f) Acts as a barrier to further encroachment by people into protected areas where the canal runs along the borders.

g) Other beneficial impacts are some degree of protection to ecological resources, physical resources such as land and water sources and maybe even archeological sites of importance when the UEC is operational, due to presence of monitoring teams from MASL and other agencies.

B) Adverse impacts addressed in the design stage

389 **Overall project layout and structures**

390 The UEC has undergone several significant design including route changes to accommodate environmental, social, physical and cultural resource concerns raised by the respective government agencies as well as community level stakeholders.

391 The design and route changes have been explained in Chapter 1 and 2 of this report.

392 Avoidance of social and economically adverse impacts has been addressed through selection of UEC trace to avoid human settlements as much as possible.

393 The two sites of archaeological importance impacted are in the process of being avoided by another route change of the UEC trace at the detailed design stage. The sites are:

i. Ruins at Dambulukele No.2 : GPS coordinates- 07^0N 51' 7.425" and 80^0E 50'4.756"
ii. Ruins at Dambulukele No.3 : GPS coordinates- 07^0N 51' 6.546" and 80^0E 50'4.756"

C) Impacts requiring mitigation

394 These have been identified for Physical, Socio-economic and Physical Cultural, Ecological, Archaeological / Historical aspects.

4.2 Impacts on physical resources

4.2.1 Impacts on surface and groundwater hydrology

a. Construction Phase

395 Usually encountered impacts on water and hydrology from this kind of projects are flooding, changes of groundwater levels, changes to stream flow including environmental flows,

and changes to drainage patterns, and their extended impacts to human settlements, infrastructure and services, natural habitats, ecosystems, plants and animals.

396 During the construction phase, no severe effect on water availability or hydrology is expected due to any of the construction activities.

397 However, construction of aqueducts across Lel Oya and Heerati Oya can lead to damage to banks, the stream bed, increase of sedimentation and turbidity and other forms of water pollution during that period. Generally, due to land clearing, excavation, disposal of biodegradable material, construction of culverts and bridges, tunneling and disposal of solid wastes, turbidity of surface water and water pollution can be increased during the construction period.

398 Excessive siltation of natural streams are not expected in construction of the comparatively small scale tanks as in this project, according to the experience on construction of large tanks during the past several decades

399 Resettlement activities such as clearing for housing and infrastructure including roads, and the presence of larger numbers of humans in formerly unoccupied areas (including worker camps) can also cause moderate increase of water pollution levels. Road construction can change drainage patterns and lead to greater soil erosion.

400 There will be some detrimental effects to the ground water levels in specific locations due to construction activities which are short term. Such effects are due to construction of wells, pumping of water for dewatering during construction and excavation of trenches for construction of structures like culverts, tunnels, etc. In the case of tunneling, groundwater depletion (if that takes place) may not affect the people, as the tunnels are mostly located in protected areas such as Minneriya National Park and Hurulu Forest Reserve. As the tunnel is constructed by TBM through and adjacent to the protected areas, there will not be any appreciable short term or long term effect on the seasonal water availability for wild life.

401 However, adverse effects on surface water bodies and vegetation through lowering of ground water levels above the tunnels have to be avoided and minimized by appropriate mitigation measures such as grouting and shot-creting. Groundwater is recharged by rainfall and surface water. Excessive seepage into tunnel will lower the groundwater table and more surface water will be used to replenish groundwater. Shotcreting and other methods to seal-off the tunnel surface would reduce groundwater seepage into the tunnel and reduce impacts on surface water bodies and vegetation.Therefore the long term adverse effects on ground water tables will be minimized.

402 The effects are likely to be less severe in tunnels dug using the TBM as opposed to those constructed using blasting methods. See Table 4.1 below.

Table 4.1 Comparison of impacts of different types of construction methods

Type/method of Construction	Tunnel		Open Canal	Cut and Cover
	TBM	Blasting		
Type of impact[2]				
Loss of surface natural habitat (vegetation, soil, animals)	+	+	+++	++
Change of drainage pattern	N	N	+	N
Change of surface water levels	N	N	++	N
Change of stream flows including environmental flows	N	N	+	+
Soil erosion/loss of soil stability	+(*)	+	++	++
Change of ground water table	+	+	N	N
Surface water pollution by runoff and chemicals used in construction	+	+	+	+
Noise	+	+++	++	++
Vibration	+	++	++	++
Dust	+	++	+	+
Release of hazardous and toxic chemicals	N	N	N	N
Release of air pollutants including particulate matter to the air	N	++	++	++
Creation of large amounts of excavated material for disposal	++	++	++	++
Need for disposal sites for excavated material	++	++	++	++
Need for access roads to site of operation of machinery and use of materials	+++	+++	+++	+++
Need for power supplies to operation of machinery	++	+	+	+
High levels of construction disturbance driving away animals	+	+++	++	++
Relocation of houses and other infrastructure along the canal trace	N	N	++	++
Safety of operational staff	+	++	+	+

Impact levels- High- +++ Medium- ++ Low- + N- None

(*)What is meant here is not loss of potential stability for TBM. There could be some externals steeply sloping areas which may become vulnerable under heavy rainfall of high intensity over long periods.

403 For all points where the UEC crosses roads, village roads etc (open canal and cut and cover) a bypass will be created prior to construction of the canal. This change will be limited to the period of construction of that canal section and therefore will not be a significant impact.

b. Operation and Maintenance Phase

404 No adverse effects are expected for water availability or hydrology during this phase. But there will be minor changes in the natural stream flow pattern below the proposed UEC canal due to construction of canals. There is mitigation measures proposed to minimize this impact.

c. Environmental Flows

405 The small streams, across which UEC passes, are non-perennial. The UEC intercepts 3 such streams at Kongetiya, Madetthewa and Bogaswewa. Water balance for the UEC Project was prepared without expecting any inflow from this stream; as such their flow is not needed for UEC operations. These streams are ungauged, and therefore it is not possible to release an exact, measured amount of water to them. However, it has been noted that appreciable flow occurs in these streams during maha season, especially from October to December. As such, during the maha season, downstream control gates of level crossings in the UEC will be operated to ensure that flow downstream of the level crossing is equal to the UEC flow upstream of the level crossing. The inflows from streams will be released to the same stream for irrigation and environmental uses. During dry weather, any irrigation releases from the UEC are not planned by the designers.

406 In the case of other streams, the following design measures apply to the stream flow:

i. When the stream flows at a higher elevation than UEC, a drainage over-crossing will be used to convey stream flow,
ii. When stream flows at a lower elevation, stream will be continued via a drainage under-crossing
iii. In the case of larger stream such as Heerati Oya (crossing UEC) and Lel Oya (crossing KMTC) aqueducts will convey UEC across the streams.

407 As there is no disturbance to the existing hydrology, releasing of environmental water especially for that purpose is not required. The bottom sluices of the above mentioned three tanks (level crossings), together with UEC regulators,will be operated suitably to fulfill this condition. The three streams crossing the level crossing tanks generally go dry during some months of the year. But due to continuous water flowing into these tanks after the operation of the UEC, the drainage water will collect to the original stream improving the current situation. This will also benefit the ecosystems as well as the vegetation and wildlife. Thus the riparian flows will not be affected negatively.

4.2.2. Quality of Air

408 **Construction phase:** Air quality can deteriorate during the construction periods due to exhaust fumes, dust due to exposed surfaces of transported of materials, from stockpiles of materials, rock blasting and crushing, creation of access roads etc. During operation of diesel or petrol driven machinery (use of fossil fuels, Carbon Monoxide (CO), oxides of nitrogen (NO_x) and Sulfur Dioxide (SO_2) would be released to the atmosphere. There can also be release of particulate matter (PM), hazardous volatile chemicals, and metals from specific point sources during construction activities. Due to rock excavation and transport, transport of other materials and earthworks there will be an increased vehicular traffic on most of roads of project area and the amount of dust released into the air, especially during the dry periods, will be significant. All these need to be mitigated.

409 Special attention should be paid during construction activities within and adjacent to protected areas especially Minneriya National Park (MNP) and Hurulu Forest Reserve (HFR) (including the Man and Biosphere component of this forest reserve), Minneriya-Giritale Nature Reserve and Elehera-Giritale Sanctuary to reduce negative impacts on ambient air quality as much as possible. As the TBM will be used for construction of tunnels within a section of the MNP and the whole length within HFR, impacts associated with tunnels created by blasting, and open canal construction are not anticipated. All adverse impacts on air quality should be mitigated.

4.2.3. Noise and Vibration

Construction Phase

4.2.3.1 Machinery and Equipment

410 When tunnels are excavated with the blasting method there will be large amounts of noise and vibration with negative impacts on humans and wildlife. Terrestrial fauna such as birds and mammals will be affected due to blasting required to construct approximately 840m tunnel within Elehera-Giritale sanctuary. Construction of the tunnel segment using blasting in the KMTC route will create high levels of disturbance to the animals of the hill sides and adjacent areas during construction.

411 The tunnel sections excavated using the TBM are not expected to create impacts such as those from blasting methods. The TBM excavated tunnels are approximately 18m below ground level and even vibrations not expected to be felt much by those above ground.

412 In general the operation of machinery, transport of materials, land clearing, excavation, compaction, drilling, blasting, creation of worker camps, creation of new access roads and upgrade of existing roads to accommodate project activities, relocation of affected families in new areas, creation of new roads and some forms of upgrading of infrastructure in resettlement

areas etc. will generate noise and vibration. These will range from moderate to high level impacts, but confined to specific locations for limited periods of time of the construction phase.

413. The KMTC and about 840m of the UEC (between 17.87 and 23.20 km) will be constructed by drilling and blasting. Due to such activities, noise and vibrations are unavoidable impacts of such a project and all negative impacts will be minimized, and/or mitigated.The recommended mitigation measures are described in Table 9.2.

4.2.3.2 Noise from worker facilities including camps

414 Noice and disturbance can result from worker camps and this can impact residential values. Siting of such facilities will be done to avoid/minimize adverse impacts especially to protected areas as much as possible. If unavoidable, adverse impacts from the above construction related locations will be mitigated.

4.2.4. Sharing of water and related issues

415 As existing waterways will be allowed to flow with the minimum disturbance, sharing of water will not arise as an issue during the construction phase. Studies carried out by MCB Consultants in 2012-2013 propose new diversions from Polgolla, Uma Oya, Kalinga Nuwara, Hasalaka Oya, and Heenganga, enabling transfer of water through UEC, after carefully assessing the unutilized water resources of the Mahaweli River and its tributaries. Analytical descriptions of these diversions are given under the cumulative impacts analysis on hydrology (See Annex VII). It is noted that new diversions proposed in this water balance study does not violate the river maintenance flow (*which includes irrigation requirements of the downstream and environmental flow*).

416 **Operation and Maintenance Phase:** Kongetiya, Bogahawewa and Madeththewa, which will function as level crossings, are equipped with a sluice crossing the canal underneath to provide riparian water flows and spillways to discharge excess canal flows. Therefore, riparian rights of the current users will not be affected. The major irrigation schemes which are benefitted by the UEC will also have additional water and therefore, the riparian rights are not affected. Water received by Elehera –Minneriya Yoda Ela (EMYE) and the tanks fed by EMYE from the streams will not be affected either.

4.2.4.1. Ecological impacts in the downstream due to low flows

417 As described in the previous sections, the level crossings are equipped with sluices to provide water to the riparian users and for environmental reasons. These small streams are dry during the dry periods. Low flows will not be affected by the UEC, due to the above arrangement.

418 One of the conditions laid down by the Department of Wildlife is that sluices of these tanks be designed to release only 50% of the water allowing sufficient water retained for wildlife

4.2.5 Loss of stability of slopes, tunnel/canal trace and potential for landslides

419 **Construction Phase:** If the conveyance route from Kaluganga Reservoir to Moragahakanda Reservoir consisted of open canals on a steep terrain, proper and expensive slope stabilizing measures are essential. However the currently adoption is to have two tunnel segments connected by an aqueduct through Lel Oya. As such it would not cause severe slope stability problems, less impacts on the surrounding vegetation as it would in an open canal. However at the inlet and outlet portal areas some stability problems could be anticipated due to clearing of the slopes and removal of vegetation.

420 The thickness of completely weathered rock, dip of rock strata and foliation planes, and ground water table are the dominant factors influencing stability.

421 As stated earlier, Kaluganga - Morahahakanda route's topography consists of steeply sloping mountains. Despite the implementation of stability measures under the project, there exists some danger of slope failures when such are exposed to severe adverse climatic factors, such as heavy rainfall of long duration. In tunnel 1 of KMTC geological investigation carried out at inlet portal [1+160 km] indicate favorable geological condition from the elevation 220.5m msl to a depth 11.30 m. Slightly weathered quartzo-feldspathic rock and followed by fresh charnoritic gneiss accompanied by very good core recovery values (reaching 100% at times) and rock quality designation (RQD) values are found below the canal bed level, in this reach.

422 This charnoritic gneiss with little or no fracture at this level proves ideal condition for tunnel. It may even be possible to shift the inlet portal towards U/S, so that stability problems at the inlet of tunnel are minimized, which eventually results in less need of stabilizing measures. At the outlet portal around 2.8 km chainage also 6.00 m thick overburden exists inclusive of 1.50m thick clay (CL type) layer and from 5.80 m depth completely weathered rock occurs up to 11.20 m below that fresh calc-gneiss rock with very good core recovery values (CR) & RQD values exists at the tunnel bed level & below.

423 This calc gneiss revealed tight nature of joints with 100% CR & RQD values at this elevation. However it would be necessary to take some stabilizing measures at the outlet portal since there is somewhat thick completely weathered overburden at the upper elevation. This favorable geological situation could be expected even in the central portion of the tunnel despite encountering two different types of lithology. However further investigation should be carried out performing all relevant tests to ascertain the actual condition.

424 In tunnel 2 of KMTC geological investigation carried out revealed the geological situation from the elevation 206.0m to a depth 3.0m thick clay layer and completely weathered rock at 3.75m depth and slightly weathered rock level at 6.30m which is Chranokitic gneiss. At 9.00m depth fresh charnokitic gneiss occurs indicating very good CR&RQD values and

continues the same situation way down tunnel bed level. Hence it is clear that favorable condition for tunneling exists at the inlet portal of tunnel 2.

425 The over burden 6.3 m may require some stabilizing measures at the inlet portal which would be of minor magnitude. Similar favorable condition could be anticipated in the rest of tunnel 02. However the tunnel 2 is around 6km long it would be necessary to do further geological investigation at the central portion and outlet portal to ascertain the actual conditions.

426 The first tunnel of UEC commences from 17+870 Km location and stretches over 150m. Currently available geological information indicate the tunnel section lies within Biotite Gneiss area and the maximum elevation rises above 175m MSL i.e. more than35m above bed level.

427 Tunnel section near Pekkulam in the section not rising much above tunnel bed level may not give rise to any serious stability problem. Initial stretch of 17.5 Km of the canal is mostly contour aligned and would not cause stability problems. After passing Madettawewa level crossing canal passes through hilly area but again not rising much above canal bed level in between 17+740km &17+920Km. Same situation exists up to 22nd km. The tunnel sections near Pekkulam in the section between 30Km and 37Km do not rise much above tunnel bed level may not give rise to much stability problems. Ongoing geological investigations would reveal the actual geological situation of the area and based on the outcome the kind of treatments required for the tunnel could be determined at the detailed design stage.

428 The tunnel proposed in the last stretch of the canal near Habarana-Polonnaruwa road at 42 km does not rise above 200m msl, i.e. its maximum around 44km location lies within marble over 5 km according to the available geological information in its initial stretch and then intercepting. Several lithological units such as Migmatized Gneiss, Garnet- sillimanitebiotite gneiss few Quartz veins &Feldspathic gneiss need to be investigated to verify the geological situation, and based on that stability at the inlet and outlet portal areas and in between can be finally determined. However, the previous geophysical investigation indicates the average depth to bed rock is 10 m.

4.2.6. Soil stability/Soil Erosion

429 **Construction Phase:** Loss of soil stability and soil erosion takes place due to the removal of vegetation cover, and numerous construction activities. It can cause loss of soil fertility and induce slope instability. Effective and efficient mitigation measures can not only reduce, but could improve the conditions over the existing conditions.

430 As tunnels are to be excavated, another form of soil and rock wash can be expected from improper handling of excavated soil and rocks produced during tunneling. Disposal of those soils and rocks at unsuitable locations such as stream banks, slopes, adjacent to protected areas etc can result in environmental damage by soil wash and subsequent siltation of downstream land areas or water bodies. Soil used for construction of embankments of open canal sections within protected areas can wash away during heavy rainfall and contribute to waterways being blocked.

Construction of access roads should be done in a manner that does not cause higher soil erosion and damage to road surfaces. All of these have to be mitigated where appropriate.

4.2.7. Development of new lands for agricultural purposes and resulting impacts

431 There are no new lands planned to be developed by the UEC. The main benefit of the project is to increase the cropping intensity of the cultivated lands under major and minor schemes. Increased agricultural opportunities will increase use of agrochemicals in the command areas of the Huruluwewa. This has been considered in the mitigation measures and recommendations for long term programmes for reduction of artificial agrochemical use in included.

In the Kantale Sugar cultivation area, already cultivated lands will receive additional irrigation water.

4.2.8. Impact on mineral resources

432 UEC canal consists of several open canal sections, cut &cover sections, conduit sections & tunnel sections all of which are concrete lined with restricted cross sections. The canal is not expected to cause much disturbance on existing mineral resources. Along its length, the canal passes several lithological units and most importantly some Quartz veins of high purity in the initial stretch and Marble in the last stretch. Tunneling has to pass through Marble in a confined area over 5 Km and the method adopted for tunneling would mostly determine the usability & disposability of Marble coming out as tunnel muck. At present TBM is considered as the tunneling method. As such, the tunnel muck will be in small pieces and marble will not have much usability. Quartztic gravel excavated during the canal construction can be utilized for canal bunds, back filling and other earthen constructions of this Project.

4.2.9 Worker camps

433 A site for a Worker Camp has been identified and is shown by Figure 2.1. Worker camps can have adverse impacts on residential vales, recreational uses, scenic views, health and safety and water uses. They can also contribute to solid waste generation and water pollution. The impacts depend on the location of sites and their management. Mitigatory measures are discussed in Chapter 5.

4.2.10 Occupational health & safety

434 As most of the tunnel will be excavated using TBM, the associated risks to the workers who may have limited experience with this type of machines should be given adequate attention. Fire hazard, getting into contact with moving parts, inadequate ventilation, getting exposed to harmful gases are some of the likely safety risks.

In the case of drill and blast type tunnels, use of explosive materials, accidental blasting, and injuries from "fly rock" are the safety risks. In open channel excavations and in the transport of excavated material, use of heavy machinery, dust and exhaust gases can affect the workers.

4.2.11 Access roads and disposal sites

435 It is noted that about 7.0 ha will be needed for access roads and about 16.0 .ha area needed for the disposal sites including TBM launch and retrieval points. Although mostly degraded lands are selected as disposal sites, some vegetation removal will be required in both cases. If there is free entry to the access roads, it can affect the safety of the protected areas. If the disposal sites are not correctly located and landscaped, they may have adverse impacts on water bodies, water quality and habitats. Mitigation measures are discussed in Chapter 5.

4.3 Socio-economic impacts

4.3.1 Anticipated environmental impacts of the proposed project

436 The population within the direct impact area of the project can be considered as affected persons. The people living in the project area (within in the 50 meter width of center line area) are directly affected, and have to be resettled in suitable locations. People that need be relocated can be categorized as follows;

- Families whose residence and home gardens are affected
- Families whose home gardens are only affected
- Families whose high lands are affected
- Families whose paddy lands are affected
- Indirectly affected families

437 There will be direct impacts to the residences and home gardens of 17 families. The social impact assessment survey team during their walk through survey found that the livelihoods of 51% of these affected families are fully or partially dependent on agriculture or agriculture related activities. According to the social survey, the total affected residential land area is about 9acres. This mainly includes highland crops, coconuts, banana and fruits. In addition to this, there are small stretches of paddy lands. Although a substantial extent of lands are governments lands given to families for land development under permits, they have lived in these lands for more than 20 years and thereby claim full ownership. In parallel to this EIA a detailed socio-economic survey is being undertaken to finalize the resettlement plan. Therefore, based on the final trace the number of affected persons may differ to that presented in this EIA and the more accurate information will be found in the resettlement plan prepared for the project.

Table 4.2 Affected extent of Residential lands

Type of deeds	Total Land Area (Acres)	Affected Land area (acres)
Outright	3.25	1.63
Swarnaboomi	6.25	3.40
Jayaboomi	2.00	0.25
LDO	7.50	2.65
Annual Permit	3.25	1.81
Encroached	-	-
	22.25	9.74

Social Baseline Survey -2014, MCB Consultants

438 **Impacts on property values:** Sixteen (16) families will be fully or partially affected and 1 family will be isolated. Two (2) will be fully affected by the project and seem to show a certain reluctance to leave their properties. But most of the families have expressed their agreement to leave if they receive a suitable compensation package including land for resettlement.

Table 4.3: Nature of Damage to the property

GND	Residence Houses			Residence Land	
	Fully	Partially	Isolate	Fully	Partially
Elahera	1				1
Damanayaya	12		1	2	11
Kottapitiya	3				3
Total	16		1	2	15

Social Baseline Survey -2014, MCB Consultants

439 Considering about the lands, Two (2) families will lose their entire land and 15 families lose a significant portion of their land. Sixteen (16) houses will be fully affected and one (1) house will be isolated. Out of 17 buildings 13 are permanent, 2 are semi-permanent and 2 are temporary. The total population of the families who will lose their residence is 58. Most of them live in the Damanayaya GN division and the second highest is in Kottapitiya GND.

4.3.2. Other Social Impacts

440 In addition to the above stated major issues, the following were highlighted:

- The most common complaint from the populace seems to be the loss of connection with relatives, friends and neighbors that they enjoyed prior to relocation.
- A relatively few number of people also stated that loss of access to religious places was a significant issue.
- Regarding the availability of infrastructure, people are of the opinion that they may stand to face a disadvantage when roads and provision of electricity is concerned. When asked about preferences in relocation and resettlement, there seems to be no consensus among the community, although a significant percentage opted to be resettled with the lands and financial compensation which is sufficient to cover any losses they might incur.
- When the place of relocation is considered, on the other hand, a slight pattern is discernible; the preference seems to be towards relocation *as near as possible* to their previous area of residence.

Table 4.4 Social safeguard issues and other risks

Issue	Nature of Social Issue	Impact
Involuntary Resettlement	The structures that will be affected by the project include residential, commercial and other buildings. Those engaged in commercial livelihoods such as vendors within the project area will also be affected. These people too will need relocate to suitable places.	Around 25 houses will be fully affected by the project. This is a significant impact.
Other Property	The lands affected by the project include agricultural lands with permanent and seasonal crops. The farmers/owners of these lands will need assistance to carry out their livelihood activities	About 9 acres of residential land owned by 26 families will be acquired by the project. Further 4.3 acres of paddy lands will be acquired. This is a significant impact.
Indigenous Peoples	There are no indigenous people in the project area.	No impact
Cultural Property	None	None

Labor **Employment Opportunities**	Opportunity for employment for people of the project area is a beneficial impact	A beneficial and significant impact
Labor Retrenchment	Labor is used only during the construction phase and will be implemented in compliance with applicable labor laws. When hiring laborers for project work preference should be given to the people living in the project area.	Efforts shall be made to ensure that all civil works contractors comply with all applicable labor laws and regulations of Sri Lanka and in particular (a) to not employ child labor, and (b) to provide appropriate facilities for children of workers at construction sites as well as providing equal pay of men and women for work of equal values and (c) to put into practice measures to ensure health and safety of workers, including appropriate sanitation facilities for women. A beneficial and significant impact
Impacts to Livelihood	Only the relocation of 3 families whose livelihood is farmers or agricultural labors is needed. 31 families will lose a small part of their home land (which will be inundated to the project) and lose their earnings from that land.	Need to be resettled in the same area without disturbance to their livelihood. This is a significant impact. Need to compensated
Social impacts due to	Local communities will experience difficulties when	These impacts are of limited

construction activities **Impacts on community health and safety**	using existing major roads as well as by-roads connecting to construction sites. Creation of high levels of dust by 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 Environment pollution especially of water sources, due to 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 lead to stagnant water collection. Risk of accidents, release of toxic gases and spillage of toxic chemicals that can affect nearby communities Bad influence on local youths from migrant labors like drug additions, alcoholism etc.	significance Need to take proper safeguards measures to prevent, and reduce and mitigate all adverse impacts on community health and safety issues that may arise due to the project. A baseline health status survey of the affected communities and in the project impact area would be very useful in monitoring changes in health status during the operation and maintenance phase
Other Risks and/or Vulnerabilities Others (conflict, Social	Interruption to the education of the children in resettled families and burden on the existing education facilities (schools) in the proposed resettlement areas Disturbances to the social relations	Need to provide education facilities without disturbance to children's education. This is not a significant impact. Take all possible steps to protect their relationships by identification

	ships due to resettlement	of resettlement locations such that resettlement as a group is possible.
Sexually transmitted diseases and HIV/AIDS	No record of HIV/AIDs is found in the subproject area (Department of Health).	Sexually transmitted diseases and HIV/AIDs as a result of the influx of migrant laborers/construction workers are rather low as priority will be given to local hiring of labor. This problem arising within the project period is possible despite the still strong traditional social values in the affected villages, which will counter this threat. This is because a proportion of skilled laborers, workers of other categories and persons associated with provision of other services will come from outside of the project area. Therefore, as preventive measure appropriate and timely information and awareness of construction workers and the communities on the risks of sexually transmitted diseases and HIV/AIDS is important. Measures of anti-trafficking of women and children should be made part of the health and safety program implemented at construction campsites.
Others (conflict, political instability, etc.), please specify	None.	None.

4.4 Ecological Impacts

4.4.1 Impacts on protected areas

441 The proposed Upper Elahera canal traverses mainly (68%) through four protected areas and the rest through human modified areas. The protected areas are Minneriya-Giritale Nature Reserve, Elahera-Giritale Sanctuary (all two under the jurisdiction of the Department of Wildlife) and Hurulu Forest reserve (part of which forms the Hurulu Man and Biosphere Reserve).The UEC runs as a tunnel along the border of Minneriya NP and has no impact on surface fauna and flora as the tunnel section will be dug using the TBM.

442 Out of the two wildlife reserves the UEC will have a moderate impact on Minneriya-Giritale Nature Reserve. The only wildlife reserve that will be significantly impacted by habitat loss and fragmentation and degradation is the Elahera-Giritale Sanctuary,where 40% of the canal trace will be located. The estimated loss of habitat is around 87 ha, which is approximately 1.0 % of the total extent of the sanctuary.

443 Canal sections traversing the different protected areas will be constructed using different methods. The canal will pass as an underground tunnel in parts of the Elehera-Giritale Sanctuary, and Minneriya-Giritale Nature Reserve and Hurulu Forest reserve (part of the Hurulu Man and Biosphere Reserve). Therefore, this will not result in above ground loss of habitat or habitat fragmentation in those sections of the canal. Tunnels constructed using the TBM create less impacts than sections created using blasting. The anchoring yard for the TBM which is expected to be around 2 ha in area, is located outside of MNP and HFR, and removal and disposal of tunnel muck will also not be within these two protected areas. The present land use of these areas for anchoring and retrieval is timber-extracted plantation which requires rehabilitation.

444 In the forest plantation the canal will pass through as a double conduit and therefore, will have a minimum negative impact. Therefore, the overall impact of the canal on forest reserves is not significant

445 The canal mostly traverses the Elehara-Giritale Sanctuary as an open canal, buried canal (cut and cover) and as an aqueduct and a double conduit section, and three levels crossings (already existing tanks) within this sanctuary. Inside the Minneriya National Park, section of the canal will pass as a tunnel. Construction work in the sanctuary and the MNP (buried canal) will create loss, fragmentation and degradation of habitats from canal itself, creation of access roads and also adverse impacts on air, water and soil quality, and high levels of disturbance through noise, vibration and release of exhaust fumes, particulate matter, and sometimes hazardous materials.

446 For all protected areas traversed by the UEC, whether national park, forest reserve, sanctuary, nature reserve, plantation forest, increased access by humans and vehicles during the construction, and operation and maintenance phases can lead to low to high adverse impacts-increased disturbance to wildlife especially elephants, other large mammals, birds, illegal removal of non-timber forest products and introduction of alien invasive species.

447 In all protected areas special attention should be paid when removing vegetation, operating machinery, transport of materials and disposal of excavated material and creation of access roads.

4.4.2 Fauna

448 The main habitat types observed along the canal trace include undisturbed and degraded dry-mixed evergreen forest, scrublands, riverine forests, vegetation associated with rock outcrops, grasslands, home gardens, paddy lands, abandoned chena, other agricultural lands and teak plantations. Each of these habitats supports rich faunal and floral assemblages, especially the protected areas. The main negative impacts that will arise include loss of habitat as well as blockage of movement paths for animals, especially large charismatic species such as Asian Elephant and other ground dwelling species that cannot cross the canal.

449 Most of these impacts can be mitigated with proper design and following environmental best practices described in chapter 5

450 Based on the field investigations carried out to date the major adverse impacts on fauna identified are as follows

451 **Impact on terrestrial fauna and flora due to loss, fragmentation and change of habitats**: The canal section will act as a temporary physical barrier for wildlife during the construction phase for tunnels and buried canals. Within the Elehara-Giritale Sanctuary, the terrestrial species that are utilizing the area of the canal trace area will lose part of their habitat. Further, the section of the canal that will be constructed as an open canal will result in fragmentation of habitats, especially of those animals that have low mobility. An animal movement in the area is likely to be blocked due to the establishment of the open sections of the canal, which is a negative impact of the project. Further, since the open canal is lined with concrete, animals can fall into the canal that will result in either death or injury to these animals.

452 **Impact on wildlife migration**: No specific animal corridors were observed during the survey period. However, forest and the disturbed forests are frequented by large charismatic animals such as elephants and other mega fauna such as Leopard, Sambur and Spotted Deer. Their movements are likely to be affected due to the establishment of the open canals. Therefore

the proposed development will result in loss of habitat and hamper their movements to some degree. The area that will be impacted is also utilized by several species of forest dwelling migratory birds, especially the riverine forests and other forest habitats. Therefore, the project will result in loss of habitat for these migrant birds as well. None of the migrant birds observed in the project area are restricted to this area. Further, all the migrant species observed show a wide distribution in Sri Lanka. As such the loss of habitat for these species will not be a significant impact.

453 **Ecological impact in the downstream due to low flows**: The UEC will be built to channel water from Moragahakanda and Kaluganga reservoirs to the northern region of Sri Lanka. Construction of the canal will not directly result in any low flows as it is not direct diversion of a river. However, the construction of the two large reservoirs Morgahakanda and Kalu Ganga will result in low flows in the Ambanganga and Kalu ganga which has been separately dealt with in the combined environmental management plan developed for these two projects.

454 The main impacts from the Moragahakanda and Kaluganga projects (considered as associated facilities to this project) are given in AnnexX together with the environment management plans developed for them. Those EMPs are being implemented.

455 **Introduction of invasive species due to the project**: At present only a few invasive alien species occur in the project area. However, during the construction stage earth moving machinery as well as construction material such as soil and gravel that are brought into the site can introduce seeds of invasive alien species into the area. Further, the areas cleared of vegetation to extract borrow material as well as construction material storage areas are also potential sites for establishment of alien invasive species. Therefore, during the construction stage there is a strong possibility of introduction and establishment of invasive plant species into the project area which can subsequently spread into surrounding areas. As much of the work takes place in protected areas, special attention needs to be taken to prevent the introduction of alien invasive species.

456 **Impacts on rare and endemic species**: Only a few endemic and threatened species were identified in the study area during the survey. This includes seventeen species of endemic animals(7% of all the recorded faunal species) and ten species of endemic plants (7% of all the recorded plant species). Further eight species of nationally threatened animals (3% of all the recorded faunal species) and four species of nationally threatened plants (2% of all the recorded plant species) were observed in the project area. This is the normal pattern observed in the Dry Zone habitats which are rich in terms of species diversity but poor in terms of endemic or

threatened species compared to Wet Zone forests. None of the threatened or endemic species are restricted to the project area. Further, less than 5% of their populations will be affected due to the proposed project activities and therefore, the proposed project will not have a significant impact on threatened or endemic species present in the project area.

457 **Impact on biological diversity of the area**: The project area comes within the Low Country Dry Zone of Sri Lanka. Compared to the wet zone of Sri Lanka, the dry zone habitats do not support critical elements of Sri Lanka's biodiversity such as endemic and threatened species with restricted ranges as was observed during the field study. Yet the dry zone habitats are rich repositories of indigenous flora and fauna, especially charismatic large mega fauna such as Elephants, Leopards, Sambur etc., The natural habitats present in the area function as rich biodiversity repositories, especially the terrestrial habitats dry-mixed evergreen forests, disturbed dry-mixed evergreen forests and scrubland. Approximately 160 ha of out of these will be lost permanently due to the proposed project which will have an irreversible impact on the biodiversity inhabiting these habitats. However, the extent of the habitat affected is relatively small area compared to the total extent of these habitats that are present in Sri Lanka. Therefore, the overall impact is not significant considering the extent and magnitude of the impact.

458 **Other impacts that will arise due to the proposed project :** Impacts due to labour force for construction activities will lead to establishment of campsites, generation of sewage, waste water and solid waste. Further, they may engage in activities that are detrimental to natural habitats such as hunting, and illegal extraction of timber and non timber forest products.

459 Noise and vibrations that will arise due to activities such as excavation, cutting, drilling and filling and compaction work, as well as operation of construction related vehicles during the construction phase will cause disturbance especially to the fauna that inhabits the project area.

460 Clearance of plant cover during the construction phase will lead to increased soil erosion, which in turn will result in increased sedimentation of natural waterways in the cleared areas. Further, access road creation, land preparation will result in blockage or alteration of natural flow paths in the area resulting changes in the drainage patterns in the area.

461 **Impacts from the KMTC on fauna:** This component of the project lies within the land use category known as unclassified forest, and consists of a short open canal, two tunnel lengths within steep hill slopes connected by an aqueduct across Lel Oya, a natural stream running in the forests of the two tunnel lengths, continued with drilling and blasting. The drilling and blasting method will create the adverse impacts associated with this method of construction and given in previous sections of this chapter. See also Table 4.1.

462 Given its flow path along relatively undisturbed hillsides, Lel Oya is likely to harbor important assemblages of aquatic vertebrates and invertebrates.The aqueduct goes above the stream at a higher level than the water level of Lel Oya.The aquatic species diversity and water quality studies have not been done. The impacts on this stream due to construction of an aqueduct across it will be highly significant during the construction stage by operation of machinery, transport of materials and humans to the site and increased access to forests. Damage to banks, stream bed can result from construction, increase of turbidity, sedimentation and other forms of water pollution will damage the freshwater and riparian communities of natural streams such as Lel Oya. Monitoring of these aquatic habitats is included.

463 Removal of vegetation, creation of inlet and outlet portals, and access roads along steep hill sides will cause significant loss, fragmentation and degradation of natural habitats, increased soil erosion, increased risk of slope failure. Distance from the tunnel portal to the nearest disposal site is 1.7 km, comprising of an access roads.

464 A main risk of construction activities is increased access to forested areas by humans during construction. This is less so during the operation and maintenance phase. However, opening up of formerly relatively undisturbed areas to humans leads to increased poaching, clearance of forest patches, setting fires, removal of timber, non-timber forest products such as medicinal plants, ornamental plants, stones, sand and gravel from stream beds, and introduction of alien invasive species etc. Freshwater fish, and amphibians, are often targets of collectors of animals, while nests of birds and sometimes birds, reptiles among other animal groups are collected.

465 Special attention should be given to increased access by humans and vehicles to the KMTC area during the construction phase, as the KMTC traverses an area with higher biodiversity values than in most parts of the UEC canal that starts from the Moragahakanda reservoir. Two of the three proposed disposal sites for excavated material of the KMTC (Table 2.10 B) also need to be rehabilitated after the end of the construction phase.

466 Generally, increased soil erosion, increased turbidity and other forms of water pollution, blocking of water flows and loss and degradation (even if limited to specific locations) of its in-stream and riparian plant and animal assemblages are the most likely impacts. Operation and maintenance phase of the KMTC is anticipated to have only low negative impacts on stream flows and its riparian biodiversity, if properly enforced mitigation measures are placed.

467 **Increased human elephant conflict in the UEC and KMTC project areas:** The area around Elehera-Giritale sanctuary where much of the open canals will be located is also frequented by elephants and the establishment of the canal can change their movement patterns that may intensify the human-elephant conflicts that exist in this area at present. A detailed

technical investigation on the Human-Elephant Conflict is to be commenced soon, by the project proponent in the near future. This report is expected to be completed before the commencement of constructions on this project.

468 The UEC or KMTC tunnel by themselves will not contribute to HEC as the habitat loss due to these activities are negligible with respect to elephants. However, HEC will result due to indirect impact of change in cropping intensity in the areas that will receive irrigation water from the two canals which will result in major loss of dry season feeding grounds for elephants which may lead to escalation of the present level of conflict. However, to quantify this impact is beyond the scope of this EIA as it will require detailed data collection in the identified command area(s) of the UEC.

469 Therefore, the Ministry of Irrigation has already commissioned a detailed study on the Human-elephant conflict dimension not only for UEC project but for all of the projects that will be implemented by Irrigation Department in North-central and Northern Province. The project will be initiated by IUCN and this will provide a quantitative estimate of the nature of changes expected in the Human-elephant conflict as well as potential solutions on location specific manner. (See Annex VIII)

4.4.3. Ecological Impacts on Flora

470 **Habitats/ Flora:** The main activity in the canal construction stage will be the clearing of vegetation and excavation of ground along the entire canal path, except in tunnel sections, to a width of about 30 and 50m in cut and cover areas and in open canal sections, respectively. Heavy earth moving equipment such as bulldozers will have to be mobilized for the task of uprooting trees, clearing of vegetation and excavation of the canal. Due to the removal of trees and excavation up to several meters in depth a complete habitat loss will take place along the canal path except where the canal passes through tunnels. During the canal construction, canal bund (canal maintenance road) will be erected by laying part of the excavated soil cover. Then soil erosion will take place from the side slopes of the soil filled canal bund structure. In addition, during heavy rains there is a possibility of minor collapsing within these soil filled canal bund structure. With rain water, soil materials are get eroded and the eroded soil materials are transported along the minor streams and these stream paths finally connect to larger streams such as Heeratioya. This might result in heavy siltation related issues in streams in the project area and that will affect natural aquatic habitats.

471 The UEC traverses through protected areas and the main impacts are habitat loss, fragmentation and degradation of existing undisturbed habitats. The habitats found in tunnel sections of the canal will not be disturbed due to the construction activities. Natural habitats in the right of way of the open and cut and cover sections of the canal, 30-50 m width, will be lost and the surrounding habitats would be degraded due to the excavation and other activities related

to the construction of canal and preparation of access roads. Altogether approximately 160 ha, including undisturbed and degraded forest habitats, scrublands, will be lost along the canal.

472 Natural habitats such as dry-mixed evergreen forests, scrublands, riverine forests, and marshes support rich floral assemblages that are different to the plant communities found in the man-made habitats. The species richness in these habitats is comparatively high and furthers the species composition also different from the man-made habitats.
The main impacts anticipated due to the project on these natural habitats are habitat degradation, fragmentation and loss of habitat.

473 Some sections of the proposed canal, passes through human modified habitats such as home gardens, paddy fields, agricultural and abandoned lands. The species assemblage observed in these habitats was dominated by common species which are generally found in such man made habitats. These species show a high degree of adaptability to changes and therefore will not be affected a great degree by the proposed project.

474 Only a few endemic and threatened species were identified in the habitats along the canal during the survey. This includes 10 endemic and 04 endangered plant species recorded in the project area. The recorded endemic and threatened plant species are found outside the habitats of proposed canal. Therefore the UEC will not have a significant negative impact on these species.

475 **Number and Type of Trees over 30 cm dbh that will be removed due to the Project:** A number of tree species which are having the Diameter at Breast Height (DBH) more than 30 cm have been recorded in 5 x 100 m plots along the transects to get an estimate of the number of trees per ha to be removed in the forested areas due to the construction of the canal. The tree species found in the canal chainage 27.4 to 28.6 km (0205230, 0300907) and 11.5 km at Damanayaya were sampled.

476 The undisturbed dry-mixed evergreen forest in the canal section consist of tree species such as Ebony, Wira, Mora, Wewarana, Milla, Welan, Kon, Madan, Dunumadala, Halmilla, Maila, Thimbiri, Ehela, Daminiya, Kumbuk, Burutha, Palu and Helamba. The survey showed that the forest stretch in this area having about 150 trees/ ha, of >30 cm dbh.

477 The secondary forest in the Damanayaya area (0203212, 0286480) is having less number of trees (90-100) compared to the forest in the canal chainage 27.4 to 28.6 km. However, at present it is difficult to estimate the total number of trees to be removed due to the project activities. Also the number of trees has to be removed in borrow areas, disposal sites and other areas with temporary structures and access roads to be estimated during the detail design phase. This has to be carried out once the total width of the canal is marked on the ground before the construction activities are commenced. It is estimated that about 86 ha of forest, both undisturbed and degraded, are found along the UEC canal.

4.4.4 Evaluation of the Habitats present in the project area in relation to ADB safeguard policy

478 The following was carried out in order to meet the ADB Safeguards Policy Statement 2009. It was necessary first to identify whether the project affected area qualifies as a critical habitat. Therefore, it is pertinent that the project site is analyzed against the criteria that are presented in the SPS 2009 that defines a critical habitat.

479 **An area with high biodiversity value:** An area with high biodiversity value is defined based on a broad set of attributes such as relative size of the area, condition of the area, whether it is a habitat for threatened, endemic or restricted range species or whether it provides crucial connectivity across the landscape. The project impacted area is approximately 160 ha in extent, which is too small to be considered as an ecologically significant landscape. Further, many of the natural habitats in the project area are highly influenced by human activities at present or in the recent past and therefore are not in a pristine condition.

480 These habitat support a much smaller proportion of threatened and endemic species (refer table 3.15 and 3.16) compared to some of the high biodiversity habitats in the wet zone of the country such as Peak Wilderness Nature Reserve or Knuckles Conservation Forest. Further, the site does not function as a critical habitat for any of the threatened or endemic species that inhabits the project affected area. Further, none of the species recorded in the project affected area are restricted to the area nor does it function as a habitat that support restricted range species. Finally, the project affected area does not function as a crucial corridor connecting important habitats or landscapes.

481 Therefore, even though the site selected for the project supports a diverse species assemblage it cannot be considered as an area of high biodiversity value.

482 **Habitat required for the survival of critically endangered or endangered species:** The species assemblage recorded in the site selected for the proposed project did not include any critically endangered species. One Nationally Endangered species and four Globally Endangered species were recorded at the study area. However, none of these species are restricted to the study area and less than 5% of their population will be impacted by the proposed project activities (please refer to section 3.26, paragraphs 335-341 for a detailed evaluation of te impact of on speciels listed as nationally or globaly endangered). Therefore, the survival of these species is unlikely to be severely compromised by the project. Further, the extent of habitat lost due to the project is estimated to be around 160 ha which will not have a significant impact other than on less mobile species.

483 **An area having special significance for endemic or restricted-range species**: Altogether 27 species of endemic plants and animals were recorded in the project affected area. However, none of these species are listed as restricted range species. Therefore, this condition does not apply for the project affected area.

484 **A site that is critical for the survival of migratory species:** Altogether sixteen species of migratory birds were recorded in the project affected area. All these species are commonly found in forest habitats of Sri Lanka. Therefore, the project area does not function as a critical habitat for the survival of migratory species.

485 **An area supporting globally significant concentrations or numbers of individuals of congregatory species:** The project affected area does not function as a habitat that supports congregatory species. Therefore, this criterion does not apply.

486 **An area with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services:** The area does not support any unique species assemblages or provide key evolutionary or ecosystem services. Thus this condition does not apply.

487 **An area having biodiversity of significant social, economic, or cultural importance to local communities:** Even though the local communities depend on the biological resources such as obtaining fuel wood, food, medicine in their day to day life at a subsistence level, the biodiversity in the area does not play a significant social, economic or cultural role.

488 **An area either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites**

489 The project area does not contain any Ramsar sites or World Heritage sites. However, approximately 68% of the project activities take place in already declared protected areas managed by the Department of Wildlife Conservation or Forest Department. Therefore this condition does apply for this project.But as indicated in Table 3.9 in three out of the four protected areas the canal will be passing as a tunnel and therefore will have minimal impact on the surface dwelling species while in other two protected area the area impacted is less than 2% of the declared area and therefore will not have a significant impact on the ecological processes of the protected area.

4.5Anticipated impacts of proposed project on the identified archaeological remains and remains of archaeological nature

490 Recommendations of the report provided by the independent archaeological impact assessment are given as Annex XI. Its findings give priority for avoidance, minimizing and mitigation of all types of impacts on sites of archaeological importance and will form the main document identification of impacts and mitigation measures for the sites of archaeological importance. A separate assessment of sites of historical and archaeological importance likely to be impacted by the UEC was conducted in 2013. Its findings are summarized below.

491 All archaeological remains and remains of archaeological nature which were identified with in the project area during the survey was plotted in the maps provided by the project authorities in order to identify their position with respect to identified areas of proposed project activities. A list of sites with anticipated impacts on them are described below.

a) Shyila Gangaramaya Temple

492 An ancient temple with different cut marks in a rock surface was identified within a distance of about 1500 meters from the right side of the Canal near Elahera Junction. GPS Points of the site is 07^0N 44' 3.259" and 80^0E 47' 17.590". Accordingly **no impact** will be caused due to the construction of the canal.

b) WelanKatuwa Ancient Tank

493 Damaged Welankatuwa Ancient Tank about 200 meters from the right side of the Canal was identified. The tank is now destroyed and not being used. GPS Points of the site is 07^0N 43' 52.322" and 80^0E 46' 27.460". Accordingly **no impact** will be caused due to the construction of the canal.

c) Athikampitiya Ruins near Wadi Ela

494 Ruined Structure with lime stones was identified about 245 meters from the left side of the Canal. Stone pillars and stone blocks used for wall were identified within the area. GPS Points of the site is 07^0N 43' 45.713" and 80^0E 46' 13.491". Although **no direct impact** will be caused due to the construction of the canal but **there will be an indirect impact** during the construction stage due to the movement of heavy vehicles.

d) Thanthiriglala Ruins

495 An area with stone blocks belongs to a ruined structure was identified in an area within a distance of about 1400 meters from the left side of the Canal. GPS Points of the site is 07^0N 45’ 18.363” and 80^0E 46' 16.722". Accordingly **no impact** will be caused due to the construction of the canal.

e) Orumendi Siymalawa

496 Ancient mound belonging to an ancient stupa was identified near the EleheraMinneriya Yoda Ela by the side of the road was identified about 615 meters from the right side of the Canal. GPS Points of the site is 07^0N 45' 42.449" and 80^0E 48' 16.573". Accordingly **no impact** will be caused due to the construction of the canal.

f) Puwakgha Ulpatha

497 An ancient spring named PuwakgahaUlpatha was identified within a distance of about 800 meters from the left side of the Canal. GPS Points of the site is 07^0N 49' 23.682" and 80^0E 49' 9.344". Accordingly **no impact** will be caused due to the construction of the canal.

g) Damanayaya Walsge

498 A cave with ancient bricks named as DamayayaWalsge was identified with in a distance of about 300 m from the left side of the Canal. GPS Points of the site is 07^0N 46' 58.920" and 80^0E 48' 0.194". Accordingly **no impact** will be caused due to the construction of the canal as it is situated in a considerable higher elevation of the canal.

h) Ruins at Dambulukete – No. 1

499 Ancient structure which has been excavated by treasure hunters was identified within Dambulukele within a distance of 100 meters from the right side of the Canal. GPS Points of the site is 07^0N 50' 33.015" and 80^0E 50' 5.371". Although **no direct impact** will be caused due to the construction of the canal but **there will be an indirect impact** during the construction stage due to the movement of heavy vehicles.

i) Ruins at Dambulukete – No. 2

500 Ancient structure which has been excavated by treasure hunters was identified within Dambulukele within a distance of 12 meters from the right side of the Canal. Stone pillers and tiles were identified within the area. GPS Points of the site is 07^0N 51' 7.425" and 80^0E 50' 5.442". Accordingly **a direct impact** will be caused due to the construction of the canal.

j) Ruins at Dambulukele – No. 3

501 Ancient structure with stone retaining walls was identified within Dambulukele on the Canal Path. GPS Points of the site is 07^0N 51' 6.546" and 80^0E 50' 4.756".Accordingly a direct impact will be caused due to the construction of the canal.

k) Archaeological Ruins at Pekkulama

502 Ancient structure with stone blocks, stone pillars, tiles and potsherds was identified within a distance of about 250 meters from the right side of the Canal. This is belongs to an ancient settlement. GPS Points of the site is 07^0N 55' 26.724"and 80^0E 49' 24.927". Although no direct impact will be caused due to the construction of the canal but there will be an indirect impact during the construction stage due to the movement of heavy vehicles.

l) Rock Out Crop with Cut Marks

503 Rock out crop with cut marks was identified within a distance of 400 meters from the left side of the canal. It is situated in the Central Province, Matale District, Dambualla Divisional Secretariat Division, Polwatta GS Division at GPS Point 07^0N 55' 50.361" and 80^0E 48' 53.747".Accordingly no impact will be caused due to the construction of the canal.

m) Ancient Tank Bund of the Beegahawela Ancient Tank

504 Ruined ancient tank bund of the Beegahawela Ancient Tank was identified within a distance of about 236 meters from the right side of the Canal. GPS Points of the site is 07^0N 55' 31.932" and 80^0E 49' 24.014".Although no direct impact will be caused due to the construction of the canal but there will be an indirect impact during the construction stage due to the movement of heavy vehicles.

n) Archaeological Ruins near Beegahawela Ancient Tank by the side of RuppeEla

505 Ancient structure which has been excavated by treasure hunters was identified within a distance of about 453 meters from the right side of the Canal. Stone pillars and stone retaining walls could be identified with in the area. GPS Points of the site is 07^0N 55' 50.361" and 80^0E 48' 53.747". Accordingly **no impact** will be caused due to the construction of the canal.

o) Gallinda Ancient Mahasen Devalaya

506 GallindaAncientMahasenDevalaya is situated within a distance of about 769 meters from the left side of the Canal. GPS Points of the site is 07^0N 41.338" and 80^0E 47' 34.871".Accordingly no impact will be caused due to the construction of the canal.

p) Gallinda

507 Ancient Gallinda is situated within a distance of about 762 meters from the left side of the Canal. GPS Points of the site is 07^0N 59' 35.088"and 80^0E 47' 36.340".Accordingly no impact will be caused due to the construction of the canal.

508 The sites that will be directly impacts need to be addressed with possible UEC canal route changes to avoid them. Those with indirect impacts need to be protected from project activities to avoid damage and possible loss of parts in consultation with the Department of Archaeology, the project proponent and other experts.

4.6 Cumulative Impacts

509 This section describes two types of impacts. First the cumulative impacts of UEC and other developments in the project area. Secondly a strategic level assessment of impacts of the entire Water Resources Development Investment program which looks at cumulative impacts of the UEC project, North Western Province Canal Project and Raising of Minipe Anicut and rehabilitation of Minipe Left Bank Canal and its associated facilities.

4.6.1 Impacts of UEC with respect to other developments in the project area -

1. Hydrology and water sharing

510 As the UEC is not designed to intercept any stream flows interactions and cumulative impacts with on-going irrigation related projects is expected to be minimal. Environmental flows of streams and other waterways in the project are not anticipated to be adversely affected.

2. Soil erosion and slope stability

511 These impacts can result from a multitude of small, medium and large development activities as well as actions of individuals of the area. Even though project activities causing increased soil erosion and possible slope failure will be mitigated, there are possibilities of these occurring due to actions beyond the project. Locations with higher risk of slope failure and soil erosion need to be monitored adequately during the operation and maintenance phase. Construction of canals along steep slopes, and the weight of water to be conveyed can cause instability of slopes. Soil erosion is also high in steep slopes where vegetation is removed. By adopting a tunnel-based design for KMTC, this risk has been substantially avoided.

3. Water quality

512 As the UEC is not designed to provide water supplies along its route except for the three level crossing tanks until it reaches Huruluwewa, and as other water sources will not contribute to it along the way, no significant cumulative impacts on quality of water conveyed within the UEC or water bodies along it are anticipated. Beyond Huruluwewa, the UEC feeds minor tank cascade systems along the Manankattiya-Mahakanadarawa route and in the Yan Oya anicut system. There may be changes to water quality in this section of the UEC, which are assumed to be positive. It should be monitored during the operation and maintenance phase.

513 One long term impact of the increased agricultural productivity (from irrigated agriculture) due to this project would be greater use of pesticides and fertilizers in areas benefitting from enhanced supply of water. This greater use usually results in agricultural run-off causing nutrient loading and contamination of downstream waterways, including tanks, streams, oya and rivers by agrochemicals and including rodenticides. This results in travel of agrochemicals and their derivatives along food chains. In a country and a local area where misuse and overuse of pesticides and fertilizers is causing much concern, and where the incidence of Chronic Kidney Disease of Unknown etiology is significantly high, and is being at least partly attributed to contamination of drinking water sources by agrochemicals, this serious and longer term impact should be addressed in effectively. The project will contribute by way of better management of irrigation water supply and contribution to improved agronomic practices of the Department of Agronomy. Long term monitoring of water quality parameters as set out in the EMP is essential to assess changes in salinity, physio-chemical water quality parameters and to assess impacts of possible increase of use of fertilizers and other agrochemicals.

4. Impacts on forest cover, degree of fragmentation and degradation

514 The Elehera-Giritale Sanctuary, and the Minneriya-Giritale Nature Reserve contains many degraded forest patches and is subject to illegal entry as well as collection of forest produce. Minneriya NP and Hurulu Forest Reserve are better protected due to their higher conservation status. However, as there is loss, fragmentation and degradation of habitats from the UEC in some protected areas and as there are other planned development projects in the same region, unless offset by reforestation at a suitable scale to offset the losses from this project and other developments, net loss of forest cover will be the result.

5. Impacts on living standards and the general economy of the project area

515 The benefited are of the UEC are the irrigation systems under Manankattiya-Mahakanadarawa water supply route and Huruluwewa and Yan Oya system. General economy of the area will be improved mainly through the better incomes to the farmers. Increased cropping intensity and yields will bring about a production increase. Cultivation of other crops will further increase the income of the farmers. Such increases will influence the growth of markets, use of machinery and associated service facilities, growth of agricultural inputs trade, growth of town centers and improved transport and communication facilities. This will lead to better living standards including the provision of safe drinking water and sanitation.

6. Impacts of associated facilities

516 The impacts of two associated facilities of the UEC, the Kaluganga and Moraghakanda reservoirs are identified in their respective EIA documents. Further their combined Environment Management Plan with measures to mitigate, and monitor a range of actions to counter environmental impacts due to both these large scale developments, is currently being implemented. The impacts of the KMTC outlet on the area surrounding Moragahakanda reservoir are partly addressed under that plan.

517 However, it is necessary to consider impacts on forest cover, degradation of habitats, biodiversity including species diversity of plants and animals, ecosystem services, corridors for movements of animals, providing refuges for threatened plants and animals in an integrated manner. Recommendations of the biodiversity and ecological assessment of Kaluganga Reservoir and Agriculture Extension Project (to fulfill conditions set by the Central Environmental Authority) was to identify and declare the new Moragahakanda-Kaluganga Wildlife Reserve and also elephant corridors (two) to connect the Knuckles Region with the Elehara-Giritale Nature Reserve and Wasgomuwa National Park creating a ring of corridors for wildlife movements, under the Department of Wildlife. Further agreements have been signed with the Forest Department and the Department of Wildlife Conservation to carry out habitat

enrichment, forest cover improvement, watershed conservation etc. Implementation of these recommendations would negate much of the cumulative negative impacts from the KREAP and MDDP and UEC. In addition to the EIAs, biodiversity assessments were carried out and are being implemented. The assessments are in line with ADB's environmental safeguard policy principles. IUCN has been commissioned to undertake routine monitoring.

4.6.2 Cumulative impacts of the Water Resources Development Investment Program

518 Based on the findings of a Strategic Environment Assessment[3] undertaken by the government for the Mahaweli development program, the cumulative impacts of two key areas: biodiversity and hydrology were assessed for the investment program's projects and the under-construction Kaluganga and Moragahakanda Reservoirs, which are associated facilities. Mahaweli systems directly impacted by WRDIP include system E (Minipe), System IH (Nachchaduwa), system MH (Huruluwewa) System I (Mahakanadarawa).. The project will involve three sub projects

1. **Upper-Elahera Canal Project** – this includes, Kaluganga-Moragahakanda link canal and Upper-Elahera canal. Kaluganga and Morgahakanda reservoirs currently under construction are considered as associated facilities to the UEC project.

2. **North-westernCanal Project** – This includes a canal from Lenadora to Kaduruwewa and establishment of two storage tanks, Maha Kithula and Maha Kirula

3. Raising the Minipe Anicut and rehabilitation of the Minipe LB canal

519 Each of the three sub projects of the proposed WRDIP will have an impact on one or more protected areas that have been established under the Fauna and flora Protection Ordinance or Forest Ordinance managed by the Department of Wildlife Conservation (DWC) or Forest Department (FD) as shown in Table 4.5.

Table 4.5. The protected areas that will be impacted by the WRDIP

Name of the Protected Area	Category	Extent (ha)		Year of Declaration
		Total	Affected	
North Western Canal Project				
Kahalla- Pallekele	S	21,690	342 (1.6%)	1989
Upper Elahera Canal Project				

[3] Ministry of Agriculture Development and Agrarian Services, *Dam Safety and Water Resources Planning Project: Strategic Environmental Assessment - Mahaweli Systems*, December 2012

Elahera-Giritale	S	14,035	190 (1.4%)	2000
Minneriya- Giritale	NR block III	4,745	0	1995
Minneriya	NP	8,889	15 (0.2)	1997
Hurulu	FR	25,000	0	1942
Upper Elahera Canal Project				
Victoria-Randenigala-Rantambe	S	42,089	25 (0.1%)	1987

S- sanctuary, NR- nature reserve, NP – national park, FR- forest reserve **Note**: The proposed project activities of Kalu Ganga, Moragaha Kanda and Kaluganga-Morgahakanda Tunnel will not take place inside any declared protected areas.

Data Sources: MIWRM, 2014a; MIWRM, 2014b; MIWRM, 2014c; NRM, 2008; TEAMS, 1998

520 **Description of protected areas according to the IUCN categorization (Dudley, 2008)**

1. **National Park (NP)**: A Category II protected area managed by DWC.
2. **Nature Reserves (NR):** ACategory IV protected area managed by DWC.
3. **Sanctuaries (S)**: ACategory VI protected area managed by DWC.
4. **Forest Reserve (FR):** ACategory IV protected area managed by FD.

521 The environment assessment reports of each of these sub projects have presented an analysis of the impact of the sub project on biodiversity and protected areas. The direct impact area of the WRDIP includes several protected areas. Further, Mahaweli river basin is the largest river basin in Sri Lanka with unique biogeographical attributes (there are several threatened endemic species that are restricted to Mahaweli River Basin). Therefore, the cumulative impact of the three proposed subprojects and their associated facilities on protected areas and critical species in the project affected areas was assessed. This report presents the findings of the cumulative impacts of the proposed WRDIP on the biodiversity in project impact area.

522 **Habitat Diversity:** Several natural habitat types were recorded in the project affected areas of WRDIP. These include tropical moist semi-evergreen forests, dry mixed evergreen forests, riverine forests and scrublands. A brief description of these habitat types are given below. Extents of these habitats that will be affected by each sub project is given in Table 4.6.

523 **Tropical Moist semi-Evergreen Forest**: These are closed canopy forest that generally consists of three layers, the canopy (20-25 m), sub canopy (5-10 m) and ground vegetation. The

dominant plant species present in these forests include *Berrya cordifolia* (Hal Milla), *Pterospermumsuberifolium* (Welan), *Vitex altissima* (Milla), *Lepisanthes tetraphylla* (Dambu), *Stereospermum colais* (Dunu madala), *Haldina cordifolia* (Kolon), *Mitragyna parvifolia* (Helamba), *Ventilagomadraspatana* (Yakada Wel), *Holoptelea integrifolia* (Goda Kirilla), *Cipadessabaccifera* (Hal Bebiya), *Trema orientalis* (Gadumba), *Schleichera oleosa* (Koon), *Morinda coreia* (Ahu), *Azadirachta indica* (Kohomba), *Ficus* sp. (Nuga), *Ficus microcarpa*, *Ficus hispida* (Kota Dimbula), *Hibiscus vitifolius* (Maha Epala), *Careyaarborea* (Kahata), *Peltophorum pterocarpum*, *Bauhiniaracemosa* (Maila), *Flueggea leucopyrus* (Heen Katu Pila), *Croton aromaticus* (Wel Keppetiya), *Bridelia retusa* (Ketakala), *Merremia umbellata* (Kiri Madu) and *Alstoniascholaris* (Ruk Attana)

524 **Dry-mixed Evergreen Forest**: These are typical dry zone climax forest formations where the canopy reaches between 20-30 m beneath the canopy layer, the sub canopy (15 m), a shrub layer (5 m) and a herbaceous plant layer (1 m) can be seen. The canopy consists of tree species such as *Manilkara* (Palu), *Drypetes* (Wira), *Chloroxylon* (Burutha), *Alseodaphne* (Wewarana), *Berrya* (Halmilla), *Diospyros* (Kaluwara), *Schleichera oleosa* (Kon), *Pterospermum canescens* (Welan), and *Vitex altissima* (Milla). The sub canopy of the forest is dominated by *Drypetes* (Wira) and other medium sized trees such as *Diospyros ovalifolia, D. ferrea, Feronia acidissima, Xylopia nigricans, Nothopegia beddomei, Pleiospermium alatum, Cassia fistula*, *Bauhinia racemosa* can also be seen in this layer. The shrub lyer comprise of species such as *Ochna lanceolata, Tarenna asiatica, Memecylon angustifolium, M. capitellatum, M. umbellatum, Mallotus resinosus, Croton laccifer,* and *Dimorphocalyx glabellus.*

525 **Riverine Forest:** These are narrow strips of tall forests found along the banks of streams and rivers. This habitat is dominated by water loving trees such as *Terminalia arjuna* (Kumbuk), *Madhuca longifolia* (Mi), *Pongamiapinnata* (Magul Karanda), *Ficusracemosa* (Attikka),and *Naucleaorientalis* (Bakmi).Other species such as *Polyalthia longifolia* (Owila)*, Diospyros malabaricum* (Timbiri)*, Mangifera zeylanica* (Etamba)*, Nothopegia beddome* (Bala)*, Garcinia spicata* (Ela gokatu)*, Diospyros ferrea, Diospyros montana, Diospyros ovalifolia* (Kunumella)*, Homonoia riparia, Cynometra zeylanica, Hydnocarpus venenata* (Makulu)*, Barringtonia acutangula,* and *Vitex leucoxylon,* are found in these forests. *Dimorphocalyx glabellus* (Weliwenna) is the common understorey species found in the riverine forests.

526 **Scrublands:** Scrub vegetation forms in places where chena (shifting cultivation) have been abandoned. Soon after a chena plot is left to fallow, various herbaceous pioneer species begin to appear followed by woody species in a series of succession leading to the appearance of a secondary forest. It is found in areas where the climax forest is degraded. The degraded areas

takes a long time to be converted back to closed-canopy forests through natural succession. The early seral stages of this natural succession are regarded as scrublands. These scrublands are comprise of a mixture of tree, herbaceous and shrub species such as *Azadirachta indica, Bauhinia racemosa, Carissa spinarum, Catunaregam spinosa, Dichrostachys cinerea, Flueggea leucopyrus, Gmelina asiatica, Grewia orientalis, Hugonia mystax, Ichnocarpus frutescens, Lantana camara, Limonia acidissima, Memecylon umbellatum, Phyllanthus polyphyllus, Scutia myrtina, Syzygium cumini, Toddalia asiatica* and *Ziziphus oenoplia*.

Table 4.6.The main naturalhabitats that will be affected by the WRDIP and its associated facilities

Type of Ecosystem	Extent (ha)		Name of the Sub Project
	Total	Affected	
Moist semi-evergreen forests	24,191,640	3,540 518	Moragahakanda* Kalu Ganga*
Dry mixed evergreen forests	108,108,440	149 300 1,804 4,990	UE Canal NWP canal Moragahakanda* Kaluganga*
Riverine forests	2,229,040	25 5 61	Minipe Raising Kaluganga Link tunnel Kaluganga*
Scrublands	45,957,560	56 50 108	UE Canal NWP canal Moragahakanda*

Abbreviations Used: **UE** - Upper Elahera, **NWP** - North-western Province *- Moragahakanda and Kaluganga reservoirs are currently under construction and will not be funded by the WRDIP
Data Sources: MIWRM, 2014a; MIWRM, 2014b; MIWRM, 2014c; NRM, 2008; TEAMS, 1998

527 Total amount of natural habitats that will be affected by the WRDIP and associated facilities is approximately 11,606 ha. Out of the total extent of natural habitat lost, the WRDIP projects will only contribute to about 5% (585 ha) while the remaining 95% of the habitat loss will result due to Moragahakanda and Kaluganga projects that include two large reservoirs and large scale resettlements. Compared to the total extent of the available habitat in Sri Lanka, the area affected by the WRDIP and associated facilities is estimated to be approximately 0.006%.

528 **Species Diversity:** The species diversity was found to be highest in the Moragahakanda and Kaluganga projects compared to other sub projects. This could be attributed to the fact that

the area impacted by these two projects is much greater than the other sub projects. A summary of the fauna and flora recorded in the project impacted area of each sub project is given in table 4.7.

Table 4.7 A summary of the fauna and flora recorded in each the project affected areas of each sub project of WRDIP and associated facilities.

Project Name	Total	Endemic	Exotic	Migrant	CR	EN	VU	NT
KGP - Flora	401	29	43	0	0 (1)	7 (0)	16 (6)	14 (0)
KGP - Fauna	327	51	1	16	5 (0)	5 (11)	17 (1)	19 (3)
MKP - Flora	456	29	71	0	0 (0)	7 (2)	13 (7)	11 (0)
MKP - Fauna	272	45	2	12	6 (1)	6 (11)	10 (1)	22 (8)
KMT - Flora	130	13	10	0	0 (0)	3 (0)	7 (4)	10 (0)
KMT - Fauna	136	9	0	7	0 (0)	1 (1)	2 (0)	2 (1)
UEC - Flora	174	10	10	0	0 (0)	2 (0)	2 (1)	1 (0)
UEC - Fauna	240	17	1	16	0 (0)	3 (4)	3 (4)	7 (4)
NWP - Flora	133	9	3	0	0 (0)	0 (1)	0 (0)	0 (0)
NWP - Fauna	181	15	1	9	0 (0)	5 (4)	2 (2)	6 (8)
MAR - Flora	240	17	62	0	0 (1)	3 (0)	14 (5)	16 (0)
MAR - Fauna	147	14	1	1	0 (0)	1 (4)	6 (0)	7 (5)

Abbreviations used: KGP – Kalu Ganga Project, **MKP** – Moragaha Kanda Project, **KMT** – Kaluganga-Moragahakanda Tunnel, **UEC** – Upper Elahera Canal, **NWP** –North-western Province Canal, **MAR** – Minipe Anicut Raising, **CR** – Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened.

Data Sources: EML, 2011; IUCN, 2007; MIWRM, 2014a; MIWRM, 2014b; MIWRM, 2014c; NRM, 2008; TEAMS, 1998

529 **Threatened and Endemic Species:** Altogether 46 endemic plants species were recorded in the project impact areas of all the sub projects (see annex I). These included 10 species listed as Endangered, 22 species listed as Vulnerable, 22 species listed as Near Threatened and 26 species listed as Least Concern in the National List of Threatened Species (MOE, 2012). Further, out of the 46 endemic species recorded 1 species is listed as Critically Endangered, 3 species as

Endangered, 7 species as Vulnerable in the Global List of Threatened Species (IUCN, 2014). It should also be noted that all but 1 species has been evaluated using an old version of the Global Criteria (version 2.3 in 1996) and the status given in the global list is outdated for Sri Lankan flora. Further 35 out of the 46 endemic species have not been evaluated in the Global list.

530 Therefore, the listing provided in the national list is a more reliable depiction of the present conservation status of Sri Lankan flora. In addition to these threatened endemic fauna 17 species of native plants (5 - Endangered and 12 - Vulnerable) listed as Nationally threatened and 17 species as Nationally Near Threatened has been recorded from the project affected areas of WRDIP. Likewise 2 native species of plants listed as Globally Vulnerable has also been recorded from project affected areas of WRDIP.

531 Among the fauna recorded in the project impacted areas of each of the three sub projects of WRDIP, 66 are endemic to Sri Lanka (see annex I). These 66 endemic species included 7 species listed as Critically Endangered, 9 species listed as Endangered, 26 species listed as Vulnerable, 32 species listed as Near Threatened and 32 species listed as Least Concern in the National List of Threatened Species (MOE, 2012). Further, out of the 66 endemic species, 1 species is listed as Critically Endangered, 12 species as Endangered, 11 species as Vulnerable, 4 species as Near Threatened and 38 species as Least Concern in the Global List of Threatened Species (IUCN, 2014).

532 As in the case of flora, the status indicated in the Global List are outdated for Sri Lankan fauna, especially for the endemic species where the listing provided in the national list is a more reliable depiction of their present conservation status. Further 39 out of the 66 endemic species have not been evaluated in the Global list. In addition to these threatened endemic fauna 12 species of native plants (4 - Endangered and 8 - Vulnerable) listed as Nationally threatened and 23 species as Nationally Near Threatened has been recorded from the project affected areas of WRDIP. Likewise 6 native species of plants listed as Globally threatened (3 - Endangered and 3 - Vulnerable) and 9 species as Globally Near Threatened has also been recorded from project affected areas of WRDIP.

533 **Restricted Range Species:** Mahaweli River, the largest river basin in Sri Lanka with a watershed area of 10,448 km^2 represents ca. 16% of the land area of the Island. The upper catchment of the Mahaweli river supports one of the most high biodiverse areas in Sri Lanka, the Knuckles Conservation Forest. Further, Mahaweli River and some of the sub catchments (Raththota oya, Kalu ganga, Theligamu oya and Kambarawa oya) of the Amban ganga, one of the main tributaries of Mahaweli river, is inhabited by number of fish that are endemic to Sri

Lanka and restricted to these sub catchments. Altogether 11 endemic species are restricted to the Mahaweli river. In addition, there appears to be number of yet undescribed species of fish inhabiting Mahaweli river. A list of species that are restricted to Mahaweli river are shown in table 5 along with comments on the impact of the proposed WRDIP on these species.

Table 4.8 List of species that is restricted to the Mahaweli river basin

Family	Scientific Name	Common Name	TS	NCS	GCS	Remarks
Cyprinidae	*Devario aequipinnatus*	Knuckles Danio	E	CR	LC	KG and MK
Cyprinidae	*Labeo fisheri*	Common Labeo	E	CR	EN	MK
Cyprinidae	*Laubuca insularis*	Knuckles labuca	E	CR	NE	KG and MK
Cyprinidae	*Puntius martenstyni*	Martenstyni's barb	E	CR	EN	KG and MK
Cyprinidae	*Puntius srilankensis*	Blotched filamented barb	E	CR	NE	KG and MK
Dicroglossidae	*Nannophrys marmorata*	Sri Lanka rock frog	E	EN	VU	Not affected
Agamidae	*Ceratophora tennentii*	Leafnose lizard	E	CR	EN	Not affected
Agamidae	*Cophotis dumbara*	Knuckles pygmy lizard	E	CR	CR	Not affected
Agamidae	*Calotes pethiyagodai*	Pethiyagoda's crestless lizard	E	NE	NE	Not affected
Scincidae	*Chalcidoseps thwaitesii*	Fourtoe snakeskink	E	CR	NE	Not affected
Gekkonidae	*Cyrtodactylus soba*	Knuckles forest gecko	E	CR	NE	Not affected

Abbreviations used:TS - Taxonomic Status, **E** - Endemic, **NCS** - National Conservation Status, **GCS** - Global Conservation Status, **CR** - Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NE** - Not Evaluated, KG – Kaluganga reservoir (associated facility to WRDIP), MK-Moragahakanda reservoir (associated facility to WRDIP)

Data Sources: Amarasinghe *et al*., 2014; ARROS, 2005; IUCN, 2014; MOE, 2012; Pethiyagoda, 1991; Pethiyagoda *et al*., 2008; Samarawickrama *et al*., 2006.

534 Out of the 11 restricted range species that occur in the Mahaweli river basin five species of freshwater fish has been recorded in the areas to be inundated under the Moragahakanda and

Kaluganga reservoirs. None of these species have been recorded in the project impacted area of the three subprojects coming under the WRDIP. The Mahaweli Authority of Sri Lanka with the assistance of IUCN Sri Lanka has already completed a translocation programme where the fish species identified to be impacted by the proposed Moragahakanda and Kalu ganga development projects have been relocated to suitable locations in the upper catchment of the Mahaweli River.

535 **Mitigation Measures:** Mitigation measures for the ongoing constructions of Kaluganga and Moragahakanda reservoir are currently being implemented (includes reforestation in degraded areas, introduction of community forestry programs in buffer zones and canal reservations, forestry programs in upper watershed areas, control of invasive species in existing protected areas, habitat enrichment in the protected area network in the immediate vicinity, and declaration of two new protected areas and establishment of elephant corridors to ensure free movement of wildlife and translocation of critical species from project affected areas into safe and suitable sites). The following discusses the overall measures in place to address the key issues for the for the three sub projects that comes under the proposed WRDIP. These include loss of habitat, disruption of movement patterns and death or injury to animals from falling into the canal (applies only to NWP and UEC sub projects), escalation of human-elephant conflict and reduction of downstream flow (applies only to Minipe raising project).

536 **Loss of Habitat**: A habitat enrichment programme will be undertaken with the aim of reforesting/ enriching approximately 1000 ha under the three sub projects (500 ha under Upper Elahara Canal, 350 ha under North-western Province Canal and 145 ha under the Minipe LB canal rehabilitation project) to achieve an overall biodiversity offset ratio of 2. The main aim will be to restore degraded areas or undertake reforestation of plantation forests within protected areas (250 ha in Minneriya-Giritale and 350 ha in Kahalla-Pallekelle Sanctuary). This will lead to increased habitat complexity and thereby enhance the carrying capacity of these protected areas which will compensate for the habitat loss.

537 In addition to these efforts restoration of tank catchments will be undertaken with the aim of reducing the sedimentation of tanks as well as enhance their carrying capacity. Third aim of the reforestation programme is to link existing protected areas to prevent fragmentation of habitats. Such an opportunity is only presented in the Minipe LB canal where it has been proposed to undertake reforestation of the canal reservation to create a riverine forest that can link three important protected areas, namely Victoria-Randenigala-Rantembe Sanctuary, Knuckles Conservation forest and Wasgomuwa National Park.

538 **Disruption of movement patterns and death or injury due to animals from falling into the canal:** Since the upper Elahera canal and north–western province canal project involves

establishment of long stretches of open lined canals it will result in disruption of movements of animals, especially less mobile species. Further, animals falling into the canal resulting in death or injury have been identified as a one of the main impacts of some of the long lined canals that are already being operated by the MIWRM. Therefore, thecanal design has incorporated structures in the open sections of the canal at 500 m intervals to ensure safe passage of animals across the canal as well as to facilitate those animals that fall into the canal to exit the canal safely.

539 **Escalation of Human-Elephant conflict**: Under each of the three sub projects of WRDIP money is set aside to provide short term solutions for human-elephant conflict that will arise due to the project. However, it should be noted that human-elephant conflict is wide spread socio-political problem that requires a long term solution. Therefore, MIWRM has already commissioned a study through IUCN Sri Lanka to develop and institute a long term human-elephant conflict management strategy within the entire area that will undergo a change in the cropping pattern under the proposed WRDIP to ensure that human-elephant conflict will not prevent accruing the overall benefits envisaged through the proposed water resource development under the WRDIP.

540 **Reduction in downstream flow:** This impact will take place only in one of the three sub projects of WRDIP (the Minipe raising) as the proposed project will result in diversion of more water in to Minipe LB and RB canals. As a result a stretch of about 6.5 km between the Minipe anicut and the confluence between Mahaweli river and Badulu oya will be subjected to low flows. Further, this will result in the reduction of the wetted perimeter of the river. These two impacts will result in a reduction of population densities of aquatic fauna and flora inhabiting this stretch of the river. Therefore an e-flow shall be released to meet the ecological demands of the river. According to the water balance study, taking into account the water flow in this affected section of the river for the past 50 years, the e-flow along with spillages from Minipe anicut will ensure that at least 28% of the Mean Annual Flow of the river will be released into the river.

541 Further, a short (0.5 m) weir will be constructed across the Mahaweli river downstream of the Minipe Anicut so that the e-flow released will be dispersed across the river bed to ensure that the wetted perimeter of the river shall not decrease drastically from its present day level. This will ensure that the aquatic species present in the river will not decline in their distribution and deep pools within the river that can support large fish species such as the Marsheer, are continuously refreshed and therefore the quantity and quality of water in such pools will not

decline even with the increase in the diversion of water from the main river after completion of the Minipe raising.

542 **Conclusions:** The proposed sub projects of the WRDIP will not have any impacts on the endemic and Critically Endangered or Endangered faunal species that are restricted to the Mahaweli River Basin. *Semnopithecus vetulus* (Purple-faced leaf monkey) is the only endemic endangered species that was recorded in the project impacted area of WRDIP projects. This species was recorded in the command area of the North-western Province Canal sub project and the proposed development activities will not have an impact on this species as it will not result in any habitat loss of the species. In addition to this four non endemic Endangered species, *Elephas maximus* (Asian Elephant), *Prionailurus viverrinus* (Fishing cat), *Panthera pardus* (Leopard) and *Melursus ursinus* (Sloth bear). Other than the Asian Elephants rest of the endangered species occur primarily in protected areas and the proposed development activities will not result in a significant habitat reduction of any of these species.

543 **Hydrology and Water Sharing :** The proposed Project (Water Resources Development Investment Programme-WRDIP) covers three major conveyances namely, Kaluganga-Moragahakanda Transfer Canal (KMTC) of capacity 35 cumec from Kalu Ganga reservoir to Moragahakanda reservoir, and Upper Elehera Canal (UEC) of capacity 40 cumec from Moragahakanda to NCP canal downstream of Huruluwewa supply point and North Western Province Canal (NWPC). These diversions are made possible by other proposed diversions beyond the project scope, such as Randenigal-Kalu Ganga transfer of water, and diversions at Kalinga Nuwara (considered under Phase 2 of the program)

544 At the Randenigala reservoir, the first diversion point, 180 MCM of Uma Oya water will be diverted to Randenigala, and 555 MCM from Randenigala will be diverted to the proposed Randenigala-Kaluganga Transfer Canal (RKTC), which is only 24% of total flow available at diversion point. RKTC will be augmented from the power flows of the proposed Hasalaka and Heen Ganga reservoirs, to increase the total diversion to Kalu Ganga to 660 MCM annually. The proposed Pumping Station will abstract 10% of the flow at Kalinga Nuwara (located downstream of Minipe on Mahaweli river). It, while, supplementing from excess flow at Angamedilla will transfer 245 MCM to Elehera-Minneriya Yoda Ela.

545 It has been observed that more than 900 MCM (2005-2010) of water spills over at Minipeanicut annually. The long-term average spillage is estimated to be more than 1,000 MCM per annum (1970-2010). Due to diversions at Randenigala, and raising of Minipe Anicut, annual spills over the MinipeAnicut will be reduced to 278 MC after the Project. Reference to the recommendations of the IEE report, a minimum of 8 cumecs will be released from the silt ejectors incorporated to the anicut, as well.

546 Kalu Ganga reservoir will be operated such that there would be sufficient releases from the reservoir to ParakramaSamudra Scheme (PSS) to maintain its water level above 50% storage level and to maintain its CI at 200% level.

547 The UEC has three level crossings, which are designed so that the flow from local streams to these level crossings will not be abstracted to the UEC. Thus they do notchange the current water availability to the eco systems and irrigation systems downstream of the level crossings.

548 The UEC will divert about 128 MCM of water to Huruluwewa and this will be utilized in the Yan Oya Basin. Apart from Huruluwewa command area, the small tank systems will be benefited by this diversion. In addition, return flows produced by these directly-benefited irrigation systems will enhance water availability within the river basinand enhance groundwater resources, as well.

549 The proposed Pumping Station at Kalinga Nuwarawill abstract 10% of the Mahaweliflow at that location (located downstream of Minipe). This amount of water will be extracted out of the excess flow at Angamedilla, which spills during the rainy season each year. River maintenance flow allowed in the designs at Kalinga Nuwara is a minimum of 4.25 cumecs (MCB, 2012c). Angamedilla flows will be reduced from 398 MCM to 306 MCM/annum, due to these diversions (MCB, 2012b).

550 Diversions from UEC would benefitMahaweli systems IH and MH as well and enable augmentingagricultural and drinking water requirements of the NWP consisting of water scarce upper reach of MiOya basin and HakwatunaOya reservoir scheme of the DeduruOya basin. Additional water retained in small tanks will enhance groundwater resources, as well.

551 Diversions at proposed diversion points allowfor river maintenance flow which would include downstream consumptive use with provisions for the future demands and the environmental needs.

552 The proposed diversion routes link Victoria, Randenigala, Kalu Ganga and Moragahakanda reservoirs having more than 2000 MCM storage for regulation and storage. The introduction of more than one diversion routes (alternative routes)for all major irrigation systems, crop diversification during yala season , and promoting effective water management programs will enhance the adaptation capacity of the system against climate change. Provisions are made to extend pumping at Kalinga Nuwarato the Maha season under drought situation to maintain safe water levels in main storage reservoirs.

553 In the NCP Canal Project designs, the concept of environmental flow has been incorporated as “river maintenance flow”, defined as “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.” (MCB, 2012C).Considering the uncertainties and inadequacy of data, the adopted process of calculation

takes the minimum monthly flows also into consideration in addition to a percentage of mean annual flows, which is described in the annexed report on Cumulative Impacts. (See Annex VII).

554 In addition to the major diversions, the UEC and NWPC intercept several small streams. The Water balance was prepared without expecting any inflow from these streams. In most cases, these streams are by-passed by drainage under-crossings, drainage over-crossings and aqueducts on the conveyance canal. Wherever level-crossings occur, the spillways of such level crossings have been designed to pass the stream flow without abstracting by the conveyance Canals.

555 Both the NCP Canal and NWP Canal will augment the water supply to small tank cascade systems located in the NCP and the NWP. From the ancient times, these tanks have utilized the return flows from upstream tanks to store and supply to the crops in the command area.The NCP and NWP canals will directly augment a set of small tank irrigation systems in the MalwathuOya, ParankiAru, Pali Aru, KanakarayanAru, Ma Oya and Yan Oya (UEC and NCP Canals) and MiOya, HakwatunaOya/DeduruOya (NWP Canal). The water availability in these river basins will be enhanced due to direct diversions as well as return flow resulting after crop water use in the directly benefited schemes. However, it is unlikely that there will be any excessive return flow during yala season because the water balance studies carried out by the MCB shows that water supply by the NCPC and NWPC will be sufficient only for 80% of the command area in that season.

556 The regolith aquifer in these parts of the country is heavily dependent on surface water and additional water retained in small tanks and the return flows will enhance groundwater resources as well, especially in the dry season. In the Maha season when there is a lot of rain, groundwater is recharged by both rainfall and surface water in the tanks. As such, groundwater levels are generally high during Maha season, and NCP/NWP Canal diversions are unlikely to make a significant change during the rainy period. However, NCP/NWP canal diversions can increase the groundwater levels in the Yala season, benefitting tail-end farmers who suffer from water shortages who could tap this water source. In addition, groundwater is used for domestic purposes.

557 Studies carried out in similar diversion projects have shown that groundwater levels are enhanced after diversions, but they fall down in the command areas after irrigationsand small tank cascades benefitted by NCP and NWP canals can be expected to perform in the same manner. Tank water levels are also likely to fall during the end of yala season. Therefore, high groundwater levels cannot be expected throughout the year. Problems such as water-logging and salinisation have not been reported from similar diversion and small tank augmentation projects such as WeliOya and Mau Ara. However, it is recommended that the quality of return flow is periodically monitored, considering the increased cropping intensity and promotion of crop diversification, after the project implementation.

4.7. Unanticipated Impacts

558 Such impacts are always possible in a project of this size and complexity. Such impacts are more likely to result from natural or man-made disasters. Therefore the MIWRM, MASL, PMU, contractors and other relevant stakeholders should be prepared for any contingencies arising from unanticipated impacts.

559 **Decommissioning of contractor's facilities and structures:** The expected lifetime of this project is 30 years (MCB, pers.comm). The associated facilities of the Kaluganga Reservoir and Morgahakanda reservoir are dams which have longer lifetimes that the canal. These structures would be rehabilitated when their lifetime is over, but would not be decommissioned. However, the project proponent should consider the major types of impacts that would occur when the temporary facilities, (contractor's temporary stores, temporary offices, worker camps, temporary disposal sites, temporary access roads etc.) are decommissioned. Some structures may be reused for different purposes and/or materials recycled. The area around the tunnel portals, which are to be used for TBM launching, stores etc, will be rehabilitated.

560 Natural habitats that were affected by this project such as the protected areas need to be rehabilitated as much as possible after decommissioning.

4.8 Impacts of the environment on the project

561 **Impact of Climate Change on the project:** The two most important climate variables for this investment are temperature and rainfall.

562 The analysis of temperature records over a 100-year period showed an increase in air temperature in all meteorological stations from 1961 to 1990 (Fernando and Chandrapala,1992). The rate of increase over this period was of the order 0.016^0C per annum or the equivalent of 1.6^0C per 100 years.

563 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 (Imbulana *et al* 2010). Over the period 1931 to 1990 average annual rainfall is reported to have decreased from 2,005 mm to 1,861 mm, a decline of 7% (Jayatilake et al, 2005). Considerable variation in spatial and seasonal distribution of rainfall is predicted for Sri Lanka with a trend towards increasing variability of weather events.

564 The KMTC+UEC have been designed to be viable and deliver its intended outcomes for a 30 year time period. However, climate change has emerged as the major environmental issue of this century.

565 Climate change also includes the aspect of extreme events such as tropical cyclones, hurricanes, very high wind speeds and high flood level, severe drought conditions, and increased

variability of the weather. All of these are expected to be more frequent due to climate change. Therefore, its implications for hydrological regimes and water resource based investments in Sri Lanka have to be considered.

566 Climate Change 2007 Synthesis report of the Intergovernmental Panel on Climate Change predicts substantial increases in surface air temperature in South Asia from 2010 onwards, with a significant acceleration of warming with time. Precipitation is generally predicted to increase until 2069 and then decline. In South Asia, most of the models project a decrease of precipitation in December, January and February. But there will be an increase in the other months until 2099 (Cruz *et al*, 2007). Some of the studies carried out at the national level agree with this prediction. Jayatillake *et al*, (2005) compare average rainfall from 1931-60 with 1961-90 and show that rainfall during North East Monsoon (which occur during December to February) has decreased by 19%. In contrast, the rainfall during South West Monsoon (May-September) has increased by about 9%. However, whether these changes will continue to the future is not clear. Spatial variation of climate change impacts have to be discussed with this background. The impact of climate change on cereal production is negative. A substantial decrease in cereal production is predicted for Asia and the decrease in South Asia can be up to 30%.

567 Benefited areas of UEC lies in the dry zone where a large part of rainfall is received during North-East Monsoon. Mahaweli River has its upper catchment in the wet zone and receives water during both monsoons. As such, Mahaweli has the potential to store and transfer water to the dry zone during the dry periods. In such water transfers, downstream water requirements resulting from various water uses including environmental needs will be taken into account, and the transfers will be regulated by the operating agency in response to the downstream demand. In a flood situation, the current practice of both ID and MASL is not to divert water to the command areas under a reservoir, but to open the spill gates of a reservoir and safely discharge water to a stream or a river, when the water level in the reservoir approaches the spill level. Moragahakanda reservoir will also be operated in a similar manner, and no diversions to UEC will be made if there is a flood situation in the benefited areas in NCP and NP

Scoping Matrix for the UEC Project EIA

Impact	Pre-construction				Construction Phase															Post Construction Phase					
Activities → / **Parameters** ↓	Land acquisition	Resettlement	Soil Investigations	Testing of construction material	Migration of workers	Securing Access	Worker Camps	Land Clearing, Disposal of biodegradable Materials	Excavation	Compaction	Blasting & Drilling	Transport of construction material	Barriers - Fencing	Culverts & bridges	Tunneling	Grouting	Embankments & retaining walls	Construction Waste	Solid Waste	Landscaping, Rehabilitation, Restoration	Provision of Irrigation Water	Provision of Drinking Water	Reservoirs/Ponds	Secondary developments	Changes in accessibility	
Water																										
Turbidity	0	-1	0	0	-1	-1	-1	-2	-2	0	-1	-1	0	-2	-2	-1	-1	-1	-1	2	-1	0	2	-1	0	
Groundwater quality	0	0	0	0	-1	0	-1	-1	0	0	0	0	0	0	0	-1	0	0	-1	1	1	0	2	-1	0	
Surface water quality	0	0	0	0	-1	-1	-1	-2	-2	1	-1	0	0	0	0	0	0	-1	-2	1	1	0	2	-1	0	
Recreational uses	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	3	1	1	
Air																										
Particulate matter and dust	0	-1	0	0	-1	-1	-1	-2	-1	1	-2	-1	0	-1	-1	0	-2	-2	0	1	0	0	0	0	0	
Noise and vibrations	0	-1	0	0	-1	-1	-1	-2	-2	-2	-2	-1	0	-1	-1	0	-2	-2	0	1	0	0	0	0	0	
Hydrology																										
Flooding	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	-1	-1	-1	0	0	0	0	3	-1	0	
Ground water levels	0	0	0	0	0	0	0	0	-1	0	0	0	0	-2	0	0	0	0	0	0	3	0	3	-1	0	
Stream flow (vol)	0	0	0	0	0	0	0	-1	-1	0	0	0	0	0	0	-1	-1	-1	0	0	2	0	-2	-1	-1	
Drainage patterns	0	1	0	0	-1	1	-1	-1	-1	0	0	0	-1	0	0	-2	-1	-1	0	1	1	0	1	-1	-1	
Earth																										
Soil erosion	0	-1	0	0	-1	-1	-1	-2	-2	2	-1	0	0	-1	-2	-1	-1	0	0	2	-1	0	0	-1	-1	
Stability	0	1	0	0	0	1	0	-2	-2	2	-1	0	0	-1	-2	-1	-1	0	0	2	0	0	-1	0	-1	
Fauna- Terrestrial																										
Species diversity	0	-1	0	0	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	1	0	0	1	-1	0	
Rare & endangered species	0	-1	0	0	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Habitats	0	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	-1	0	
Migration patterns	0	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	
Human -elephant conflict	-1	-1	0	0	-1	-1	-1	-1	-1	0	-1	-1	0	0	0	0	0	0	-1	0	-2	0	1	-1	-1	
Fauna - Aquatic																										
Rare & Endangered Species	-1	0	0	0	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Diversity	0	0	0	0	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	1	0	0	
Disease- insect vectors	-1	-2			-1	-1	-1	-1	-2	0	0															
Flora- Terrestrial																										
Species diversity	-1	-1	0	0	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	-1	0	
Habitats	-1	-1	0	0	-1	-1	-1	-1	-1	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	-1	0	

Impact	Pre-construction				Construction Phase															Post Construction Phase					
Activities → / Parameters ↓	Land acquisition	Resettlement	Soil Investigations	Testing of construction material	Migration of workers	Securing Access	Worker Camps	Land Clearing, Disposal of biodegradable Materials	Excavation	Compaction	Blasting & Drilling	Transport of construction material	Barriers - Fencing	Culverts & bridges	Tunneling	Grouting	Embankments & retaining walls	Construction Waste	Solid Waste	Landscaping, Rehabilitation, Restoration	Provision of Irrigation Water	Provision of Drinking Water	Reservoirs/Ponds	Secondary developments	Changes in accessibility	O&M of irrigation structures
Residential	-2	3	0	0	N/A	-1	-1	-1	-1	0	-2	-2	-1	0	0	0	0	-1	-1	2	2	3	2	1	1	0
Commercial	-1	2	0	0	1	1	1	-1	-1	0	-1	-1	-1	0	0	0	0	-1	-1	2	2	2	1	1	1	0
Agricultural	-2	3	0	0	0	1	0	-1	-1	0	0	0	0	0	0	0	0	-1	-1	1	3	3	3	1	1	3
Recreational uses	-1	1	0	0	1	-1	-1	-1	-1	0	-1	-2	-1	0	0	0	0	-2	-2	2	2	3	3	1	1	0
Aesthetics																										
Scenic views & sites	0	0	0	0	0	-1	-1	-1	-1	0	-2	-1	-1	0	0	0	-1	-1	-2	2	2	0	2	0	0	0
Open space qualities	0	1	0	0	0	-1	-1	-1	0	0	-1	-1	-1	0	0	0	0	-2	-2	1	0	0	1	0	0	0
Topographic character	0	1	0	0	0	0	0	-1	-1	1	-1	0	-1	0	0	0	-1	-1	-1	1	0	0	0	####	0	0
Human Interest																										
Housing	-2	2	0	0	0	-1	0	0	0	0	-1	-1	0	1	0	0	-1	-2	-2	1	1	2	1	2	2	0
Health and safety	0	2	0	0	-1	-1	-1	-1	-1	-1	-1	-2	0	0	0	-1	-1	-2	-2	2	0	2	0	1	1	0
Water uses	0	0	0	0	-1	0	-1	-1	0	0	0	-1	-1	1	0	0	0	-1	-1	1	3	3	3	1	1	2
Historical/ religious/ archeological sites	-2	0	-1	-1	0	-2	0	-2	-1	0	-1	-1	-1	0	0	0	-1	-1	-1	0	0	1	-1	-1	-1	0
Education	0	2	0	0	0	0	0	0	0	0	0	-2	0	1	0	0	0	-1	-1	0	0	2	0	1	1	0
Transportation																										
Transportation/ accessibility/ movement		2	0	0	1	0	1	0	-1	1	0	-1	-1	1	0	0	1	-1	-1	1	0	0	-1	1	2	0
Existing transportation systems		2	0	0	1	0	1	0	-2	0	0	-1	-1	2	0	0	-1	-1	-1	1	0	0	0	1	2	0
Economic																										
Land values	-2	2	0	0	1	0	0	0	-1	1	0	-1	-1	1	-1	0	-1	-2	-2	2	2	3	2	2	2	0
Employment opportunities	0	2	1	1	1	1	1	0	1	1	0	1	1	1	2	1	2	-1	-1	1	3	2	2	1	1	1
Livelihood	0	1	0	0	1	1	1	0	-1	1	0	-1	-1	1	1	1	1	-1	-1	2	3	2	2	1		1
Tourism	0	0	0	0	N/A	1	-1	0	-1	0	0	-1	-1	1	0	0	0	-1	-2	2	2	3	2	1	2	0
Local economic conditions	0	2	0	0	1	1	1	0	1	1	0	0	-1	1	0	0	0	-1	-1	1	3	2	2	1	2	1
Regional economic conditions	N/A	2	0	0	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	2	2	1	1	1
National economic conditions	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	1	1	1	1

Severely negative	-3
Moderately negative	-2
Minor	-1
Highly positive	3
Moderately positve	2
Minor	1

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

Figure 4.1- Layout Plan of UEC Showing Affected Houses

CHAPTER 5

5. PROPOSED MITIGATORY MEASURES

5.1 Mitigation measures for the physical environment including alternative methodologies

5.1.1 Water and Hydrology

568 **Mitigating measures for changes of ground water table and disruption of ground water flow:** As the UEC is a concrete lined canal it would not cause much disturbance to prevailing ground water flows except in tunnels. In the initial stretch of canal due to the level crossings (3 tanks) replenished with water from the canal, the project would have a positive impact on the ground water table in the vicinity. In the case of KMTC the geological investigation carried out indicatedfavourable conditions for tunneling in both sections fresh and of tight joints at the tunnel.

569 This means that the rock can be expected to be water tight which would not allow ingress of water in to the tunnel or from the tunnel. Few more bore holes with relevant tests including W.P.T. in between portals would determine actual status of permeability of rock. If any weak/permeable zones are encountered they should be treated properly with grouting, anchor bolting etc. Under such circumstances we may not expect undue lowering of water table even in the tunnel sections. For example in the 1st tunnel of KMTC the geological investigation carried out at inlet portal indicated that G.W. Table at a depth of 7.60m below the 220.5m MSL surface elevation which is well above tunnel crown level. But the fresh Charnokitic gneiss with tight rough joins at the tunnel level would not be permeable and hence won't affect the G.W.T. in the long term. However during the construction of canal & Tunnel we may anticipate some changes in G.W.T.

570 For the cut & cover and conduit sections of the canal G.W.T. can be affected during construction stage.

571 Above the cut & cover and conduit sections of the canal, a fairly thick permeable layer (sandy/gravelly) could be used so that the construction won't have long term effect the G.W.T. as the draining is allowed to take place in both directions above the canal.

572 All the tunnels will be lined at reached which are considered permeable. TBM has the capability to line the surface, while boring. So the effect on ground water is made minimum. Open canal section is lined and cut and cover conduits are concrete structures. Therefore, construction methods decided by the designers will minimize the adverse impacts on ground water table.

573 Groundwater depletion under tunnel construction will be for short term. In the case of TBM, the tunnel will be lined at weak sections while proceeding. Tunnel liners will be installed with the advancement of the machine. Tunnel expert will decide on the water proofing method such as rubber water seals/gasket joints. In the drill-and-blast sections also, it is not possible to proceed with tunneling if there is water leakage. At such places, the tunnel will be lined before proceeding. In the case of open canal sections, water would have to be removed from foundations for construction. However, this will have only a short term and localized effect, as the water will not be moved to a long distance.

574 In the case of tunnels, the mitigation measures such as lining are already incorporated to the design. Open canal excavation and foundation laying will be completed during the dry periods, to avoid problems with dealing with water.

575 **Environmental flow:** Preparation of Standing Orders with regard to operation of the existing tanks and strict monitoring of the entire UEC during construction is very important. Further, standing orders should allow releasing of water to the stream on demand during long dry spells. The streams that are influenced by the level crossings of UEC are non-perennial. As such, water has to be released according to the current stream flow pattern. The UEC will be operated in such a way that stream flows are not retained by the level crossings. Using flow measuring gages in the UEC, inlet and outlet controls of the level crossings, it will be ensured that inflow to the level crossings are released to the downstream. The requirement that 50% of water is retained for the use of wild life is met by the operation of UEC. The operational decisions will be made by the Mahaweli Authority of Sri Lanka (MASL).

576 **Surface water quality**: Adverse effects during the construction phase have to be minimized by making the workers and operators aware and also providing suitable and protected locations for disposal of solid wastes and providing with proper sanitary facilities and adopting proper mitigatory measures as described in section 5.1.3 to minimize erosion of exposed working surfaces. The maps indicating the identified disposal areas are given in Chapter 2. Silt traps will be provided on the UEC upstream and downstream of the level crossings and silt will be flushed out. In the long term, the project is anticipated to improve the water quality of Hurulu wewa. Monitoring measures will be given to monitor the surface water quality of this project.

5.1.2 Adverse impacts on hydrology

577 In the designs UEC, precautions have been taken not to mix up the general flow pattern of the project area or the existing hydrology except for level crossings at Kongetiyawewa, Bogahawewa and Madethtawawewa.

578 The drainage paths or stream crossings will be disturbed during the construction period and special attention has to be paid so that the disturbance to natural drainage is maintained at a minimum. Temporary by-pass structures will be provided to the streams during the construction period. The disturbance can be minimized by

i. Construction schedule which is prepared by considering the climatic situation, specially the work inside the streams to be done as far as possible during the dry spells.
ii. The construction has to be completed within a short period employing the maximum resources.
iii. If the stream is to be coffer dammed, a bypass canal or a suitable under pass has to be provided.

579 The first km of UEC runs as an open lined double banking contour canal along the foot of the hill. Drainage under crossings will be provided in this stretch for all stream crossings so that UEC will not disturb the local stream flows. The drainage will be disturbed during the construction period and scheduling has to be made to shorten the construction period and minimize disturbances to natural drainage.

580 Small scale flooding can be expected due to improper disposal of non bio-degradable material, setting up of barriers, grouting, embankments and retaining walls, disposal of construction waste etc. Most of the adverse impacts are due to the improper disposal methods. Disposing any material in a manner of blocking streams and drainage paths have to be avoided. The Project Implementation Agency will have to appoint a person to oversee and prevent environmentally damaging actions.

581 During the construction stage, structural arrangements such as by-passes and pumping where necessary, to release rain water without flooding needs to be incorporated to any temporary constructions. It should be noted that measures for safe conveyance of flood waters have been incorporated to all permanent constructions by the designs engineers. The return period considered for level crossings is 50 years.

582 Mitigation of impacts on groundwater area addressed through concrete-lining of the tunnel and grouting, which are a part of the design and have been addressed previously.

5.1.3 Mitigating measures against loss of slope stability, soil stability and increased potential of landslides

583 **Slope failures:** All detached/unstable pieces of rock, boulders should be removed especially at the inlet and outlet portal areas of tunnels. Terracing could be adopted in deep cuts in excess of 15m & especially at the inlet and outlet portal areas. Consolidation grouting would improve the stability of moderately weathered rock and shot- creting for weathered rock surface could also be adopted. If the foliation planes dip towards inlet & outlet portals it is also of paramount importance to do anchor bolting after evaluating the stability. However proper drainage is vital in the case of stability problems & may even be required to introduce horizontal drains inside the subsurface around the inlet & portal areas and also at the hillsides along canal. Inside the tunnels also concrete lining & anchor bolting would eliminate risk of failures in the weak zones.

Left: Installing Horizontal drains on slopes and right: horizontal drains in operation

584 In similar projects carried out so far in Sri Lanka, the provision of horizontal drains has not been given due consideration. It is emphasized that proper stabilization methods accompanied by proper drainage can effectively reduce the possibility of landslides and slope failures. In the KMTC reach, hillsides with steep slopes could also be stabilized with horizontal drains & Anchor bolts where necessary which would drastically reduce the danger of sliding due to heavy rainfall. Constructing these will be decided at the construction stage and provision for cost is made under mitigation cost.Steepness of the slope, soil type, surface vegetation and depth to water table affect the slope stability and engineers will decide on the mitigation methods after investigating the contributing factors.

585 Natural coir fibres with 18mmX 18mm (0.75" × 0.75") opening can also be used on cleared hillsides, banks and slopes which increases vegetation and improves stabilization without harming the environment. This is a biodegradable material, cost effective and readily available in Sri Lanka. The weathered stones which can't be used as concrete material may also be used for construction of stone walls in terracing which is environmentally friendly. Terraces reduce the rate of runoff on slopes & thereby prevent soil erosion and hence stabilize slopes.

Terracing with stone walls

586 In the case of TBM, when the machine advances, the ground in front of the machine and the tunnel is supported by the TBM shield, and pre-cast tunnel liners are installed as the machine advances through unstable or soft ground. Concrete liner segments will have rubber gaskets or other water-proofing between them to prevent water from entering the tunnel. Grouting will be performed by TBM itself to fill the space between liner segments and the surrounding ground to prevent land settlement. Ground water control will be further refined with the Tunnel Expert.

5.1.4 Disposal of construction waste material and disposal areas

587 Soil removed in the excavation of canal can be mostly used in forming the bunds. These soils includes SC, SM, CH and GC & GM. SC& CH are proper construction materials and can be directly used for the construction of canal bunds; SM can be used for sub grade of road GC & GM be used for top layers of bund and as wearing surface. This will in turn reduce the requirements from Borrow Area for bunds thus reducing the amounts of material to be excavated. The sand removed from the streams &Alluvialplanes in the initial stretch can be used for construction material in concrete lining and in other structures. Part of the Alluvium removed from streams may also be used as backfill material above the cut & cover sections and conduit sections where permeability is important. The excavated material that is not suitable for construction will be sent to disposal areas, described in Chapter 2.

588 Disturbance to topography can be minimized considerably once the correct selection of material & proper methods of compaction are adopted for backfilling around structures and borrow areas. And also proper stabilizing measures including terracing, shot-creting& provisions of drainage including horizontal drains andturfing on the cleared slopes section would enhance stability while adding to scenic beauty especially at the open canal sections and inlet &out portal areas of tunnels.

589 The borrow areas indicated shall be restored by mechanical means and replanting. All pits shall be filled with suitable excavated material, proper gradient on the slopes to be maintained allowing the drainage to occur easily.

590 Location of the disposal sites for the upper Elehera canal and tunnel excavations have been identified and demarcated on the plans and layout maps included in Chapter 2, associated facilities. It should be noted that the construction work shall be planned so that the maximum use of excavated materials, earth, rock and quarry dust need to be made for construction, to minimize dispose and waste. The tunnel and other sections of the canal trace have been set almost all through the lands under the jurisdiction of the Department of Wildlife and the Forest Department. Therefore, disposal areas have been selected in previous borrow areas, abandoned quarries and for repairing the bunds of existing irrigation facilities etc.

591 Currently the Ministry of Irrigation and Water Resources Management is proceeding with getting the required permission for these disposal sites from the relevant authorities. The Project Management Unit will monitor that the disposal will be carried out at the specified locations only. Further, all the natural streams and wetlands have been avoided in selection of disposal

areas. It is recommended to cover the rock dumps with approximately 1 m thick layer of soil and to grow grass and naturally grown suitable types of trees on top of the dumped heaps.

592 The rock dumps can be re-used for future local construction works such as roads and buildings.

5.1.5 Mitigating measures against degradation of mineral resources

593 The only valuable mineral resource of sizable quantity that may be affected in the project would be the Marble in the last stretch of canal trace where tunneling has to be done. Usability/disposability of this marble would be determined by the method of construction adopted in tunneling. If tunnel boring machine method is adopted the muck would mostly be in the form of dust in addition to flaky particles. Marble in flaky form would have to be evaluated economically to see whether it can be used somewhere. The other option is to use this marble for construction [concreting] if it satisfies Abrasion Value & Impact Value after testing.

594 The quartztic gravel encountered in the excavation of canal can be used for top layers of the bunds as wearing surface.

595 If precious stones are found, action will be taken to inform the appropriate authorities including Divisional Secretary, Geological Surveys and Mines Bureau and National Gem and Jewellery Authority, by the Project Management Unit.

5.1.6 Adverse impacts on air

596 The adverse impacts on air are temporary. Nevertheless, they have to be mitigated to avoid affecting the health of the people and environment.

597 Land clearing has to be kept to a minimum, and should be confined to preparing access roads, building houses etc, which are essential. Machines with high level of vibration should be avoided during the night. Transport of cleared material should be covered to minimize particulate matter and dust, as per environmental regulations.

598 Following actions have to be carried out by the contractor to manage air quality at construction sites

(a) Vehicles and machinery should be fitted with exhaust systems and devices and vehicles should have valid emission licenses.

(b) Minimize the quantity and duration of soil exposure

(c) Watering of construction sites as required minimizing the potential of dust causing inconvenience to nearby residents. Watering frequency should be increased during periods of high risk (e.g. high winds)

(d) All vehicles transporting construction material should have coverings to prevent dust generation

(e) Monitoring of air quality by an independent group/person at selected sites with potential high impacts

5.1.7 Adverse impacts due to Noise and Vibration

599 It is recommendedusing a TBM for the excavation of tunnels whenever possible depending on the geological condition and other aspects to avoid ground vibration in the area and excessive noise. In addition the following steps have to be followed during the construction to reduce noise and vibration causing events.

(a) Blasting and drilling, should be carried out in accordance with current practice standards. Air Blast Over Pressure (ABOP) level due to multi-bore hole for type 3 building is 120 db. The air blast levels and fly distance of rock and debris depend on several factors such as orientation of the free face, stemming height, blasting material and weight of explosive detonated per delay period. Contractor should be give specifications to control these aspects.

(b) Adequate community notice of any scheduled, typical noise generating events will be provided.

(c) Liaison by the PMU/Contractor with the Grievance Redress Committee or the respective GN over the scheduling of events generating high noise levels would enable potential conflicts over timing with important community events such as religious and cultural occasions

(d) According to the proposed noise standards of CEA the boundry of construction sites shall not produce more noise than 75 db during day time (6.00 -21.00 hrs) and 50 db during night time (21.00 – 6.00). As TBM is used at most locations, noise generation is controlled to a substantial degree. Some noise will be generated at the tunnel portals, but these would not disturb schools, religious centres, etc, due to the location of portals away from such places.

(e) Vehicles should be subjected to periodic maintenances to ensure adherence to noise standards.

5.1.8. Occupational Safety –

600 Appropriate safety measures should be formulated for the construction and other staff as per Department of Labour guidelines.
(www.ilo.org/colombo/areasofwork/safety_health_at_work/lang-en/index.htm, and shall be incorporated to the standard contract documents.

601 Some features of the TBM related to worker safety, which are being considered to be incorporated to the design, are as follows:

a. Automatic smoke detectors and foam and water spray type fire equipment
b. Emergency stop mechanism
c. Guard rails on all moving machinery
d. Adequate lighting
e. Monitoring equipment with cameras fitted to important locations and communication system with control
f. Electrical isolators and lock-off devices fitted on items containing dangerous moving parts
g. Continuous monitoring of gas levels
h. Adequate ventilation arrangement and personal protective equipment

602 A safety assessment shall be carried out by tunneling experts and the necessary safety measures will be included in the specifications, conforming to international standards.

603 A site for a Worker Camp has been identified and is shown by Figure 2.1. The location will be finalized with the contractor. Once the site is finalized, the contractor will provide necessary facilities such as water supply and sanitation. Provision facilities will be covered by the conditions of the contract, and they would include:

a. water supply
b. sanitary facilities
c. arrangement for disposal of waste
d. first aid facilities
e. access to healthcare (hospitals) during accidents
f. safety gear, gas masks, helmets etc

5.1.9Advantages of TBM over drilling and blasting methods

- A circular TBM cross-section is superior with regard to rock stability than a typical drilling and blasting (D&B) cross-section. TBM boring will not alter the fissures and joint characteristics of the rock mass. Pre-excavation grout may only be influenced slightly - if anything at all - by the boring.
- Tunnel muck disposal is reduced.
- Safety is better because nearly every type of TBM the rock support is installed from within protected/shielded areas. The safety is better due avoiding the use of explosives as well.
- Longer tunnels can be excavated from one heading due to the improved ventilation characteristics and the higher excavation advance rates obtained by TBMs. *As such, this method requires less adit tunnels*
- Omitting or reducing number ofadits/job sites means less road construction, less costs and less environmental impact.

- Significantly less environmental disturbances of surrounding areas (noise, vibrations)
- No blasting fumes in the tunnel and outside the tunnel portal. Blasting fumes contains CO2 and other gases harmful to people and environment.
- Using a continuous conveyer to transport excavated muck reduces the need for diesel powered vehicles in the tunnel and less noxious fumes.
- Shielded TBMs and watertight lining can prevent lowering of water table and undesired ground settlements

5.2 Mitigation measures for the Socio-cultural environment

604 It has to be noted that this project is at its feasibility stage and funding will be available/identified for its implementation in near future. A comprehensive Resettlement Action Plan is being prepared to address all issues of affected persons. At present, detailed surveys to establish the extent to which each affected family/individual will be affected is being conducted.

5.2.1 Preparation of the Resettlement Plan

605 The UEC project will have some adverse impacts on houses and properties (especially lands) and therefore during the project implementation stages, resettlement will be most important component requiring due consideration.

606 A separate study is being carried out to prepare a comprehensive resettlement plan according to the procedures and other principles of the Involuntary Resettlement Policy of the Government of Sri Lanka (NIRP-2001), and to meet the conditions of Involuntary Resettlement of Safeguards Policy Statement of the ADB (2009). Although this report provides the preliminary material necessary to initiate a resettlement plan, the preparation of a Resettlement Action Plan (RAP) is needed to gather detailed information related to the individual plots of homesteads, houses and properties affected. Once the RAP is prepared and all the parameters are identified, the project proponents will be able to implement the RAP during the project implementation stage. This RAP is currently under preparation.

5.2.2 Will the project activities create relocation of families

607 Project interventions will require the relocation of some families and acquisitions of lands. Detailed resettlement action plans need to be prepared according to respective policies and other legal instruments. The information provided in this section will indicate the magnitude of the resettlement issues under this project. Information presented here is based on preliminary surveys. Details of the resettlement are presented in a separate document on resettlement.

5.2.3 Impact on houses and lands due to the formation of canal

608 About nine acres owned by 16 families need to be acquired amongst privately owned property. One family will be isolated. Detailed compensation packages for families to be resettled are identified in the resettlement plan.

5.2.4. Mitigation of impacts on agricultural activities

609 Livelihood restoration plans will be prepared based on the nature of the livelihoods affected. Since most of the families in the proposed project area are dependent on agriculture as a livelihood, and the grant of a concessionary piece of land (free of charge) is in their best interests. The MIWRM will follow the NIRP policy on potential impact of the project on livelihoods of the people as well as the Social Safeguards Policy (2009) of the ADB and meet conditions to restore their livelihoods.

5.2.5 Mitigation of Impacts to the commercial activities

610 Businesses ventured in the affected areas require special attention. In these cases, the income of the business owners are likely to suffer until their businesses can be relocated to another place and customer base can be re-established. During this period a compensation package needs to be given these business owners so as to compensate for their reduction in income.

5.2.6 Transportation over the canal

611 The villages situated on either side of the UEC will be separated due to construction of the proposed canal. In order to avoid the separation of people and for theme to maintain ties, bridges need to be built once every Km. over the canal.
This will provide facility for village families who were separated due to the canal construction.

612 During the construction phase, when the canal trace crosses roads as an open canal or as a cut and cover section, a bypass road will be constructed first to avoid disturbance to traffic.

5.2.7Employment opportunities in the project

613 This is a beneficial impact as the local population is expected to be given preference whenever possible for employment in project work. However, negative impacts could arise if children are employed even in less risky types of activities.

614 Efforts shall be made to ensure that all civil works contractors comply with all applicable labor laws and regulations of Sri Lanka and in particular (a) to not employ child labor, and (b) to provide appropriate facilities for children of workers at construction sites as well as providing equal pay of men and women for work of equal values and (c) to put into practice measures to ensure health and safety of workers, including appropriate sanitation facilities for women.

5.2.8Community health and safety

615 As stated in the socio-economic impacts section in Chapter 4, there are many concerns that will arise during the project period. The major concerns are:

- Environmental pollution (water, air and soil), soil erosion creating problems to adjacent communities by affecting road surfaces, agricultural fields, home gardens, streams and other waterways etc.
- High levels of noise, vibration, dust, particulate matter, exhaust fumes, and toxic fumes from construction activities and operation of machinery
- Risk of accidents due to increase in vehicular traffic (construction equipment, material transport) and possibility of falling into open dug areas.
- Increased risks of accidents and spills of chemicals, oils that affect nearby communities
- Impacts on the general health status from project activities
- Use of children in construction activities
- Risks of sexually transmitted diseases and HIC/AIDS spread
- Other problems faced by vulnerable groups such as women due to influx of migrant workers of a large labor force of the project

616 The project should take proper safeguards measures to prevent, and reduce and mitigate all adverse impacts on community health and safety problems due to the project.

617 While environmental impacts will be addressed through mitigation measures listed previously, others that are of a socio-economic nature need to be part of specific mitigation measures.

618 **Risks of sexually transmitted diseases and HIV/AIDS spreading in the project area:** Despite this being a low probability, as a proportion of the workers of the project will come from outside of the area, as a preventive measure appropriate and timely information and awareness of construction workers and the communities on the risks of sexually transmitted diseases and HIV/AIDS is important.

619 **Risks to women and children:** Measures on anti-trafficking of women and children should be made part of the health and safety program implemented at construction campsites.

620 **General health impacts:** There could be complaints from communities over the quality of air during construction at some sites. Activities that release dust, particulate matter and toxic fumes will lead to lung related health issues and cause more adverse effects on elderly, children and those already afflicted with asthma and other lung related problems.

621 A significant proportion of skilled laborers, workers of other categories and persons associated with provision of other services will come from outside of the project area to reside and visit during construction. In addition, there will be an influx of small scale commercial enterprises, sales persons, service providers etc. to the project area. Therefore, as a preventive measure appropriate and timely information and awareness of construction workers and the communities on the risks of sexually transmitted diseases and HIV/AIDS is important.

622 All above measures should be taken in conjunction and in consultation with the local and regional health authorities (Ministry of Health) who have experience in identifying diseases and morbidity, and experience with community health programmes.

623 Measures of anti-trafficking of women and children should be made part of the health and safety program implemented at construction campsites.

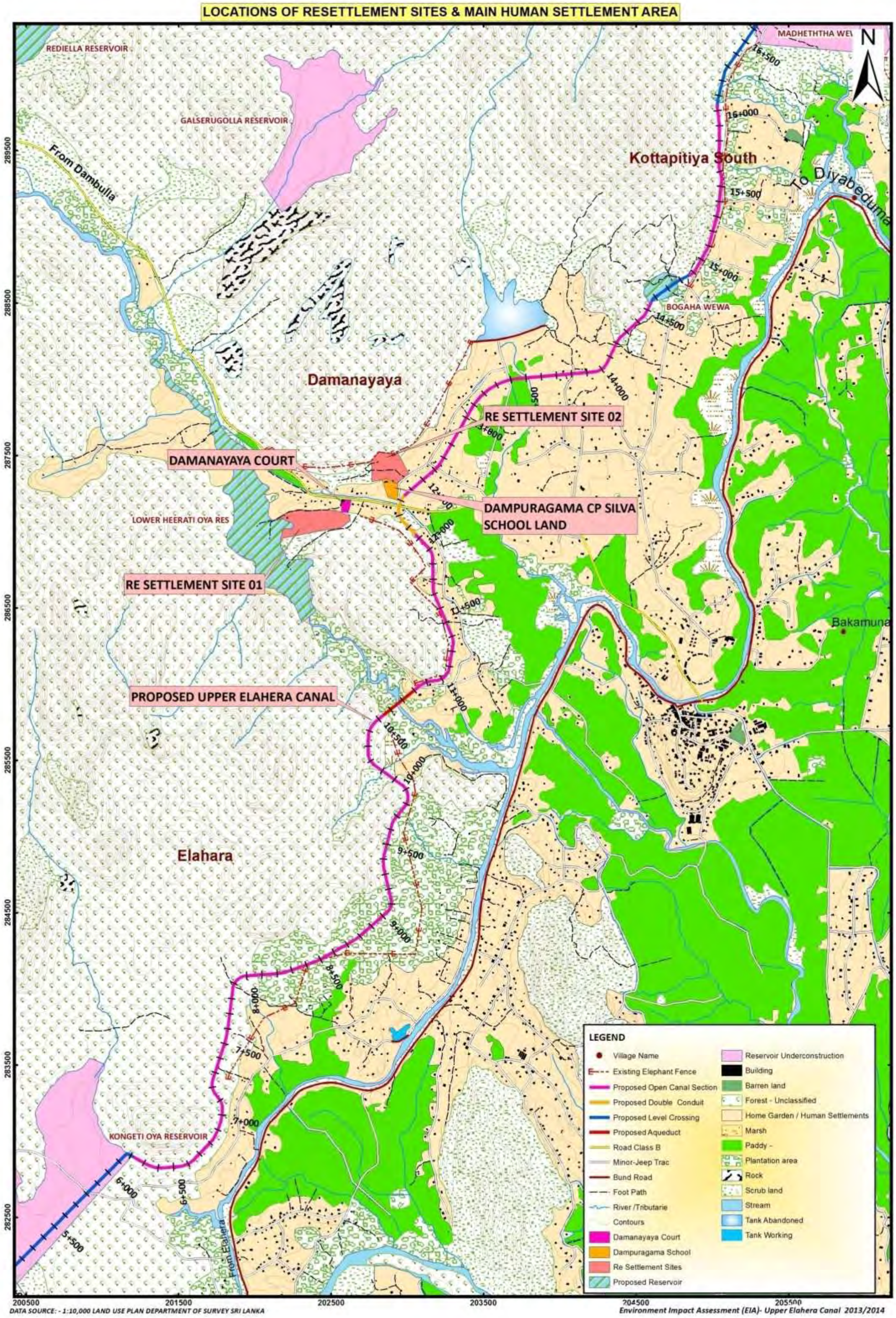


Figure 5.1 – Locations of Resettlement Sites and Main Human Settlement Area

5.3 Mitigation measures for impacts on flora/habitats

624 The most significant impact that will arise due to the project includes loss of habitats due to establishment of the proposed canal and temporary access roads. The area to be reforested is 500 ha which now makes the biodiversity offset ratio of 500 /160 = 3. 13.

625 Once the project activities are over degraded areas along the canal could be restored by carrying out a reforestation/ restoration programmes. Trees can be planted along the access roads, quarry sites, sites of labour camps and other areas without tree cover. Also, enrichment planting could be carried out in canal reservations if the vegetation is degraded due to the project activities. Discussions need to held with Forest Department and Department of Wildlife Conservation officials to select areas most suitable for reforestation/enrichment planting within the project impact area. A list of species suitable for enrichment planting is found in the Annex VI- Table 05

626 The rate/ha for reforestation and maintenance of plants up to required growth stage is Rs. 600,000. As the Forest Department plants native species (that are relatively slow growing in comparison to exotic species used in the past), in its reforestation/habitat enrichment programmes, greater time and effort is needed. This cost/ha includes maintaining the nursery plants between 18-27 months of age; undertaking 5 weedings in the 1st year, 4 in the 2nd year and 3 in the 3rd and at least 1 weeding in the 4thyears of age. In addition, fire break lines have to be maintained.

627 Around 500 ha (to compensate for the loss of 160 ha due to project) are currently recommended for reforestation/enrichment as mitigation measures. This figure was arrived at by considering the availability of areas for reforestation and enrichment. This includes reforestration, enrichment planting along the canal banks and degraded areas (250 ha) and in the area between Huruluwewa FSL and UEC (250 ha).The current total cost is SLR 300 million. The Sri Lanka Forest Department Circular No. 28/ 1998 gives the details of number of man days for planting, maintenance of forest plantations and nursery practices.

5.4 Mitigatory Measures for impacts on Fauna and their habitats

628 The two most significant impacts that will arise due to the project include loss of habitat due to establishment of the canal that will result in loss of approximately 160 ha of natural habitats such as dry-mixed evergreen forest, degraded dry-mixed evergreen forest and scrubland. These habitats function as rich faunal and floral repositories. This impact is irreversible but through compensatory planting we can offset this impact. As stated in para 629 as a compensatory mechanism it is recommended that the project will invest on restoration of degraded areas with native species within the protected areas around 250 ha, especially within the Elahera-Giritale sanctuary. The remainining 250 ha selected for compensatory planting is the area between the canal and Huruluwewa FSL (as described in para 634).

630 Further, study commissioned by MIWRM to assess longer term impacts on migratory patterns and routes of wildlife and on human-wildlife conflict will provide more information.

The monitoring programme recommends monitoring of biodiversity, which should be based on transects and point counts within natural habitats crossed by the UEC.

631 Further, it is recommended that the existing electric fence is realigned along the right bank of the canal and following further consultation those who have encroached into the sanctuary are relocated to the right bank so that the area on the left bank of the canal can be restored to enhance the habitat quality and thereby the carrying capacity of these habitats as measure of compensation for the loss of habitat that will result due to the proposed project. However, this proposed relocation does not arise due to the project, but is considered as a good measure to restore already encroached areas. The number of encroached families is not known at presents, and if the DWC and MIWRM consider moving forward with this proposal, needs to be ascertained at later date. They are not included in the RAP. This will however be dependent on discussions with the relevant community families.

632 It is also recommended that the project provides funds for replanting the teak planted areas s within the three wildlife reserves with suitable indigenous trees to enrich the forest habitat within these reserves and thereby increase the carrying capacity of these reserves for indigenous species.

633 The second significant impact is the escalation of human elephant-conflict due to the disruption of their movement patterns. It is therefore recommended that the existing electric fence is moved to the right bank of the open section of the canal and wall of the canal on the right bank should be made steep so that canal will act as an impediment for the elephants to enter the human use area. The left bank should have a lesser slope so that animals that inhabit the sanctuary can have access to water. No human uses should be allowed on the left bank of the canal that traverses through the Minneriya-Giritale sanctuary and if there are encroachers on the left bank they should be resettled outside the protected area.

634 The local community should play a lead responsibility for the maintenance of the electric fence under the supervision of the Department of Wildlife Conservation and coordinated by the Divisional Secretary. An endowment fund should be established to meet the financial needs for fence maintenance. Further, additional funds should be set aside to construct at least 50 km of electric fences if new conflict centers are created due to the establishment of the proposed project. Institutional arrangements for management of such funds and its mechanisms need to be established during the project period in consultation with the DWC and local communities.

635 Increasing fragmentation and blocking of migratory routes are significant threats to the elephants and other fauna. Declaration of already identified migratory routes as soon as possible is also recommended. It should be noted that the UEC is designed and routed within Minneriya NP in such as manner that it has no impact on the hydrology of Minneriya Tank

which is the center of a spectacular gathering of elephants especially during the dry season. Construction within the national park is also to be avoided during this period of the year.

636 As a long term measure, the project proponent has initiated a study into the impacts on wildlife especially those needing migratory routes and larger ranges in the wider region within which the project is located. This will serve as long term management tool to address human-wildlife conflict. Annex VIII contains the outline of this proposal.

637 As the project involves long lined canals the canal design has incorporated structures in the open sections of the canal at intervals to ensure safe passage of animals across the canal as well as to facilitate those animals that fall into the canal to exit the canal easily.

638 At a meeting held with officials of the Department of Wildlife Conservation, in 2013, the following were discussed:

1. The DWC noted that elephants gather near Minneriya Tank and other water bodies during the dry season from about July to October. It was advised not to disturb their movement and to restrict construction activities across their movement paths during that period. This was agreed to, and the construction schedule will be prepared in consultation with DWC.
2. The period of construction within Minneriya NP to be kept to a minimum.as there is a section of the tunnel that will be created by the blasting method.
3. Safe passage and escapes (when accidently falling to the canal) for wild animals be provided in at least 400 m intervals. This has been considered in the detailed design.
4. During the construction period that person/s from DWC will work closely with the project proponents. This will help to relocate/rescue any animals that may get trapped in a project work area, or threaten the workers and to reduce/prevent illegal activities such as hunting and removal of animals, plants and other resources from within MNP, the sanctuary and the nature reserve.

645 Preliminary discussions with the DWC officials resulted in the following mitigation measures being identified as suitable to be carried out under this project.

Measure	Purpose	Cost
Rehabilitation of 10 small tanks within protected areas of the DWC	Improve water resources for wildlife especially during the dry seasons	At @ SLR 3 million /tank Total cost of SLR 30 million
Removal of alien invasive plant species in 250 ha inside protected areas	Improve habitat quality and availability	SLR 20 million
Establishment of a new office of the DWC at Dambulla	Increase capability for monitoring and protection of	SLR 6 million

	wildlife and their habitats	
Provision of five motorcycles for wildlife officers patrol duties	Increase of capability for monitoring and protection of wildlife and their habitats	At@ SLR 250,000 x 5 units Total cost of SLR 1.25 million
Solar powered water supply systems for use in PAs	Improve conditions within PAs for DWC	At @ SLR 3.5 million x 5 units Total cost of SLR 17.5 million
TOTAL COST		SLR 74.75 million

639 **Mitigation measures against introduction and spread of alien invasive species:** As there are only a few AIS present in the project area, this serious threat resulting from project activities must be mitigated. As there are large extents of protected areas nearby and as the project work will also be carried out within parts of protected areas, the following should be implemented.

640 A baseline survey of alien invasive species in the project area with specific locations of their occurrence, extent and trends of spread must be conducted. From the results of this survey, supplemented by the existing information on alien invasive species occurring in the general region of the UEC, and with inputs from major stakeholders such as the Ministry of Environment and Renewable Energy, the Department of Agriculture, Department of Agrarian Services, the local and provincial authorities, the project proponent should develop a detailed AIS management plan aimed at prevention and/or reduction of introduction, and management if already introduced.

5.5 Proposed Mitigatory Measures to Minimize the Anticipated Impacts on identified Archaeological Remains and Remains of Archaeological Nature

641 As stated in Chapter 4, there are some sites of archaeological importance that are directly affected by the project. The project designers are in the process of drawing up plans to avoid damage or loss of sites. The independent archaeological assessment conducted by the Archeological Department of Sri Lanka, provided by the project proponent will serve as guidance for avoidance and minimizing of adverse impacts.

642 **General considerations of environmental impact mitigation and management**

- Conditions related to all significant impacts of construction activities should be in contract conditions, and strictly field monitored.
- All operators/operations that require Environment Protection Licences and permits from the Central Environmental Authority, the Geological Survey and Mines Bureau, local authorities etc. should be obtain such licenses/permits prior to commencement of operations and should be included in contract conditions.
- Decommissioning of equipment, machinery at the end of construction phase should be conducted speedily and effectively

- Liasion with the grievance redress committee (GRC) established in project affected areas is very important to resolve environmental and social problems affecting the community
- The PMU should have a unit staffed with officers with suitable training and experience to co-ordinate/liaise with relevant stakeholders and be in charge of field level environmental impact management. Liaisons with officials of the departments of forest and wildlife conservation are very important, as well as with the GRC that is major forum for community representation. The functions and duties of the unit/persons should be detailed before start of construction activities.

643 This unit/persons should report to the Project Director on a regular basis and also represent the PMU where necessary to resolve problems over environmental impacts of project activities.

Figure 5.2 – Proposed Reforestation Area in the Catchment of Huruluwewa

CHAPTER 6

6. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

644 During the project design and feasibility studies there was a continuous information disclosure engaging stakeholders at all levels. During the initial period meeting were held with Divisional Secretaries, Chairmen of Pradeshiya Sabhas and government officers were informed on the project by the feasibility team. Such meetings were held in Elahera and Galenbindunuwewa Divisional Secretary Offices.

645 Two community meetings held representing all the affected families. Following table provides basic information on the meetings.

Table 6.1 Details of the Community meetings

DS Division	GN Division	Date	Venue	No. of stakeholders represent	No. of officers present
Elehera		Jan-March 2013	Field surveys	Approx. 20	04
Galenbindunuwewa	Yakalla	21st April 2014	Yakalla Community Hall	22	07
Elahera	Elahera	22nd April 2014	Elahera Community Hall	18	05

646 Officers representing following agencies were present.

1. Ministry of Irrigation and Water Resources Development
2. Irrigation Department
3. Divisional Secretaries, Galenbindunuwewa/ Elehara
4. Grama Niladaries of relevant GN divisions.
5. Land Officers of DS office
6. Consultants

647 The communities in the project area were consulted in order to raise awareness about the project as well as the possibility of relocation and other impacts. The issues that were raised and discussed were, among others:

- Issues pertaining to the details and implementation of the project;
- The possibility of relocation for some of the affected families and other issues connected to this.

648 The participator approach system was utilized in order to gauge the responses of the communities to the project and its impacts. The response rate to this method was about 90%

from the affected party. The parties with whom these issues were discuss included the community members, government officials, as well as all parties liable to be affected by the implementation of the project. The grievances that were raised by the affected parties were discussed and solutions given where necessary and practicable.

649 Also, the details pertaining to the project were explained to the communities with the maximum transparency. This was considered to be especially important since the communities were those impacted as well be to be the final beneficiaries of the project outcomes.

650 The relevant views expressed by the community at the discussions are summarized below.

651 The programmes carried out under the two sections.

1. The first section of the programme dealt with the awareness of the community about the UEC project. This includes information about the canal trace, design, benefits of the project, Time period, Budget, etc.
2. The second section of the programme was concerned with raising the awareness of the affected community about the resettlement and compensation programmes. This 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.

652 The first part of the programme was conducted by project engineers of the UEC staff and explained clearly all the information regarding to the project. People asked to change the canal trace to minimize impacts to the community. Most them expressed find to alternatives to issue water for their lands. The provision of water for drinking and domestic purposes was also discussed.

653 The Consultants explained the environment, social and economic impacts to the affected community. This programme was carried out according to the participatory approach system. As a group exercise, the Social and economic impacts to the community were identified and the mitigation procedure was also discussed.

654 In this discussion, attention was paid to the following sectors:

- Families affected to the residence and home gardens
- Families affected to the home gardens only
- Families affected to the high lands
- Families affected to the Paddy lands
- Indirectly affected families
- Members of CBOs

655 The community members stated that many problems arose regarding the loss of their lands and houses. Their livelihood mainly depends on the crop cultivation and work as agricultural labour activities. They built their houses step by step within a long period. Therefore they need a sufficient compensation package. All the participants expressed their agreement to this system. The social value should also be considered and not just the economic value, in compensating for the losses of the people. The ideas expressed by all

involved were that the compensation should also adequately take into consideration the disruption of the social life of the affected people, and that a more generous package should be provided as a result. As such the factors discussed below should be taken into consideration.

- All the families unanimously expressed that their interest in locating themselves within the remnant parts of their lands which will not be affected by the project. Most of the people will be lose less than 30 percentage of the land. If the houses damaged there is a sufficient land to rebuild a house.

- 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 were highlighted.

- Some famers ask for available opportunities for getting water for cultivation for agriculture and drinking and domestic purposes. Since they traditionally face severe droughts in the Yala season, it would ease their problems no end if sufficient water was provided in the dry season.

- Some people expressed that most of the families owning one acre or half an acre of land losing a part of it is a problem to their livelihood and need a sufficient amount of compensation.

- No objections were expressed by the participants about the construction of the UEC. Their view was after completion of the UEC the land value of the existing land will go high.

- Another issue forwarded by the community is due to the relocation they loss of connection with relatives, friends and neighbors that they enjoyed currently. The current relationship was built within the long period it is difficult to rebuild with the new families. In this area with the relation of neighbors their children have security.

- A few people also submitted that loss of access to religious places was a significant issue. Some explained that they have loss of the membership in the current societies and loss benefits.

- Regarding the evaluation of infrastructure, the people are of the opinion that they may stand to face a disadvantage where electricity and roads are concerned. When inquiries were raised about preferences pertaining to aspects of relocation and resettlement, there seem to be no consensus among the members of the community as such, although a significant percentage opt to be resettled with the lands and compensation which is sufficient to cover ant losses they might incur at all levels.

- When the place of relocation is considered, on the other hand, a slight pattern is discernible; the preference seems to be towards relocation *as near as possible* to the area.

- They ask for compensation for timber trees which due to be removed; but to be used subsequently to build their houses.
- Provide facilities available now such as electricity for the newly build house as a case of relocation.

- Provide employment which will be created due to the construction programme.

- The community was informed of the compensation package that they would receive.

- After all the compensation done could be started the construction works.

- They have doubt government valuation will be low and not pay in a sufficient level will be delayed.

- The community representatives should be included to the valuation committee and grievances committees

Awareness meeting held at Community hall in Galenbindunuwewa

656 A meeting was held on 21.07.2014 with the stakeholders in the water sector including NGO's, by the MIWRM. The objective of the meeting was to make the stakeholders aware of the NCP project and obtain constructive ideas to carry the projects carried out by the ministry in an environment friendly manner. The approach to develop a strategic environmental action plan to mitigate HEC was also presented and discussed. The minutes of the meeting is given in Annex V. As given elsewhere in this document, the GRM will be operationalized during the project period**.** This mechanism will involve consultations at the community level in the project area.

657 This document will be made public as per the requirements for EIAs of the National Environment Act of 1980 and public comments solicited. It will be made

available in all three official languages of Sri Lanka. The EIA report will be made public on ADB's website 120 days prior to consideration for funding by its Board.

658 The project has designed a communication strategic plan which describes the consultation process to be carried out during project implementation. Various activities have been designed under this plan to not only to keep informed those directly impacted but other parties as well on the project's progress.

Awareness meeting held at Community hall in Elahera GN division

CHAPTER 7

7. GRIEVANCE REDRESS MECHANISM

7.1 The Rationale

659 **The Rationale**: During the construction and implementation phases of any development project, a person or group of people can be adversely affected, directly or indirectly due to the project activities. The grievances that may arise can be related to social issues such as eligibility criteria and entitlements, disruption of services, temporary or permanent loss of livelihoods and other social and cultural issues. Grievances may also be related to environmental issues such as excessive dust generation, damages to infrastructure due to construction related vibrations or transportation of raw material, noise, traffic congestions, decrease in quality or quantity of private/ public surface/ ground water resources, damage to home gardens and agricultural lands *etc*.,

660 Should such a situation arise, there must be a mechanism through which affected parties can resolve such issues in a cordial manner with the project personnel in an efficient, unbiased, transparent, timely and cost-effective manner. To achieve this objective, a grievance redress mechanism (GRM) has been included in the overall Environmental Management framework of this project.

661 In order to ensure that any grievance that may arise is resolved in a manner that will accrue maximum benefits to both the project and affected parties, the following aspects were taken into consideration in developing the proposed GRM:

- Establish an effective communication link between the project and affected parties
- To build up productive relationships among the stakeholders including affected parties
- Provide a mechanism for the affected parties to negotiate and influence the decisions and policies of the project which might adversely affect them
- Mitigate or prevent adverse impacts of the project on the environment and produce appropriate corrective or preventive action
- To harmonize project activities with the activities of potentially affected parties to avoid grievances or disputes if possible before they arise
- Should a grievance or dispute arise, provide a forum for addressing such issues at the lowest possible level so that they are resolved as and when they occur.

7.2 Complaints Management

662 All complaints regarding social and environmental issues are usually 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 (GRC, see below).

663 The proposed complaint handling and Grievance Redress Mechanism is illustrated in Figure 7.1.

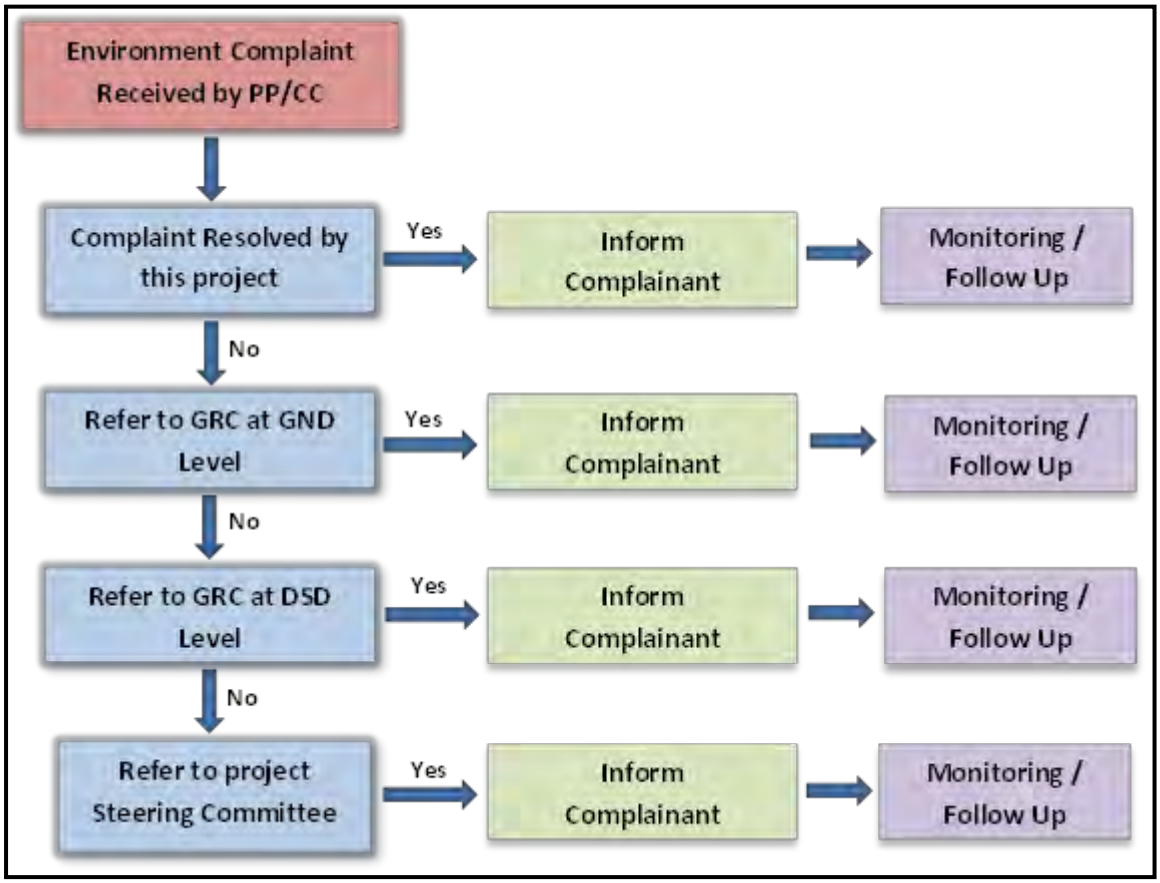


Figure 7.1- Complaint handling and Grievance Redress Mechanism(PP = Project Proponent (MI&WRM); CC = Construction Contractors)

664 **Grievance Redress Committee (GRC):** The Upper Elahara Canal Project, in keeping with the ADB and national safeguard policies, will set up Grievance Redress Committees (GRC), which will function as independent bodies to find solutions to the grievances and disputes of the affected and concerned parties.

665 The appointment of the GRC will be notified to the general public by publication of a notice in national newspapers in three languages i.e., Sinhala, Tamil and English. The local community will also be informed about the grievance handling procedures of the project through Grama Niladharis of the area and displaying notices at important public places including key construction sites within the Divisional Secretariat Divisions of Elehara, Gallenbibunuwewa, Palugaswewa and Higgurakgoda.

7.2.1 Institutional Arrangements for GRM

666 Grievance Redress Committees will be set up at two levels, the Grama Niladhari level and Divisional Secretary levels of the Elehara, Gallenbibunuwewa, Palugaswewa and HiggurakgodaDS Divisions. The Grama Niladhari or the Divisional Secretary will function as the Chairperson of the respective GRC's. Members to represent the Affected Persons (AP) at the GRC will be appointed from among respected persons in the area on the recommendations of the Divisional Secretaries of Elehara, Gallenbibunuwewa, Palugaswewa and Higgurakgoda. Other members of the GRC shall be the Project Director (PD) or relevant officers from the PIU, representative(s) from relevant Community Based Organizations, representative(s) of the Contractor(s) and representative(s) from relevant line agencies. An officer nominated by the Project Director of the UEC project will serve as the Secretary to the GRC. An honorarium will be paid to the members of the GRC and the required funds for operation of the GRC will be borne by Irrigation Department.

1) GR Committee at GND level

667 **Committee Structure**: Grama Niladhari, Village level government officer (agrarian services/ ID), CBO 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.

668 **Role of the Committee**: Receiving complaints and grievances pertaining to the project activities submitted by the affected person or community.

669 Investigate, discuss and analyze the problems within the committee and propose fair and just solutions or remedies if possible. Otherwise, pass it to the committee at the next level with suitable recommendations.

2) GR Committee at DSD level

670 **Committee Structure**: Divisional Secretary**,** Grama Niladaris of relevant GNDS, Project director or his representative of PIU, CBO leaders, Contractors or his representative, relevant line agencies

671 **Role of the Committee**: Investigate, discuss and analyze the problems in broad detail within the committee and propose fair and just solutions or remedies if possible.

672 If the GR committee at the DSD level fails to resolve the issue, it will be directed to the project steering committee where it has to be resolved.

673 A regular time table should be prepared for the meetings of the relevant committees setting dates and times and a regular process should be developed to inform the committee members of the meeting dates and times.

674 At Grama Niladari level the community should be informed of the places, times and procedures of accepting and hearing grievances & complaints from the community.

675 A minimum time period should be set to deal with the problems at each level (2 weeks maximum).

676 **Terms of Reference of GRC:** The GRM will be established by Irrigation Department during the pre-construction stage, so that the GRC and grievance redress procedures are in place and functioning before land acquisition, resettlement and project construction activities begin. The following is a draft ToR for the GRC, which Irrigation Department will consider and incorporate or amend as necessary:

- The GRC will examine any kind of dispute or grievance arising out of implementation of the Resettlement Plan (RP) and Environmental Management and Monitoring Plans (EMP and EMoP) and resolve such disputes and grievances in a transparent manner.
- GRC will not deal with matters that are pending in a court of law.
- The GRC will not have any jurisdiction over the amount of compensation determined by the Chief Government Valuer.
- The decision of the GRC is deemed final, although a dissatisfied complainant may seek redress through the Sri Lankan legal system, if they so wish.
- Only authorized members will be allowed to participate in the GRC meetings (including the relevant Affected Persons and their representatives).
- A decision on a particular dispute/grievance will be made unanimously or on a majority vote basis.
- The disputes and grievances will be resolved on the first day of the hearing or within 2 – 4 weeks of the first hearing where the issues may be more complicated and more information is required to arrive at a decision.
- A Hearing of certain disputes or grievances may be postponed and a new date be fixed if more evidence is required to make decisions.

- The decision of the GRC will be intimated to the Project Director and the aggrieved party in writing within a week from the meeting.

677 A suitable place and other facilities to conduct the meetings of the GRC will be provided by the UEC Project. However, GRC meetings can also be held at any other suitable location for the convenience of the affected parties (e.g. in case of ill health or any other valid reasons).

678 The GRC is expected to meet at least once a month, although more meetings may be held depending on the number of complaints received. The GRC may make field visits where necessary and these will be facilitated by UEC Project.

679 **The following general conditions should also apply**: Persons who make appeals to the GRC shall attend the meetings of the GRC in person. In a case where the appellant is unable to attend the meeting on the appointed date due to sickness or other unavoidable circumstances, he/she can nominate a close relative or other representative in writing.

680 No legal professionals are allowed to represent an appellant.

681 Appellants may request an alternative date to attend at a particular meeting of the GRC if they are physically unfit to attend the meeting or due to other unavoidable circumstances.

682 There is the need of establishment of an internal mechanism in the MI&WRM to look into individual or collective complaints and grievances of the Project Area community pertaining to matters connected with the project activities. They should be able to analyze public grievances received to help identification of the problem areas in which modifications of policies and procedures could be undertaken with a view to making the delivery of services easier and more expeditious. They should deal with every grievance in a fair, objective and just manner and issue written reasons for every grievance rejected. This would lead to develop a finer rapport between the Project and the affected community and also reduce the hardships connected with problems the community is facing individually or collectively. This mechanism should also provide counseling and awareness on following **.**

- Awareness of the Project
- Identifying the affected families
- Payment of compensation
- Establishment if infrastructure facilities

683 The structure of the Grievance Redress Mechanism has been built in a manner that the community will be able to participate in discussions with relevant officers in solving their problems starting at the grass root level and linked to the higher level.

CHAPTER 08

8. THE ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

684 The environmental management plan is based on the anticipated impacts and their mitigation measures that are provided in chapters 4 and 5. However, as the project progresses, the EMP should be updated regularly to include any additional requirements, such as unanticipated adverse impacts that may arise during project implementation. The EMP is designed to minimize and mitigate and/or offset unavoidable adverse impacts, and to enhance beneficial impacts.

685 The primary responsibility for implementing the EMP lies with the contractor and the Project Management Unit (PMU) of the Upper Elehera Canal Project of the Ministry of Irrigation and Water Resources Management, and the Mahaweli Authority of Sri Lanka, GoSL. Other government and non-government organizations, community and civil society representatives will also play a role in monitoring the environmental impact management of this project. See also the Grievance Redress Mechanism in Chapter Five. The detailed structure of the project management authority, its functions, responsibilities, implementing arrangements etc. are yet to be finalized.

A. Implementation arrangements

686 The project management structure for the UEC is being designed by the Ministry of Irrigation and Water Resources Management. It will comprise of a Program Management Unit headed by a Program Director, supported by a Project Implementation Unit (PIU) located at project sites and senior officers handling environmental conservation and mitigation aspects, construction aspects, procurement aspects etc. The PMU and PIU will include an environmental officer each. In addition a national and international environment expert will be hired by the project management unit to provide technical support for the environment monitoring work.

687 The international and national consultants and environmental officer attached to the PMU will be responsible for management of environmental safeguards in the entire program and will prepare monitoring protocols and train the environmental officers attached to the PIUs as well as supervise the work done by environment officers.

688 In addition to routine monitoring by the PMU, Independent monitoring of the project impact and mitigation will be handled by an independent group of specialists as and when required.

Implementation Arrangements

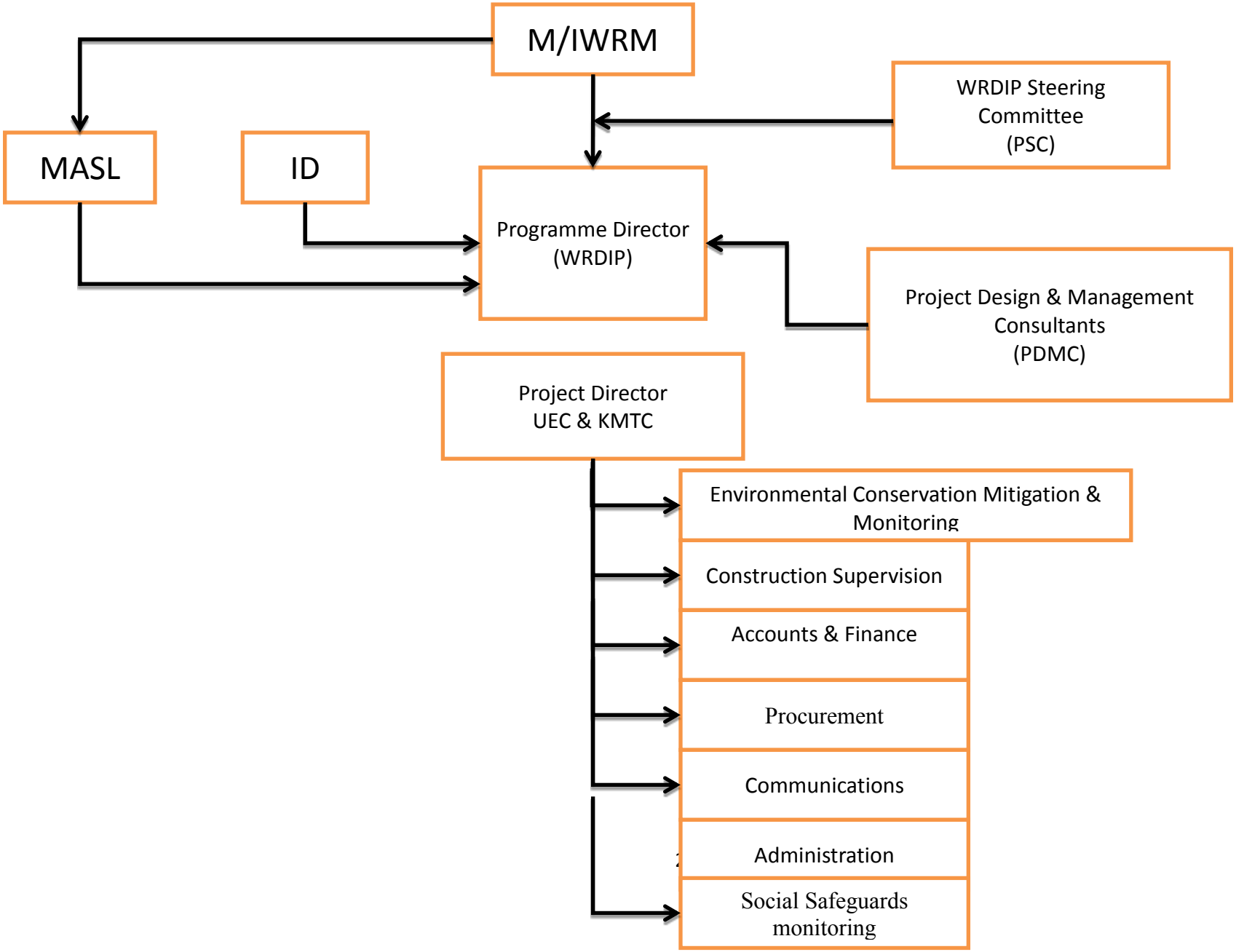


Table8.1 Permits, clearances and approvals

Ownership organization	Purpose	Responsible Organization	Time Frame
Ministry of Irrigation and Water Resources Management (MIWRM)/Government of Sri Lanka	Construction and operation of the Upper Elehera Canal Project	MIWRM	Project period including signing of loan agreements – yet to be achieved.
MIWRM	Obtaining environmental clearance for the project after submission of the Environment Impact Assessment Report (EIAR)	Central Environment Authority (CEA)/Ministry of Environment and Renewable Energy	Period set by the CEA scoping committee for EIAR - yet to be achieved.
MIWRM	Approval of scoping report and issuance of TORs for EIAR	CEA	Period set by CEA - achieved
	Issuance of letters of consent and any conditions for proceeding with the EIA process for the project	The Forest Department/Ministry of Environment and Renewable Energy	Period set by CEA - achieved
	Issuance of letters of consent and any conditions for proceeding with the EIA process for the project	Department of Wildlife Conservation/Ministry of Wildlife Resource Conservation	Period set by CEA - achieved
	Preparation of an independent Archaeology Impact Assessment for the project	Department of Archaeology/Ministry of National Heritage Conservation	Period set by the CEA for preparation of the EIAR - completed

Ownership organization	Purpose	Responsible Organization	Time Frame
	EIAR approval	CEA	Period set by the CEA – yet to be achieved.
MIWRM	Approval of the EIAR by the ADB	ADB	Mandatory period of 120 days disclosure period prior to approval for financing
MIWRM	Clearance to conduct construction within Minneriya NP, Elehara-Giritale Sanctuary and Minneriya-Giritale NR, Hurulu FR, plantation forest	Department of Wildlife Conservation, Department of Forests	Time period agreed between MIWRM and the departments - yet to be achieved.
MIWRM and PMU	Permits for extraction of rock, soil etc from already operational quarries	Geological Survey and Mines Bureau (GSMB), CEA (Environment Protection License (EPL), DS, GN	Construction phase - yet to be achieved.
MIWRM and PMU	Obtaining power supplies for operation of TBM, project offices, worker camps and other facilities of the project	Ceylon Electricity Board/Ministry of Power and Energy	Construction phase - yet to be achieved.
MIWRM and PMU	Access roads creation and modification of existing roads.	MIWRM / PMU and Road Development Authority	Construction phase - yet to be achieved.
MIWRM and PMU	Pipe borne water supplies to project facilities	Water Supply and Drainage Board, DS, Secretary, GN	Construction phase - yet to be achieved.
MIWRM and PMU	Valuation of properties and lands to be acquired by the project	Valuation Dept/GOSL, Department of Agriculture Department of Agrarian Development, Grievance Redress Committee of the project,	Before commencing construction

		community based organizations of the affected areas	
Ownership organization	**Purpose**	**Responsible Organization**	**Time Frame**
MIWRM and PMU	Compensation packages approved	MIWRM, PMU, Grievance Redress Committee of the project, community based organizations of the affected areas	Before commencing construction
MIWRM and PMU	Resettlement of families	Pradehiya Sabha (PS), other local authorities, DS, GN, Department of Social Services, Grievance Redress Committee of the project, community based organizations of the affected areas	Before commencing construction
MIWRM and PMU	Provision of infrastructure for resettled areas	PS, other local authorities, DS, GN, RDA, CEB, Water Supply and Drainage Board(Ministry of Water Supply and Drainage, Grievance Redress Committee of the project, community based organizations of the affected areas	Construction phase
MIWRM and PMU	Entering resettled school children into new schools	Department of Education, regional education authorities, Grievance Redress Committee of the project, community based organizations of the affected areas	Construction phase
MIWRM and PMU	Facilitating other services such as health care, social services for senior citizens etc.	Regional health authorities, DS, GN, Grievance Redress Committee of the project, community based organizations of the affected areas	Construction phase

Ownership Organization	Purpose	Responsible Organization	Time Frame
MIWRM and PMU	Construction of worker camps, establishment of water, sanitation and waste disposal facilities for workers	Contractor after obtaining and permits from the local government authorities.	Construction phase
MIWRM and PMU	Permits for transport of sand, rock, excavated materials and operation of disposal sites from the GSMB and DS.	Contractor	Construction phase
MIWRM and PMU	Operation of metal crushers, concrete mixing, batching plants, use of explosives for blasting, operation of tunnel machinery etc. After obtaining necessary permission from GSMB, CEA and local government authorities.	Contractor	Construction phase
MIWRM and PMU	Solid waste disposal after obtaining permission from local government authorities and the CEA.	Contractor	Construction phase

B. General guidelines for environmental and social impacts management

1. Social impacts management

689 The social impacts and their mitigation measures including the draft Involuntary Resettlement Plan are given in Chapter 4, 5. All activities related to social impacts will be conducted according to descriptions provided in the mitigation plan and the Resettlement Action Plan. The final Resettlement Action Plan will contain more detailed procedures and mechanisms for mitigation of socio-economic impacts. This is now under preparation.

2. Environmental management

690 For all types of environmental impacts during construction, air, water pollution, occupational safety of workers, activities that affect the safety and health of communities, etc. environmental management components to be included in tender documents with terms and conditions for implementation in contract documents.

691 **General considerations of environmental impact mitigation and management**

- Conditions related to all significant impacts of construction activities should be in contract conditions, and strictly field monitored.
- All operators/operations that require Environment Protection Licences and permits from the Central Environmental Authority, the Geological Survey and Mines Bureau, local authorities etc. should be obtain such licenses/permits prior to commencement of operations and should be included in contract conditions.
- Decommissioning of equipment, machinery at the end of construction phase should be conducted speedily and effectively
- Liasion with the GRC established in project affected areas is very important to resolve environmental problems affecting the community.
- The PMU should have a unit staffed with officers with suitable training and experience to co-ordinate/liaise with relevant stakeholders and be in charge of field level environmental impact management. Liaisons with officials of the departments of forest and wildlife conservation are very important, as well as with the GRC that is major forum for community representation. The functions and duties of the unit/persons should be detailed before start of construction activities. These unit/persons should report to the Project Director on a regular basis and also represent the PMU where necessary to resolve problems over environmental impacts of project activities.

Table 8.2 Summary of impacts and mitigation measures

Activity and Impact	S[4]	D	Mitigation Measure	Responsible Organization/s	Cost	Location/s	Implementation
Phase- Design and Planning							
UEC trace causing habitat loss, degradation and fragmentation within protected areas/natural habitats	H	L	Redesigned to avoid protected areas/natural habitats, as much as possible and creation of tunnels within protected areas.	MIWRM MCB	Included in civil cost	Section of Elehera-Giritale Sanctuary	Construction phase
Animals being trapped in canal by falling into it	M	L	Included 35 no of safe escapes for animals by mild slopes and steps in the canal banks in selected areas	MIWRM MCB	-do-	In open canal sections in protected areas	Construction phase
Blocking of migratory routes of elephants and other large animals	M	L	Reduced open canal segments especially within protected areas	MIWRM MCB	-do-	Migratory routes. See also EMP of MADP and KRAEP Annex X	Construction phase
Decrease of water for wildlife due to loss of natural habitats	L	L	Supply of water to 3 level crossing tanks to provide water mainly for wildlife	MIWRM	-do	Kongetiya, Madaththewa and Bogahawewa	Construction and O & M phases
			Open canal sections, with mild slopes to enable wildlife to access water	MIWRM MCB	Included in the civil cost	Parallel to Elehera Sanctuary and elephant fence	Construction and O & M phases
Loss of habitat from UEC and compensation for natural habitats			Additional area to be reforested between UEC and FSL of Hurluwewa	PMU to Monitor Contractor to Implement	Area of 252 ha at a rate 600,000= 151.2 Million	Between Huruluwewa FSL and 60+000 km to 65+500 of UEC	Construction

[4] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance.
Duration of Impact- Duration S-Short term, M-Medium term, L-Long term Residual Impact- Remaining impact after mitigation
Residual Impact- Moderate (negative) - ++, Low/Insignificant (negative) - +, B- Beneficial

Table 8.2 Summary of impacts and mitigation measures contd….

Activity and Impact	S[5]	D	Mitigation Measure	Responsible Organization/s	Cost[6] (SLR)	Locations/Persons	Implementation
Phase- Design and Planning							
Land acquisition and involuntary resettlement	H	L	Compensation, resettlement and other benefits included in RAP	MIWRM, PMU,GRC	Included in RAP	Locations identified in RAP	Prior to construction phase
Loss of livelihoods, assets, decrease of income from livelihoods/assets	M	M	Compensation, resettlement and other benefits included in RAP	MIWRM PMU, GRC		Households and individuals identified in RAP	Prior to construction phase
Decrease of property/asset values	M	S	Compensation packages in RAP	MIWRM PMU, GRC		Families and individuals identified in RAP	Prior to construction phase
Disadvantage due to inadequate power, water supply and sanitation facilities in resettled areas	M	S	Adequate provision of infrastructure for resettled families	MIWRM PMU, GRC			Prior to construction phase
Loss of timber trees, other home garden resources etc	L	S	Compensation packages in RAP	MIWRM P MU,GRC			Prior to construction phase
Adverse impacts on social and religious aspects of resettled individuals	L	S	Resettlement options as close as possible to former neighborhoods	MIWRM PMU,GRC			Prior to construction phase
Greater adverse impacts on elderly, women, children and persons with disabilities	H	S	Special measure for vulnerable groups in RAP	MIWRM, PMU, GRC			Prior to construction phase
Grievances due to project in affected communities	M	L	GRC established and operational with community participation	MIWRM, PMU, GRC		For each affected DS division	Throughout the project period

[5] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance.
D- Duration of impact, S-Short term, M-Medium term, L-Long term

[6] Capital and Recurrent costs included

Table 8.2 Summary of impacts and mitigation measures contd….

Activity and Impact	S[7]	D	Mitigation Measure	Responsible Organizations	cost	Locations/Persons	Implementation
Physical Resources- Construction and Operation and Maintenance							
Site clearance and removal of vegetation causing soil erosion, siltation & sedimentation of waterways, blocking of adjacent lands, adverse impacts on community	H	L	Minimum areas cleared for construction of canal, structures and other facilities; carry out work in dry seasons; design adequate drainage pathways with silt traps as required;	PMU to monitor, Contractor to implement	For a part of the measures no additional cost part included in civil cost	Total project impact area	Construction phase
Clearing of resettlement areas, for houses and infrastructure	M	L	Same as above	PMU to monitor, Contractor to implement	Included in RAP	Resettlement areas identified in RAP	Before construction phase
Creation of access roads for project and modification of existing roads causing change of drainage patterns, soil erosion and road surface damage, affecting community safety	H	L	All roads designed and constructed to prevent these negative impacts, including providing adequate culverts, slope protection Safety barriers at dangerous locations, and bypasses at locations where existing roads are crossed by open canal or cut & cover conduits. Adequate signs to indicate traffic diversion	PMU to monitor, Contractor to implement	Included in civil cost	All roads created and crossed by UEC route, by the project	Construction phase
Slope failure and soil erosion due to removal of vegetation and soil for KMTC tunnel sections	M	L	Removal of detached/unstable rocks, boulders; terracing adopted in deep cuts of 15m and above; consolidation grouting and shot-creting; drainage around the portals and hillsides; all other measures as specified in	PMU to monitor, Contractor to implement	Included in civil cost	KMTC route inlet and outlet portals	Construction phase

[7] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance. D- Duration of impact, S-Short term, M-Medium term, L-Long term

			contract documents				
Construction yards, vehicle parks and sites of temporary disposal	M	S	All such sites to be rehabilitated with suitable native species after removal of dumped material and leveling under the supervision of FD	PMU to monitor, Contractor to implement	Total of 250 ha. Contractor - SLR 150 million	All, dump sites, yards etc	End of Construction Phase

Activity and Impact	S[8]	D	Mitigation Measure	Responsible Organization/s	Cost	Locations/ Persons	Implementation
Disturbance to natural drainage patterns and stream crossings during construction of canal	M	S	Shorten period of construction; minimize disturbance to natural drainage; suitable drainage methods implemented; restoration of Lel Oya aqueduct site	Contractor to implement PMU to monitor	Included in the civil cost	Total project area	Construction phase
Changes to Ground Water Table in cut and cover and conduit sections	M	S	Layer of permeable sand/gravel to enable drainage on both sides of these sections, canal lining, treatment of weak zones;	Contractor to implement PMU to monitor	Included in Civil cost	Cut and cover and conduit sections of canal	Construction phase
Changes to Ground Water Table in tunnel sections	M	M	Grouting & Concrete lining of areas that require such interventions;	Contractor to impelement PMU to monitor	Included in the civil cost	Areas of tunnels identified in detailed designs	Construction phase
Ensuring environmental flows	M	S	Operation of sluices of existing tanks to ensure env. flows and strict monitoring to ensure during dry periods, UEC design does not affect e-flows	MIWRM / ID	No additional cost	Three level crossing tanks	O & M phase
Decrease of surface water quality	M	S	Adhere to approved solid and liquid waste management plans and avoid contamination of water; ensure compliance with current water quality standards of the CEA	Contractor responsible to implement PMU to monitor	Waste management plans part ofcivil cost for contractor Additional cost of SLRs 2 million for water quality testing by contractor	In all constructio n areas of the project	Construction phase
			Use only designated disposal sites and no disposal near banks of	PMU to monitor	Included in Civil cost		Construction phase

[8] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance.
D- Duration of impact, S-Short term, M-Medium term, L-Long term

			waterways, slopes, prevent erosion of soil used for embankment creation	Contractor to implement			
			Access roads to be constructed to reduce soil erosion	PMU to monitor Contractor to implement	Included in Civil cost		Construction phase

Activity and Impact	S[9]	D	Mitigation Measure	Responsible Organization/s	Cost	Locations/Persons	Implementation
Water pollution through worker facilities and behavior	M	S	Worker awareness, ensuring suitable locations for camps and sanitation facilities; proper waste disposal methods; suitable water supplies to camps;	PMU and Contractor	Included in civil cost	All worker camps and facilities in the project area	Construction phase
Water pollution in Huruluwewa command area through increased use of agrochemicals as a result of higher cropping intensities			Test and take appropriate action on water quality in supply canals and return water from agricultural fields for agrochemicals over the longer term; develop a programme to reduce use of agrochemicals	PMU for baseline and monitoring through independent group	PMU- 0.9 million For base line. Contractor-1.0 million/year for 10 years long term included in the Monitoring cost	Command area of Huruluwewa	Operation and Maintenance phase
Impacts of tunneling on slopes	M	L	Grouting and treatment of weak zones, lining, shot-creting etc	PMU to monitor Contractor to implement	Included in civil cost	Sites of tunneling	Construction phase
Impacts of entry and outlet portals of tunnels on hillsides	M	L	Drainage interventions, landscaping to reduce slope failure	PMU to monitor Contractor to	Included in the civil cost	Sites of tunneling	Construction phase O & M phase

[9] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance.
D- Duration of impact, S-Short term, M-Medium term, L-Long term

				implement			
Vehicles and operation of machinery causes air pollution (gases, PM)	M	S	All vehicles to have emission testing periodically, monitoring of air quality in sites of high impact	PMU	Contractor-Included in the civil cost PMU- independent groupSLR18 mn for air quality	All locations where applicable	Construction phase
Increase of dust levels due to construction activities and transport of material	H	S	Minimize quantity and duration of soil exposure; watering of construction sites; covering disposed of and transported materials; road surfaces to be paved if possible; monitoring of dust levels; in contract conditions	Contractor	Included in the civil cost	All locations where applicable	Construction
Impacts on mineral resources by tunneling, excavations	L	S	Valuable minerals such as marble to be considered for other uses	PMU	No additional cost	All locations where applicable	Construction phase
	L	S	Any chance finds of precious minerals will be informed to the Divisional Secretary, GSMB and Gem and Jewellery Authority in contract conditions	PMU Contractor	No additional cost	All locations where applicable	Construction phase O & M phase

Activity and Impact	S	D	Mitigation Measure	Responsible Organization/s	Cost	Locations/Persons	Implementation
Noise and vibration due to operation of machinery	H	S	Use TBM in the designated sites only where blasting is used, apply current practice standards and then give prior information to neighboring areas including monitoring; Pre-and post-blasting surveys with photographic evidence	PMU	Contractor- No additional cost PMU- Rs 17 million for monitoring noise vibration &blasting surveys	All locations where applicable	Construction
Noise and vibration due to construction activities	M	S	Such types of work near public-gathering places to be restricted between 7am-6 pm; monitoring of noise levels in high impact areas/events; adequate notice given to communities of such events; co-ordination with GRC for such events; license from the GSMB for operation of blasting sites; adhere to technical conditions	PMU Contractor GRC	Included in the civil cost	All locations where applicable	Construction phase
Noise from transport and other vehicles	M	S	Vehicles subjected to periodic maintenance to ensure adherence to noise standards	PMU to monitor Contractor to implement	No additional cost	All locations where applicable	Construction phase
Disposal of waste material due to tunneling, excavation, roads, other construction activities	M	S	Waste disposal only in designated disposal sites identified in EIA; adhere to guidelines; in contract documents. If any new areas to be opened for disposal, they should have prior approval of the authorities. Permanent disposal sites to be leveled, landscaped and closed by the end of construction period. All the dumped material to be removed from the	PMU to monitor Contractor to implement	Included in the civil cost	All locations where applicable	Construction phase

			temporary disposal sites.				
Solid waste disposal issues	M	S	Develop solid waste disposal management plans in consultation with local authorities; ensure compliance by contractor to guidelines; maintain monitoring programme	PMU Contractor Local authorities	Contractor-included in the civil cost PMU SLR 2 million	Designated disposal areas and all other relevant locations	Construction phase
Storage of explosive material	M	S	Ensure safety against fire and theft, with barriers, locking arrangements, employment of security	PMU Contractor	Included in the civil cost	All locations where applicable	Construction phase
Problems due to sanitary facilities of worker camps and offices	M	S	Ensure location and design of sanitation facilities to prevent contamination of water, soil; in contract conditions		Included in the civil cost	All locations where applicable	Construction phase

Activity and Impact	S [10]	D	Mitigation Measure	Responsible Organization/s	Cost	Locations/Persons	Implementation
Ecological Resources- Construction and Operation and Maintenance phases							
Habitat loss, degradation due to project	H	L	Reforestation/enrichment planting along the canal; degraded areas; based on sites and guidelines of the FD in elehera giritale sanctuary	PMU to Monitor Contractor to Implement	See Chapter 5 for activities and cost breakdown 250 ha approx. at SLR 600,000 /ha to be reforested, Contractor- SLR 150 million	Locations to be finalized in consultation with FD	Last stage of the construction phase
			Reforestation/enrichment along canal; restoration of degraded areas, improve water resource inside PAs, improving monitoring and patrol capability of DWC officers	PMU to Monitor Contractor to Implement	See Chapter 5 for activities and cost breakdown PMU- No additional cost Contractor- SLR 75.75 million	Locations to be finalized in consultation with DWC	Last stage of construction phase and O & M phase
Biodiversity and ecosystem function loss/degradation	H	L	Identify areas as offsets in consultation with FD and DWC to attain 'no net loss of biodiversity'. Identify areas in consultation with DWC and FD. This is for long term and in addition to the already identified reforestration areas	MIWRM, PMU FD, DWC	MIWRM project given to IUCN to recommend areas and costs in consultation with FD and DWC	Identify areas and costs in consultation with DWC and FD	O & M phase and longer term
Surface and ground water pollution	H	L	Same mitigation measures as in construction phase but with added water quality parameters as given in the monitoring programme of this EIA	MIWRM PMU	Cost in monitoring programme	Moragahakanda reservoir near outlet; Madaththawa level crossing	Continuation from construction phase into the O and M

[10] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance. D- Duration of impact, S-Short term, M-Medium term, L-Long term

						tank; Huruluwewa; Mahakanadarawa tank and command areas; Rs. 10 million included in the monitoring cost	
Blocking and reduction of animal migratory routes	H	L	Declaration of identified migratory corridors	MIWRM, FD, DWC	MIWRM project given to IUCN to recommend areas and costs In consultation with FD and DWC	Identified migratory routes	O & M phase and longer term
Escalation of human-elephant conflict	H	L	Develop a long term and region wide plan for HEC reduction based on longer term studies.	MIWRM FD, DWC, other stakeholders	MIWRM project given to IUCN to recommend costs	Larger region of Sri Lanka	Long term
Impacts on wildlife due to construction activities (noise, vibrations, disturbance)	H	S	Construction within and adjacent to protected areas be kept to a minimum period; use noise barriers when possible	PMU Contractor	No additional cost	Protected areas traversed by the UEC	Construction phase
			Decide on construction schedules in consultation with DWC and FD and after obtaining approvals; construction within PAs to be monitored strictly by the DWC and FD	PMU FD, DWC,	No additional cost; costs for monitoring by DWC and FD included in other mitigation costs and in monitoring programme	Protected areas traversed by the UEC	Construction phase

Activity and Impact	S [11]	D	Mitigation Measure	Responsible Organization/s	Cost	Locations/Persons	Implementation
Threats to fauna and flora by increased access by humans to protected areas and natural habitats	H	L	Strict monitoring of workers and associated persons during construction activities; monitoring of incidences of animal poaching, illegal removal of forest resources, clearing of forest patches in project area; Induction training of all workers to include awareness of regulations of the Fauna and Flora Protection Ordinance of Sri Lanka and penalties for its violations especially for poaching and illegal removal of forest resources.	PMU Contractor FD, DWC	Some costs in the monitoring programme and others in mitigation costs	Protected areas traversed by the UEC	Construction and O & M phase and longer term
			Removal of equipment and reforestation of temporary roads/points at end of construction phase	PMU Contractor	Included in costs of reforestation previously	All temporary access roads and points	Construction phase
Introduction and spread of alien invasive species	H	L	Assessment of existing alien invasive species in the project area; development of a detailed AIS management plan in accordance with guidelines established by the Ministry of Environment strictly monitor new AIS and spread of already introduced AIS	PMU Independent Group	SLR 2.0 mn	Project impact area in protected areas and forest reserves	Construction and O & M phase and longer term
			Removal and management of AIS within protected areas; Prevention of new introductions and management of prior introductions within protected areas	PMU Contractor	SLR 3 million/yr for 10 yrs	Protected areas traversed by the UEC	Construction and O & M phase and longer term

[11] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance. D- Duration of impact, S-Short term, M-Medium term, L-Long term

Table 8.2 Summary of impacts and mitigation measures contd….

Activity and Impact	S[12]	D	Mitigation Measure	Responsible Organization/s	Cost	Locations/Persons	Implementation
Occupational safety of workers	H	S	Adhering to Sri Lanka occupational safety guidelines; strict compliance monitoring need to provide all workers with protective gear, helmets, safety goggles, dust masks etc., Camps to all have emergency medical aid kits etc, Health and safety induction training to be provided to all workers including awareness on regulations.	Contractor	Included in the civil cost	All locations where applicable	Construction phase
Health and safety and security of communities	H	S	Develop a detailed management programme for accidental spills and release of toxic fumes	PMU to monitor Contractor to implement	No additional cost	All locations where applicable	Construction phase
			Ensure proper storage of toxic materials including volatile chemicals		No additional cost		
			Employ persons trained for handling of toxic chemicals to be in charge of them during construction period		No additional cost		
			Maintain records of accidents and ensure strict compliance through monitoring; in contract documents		No additional cost		
			A community liaison officer of the project to co-ordinate with GRC		Already in staff of PMU		

[12] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance. D- Duration of impact, S-Short term, M-Medium term, L-Long term

			Monitor and manage disease vector populations such as dengue mosquitoes; treatment of breeding sites of vectors	PMU Contractor	Contractor- SLR 3 million/yr for 5 yrs		Construction phase
Activity and Impact	**S** [13]	**D**	**Mitigation Measure**	**Responsible Organization/s**	**Cost**	**Locations/Persons**	**Implementation**
Archaeological and Cultural Resources							
Direct impacts on archaeological and historical resources	H	L	Avoidance of archeological sites is being achieved through route changes	MIWRM MCB Dept. of Archaeology	Included in the civil cost	Sites identified by archaeology assessment	Design and Planning stage
Risk of theft, vandalism and removal of artifacts and other components due to increased access by outsiders	H	L	Identify all archaeologically listed sites in the project area; develop a programme for monitoring their status and security and include in a chance finding procedure for artifacts and resources with responsible authorities and ownership	MIWRM PMU Dept. of Archaeology	No additional cost	Sites identified by archaeology assessment	Construction and O & M phases
Chance findings of artifacts or sites	H	L	Contractor to inform PMU and to abide by all laws and regulations on such items and sites	MIWRM, PMU , Dept of Archaeology	No additional cost	Any sites found	
Unanticipated Events							
Risks from unanticipated events	L	M	Develop a disaster risk reduction programme; training of personnel in event of disasters for emergency responses such as industrial accidents, natural disasters such as	PMU Ministry of Disaster Risk Reduction, Dept. of	PMU- SLR 1.0 million/yr for 5 yrs and there on to be taken over by	For the whole project	All phases and longer term

[13] S - Significance of Impact, H- Highly significant, M-moderately significant, L- Low significance.
D- Duration of impact, S-Short term, M-Medium term, L-Long term

			landslides, slope failures, flash floods and high floods	Meteorology, National Building Research Organization, local authorities	regional and national authorities Total cost- SLR 5 million		

8.2 Monitoring programme

8.2.1 Environmental aspects

692 **Monitoring**-There are two main types of monitoring: Internal Monitoring and External Monitoring. The former type is that which will be carried out by the project proponent and others directly associated with project implementation. This is also short term monitoring. The latter type should be conducted by independent monitoring individuals/groups and will be longer term monitoring over the entire project period. This is especially important for monitoring of habitat loss and degradation, degree l\of fragmentation, removal of timber and non-timber forest resources and water quality impacts.

693 Terms of Reference should be prepared for independent monitoring groups with high priority for impacts within protected areas of the DWC and the FD as well as within any unclassified forested areas. The second most important long term monitoring is on surface and ground water quality of the project impact area. Due to rising threat of surface and ground water pollution by agriculture, over extraction of ground water and land use changes such as gem mining, solid and liquid waste disposal, this has become a serious regional and national problem. The rapid increase of the Kidney Disease which appears to be partly contributed to by quality of water consumed by those afflicted, is another reason to maintain a scientific and rigorous programme of water quality monitoring.

694 However, unless pesticides levels are monitored in water samples of this monitoring programme, it will not provide information on its potential contribution to environmental pollution and human health issues of the region. The cost of monitoring for pesticides is very high, and organizations capable of monitoring pesticide levels with a degree of scientific accuracy required to be of practical use are also limited at present in this country. The National Water Supply and Drainage Board and the Water Resources Board currently conduct country wide assessment of ground water quality using parameters useful for pointing out sources of pollution and may be considered as monitor for ground water if acceptable to the project proponents.

695 Selection of persons/organizations for monitoring of water quality should be carried out after careful consideration of scientific capacity and expertise and availability of laboratories that can carry out testing for pesticides and heavy metals using validated methods. Monitoring of water quality of Huruluwewa command area should be part of a longer term programme. Programmes to wean farmers away from overuse and abuse of synthetic agrochemicals are national scale programmes that cannot be handled only by this project. As a start, the command areas of major tanks supplied by the UEC can be used as pilot scale programmes.

696 The project management unit should put in place an effective structure and mechanism to ensure compliance monitoring and issuance of penalties and fines for non-compliance and violations.

697 **Reporting**- Periodic reporting and progress review meetings should be part of this mechanism, where review of information and assessment of trends can take place. It is recommended that the contractor before commencement of work, prepares an environmental method statement describing the mitigatory measures that will be implemented to comply with EMP for each of the aspects of work to be carried out. This should include a reporting schedule and a format for reporting. Inclusion of a section on progress of implementation of EMP should be mandatory. Contractor reports should feed into the PMU's monitoring mechanism which in turn would provide information on progress of EMP implementation to the CEA and the ADB. A separate twice yearly environment monitoring reports should be submitted to the CEA and the ADB by the PMU.

698 Independent monitoring individuals/groups should submit twice yearly monitoring reports to the PMU and the ADB.

699 The monitoring programme is intended and should be used to support project implementation in all its phases and for the project proponent to take timely actions to prevent and reduce negative unintended impacts as much as possible.

700 The CEA will carry out monitoring visits periodically and as required if and when needed, we expect the CEA to carry out at least bi-annual monitoring. The total costs of CEA visits is expected to be covered within the amounts specified in the monitoring table. It is difficult to sum all aspects and consider in one CEA visit cost.

Table 8.3 Monitoring programme

Environmental issue	Parameters for monitoring	Responsibility	Location	Frequency	Cost
Construction phase					
Delineation of areas for clearing of vegetation, structures, camps and offices etc	Areas marked in maps and plans at planning stage *vs.* areas actually cleared	PMU FD and DWC as Independent Monitoring for protected areas	Areas within, protected areas and other designated sites	Once a month for relevant period	No additional cost for internal monitors 5000/visit for 2 year for Independent Monitoring Total cost= 120,000
Number of trees removed for canal and other structures, access roads etc.	Counts of trees and their species	PMU, FD, DWC	Selected sampling sites within all protected areas of the DWC and FD	Once a month over the construction phase	PMU- 20,000/visit for a team of 4 persons x 2 years Total cost= 480,000
Soil erosion and associated impacts	Effectiveness of mitigation measures	PMU	KMTC route and its portal areas	Once in 2 weeks for construction phase	No additional cost for PMU
Landslides, slope failures	Number and location of occurrences; effectiveness of mitigation measures	PMU, NBRO (Independent Monitoring)	KMTC tunnel area and portals	Once in six months	cost for Independent Monitoring- SLR 5.0 million
Monitoring invasive species	Number and location of occurrences species of AIS	PMU/ independent monitor	Entire UEC	Once in six months for construction period	PMU-30,000*2*4years SLR 240,000
Surface water quality	pH, color, BOD, DO, flow rate, temperature, turbidity, conductivity, TDS, salinity,	PMU Independent monitor	Moragahakanda reservoir near outlet; Lel Oya aqueduct crossing,	As required Once a month for WRB	Total cost= SLR 2.0 million

	hardness, faecal coliform bacteria, 3-4 heavy metals; CEA standards		Madaththawa level crossing tank; Huruluwewa; Mahakanadarawa tank	Independent monitor once in 3 months	
Worker monitoring		PMU	At all work sites	Frequently as required	No additional cost
Disposal of excavated material, spoils etc	Contractor should dispose at designated disposal sites, and is adopting suitable practices. Number of violations	PMU	Designated dump sites; TBM yards, Within protected areas but outside designated dump sites	Once a month	PMU= SLR 200,000
Waste management	Effectiveness of waste management programme; quantity of reused and recyclable material; types of material; financial gains from waste management	PMU Regional office of CEA (Independent Monitoring)	All camp sites, offices; all facilities generating waste	Once in 6 months	Costs for Independent Monitoring Rs. 5000/visit x 25 visits Total cost- 125,000
Ground water quality	pH, hardness, nitrates, nitrites, conductivity, TDS, Cr / Cd/ As/ Pb/ Hg	PMU Independent group	2 sampling sites at KMTC tunnel segments; 3 level crossing areas, Huruluwewa command area, Mahakanadarawa command area; village wells	Start 6 months before construction Once in 6 months	Total cost= 500,000

			adjacent to canal path in 5 selected villages		
Air quality	Compliance with CEA emission standards for high impact sites; vehicle emission license validity; number of complaints on air quality	PMU	Tunnel portal areas; selected points at canal segments within all protected areas; construction yards; selected points on roads in settlements used by heavy machinery and vehicles of the project	Establish baseline for dust levels before start of construction Once in 2 weeks	Included in mitigation cost for PMU
Noise and vibration	Compliance with standards of the CEA and GSMB; number of complaints	PMU	Construction yards; adjacent to settlements, inside all protected areas with canal segments; access roads	Once in 2 weeks	Cost included in the mitigation cost
Impacts on mineral resources	Amounts reused; monitoring of incidence of precious mineral finds and of locations	PMU, GSMB	Where ever required	As required	No additional cost
Impacts on natural habitats, flora and fauna	Habitat diversity; composition, rarity, endemism, threatened status of representative	PMU Independent Group	Forests overlying KMTC tunnel route; Selected sampling	Establish baseline at least 6 months	

	groups of plants and animals; Number and distribution of alien invasive species in transects, Special attention to dry mixed evergreen forests		points within all protected areas. Transect lines of 250m on either side canal placed at right angles to canal point to be used in lowland areas	prior to start of construction Once in 6 months	50,000/visit for a team of 3 persons x 5 visits Total cost= 250,000
Impacts on riparian and aquatic natural habitats, flora and fauna	Habitat diversity; composition, rarity, endemism, threatened status of representative groups of plants and animals in riparian and aquatic habitats of streams crossed by UEC; Number and distribution of alien invasive species in sampling points/transects, Special attention to Lel Oya riverine vegetation and recovery of aqueduct site; all stream crossings inside protected areas		Included in above		
Blocking of wildlife migratory routes	Number of incidences reported of human-	PMU	All recorded	Commence monitoring	No additional costs

	wildlife conflict and locations; provide a map of incidences with GPS co-ordinates of locations	DWC	migratory routes within the UEC canal path	one season before start of construction to compare before and after construction	
Increased threat to forest resources, plants and animals from increased access during construction	Number of incidences reported, types of species removed/reported; quantities removed/reported; number of encroachments into protected areas along canal path after project	PMU, FD. DWC	KMTC route; All protected areas within the canal path	Start at least 6 months prior to project; when and where it occurs	No additional costs
Occupational health and safety	Number and types of accidents, emergencies, injuries, disabilities etc., sites of high incidences Numbers and types of safety gear provided to workers and in which categories, report on actual usage of safety gear	PMU, Contractor, local health authorities	Where ever required	Once a month	No additional cost for PMU and Contractor DMO's and regional hospital records on medical emergencies

Community health, safety and security	Incidence of community safety and nuisance issues received by PMU, GRC, GN, DS; Adequacy of safety barriers and measures taken by Contractor and PMU; Compliance with EMP and guidelines on air pollution, dust, noise, vibration, pollution and blocking of waterways; blocking of roads and hindering traffic on roads; effectiveness of health and safety programme including disaster risk reduction programme effectiveness of the EMP There is overlap with social aspects monitoring given below in this table	PMU, Contractor GRC Independent monitor on community safety	All villages, towns and settlements adjacent to the canal path; adjacent to worker facilities, camps, construction yards, borrow areas, disposal sites (if any)	Once in 2 months Once in 3 months for IM A team of 2 trained social data enumerators under the supervision of a social safeguards specialist to carry out a pilot scale survey 3 months prior to start of construction and apply during the construction period	No additional costs for Contractor and GRC PMU- 25,000/visit x 24 visits Total cost= 600,000

Implementation of RAP					
Land Acquisition	• Appointing and mobilizing Land acquisition and resettlement staff for the field and office work on schedule •	PMU, MLD MI&WRM	Relocated area	Once a month	Costs identified in the RP
Replacement	• Replacement land available of suitable standard • Providing replacement land plots developing as specified • Providing land titles to APs • APs have receiving housing as per relocation options in the RP and house quality meets the standards •	PMU, MLD MI&WRM, ID	Where ever required	Two weeks time	Costs identified in the RP
Compensation	• Compensation payment to replace lost assets	PMU, ID	Affected communities	Once a month	Costs identified in the RP

	• APs receiving of entitlements according to the entitlement matrix • Pay payments for APs on time? • Giving transport costs, relocation costs, income substitution support and any resettlement allowances • Providing entitlements including transfer and payments for net losses for affected businesses •				
Income restoration	• Provide income earning opportunities for vulnerable groups and their effectiveness and sustainability	PMU, ID	Affected communities		Costs identified in the RP

	• Restoration of APs livelihoods to which their own living standards • Implementing income and livelihood restoration activities as set out in the income restoration plan • Carrying out capacity building and training activities • Restoration proceeding for social infrastructure and services • APs able to access schools, health services, cultural sites and activities •				
Grievances Redress	• Establishing GRC • No. of meeting held • No. of	PMU, MI&WRM	Affected communities	Once in two weeks	

	receiving complains • Actions taken to solving grievances • No of given solutions				
Operation and Maintenance phase					
Threats to habitats and species in terrestrial protected areas including forest resources by project presence	Incidence and distribution of location of encroachments into protected areas of the DWC and FD; Changes in forest quality of protected area regions adjacent to canal path; Number and locations of poaching, illegal removal of timber trees, medicinal plants; soil gravel and mineral resources, removal of threatened, rare and endemic species of plants and animals by local offices of DWC, FD,GN, DS, local law enforcement	PMU Independent monitor (This is in addition to the monitoring done by DWC & FD)	Protected areas of the DWC and FD specially Elehera-Giritale Sanctuary area adjacent to three level crossing tanks; all protected area regions within 2 km of canal path; forest reserves and undeclared forest areas above KMTC tunnel; outlet area of KMTC tunnel to Moragahakanda (forests outside Kabawara Oya)	Once in 6 months	75,000/visit for a team of 3 persons for 5 years after end of construction phase Total cost= 2,250,000.00 + 30,000*2*10 years SLR 600,000

	authorities; incidence and distribution of locations of gem mining in PA areas crossed by canal path; effectiveness of EMP in protecting habitats and species of protected areas				
Threats to riparian and riverine habitats due to project presence	Degradation and fragmentation of riverine and riparian habitats at outlet area of KMTC outlet to Moragahakanda (along Kabarawa Oya for 1 km on either side of outlet portal; quality and species diversity of riparian habitat at Lel Oya aqueduct;	PMU	Lel Oya; Kabarawa Oya	Once in 6 months	No additional cost
Surface water quality	pH, color, BOD, DO, flow rate, temperature, turbidity, conductivity, TDS, salinity, hardness, faecal coliform bacteria, 5 heavy metals; nitrates and nitrites; pesticides; CEA standards for all except pesticides	PMU Independent monitor	Outlet of KMTC tunnel to Moragahakanda; Outlet of Moragahakanda to UEC; Outlet of UEC to Huruluwewa, Outlet to Manankattiya,	Once in 3 months for 10 years	SLR 30 million

			command area of Huruluwewa		
Groundwater quality	pH, hardness, nitrates, nitrites, conductivity, TDS, 5 selected heavy metals,	PMU Independent group	2 sampling sites at KMTC tunnel segments; 3 level crossing areas, Huruluwewa command area, Mahakanadarawa command area; village wells adjacent to canal path in 5 selected villages	Once in 6 months	SLR 10 million
Reduction of agrochemicals use in Huruluwewa/Manakattiya, Mahakanadarawa command areas	Database of types and use of agrochemicals from socio economic survey	PMU and DOA	At respective command areas	Once a year for 5 years	SLR. 10 million

Table 8.4 Summary of environmental mitigation costs

No	Activity/Impacts and Mitigation Measure	Cost (Rs.)
1	**Construction yards, vehicle parks and sites of temporary dumping -** All such sites to be rehabilitated with suitable native species after removal of dumped material and leveling under the supervision of F	150,000,000.00
2	Additional area to be reforested between UEC and FSL of Huruluwewa	151,200,000.00
3	**Decrease of surface water quality** - Adhere to approved solid and liquid waste management plans and avoid contamination of water; ensure compliance with current water quality standards of the CEA	2,000,000.00
4	**Water pollution in Huruluwewa command area through increased use of agrochemicals as a result of higher cropping intensities -** Monitor water parameters of water in supply canals and return water from agricultural fields for agrochemicals over the longer term; develop a programme to reduce use of agrochemicals Water pollution in Huruluwewa command area through increased use of agrochemicals as a result of higher cropping intensities	900,000.00
	- Long term monitoring cost	. 10,000,000.00
5	**Vehicles and operation of machinery causes air pollution (gases, PM)** - All vehicles to have emission testing periodically, monitoring of air quality in sites of high impact	18,000,000.00
6	**Noise and vibration due to operation of machinery H -** Use TBM in the designated sites only where blasting is used, apply current practice standards and then give prior information to neighboring areas; Pre-and post-blasting surveys with photographic evidence	17,000,000.00
7	**Solid waste disposal issues** - Develop solid waste disposal management plans in consultation with local authorities; ensure compliance by contractor to guidelines; maintain monitoring programme	2,000,000.00
8	**Habitat loss, degradation due to project** - Reforestation/enrichment planting along the canal; degraded areas; based on sites and guidelines of the FD	150,000,000.00
	- Enrichment along canal	75,750,000.00
9	**Introduction and spread of alien invasive species** - Assessment of existing alien invasive species in the project area; development of a detailed AIS management plan in accordance with guidelines established by the Ministry of Environment strictly monitor new AIS and spread of already introduced AIS	2,000,000.00

	Removal and management of AIS within protected areas; Prevention of new introductions and management of prior introductions within protected areas	30,000,000.00
10	**Health & Safety and security of communities** - (Monitor and manage disease vector populations such as dengue mosquitoes; treatment of breeding sites of vectors	15,000,000.00
11	**Risks from unanticipated events** - Develop a disaster risk reduction programme; training of personnel in event of disasters for emergency responses such as industrial accidents, natural disasters such as landslides, slope failures, flash floods and high floods	5,000,000.00
	Total	**628,850,000.00**

Table 8.5 Summary of Monitoring Costs

No	Environmental issue	Cost (Rs.)
1	Delineation of areas for clearing of vegetation, structures, camps and offices etc	120,000.00
2	Number of trees removed for canal and other structures, access roads etc.	480,000.00
3	Landslides, slope failures	400,000.00
	- Other visits	5,000,000.00
4	Monitoring invasive species	240,000.00
5	Surface water quality (construction phase)	2,000,000.00
6	Disposal of excavated materials, spoils, etc.	200,000.00
7	Waste management	125,000.00
8	Ground water quality	500,000.00
9	Impacts on terrestrial natural habitats, flora and fauna	250,000.00
10	Community health & safety and security	600,000.00
11	Threats to habitats and species in terrestrial protected areas including forest resources by project presence	2,250,000.00
	- Poaching and illegal removal of trees	600,000.00
12	Surface water quality (O&M phase)	30,000,000.00

13	Monitor ground water quality (O& M phase)	10,000,000.00
14	Reduction of agrochemicals use in Huruluwewa/Manakattiya, Mahakanadarawa command areas	10,000,000.00
	Total	**62,765,000.00**

CHAPTER 9

9. CONCLUSIONS AND RECOMMENDATIONS

701 The long term impacts of the proposed project 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 phase and they can be minimized and mitigated with appropriate and timely interventions, with adequate supervision and monitoring by the project proponent and other stakeholders.

702 There is irreversible loss, fragmentation and degradation of natural habitats within the four protected areas, traversed by the project, namely The Hurulu Forest Reserve (including part of the Man and Biosphere Reserve) The Minneriya National Park, Minneriya-Giritale Nature Reserve and Elehera-Giritale Sanctuary and a plantation forest reserve and the relatively undisturbed forested areas of the steep hills containing natural streams with high biodiversity and ecosystem functions traversed by the KMTC tunnels, and its aqueduct across Lel Oya, a natural stream

703 The design and planning stage of the project has accommodated several major design and route changes to decrease lengths of the UEC canal within protected areas, converted open canal sections to tunnels and cut and cover within these areas, changed the technology of tunnel creation to use of a Tunnel Boring Machine (TBM) that has less adverse environmental impacts than blasting construction technology. This change alone has increased project costs substantially but it has been accepted by the proponent in view of the importance of the Minneriya National Park and the Hurulu Man and Biosphere Reserve. Minneriya National Park serves as the hub of the tourism industry of the region and should be given special attention during the construction phase. The former open canal of the KMTC route has been converted to two tunnel sections in view of the greater safety of operation and better environmental impacts.

704 Change of canal route to avoid sites of archeological importance is being designed

705 In addition, provision of water for wildlife, inclusion of safe escapes for large animals that may fall into the open canal sections, provision of three existing tanks within the Elehera-Giritale Sanctuary as level crossings of the UEC, to maintain water levels especially during dry seasons, only 50% release of water for agriculture from these tanks, to keep rest for wildlife are all very commendable avoidance and mitigation measures adopted early in the design and planning stage of this project by the proponent.

706 Long term residual adverse impacts on the four protected areas, remain even after avoidance and mitigation measures. These residual impacts can be offset by implementation of the recommendations in the environment management plan to create offset areas with equivalent or higher biodiversity and conservation values as much as possible, and by the implementation of the EMPs of the two associated facilities of the UEC, namely the KRAEP and MADP.

707 The existing human-wildlife conflict is likely to be exacerbatedby this project, unless adequate migratory routes/corridors are set aside and other mitigation measures are effectively implemented as recommended by this EIA and the EMPs of the KRAEP and MADP including any recommendations from the proposed HEC study.

708 While the project results in involuntary resettlement of families who lose their residences and/or property, the number is very small compared to the area of the project impact area. The socio-economic survey has not encountered any opposition to the project by local communities along the project route.

709 There are beneficial impacts from the UEC to irrigated agriculture, provision of water for domestic and industrial purposes in areas of the North Central Province, and expected enhancement of the local and national economy in the long term. Provision of good quality potable water is of great importance given the rise of the Chronic Kidney Disease of Unknown an etiology in this region.

710 The UEC project is therefore suitable for implementation, subject to approval by the Central Environmental Authority of Sri Lanka, along with full and effective implementation of all mitigatory, monitoring and evaluation measures in its project phases.

711 **OTHER RECOMMENDATIONS:**

1. The cumulative adverse impacts of this project should be considered in the long term and over a landscape view and suitable measures taken to address them
2. The Resettlement Action Plan should be implemented in full
3. Programmes should be put in place to decrease water pollution by agricultural activities and to increase efficiency of water use in areas receiving water from the UEC
4. Occupational safety, community health and safety concerns should all be addressed within the project period
5. As the prevalence of non communicable disease are increasing in Sri Lanka, and due to potential vector borne disease increase from construction activities, a baseline health status assessment is desirable at the start of construction phase. Monitoring of community health status in conjunction with local and regional state health authorities is recommended.
6. The potential impacts of climate change on the performance of this system should be investigated in greater detail. As the project is implemented by technical organizations (ID and MASL), they should utililize their expertise to monitor water resources availability and water balance studies in relation to projected climate change scenarios for Sri Lanka's intermediate and dry zones.
7. If there are any changes proposed to the design or canal trace the EIA and EMP will be updated accordingly.

ANNEXES

ANNEX I - TERMS OF REFERENCE

This ToR is only a guideline document. Required information on impacts mitigation measures etc. which will be useful in decision making should be incorporated in the EIA report based on the findings of the EIA study.

It also includes requirements to fulfill ADB's Safeguard requirements. Please refer to ADB's Safeguard Policy Statement 2009 available on www.adb.org for more details.

Project Name : **Modifications to Configurations of Moragahakanda - Kalu Ganga Projects**

(Proposed UpperElaheraCanal (UEC), Canal from Mannakkattiya tank to Mahakandarawa tank and Kalu Ganga - MoragahakandaLinkCanal Project)

Project Proponent : **Ministry of Irrigation and Water Resources Management**

Project Approving Agency : **Central Environmental Authority**

Report requirement : **EIA**

Validity period : **One and half years from the date of issue**

Report format :

Executive Summary

1. Introduction
2. Description of the project and reasonable alternatives
3. Description of the existing environment
4. Anticipated environmental impacts of the proposed project
5. Proposed mitigatory measures
6. Extended Cost-benefit analysis
7. Information disclosure, consultation, and participation

8. Grievance Redress mechanism

9.Environmental Management programme

10.Conclusion and Recommendation

ANNEXURE

I Terms of Reference

II References

III Sources of data & information

IV List of preparers including their work allocation and time schedules (report should be authenticated by the preparers)

V Comments made by the public NGOs and other agencies during formal and informal scoping meetings held by the EIA Team.

VI Complete set of relevant maps, tables, charts, layout plans and other details

Executive Summary

The summary should be a brief, non-technical summary of the justification of the proposed project, description of the salient features of the project, the existing environment of the project sites and its environs, key environmental impacts, the measures proposed to mitigate the environmental impacts, monitoring programme and conclusions. A one page summary table indicating the significant impacts and proposed mitigatory measures should be presented.

1. INTRODUCTION

- Background of the project
- Objectives of the proposed project and justification

  (Summarize the need or problem been addressed by the project and how the proposed project is expected to resolve the problem or the issue)

- Objectives of the EIA report

  (Specify the objectives of the assessment and the relationship of the results to project design and implementation)

- Methodologies and technologies adopted in EIA report preparation
- Policy, Legal, and Administrative Framework – should describe national and local legal and institutional framework within which the EIA is carried out. Also should identify any project relevant international environmental agreements to which SL is party to.
- Any conditions laid down by state agencies in granting preliminary clearance for the project

- **Conformity with other development plans in the area (present and proposed)**

2. DESCRIPTION OF THE PROPOSED PROJECT AND REASONABLE ALTERNATIVES

2.1 Description of the proposed project

Relevant details should be provided for all 3 project components, i.e.

(a) UpperElaheraCanal
(b) Mannakkattiya Tank and Mahakandarawa Tank link canal
(c) Moragahakanda – Kalu Ganga link canal / Tunnel

i. Location, indicating the Divisional Secretariat Division/s and the PradeshiyaSabha area/s within which the project site falls. Clear coloured and readable maps together with diagrams and photographs to be provided for reviewer to get a clear understanding of the project area and the location of all the project components.

The location map should include general location of the project site and exact location with clear coordinates.

ii. State the present ownership of the project site/s. If state owned, please submit a letter of consent from the relevant state agency/agencies.

- Description of all project components relevant to the proposed project.

(a) New constructions
- Reservoirs / tanks, canals, tunnels, service roads, new roads, resettlement sites and new irrigable areas

(b) Modifications to existing structures
- Modifications to dams (existing / planned)
- Improvements to canals, natural streams
- Modifications / improvements to reservoirs / tanks
- Improvements / alterations to roads

(c) Alterations to approved plans
- Alterations proposed for Moragahakanda – Kalu Ganga link canals
- Alterations for Moragahakanda dam to accommodate the UpperElaheraCanal
- Any other alterations

(d)

(e) Associated facilities required for the project, such as quarries, borrow pits, access roads, any spoil disposal sites . Ownership of these sites should be determined. (should describe the potential sites- preferably supported by a map showing locations of such sites,)

Size, capacities and extent of each component should also be described together with reservation requirements.

iii. The layout plan of the project at appropriate scale. This should indicate all the project components and reservation area/s to be maintained. This layout plan should indicate all new structures as well as all other relevant existing structures which are to be modified / improved under the project. Justification for selection of alignment along proposed route should be provided- including a discussion of alternative alignments considered.

- Give details on pre-construction, construction activities, phased implementation schedule, staffing and support facilities and services. (Please discuss on the phased implementation proposed if under ADB funding. It will be carried out over three tranches and this will be important to in developing mitigation measures- as construction may be carried out by different contractors)

  Requirements of raw material should also be discussed (quantities & location).

- Methodology of operation of the project components;
  - Water management proposals within the AmbanGangaBasin below the Moragahakanda Reservoir (the present and future water needs of the area is to be considered in preparing this proposal).
  - Interactions / interdependency of project components itself and with other irrigation developments of the area should also be addressed.
  - Maintenance activities, infrastructure facilities required/provided by the project can also be described.

- Project cost, investment and funding sources.

2.2 Evaluation of Alternatives

Describe reasonable alternatives considered to the proposed project which might be less harmful to the environment.

Following options can be considered for analysis of alternatives.

- Siting alternatives
- Design and technology selection
- Construction techniques and phasing
- Operating and maintenance procedure etc.
- No action alternative (to demonstrate environmental conditions without project)

Compare alternatives in terms of potential environmental impacts, mitigatory measures, capital and operating costs, reliability etc.

Give the reasons why such alternatives were rejected.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

STUDY AREA

The study area for the assessment shall include the following;

i) Project site
ii) Locations affected by construction activities (includes borrow, disposal and quarry sites)
iii) Any area beyond the project sites, where there is potential for environmental impacts

Assemble, evaluate and present available baseline data on the relevant environmental characteristics of the study area.

This chapter should provide information on physical, biological socio-economic, archaeological and cultural aspects of the environment likely to be affected by any activity of the project during and after the project. Information should be presented in a comprehensive format using tables, maps and diagrams where appropriate. The methods used to collect data should be clearly stated under each category. All technical terms should be clearly defined. The existing environment should be described under following;

3.1 Physical environment

- Topography, geology & soil, climate and meteorology, surface and groundwater hydrology, water quality including sources of water pollution.

- Land use of the project area
  - Land use of the project area, resettlement sites and irrigable area
  - A contour map should be provided indicating the land use of the inundation area at HFL of the reservoirs (This is applicable if any improvements/rehabilitation being done to the existing reservoir/s or any water bodies which will be formed/developed by the project), canals and proposed reservation areas.

3.2 Biological Environment:

- Presence ofWildlifeReserves, National Parks, Sanctuaries, Elephant Corridors, Wetlands and Forest Reserves in the directly affected area and the study area.

- An assessment of the present ecological status including the biodiversity of the area, sensitive habitats of fauna and flora and their distribution in the study

area. Information on endangered, rare, migratory and commercially important flora and fauna and species with potential to become nuisances, vectors or dangerous, should be given. Baseline data relevant to such incidences (eg; Human Elephant Conflicts etc.) of the area should be addressed. Identify if the habitat is modified, natural or critical habitats (please refer to ADB's SPS 2009- Appendix 1 on conditions to be met for each of these habitats)

- The study should identify (both in the immediate and wider area around the project site) habitats that will be affected, the range and status of the main species groups that live in the area, the status of protected areas or other important areas for biodiversity, and any potential impacts to ecosystem services that might have local, regional or global impacts. Baseline studies and data collection may need to consider seasonal factors such as species migration

  Describe if the protected area/reserved forests have management plans and if so what are the key features of the management plan and state if the proposed activities in line with the management plan

3.3 Human settlements and Land use :

Social - cultural environment (include both present and projected where appropriate)

- Population characteristics, settlements, present water supply and water uses including existing irrigation schemes
- Distribution of income and sources, goods and services,
- Cultural, historical, protected resources and archaeological aspects/considerations
- Existing health and infrastructure facilities,
- Existing environmental / social / health issues in the area.

4. ANTICIPATED ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

This chapter should show the overall effects of the project on the individual environmental components. Impacts should include the direct and indirect, long and short-term positive and negative effects.

Significance of impacts should be assessed using appropriate techniques.

When describing the impacts indicates which are irreversible or unavoidable and which can be mitigated to the extent possible. Impacts should be quantified wherever possible.

This section should also assess the potential impacts of climate change on proposed investments. Impacts at borrow sites, quarry pits, disposal sites too should be discussed. Cumulative impacts too should be assessed.

Impacts should be discussed in the order of severity.

Special attention should be given to;

- Changes in surface and ground water hydrology and resulting impacts
- Limitations in sharing water and related issues including riparian rights of irrigation schemes which are now operating in the Amban Ganga basin (present and future plans / supplementary water requirements should also be addressed).
- Loss of wildlife habitats including those resulting in human elephant conflicts
- Impacts on biodiversity due to loss of forest lands and possible disturbances to the wildlife habitats of the park/s.
- Ecological impacts in the down streams due to low flows.
- Loss of stability of slopes, tunnel / canal trace and potential for landslides/ soil stability.
- Development of new lands for agricultural purposes (if any) and resulting impacts.
- Effects on existing and proposed settlements of the area
- Relocation, of communities and loss of property including agricultural lands.
- Socio economic impacts should include occupational health and safety, community health and safety, vulnerable groups and gender issues, impacts on indigenous communities and impacts on livelihoods

5. PROPOSED MITIGATORY MEASURES

This chapter should set out the proposed measures to minimize the impacts identified in Chapter 4 to acceptable levels including conformity to Sri Lankan standards. Alternative methods of mitigation should be discussed and the effectiveness of the proposed measures that are to be provided should be stated. Mitigation methods should be defined in specific practical terms. A rationale should also be presented for selection of chosen mitigatory measures.

A management plan including proposed work programs, budget estimates, schedules, staffing and other necessary support services to implement the mitigatory measures/alternatives should be prepared.

Any conservation program / alternative measures proposed to be implemented to augment water supply to the people affected by this project shall also be discussed.

Given that the canal will traverse through large amounts of protected reserves, the projects should propose (in consultation with the DWC and FD) additional programs as appropriate, to promote and improve the conservation aims of the protected areas.

In addition the project should:

i) Be designed in a manner consistent with any national land use, resource use, and management criteria (including Management Plans, National Biodiversity Action Plans or similar documents). This will entail securing the necessary approvals from the responsible government agencies, and consulting with protected area sponsors and the local communities, including communities of Indigenous Peoples (if applicable), and other key stakeholders; and

ii) Consult protected area sponsors and managers, local communities, and other key stakeholders on the proposed project.

Mitigation measures should be designed to achieve at least no net loss of biodiversity. Therefore, post project restoration of habitats, offset of losses through creation of effective conservation of ecologically comparable areas may be considered.

6. EXTENDED COST – BENEFIT ANALYSIS (excluded for submission to ADB as this is addressed in a separate report title financial and economic analysis)

Total environmental cost (the cost of direct and indirect negative impacts, proposed mitigation cost administration and monitoring costs etc.) and benefits arising out of the proposed project due to project activities should be incorporated and discussed. Findings should reflect the benefit arising out of the proposed project.

7. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

Should describe

(i) The process undertaken during project design and preparation to engage stakeholders, including information disclosure and consultation with affected persons and stakeholders

(ii) Summarize comments and concerns received and describe how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and indigenous peoples; and

(iii) Describe the planned information disclosure measures (including type of information to be disseminated and method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation

8. GRIEVANCE REDRESS MECHANISM

This section describes the grievance redress framework (informal and formal channels) setting out the time frame and mechanism to resolve complaints about environmental performance.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME

A suitable management programme should be submitted to mitigate potential adverse impacts and monitor the changes of environment and implementation of mitigatory measures. This plan should include the following;

(i) Mitigation

- Identifies and summarizes anticipated significant adverse environmental impacts and risks
- Describes each mitigation measure with technical details, including the type of impact to which it relates and conditions under which it is required, together with designs, equipment descriptions, and operating procedures as appropriate
- Provides links to other plans such as resettlement, indigenous peoples, or emergency response as required

Monitoring

A suitable monitoring programme should be submitted to monitor the changes of environment and implementation of mitigatory measures. This plan should include the following;

- Parameters to be monitored
- Frequency of monitoring, detection limits and definition of thresholds that will signal the need for corrective action
- Location / timing of sampling
- Institutional framework for mitigation of impacts
- Responsible agency / agencies of monitoring
- Describes monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measure and documents the progress and results of mitigation

(ii) Implementation arrangements

- Specifies the implementation schedule showing phasing and coordination with overall project implementation
- Describes the institutional framework, namely who is responsible for carrying out the mitigation and monitoring, which may include, additional topics to strengthen environmental management capability, technical assistance programs, training programs, organizational changes etc,
- Identify the capital and recurrent costs to implement mitigation and monitoring measures described above. Identify the availability and source of funds to implement the measures.

10. CONCLUSION AND RECOMMENDATION

The environmental acceptability of the proposed project and key findings and recommendations of the assessment should be clearly stated. The consultants should make a firm recommendation on one of the alternatives based on available information.

Any programme to improve general environmental conditions can also be stated here.

ANNEX II - REFERENCES

Bambaradeniya, C.N.B. (Editor), 2006. Fauna of Sri Lanka: Status of Taxonomy, Research and Conservation. The World Conservation Union, Colombo, Sri Lanka & Government of Sri Lanka.viii + 308pp.

Bedjanic, M., Conniff, K. & G. de S. Wijeyeratne (2007) Dragonflies of Sri Lanka. Jetwing Eco holidays. 248p.

Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, 2007: Asia. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506.

d' Abrera B., (1998), The Butterflies of Ceylon, Wildlife Heritage Trust, Sri Lanka

Dassanayake, M. D. and Clayton, W. D. (eds.) (1996 - 2000). A Revised Handbook to the Flora of Ceylon, Vols. X – XIV, Oxford & IBH Publishing, New Delhi;

Dassanayake, M. D. and Fosberg, F. R. (eds.) (1980).A Revised Handbook to the Flora of Ceylon, Vol. I, Amerind Publishing, New Delhi;

Dassanayake, M. D. and Fosberg, F. R. (eds.) (1981 - 1991). A Revised Handbook to the Flora of Ceylon, Vols. II - VII, Oxford & IBH Publishing, New Delhi;

Dassanayake, M. D., Clayton, W. D. and Shaffer-Fehre, M. (eds.) (2006).A Revised Handbook to the Flora of Ceylon, Vols. XV Part A & Part B, Science Publishers, USA.

Dassanayake, M. D., Fosberg, F. R. and Clayton, W. D. (eds.) (1994 - 1995). A Revised Handbook to the Flora of Ceylon, Vols. VIII - IX, Oxford & IBH Publishing, New Delhi

DWC (2008).*Biodiversity Baseline Survey: Minneriya National Park*. Consultancy Services Report preparedby Green, M.J.B. (ed.), Sri Lanka Protected Areas Management and Wildlife Conservation Project(PAM&WCP/CONSULT/02/BDBS), Department of Wildlife Conservation, Ministry of Environment and Natural Resources, Colombo. 47 pp. **[http://203.143.23.34/BBS/bbs.html]**

Department of Irrigation (Hydraulic Research Laboratory), 2013, Raising/ Modifications of Minipe Anicut, Report on Hydraulic Model Studies for Proposed Raising of Minipe Anicut, Volume 1 (Final Report).

Department of National Planning, 2010. Mahinda Chintana – Vision for the Future. The Development Policy Framework.Government of Sri Lanka. Department of National Planning.Ministry of Finance and Planning.

Engineering Design Centre (EDC). 2013. Sedimentation and Water Quality Testing in Minipe Anicut, Minipe LB Canal and Conveyance System to Mahaweli System D under NCP

Canal ProjectWater Quality Assessment Report, System D. EDC, Faculty of Engineering, University of Peradeniya. Peradeniya.

Environmental Safeguards Compliance Manual- Road Development Authority of the ministry of Highway and Road Development-2009.

Goonatilake, S. de A. (2007) Freshwater Fishes of Sri Lanka. (Sinhala text) Biodiversity Secretariat, Ministry of Environment and natural Resources. 134p.

Harrison, J. (1999) A Field Guide to the Birds of Sri Lanka. Oxford University Press.

IUCN (2013) The list of threatened species. WWW.IUCN.redlist.org

Jayatillake, H.M., Chandrapala, L., Basnayake, B.R.S.B., and Dharmaratne, G.H.P. 2005.Water Resources and Climate Change.Proceedings. Workshop on Sri Lanka National Water Development Report (eds. Wijesekera, N.T.S., Imbulana, K.A.U.S., and Neupane, B.). World Water Assessment Programme. Paris. France.

Kotagama S. & Fernando, P. (1994) A field guide to the Birds of Sri Lanka. WHT Publications, Sri Lanka.224 pp.

Mahaweli Consultancy Bureau, 2012a.Pre-Feasibility Study of the NCP Canal Project.

Mahaweli Consultancy Bureau, 2012b. Draft Final Report on Modification to Configuration of Moragahakanda – Kalu Ganga (M-K) Projects to Integrate NCP Canal Project.

Mahaweli Consultancy Bureau (MCB), 2013.Interim report for modification of configuration to Moragahakanda and Kaluganga Projects to integrate NCP Canal Project layout. Appendix 1. Detailed water balance study for the NCP Canal Project.

Mahaweli Consultancy Bureau(MCB), 2011, Consultancy Services for Feasibility Study on Proposed Randenigala-Kalu Ganga Transfer Canal Complex Enroute Hasalaka Oya and Heen Ganga together with Lower Uma Oya Complexes with a Comprehensive Hydrological/Water Balance Study.

Mahaweli Consultancy Bureau (MCB), 2012, Detail WATER BALANCE STUDY for the NCP Canal Project.

Mahaweli Consultancy Bureau (MCB), 2013, Technical Proposal for Environmental Impact Assessment of Modifications to Configurations of Moaragahakanda-Kaluganga Projects (Proposed Upper Elahera Canal, Canal From Mannakkattiya To Mahakanadarawa Tank And Kalu Ganga-Moragahakanda Link Canal Project).

Mahaweli Consultancy Bureau (MCB), 2013, Final Report on Feasibility studies and detailed design of Raising/modifications to Minipe Anicut and Rehabilitation of Minipe Left Bank Canal.

MOE 2012.The National Red List 2012 of Sri Lanka; Conservation Status of the Fauna and Flora.Ministry of Environment, Colombo, Sri Lanka.Viii 476pp.

Phillips, W.W.A. 1935. Manual of the Mammals of Ceylon.Ceylon Journal of Science, Dulau and Company, London.

Safeguard Policy Statement (2009), Asian Development Bank Policy Paper, Manila, The Phillippines,

Senaratna, L.K. (2001). A check list of the flowering plants of Sri Lanka. National Science Foundation, Colombo 451pp.

Silva, A., Maduwage, K. and R. Pethiyagoda (2008) A review of the Genus Rasbora in Sri Lanka; with description of two new species (Teleostei, Cyprinidae). Ichthyol Explor Freshwaters. 21(1):27-50.`

Somaweera, R. (2006) Sri Lankave Sarpayan. Wildlife Heritage Trust (Privet) Company Limited, Colombo, Sri Lanka. (Sinhala text). 297p.

Somaweera, R. and N. Somaweera (2009) Lizards of Sri Lanka, A colour guide with Field Keys. Andreas S. Brahm , Heddernheimer Landstre. Germany. 303p.

Social assessment and involuntary Resettlement Compliance Manual Road Development Authority of the ministry of Highway and Road Development-2009

Wijeyeratne, G, De S. (2008) A Photographic guide to Mammals of Sri Lanka. New Holland Publishers (UK) Ltd. 128p.

Ministry of Finance and Planning 2010, http://www.treasury.gov.lk/publications/mahindaChintanaVision-2010full-eng.pdf)

Central Environmental Authority of Sri Lanka http://www.cea.lk/web/index.php/en/law-policy-and-institutional-arrangement-for-eia-in-sri-lanka). Accessed on 12 August 2014http://www.cea.lk/web/index.php/en/acts-regulations.

Geological Survey and Mines Bureau

http://www.gsmb.gov.lk/web/index.php?option=com_content&view=article&id=100%3Alicenses-a-procedures&catid=44%3Aservices&Itemid=68&lang=en Accessed on 12th August 2014

ANNEX III – SOURCE OF DATA AND INFORMATION

1. Mr.H.D.Ratnayake, Director General, Department of Wildlife Conservation
2. Mr. M.G. Eranda, Wildlife Ranger, DWC
3. Ms. Nadeera Kuruppu, Management Assistant, DWC
4. Mrs. MCP EWijerathne GNKottapitiya, Yakalla
5. Mr. J.S, Liyanage – GN Damanayaya
6. Mr. J.M.A. Jayawardana- GN Galenbindunuwewa
7. Mr. H.A. Darmapala – Land officer- Galenbindunuwewa
8. Mr. Manjula Amararatna, Deputy Director, Department of Wildlife Conservation
9. Mr. Mahinda Seneviratne, Deputy Conservator General, Forest Department,
10. Eng. Lalith de Alwis, Director of Irrigation Anuradhapura
11. Eng. Athula Wijewardena, Divisional Irrigation Engineer, Huruluwewa
12. Eng. R.B. Tennekoon, Project Director, Moragahakanda- Kaluganga Projects
13. Eng. D.B. Wijeratne, Deputy Project Director, Moragahakanda- Kaluganga Projects

ANNEXURE IV - LIST OF PREPARERS INCLUDING THEIR WORK ALLOCATION AND THEIR TIME SCHEDULE

No	Name	Position	Responsibilities	Signature
01	Dr. N. Pallewatta	Team Leader/ Environmental Specialist/ Ecologist	Overall management of the assignment and writing of Reports. - Personnel and Administrative management - Conducting the scoping session. - Coordinating of the Biological Studies - Coordination and executing of the study - Quality control of work done by individual consultant - Completion of individual Consultant outputs - Compilation of drafts and final reports - Pollution aspect component - Preparation of Environment Management Plan, Mitigation Plan and Monitoring Plan including proposed work programme, budget estimates, schedules, staffing and other necessary support services to implement the mitigatory measures and to monitor the progress of the implementation of the mitigatory measures -	
02	Eng. K.A.U.S Imbulana	Deputy Team Leader/ Senior Engineer	Assist the Team Leader on management of the Assignment, Writing of Reports and assisting in the following: - Personnel and Administrative management - Conducting the scoping session - Coordination and execution of the study - Quality control of work done by individual Consultant - Compilation of individual Consultant's output - Compilation of drafts and final reports	

			- Completion of Environment Management Plan, Mitigation Plan and Monitoring Plan including proposed work programme, budget estimates, schedules, staffing and other necessary support services to implement the mitigatory measures and to monitor the progress of the implementation of the mitigatory measures. - Responsible for activities relevant to Civil Engineering and infrastructure facilities. -	
03	Prof. D.K. Weerakoon	Fauna Ecologist	- Responsible for activities regarding faunal ecology for both terrestrial and aquatic fauna, impacts on increased human-elephant conflict. - Providing relevant outputs -	-
04	Prof. B.M.P Singhakumara	Flora Ecologist	- Responsible for activities regarding floral ecology for both terrestrial and aquatic flora, impacts on ecology due to hydrological changes. - Providing relevant outputs. -	-
05	Mr. P.D. Leelarathne	Sociologist/Settlement & Resettlement Expert	- Responsible for activities regarding sociological, cultural and human relocation and resettlement	-
06	Eng. R.M.W. Rathnayaka	Hydrologist	- Responsible for activities relevant to Hydrology. - Hydrological changes in Mahaweli/Ambanganga Basins. -	-
07	Eng. S.P.P Gamage	Geologist	- Responsible for activities relevant to Geology and Stability of slopes/tunneling areas potential for landslides. -	-
08	Mr. Ananda Jayasinghe	Agronomist	- Responsible for activities relevant to development of new lands for Agriculture and Agronomy component. -	-

09	Eng. S.A.A Dharmasiri	Irrigation Engineer	- Responsible for activities relevant to water and irrigation engineering	-
10	Prof. P.B. Mandawala	Archeologist	- Responsible for activities relevant to Archeology -	
11	Eng. S.R.K Aruppola	Tunnel Expert/Tunnel Engineer	- Responsible for activities relevant to tunneling and relevant issues, risks and their minimization -	
12	Dr. (Mrs.) U.A.D.P Gunawardhana	Environment Economist	- Responsible for activities regarding environmental economics and Cost-benefit analysis, Preparation of the cost of the proposed remedial and mitigation measures -	
13	Mr. Harsha Weerawanni	GIS Specialist	- Responsible for supervision of activities regarding GIS application and remote sensing and preparation of GIS Maps -	

Annex V - COMMENTS MADE BY THE PUBLIC NGOS AND OTHER AGENCIES DURING FORMAL AND INFORMAL SCOPING MEETINGS HELD BY THE EIA TEAM.

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வனசீவராசிகள் பாதுகாப்புத் திணைக்களம்
DEPARTMENT OF WILDLIFE CONSERVATION

ප්‍රධාන කාර්යාලය - අංක 811/ඒ, ජයන්තිපුර පාර, බත්තරමුල්ල
பிரதான அலுவலகம், இல. 811/ஏ, ஜயந்திபுர வீதி, பத்தரமுல்லை
Head Office - No. 811/A, Jayanthipura Road, Battaramulla

මගේ අංකය / எனது இல / My No. වජී/6/1/1/252	ඔබේ අංකය / உமது இல / Your No.	දිනය / திகதி / Date 2012.09.14

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කොළඹ 05.

ඉහළ ඇලහැර ඇළ මාර්ගය සඳහා විෂය නිර්ණය පත්‍රිකාව (TOR)

උක්ත කරුණ සම්බන්ධයෙන් මා වෙත යොමු කරන ලද ඔබගේ අංක IW/PL/WRD/04/17 හා 2012.08.02 දිනැති ලිපිය හා බැදේ.

02. මොරගහකන්ද ජලාශ වාරිමාර්ග ජල ව්‍යාපෘතිය මගින් අලි ඇතුන් බහුලව සැරිසරන කෙක්වයාර දහස් ගණනක් ජලයෙන් යටවන අතර ඔවුන්ගේ වාසස්ථාන මෙන්ම ස්වභාවික සංක්‍රමණික මාර්ගද මෙමගින් අහිමි වේ.

03. උක්ත ජලාශය නිසා වාසස්ථාන හා සංක්‍රමණික මාර්ග අවහිර වන අලි ඇතුන් බොහොමයක් මින්නේරිය ගිරිතලේ ස්වභාව රක්ෂිතය දෙසට යොමු වෙතැයි අපේක්ෂා කරන අතර එම ප්‍රදේශයේ මානව සංවර්ධන ක්‍රියාකාරකම් වලින් වලක්වා ගත හොත් ඉදිරියේදී වැඩිවිය හැකි අලි මිනිස් ගැටුමට යම් සහනයක් සැලසෙනු ඇත.

04. කෙසේ වෙතත් මොරගහකන්ද ජලාශ ව්‍යාපෘතිය හා සබැඳුනු ඉහළ ඇලහැර ඇළ මාර්ගය ඉදි කරන්නේද උක්ත සඳහන් මින්නේරිය ගිරිතලේ ස්වභාව රක්ෂිතයෙන් මෙන්ම සිගිරිය අභය භූමිය, මින්නේරිය ජාතික උද්‍යානය වැනි වනජීවී රක්ෂිත හරහා වේ.

05. මෙරට ජාතික අවශ්‍යතාවක් වන වාරිමාර්ග පද්ධතිය වැඩි දියුණු කිරීම අත්‍යාවශ්‍යයෙන්ම කළ යුතු නමුත් එමගින් පරිසරයට සිදුවන හානියද අවම කළ යුතු වේ.

06. මින්නේරිය ගිරිතලේ ස්වභාව රක්ෂිත හරහා ඉහළ ඇලහැර ඇළ මාර්ගය ගමන් කරන ප්‍රදේශ පසුගියදා වාරිමාර්ග නිලධාරීන් සමඟ වනජීවී නිලධාරීන් පරීක්ෂා කළ අතර ඊට පසු අප දෙපාර්තමේන්තුවේ ප්‍රධාන කාර්යාලයේදී මේ සම්බන්ධව සාකච්ඡාවක් පවත්වන ලදී.

07. අදාළ ක්ෂේත්‍ර පරීක්ෂා හා සාකච්ඡා තීරණ වලට අනුව උක්ත ඇළ මාර්ගය මගින් සිදු වන පාරිසරික හා වනජීවී සම්පත් වලට වන බලපෑම අවම වන ලෙස පාරිසරික බලපෑම් ඇගයීම්කට යටත්ව එහි කොන්දේසි ප්‍රකාරව සිදු කිරීමට තීරණය වූ අතර මෙම පරිසර ඇගයීම සඳහා විෂය නිර්ණය පත්‍රිකාව නිකුත් කිරීම සහ කොන්දේසි වලට යටත්ව නිර්දේශ කරන බව කාරුණිකව දන්වා සිටිමි.

i. ඇලහැර අභය භූමියේ මායිමෙන් හා දැනට ඉදි කර ඇති විදුලි වැටට සමාන්තරව විවෘතව ඇළ ඉදිකරන කොටසේ වනාන්තරය දෙසින් අලි ඇතුන් හා වනජීවීන්ට ජල අවශ්‍යතා සපුරා ගැනීමට හැකි වන සේ එම ඉවුර ඉතා අඩු බෑවුම් සහිතව ලෙස හා ගම්මානය දෙසට අලි ඇතුන්ට ගමන් කළ නොහැකි ලෙස ගම්මානය පැත්ත දැඩි බෑවුමක් පවතින ලෙස ඇළ ඉවුරු සකස් කිරීම.

ii. රක්ෂිතය තුළ ඉදි කරන කෝන්ගැටිය, තිරවිඩය, කාදුන්කැව වැව අදී වැව් වල ජලයෙන් දැනට කුඹුරු කරන්නන් නම් පමණක් නීත්‍යානුකූල කුඹුරු වලට පමණක ජලය ලබා දීම හා රක්ෂිතය තුල කිසිදු අනවසර වගා කිරීමක් සඳහා ජල ලබා නොදීම (මෙහිදී ජල පාලන කටයුතු වලට යාමේදී වනජීවී නිලධාරියකුද යොදා ගැනීමද සුදුසු වේ).

දුරකථන / தொலைபேசி / Telephone	අධ්‍යක්ෂ ජනරාල්	011 2888581	ප්‍රධාන කාර්යාලය / அலுவலகம் / Head Office	011 2888585
	අධ්‍යක්ෂ (සංරක්ෂණ)	011 2888583	ෆැක්ස් / தொலைநகல் / Fax	011 2883355
	අධ්‍යක්ෂ (පරිපාලන)	011 2888582	ඊ මේල් / மின்னஞ்சல் / E-mail	director@dwc.gov.lk
	අධ්‍යක්ෂ (මුදල්)	011 2888584	වෙබ් අඩවිය / இணையத்தளம் / Website	www.dwc.gov.lk

iii. උක්ත සඳහන් කල වැව් වල ජලය වනජීවීන්ට භාවිතා කල හැකි පරිදි මූල ධාරිතාවෙන් 50 % ක් පමණක් නිදහස් කල හැකි වන පරිදි ජල පාලන සොරොව් සකස් කිරීම.

iv. ලබා දී ඇති යෝජිත ඇල මාර්ගය දැක්වෙන සිතියම් ප්‍රකාරව සුවන්ගහඋල්පත හෙවත් මාදැස්කෑව වැවෙන් ඔබිබට මීන්නේරිය තිරිතලේ ස්වභාව රක්ෂිතය තුල,සිගිරිය අභය භූමිය, මීන්නේරිය ජාතික උද්‍යානය තුල හා සුරුළු වැව වන රක්ෂිතය තුලදී අදාල ඇල මාර්ගය පොළොව ඇතුලින් පමණක් (cut & curve, double conduit හෝ tunnel ලෙස) ගමන් කරන ලෙස සැකසීම.

v. මීන්නේරිය තිරිතලේ ස්වභාවික රක්ෂිතය මධ්‍යයේ පිහිටා ඇති පේකුලම වැව ප්‍රතිසංස්කරණය කිරීමේදී එහි ජලය දැනට රක්ෂිතය තුල අනවසර වගා කටයුතු සිදු කරන කිසිවකුට ලබා නොදීම හා එම අනවසර වගාකරුවන් රක්ෂිතයෙන් ඉවත් කර විකල්ප ඉඩම් ලබා දීම හා අදාල අනවසර වගා ඉඩම් වනජීවීන් සඳහා වෙන් කිරීම.

vi. රක්ෂිතය තුල ඉදි කරන වැව් වලින් අනවසර වගාවන් වලක්වා ගැනීම සඳහා ජලය නිකුත් කරන සොරොව් (sluice gate) නොමැතිව සකස් කිරීම.

vii. වනජීවී රක්ෂිත සඳහා ඇල මාර්ගය පොලව අභ්‍යන්තරයෙන් ගමන් කලද එහි ඉදි කිරීම් කටයුතු වලදී විශාල පරිසර හානියක් සිදුවන අතර අදාල කටයුතු නිමවූ වහාම එම ප්‍රදේශ යථා තත්වයට පත් කර වනජීවීන්ට සුදුසු පරිදි සකස් කිරීම.

viii. මෙම ව්‍යාපෘතිය මගින් සිදුවන වනජීවී වාසස්ථාන අහිමි වීම ප්‍රතිපූර්ණය කිරීම පිණිස යාබද කැලෑ ඉඩම් පවනී නම් එවා රක්ෂිත කිරීම හා පවතින රක්ෂිත ඉඩම තුල වනජීවී වාසස්ථාන වැඩිදියුණු කිරීම.

ix. මීට අමතරව පරිසර බලපෑම් ඇගයීමෙන් (EIA) සිදු කරන නිර්දේශ ක්‍රියාත්මක කිරීම.

08. උක්ත ව්‍යාපෘතිය මගින් විශාල පරිසර හානියක් හා වනජීවී සංරක්ෂණ කටයුතු වලට අහිතකර බලපෑම් සිදු විය හැකි බැවින් උක්ත කොන්දේසි වලට යටත්ව අදාල පාරිසරික බලපෑම් ඇගයීම සඳහා විශය නිර්දේශය පත්‍රිකාව නිකුත් කිරීම නිර්දේශ කරන බව කාරුණිකව දන්වා සිටිමි.

එච්.ඩී.රත්නායක
අධ්‍යක්ෂ (මෙහෙයුම්)

අත් කලේ/ඉංදි උදේනි වික්‍රමසිංහ
වනජීවී සංරක්ෂණ අධ්‍යක්ෂ ජනරාල්

පිටපත් -
අධ්‍යක්ෂ ජනරාල්, ඔධාරම පරිසර අධිකාරිය - කාරුණික දැ.ගැ.පි
වන සංරක්ෂක ජනරාල්, වන සංරක්ෂණ දෙපාර්තමේන්තුව - කාරුණික දැ.ගැ.පි
සහකාර අධ්‍යක්ෂ (පොළොන්නරුව) - කාරුණික දැ.ගැ.පි

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අමාත්‍ය මණ්ඩල කාර්යාලය
அமைச்சரவை அலுவலகம்
OFFICE OF THE CABINET OF MINISTERS

Republic Square, Sir Baron Jayathilaka, Mawatha, Colombo 01, Sri Lanka.

My No. 12/1447/508/029

Your No.

Date 2012-11-03

Eng. Ivan de Silva
Secretary
Ministry of Irrigation and Water Resources Management
Fax:2676846

DRAFT CABINET DECISION

Given below is an extract of **Item (12)** of the Minutes of the Cabinet Meeting held on 2012-10-31. These Minutes are to be confirmed at the next Cabinet Meeting.

Item (12)

Cabinet Paper No.12/1447/508/029, a Memorandum dated 2012-10-08 by the Minister of Irrigation and Water Resources Management on **"Revision of Canal Layout of Moragahakanda - Kaluganga Project"** - (Cabinet decision dated 2009-08-12 on CP No.09/1385/315/007-I refers) the above Memorandum was considered along with the observations of the Ministers of Finance and Planning; and Lands and Land Development. Cabinet having noted the benefits to be accrued on the implementation of the proposed canal layout as detailed in the observations of the Minister of Finance and Planning, decided to grant approval to the proposal in the final paragraph of the Memorandum.

Action by: **My/Irrigation and Water Resources Management** - above observations annexed.

Copied to: **My/Finance and Planning**
My/Lands and Land Development - observations of the Minister of Finance and Planning annexed.
My/Agriculture - copy of Memorandum and above observations annexed.

L. T. Jayampathy
Additional Secretary

Sgd:/ S. Abeysinghe
Secretary to the Cabinet of Ministers

Secretary 2329620

Additional Secretary 2325379
2329621

Administrative Officer 3136199

(12)

මුදල් හා ක්‍රමසම්පාදන අමාත්‍යාංශය
நிதி, திட்டமிடல் அமைச்சு
MINISTRY OF FINANCE AND PLANNING

මහලේකම් කාර්යාලය, කොළඹ 01. ශ්‍රී ලංකාව.
செயலகம், கொழும்பு 01. இலங்கை.
The Secretariat, Colombo 01 Sri Lanka

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වෙබ් අඩවිය / இணைய தளம் / Website } www.treasury.gov.lk

මගේ අංකය / எனது இல. / My No. } NP/AG/IR/CM/12/13
ඔබේ අංකය / உமது இல. / Your No } 12/1447/508/029
දිනය / திகதி / Date } 2012.10.

අමාත්‍ය මණ්ඩල සංදේශය

<u>මුදල් හා ක්‍රමසම්පාදන අමාත්‍යාංශයේ නිරීක්ෂණ</u>

අමාත්‍යාංශය	:	වාරිමාර්ග හා ජල සම්පත් කළමනාකරණ
ශීර්ෂය සහ දිනය	:	මොරගහකන්ද - කළුගඟ ව්‍යාපෘතියේ වාම් ඇළ මාර්ග සැලසුම් සංශෝධනය කිරීම 2012.10.08
යෝජනා/ඉල්ලීම	:	මොරගහකන්ද-කළුගඟ ව්‍යාපෘතියේ යෝජිත දෙවන බෝවතැන්න උමඟ ඉදිකිරීම හා හුරුළුවැව යෝජිත ඇළ මාර්ගය පල්ල කර වැඩිදියුණු කිරීම වෙනුවට, ඉහළ ඇලහැර මාර්ගය ඉදිකිරීම මගින් මෙම ව්‍යාපෘතියේ වාම් ඇළ මාර්ග සැලසුම් සංශෝධනය කිරීම.
නිරීක්ෂණ	:	කෘෂිකාර්මික සහ අනෙකුත් ක්ෂේත්‍රයන්හි සංවර්ධන ඉලක්ක උපරිම අයුරින් සපුරා ගැනීම සඳහා වාරි ජලය පහසුකම් සම්පාදනය ඉටුකිරීම රජයේ ප්‍රතිපත්තියයි. ඒ අනුව උතුරුමැද ඇළ මාර්ගය සඳහා වන පූර්ව ශක්‍යතා අධ්‍යයන ආරම්භ කෙරිණි. මොරගහකන්ද ජලාශයේ සිට මහකනදරාව වැව දක්වා ජලය රැගෙනයාම සඳහා මුලදී යෝජිතව තිබුණේ දෙවැනි බෝවතැන්න උමඟ ඉදිකිරීම හා හුරුළුවැව යෝජිත ඇළ මාර්ගය පුළුල් කර, මාතලේ, පොළොන්නරුව, අනුරාධපුරය සහ ත්‍රිකුණාමලය යන දිස්ත්‍රික්කවලට අයත් අමතර හෙක්ටයාර් 4,600 ක පමණ භූමි ප්‍රමාණයකට දියවර සැපයීමයි. ඒ වෙනුවට සංශෝධිත සැලසුම් යටතේ ඉහළ ඇලහැර මාර්ගය ඉදිකිරීම මගින් මහකනදරාව වැව දක්වා ජලය රැගෙන යාම පමණක් නොව, මහවැලි ප්‍රදේශය තුළ මෙතෙක් ඵලදායීව ප්‍රයෝජනයට නොගත් ජල සම්පත්, උතුරුමැද ඇළ මාර්ගය ඉදිකර අන්තර් ශාඛා ඔස්සේ වයඹ, උතුරුමැද හා උතුරු පළාත්වල ජලාශ හා කුඩා වැව්වලටද, රැගෙන යාමට සැලසුම් කර ඇත. එමගින් ජලය ප්‍රමාණවත්ව නොමැතිකමින් වගා කළ නොහැකි වූ ඉඩම් හෙක්ටයාර 75,000 කට පමණ ජලය සපයා සාර්ථක කෘෂි බිම් බවට පරිවර්තනය කර, එම ප්‍රදේශවල ජනතාවගේ ජීවන තත්ත්වය ඉහළ නැංවීමට ඇති හැකියාව සලකාගෙන ඇත.

ඒ අනුව සංශෝධිත අයුරු උතුරුමැද ඇල මාර්ග ව්‍යාපෘතිය ක්‍රියාත්මක කිරීම තුළින් අපේක්ෂිත සංවර්ධන ප්‍රතිඵලයන් පහතේ:

- උතුරුමැද ඇල මාර්ගය දෙපස පිහිටි වැව් පද්ධතියට අයත් කුඩා හා මධ්‍ය පරිමාණ වැව් දහසකට පමණ දියවර සැපයීම තුළින් ඒ ආශ්‍රිත කෘෂිකර්ම හෙක්ටයාර 30,000 ක් පමණ දෙකන්නයේ වගා කිරීම තුළින් ගොවි පවුල් 125,000 කට පමණ සහන සැලසීම.
- මහකනදරාව ජලාශයේ සිට වයඹ දිශාවට සහ මීටර 100 ක් ඉහළ වී ඇති වැව් පද්ධතියට සැපයීම මගින් වයඹ පළාතේ පිහිටි ප්‍රධාන වැව් අටකට සහ ගේදිගුව වැව් ව්‍යාපාරයේ පවතින ජල උණතාවය මගහැරීම මගින් වගා බිම් හෙක්ටයාර 10,000 කට වැඩි ජලය සපයමින් ගොවි පවුල් 6,000 කට පමණ සහන සැලසීම.
- වයඹ ඇල ව්‍යාපෘතියට අයත් ප්‍රදේශයේ පවතින ප්‍රධාන වැව් යෝජනා ක්‍රමවලට අයත් නව ඉඩම් හෙක්ටයාර 7,000 ක් පමණ සංවර්ධනය වීම.
- උතුරු ඇල මාර්ගය දෙපස පිහිටි නගර 15 කට පමණ පානීය ජල පහසුකම් සැපයීමට අවශ්‍ය ජලය සැපයීම.
- උතුරු පළාතේ පිහිටි පරංගිආරු සහ පාලිආරු නිම්නයන්හි ජලාශ සංවර්ධනය වීමත් සමඟ වවුනියාවේ වැව් ජල උණතාවය මගහැරවීමෙන් නව ඉඩම් හෙක්ටයාර 1,500 කට පමණ වැව් ජල පහසුකම් සැපයීමට හැකිවීම.
- උතුරුමැද ඇල මාර්ගය මගින් ඉරණමඩු හා පාවට්කුලම් ජලාශ පෝෂණය වීමත් සමඟ උතුරු පළාතේ යාපනය දක්වා කෘෂි හා පානීය ජල අවශ්‍යතා සපුරාලීමට දායකවීම.
- උතුරුමැද ඇල මාර්ගය මගින් පෝෂණය වන ප්‍රදේශයේ භූගත ජල විභවය ඉහළයාම නිසා කෘෂි ළිං සහ නළ ළිං 25,000 ක් පමණ සංවර්ධනය කිරීම සහ වැව් ජල පරිභරණය සඳහා නව තාක්ෂණික ක්‍රම හඳුන්වාදීම තුළින් ගොවි පවුල් 25,000 කට පමණ සහන සැලසීම සහ
- ඇල මාර්ගයේ දෙපස හරිත වන තීරුවක් ඇති කිරීම මගින් වන, සතුන් සහ වන සංරක්ෂණය සඳහා දායකවීම සහ මෙමගින් සංචාරක, අභ්‍යන්තර ධීවර, වෙළඳ සහ කෘෂි ව්‍යාපාර වැනි කර්මාන්ත අංශයන්හි රැකියා උත්පාදනයටද ඉවහල් වෙමින් මහවැලි ජලය යාපනය අර්ධද්වීපය දක්වා රැගෙන යාම තුළින්, දකුණේ හා උතුරේ ජනතාව අතර සමාජ ඒකාබද්ධතාවය ඉහළ නැංවීමට ද දායක වන බව හඳුනාගෙන ඇත.

ඒ අනුව, මෙම අමාත්‍ය මණ්ඩල සංදේශයේ යෝජිත පරිදි මොරගහකන්ද-කළුගඟ ව්‍යාපෘතියේ ඉහළ ඇලහැර වැව් ඇල මාර්ගය සකස් කිරීම සඳහා සංශෝධිත සැලැස්මට අනුව කටයුතු කිරීම යෝග්‍යය.

මහින්ද රාජපක්ෂ
මුදල් හා ක්‍රමසම්පාදන අමාත්‍ය

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வன பரிபாலனத் திணைக்களம்

FOREST DEPARTMENT

ප්‍රධාන කාර්යාලය, සම්පත්පාය, තැ. පෙ. 3, බත්තරමුල්ල, ශ්‍රී ලංකාව.
...ad Office, Sampathpaya, P. O. Box 3, Battaramulla, Sri Lanka

දුරකථන / தொலைபேசி / Telephones: 2866631, 2866632, 2875540
ෆැක්ස් / தொலைநகல் / Fax: (94-1) 2866633
E-mail: Forest@slt.lk.

මගේ අංකය / My Ref.: EMD/EIA/MIWRM/ID/NCPCP/2012

ඔබේ අංකය / Your Ref.:

දිනය / Date: 2012.09.11

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උක්ත කරුණ සම්බන්ධව ඔබේ අංක 08/EIA/Water/04/2012 හා 2012.08.20 දිනැති ලිපිය සම්බන්ධවයෙනි.

02. ඉදිරිපත්ව ඇති සංශෝධිත සැලසුම්වලට අනුව, මෙම දෙපාර්තමේන්තුවට අයත් හුරුළු ජාත්‍යන්තර මිනිසා හා ජෛවගෝලීය රක්ෂිතය හා වෙනත් රක්ෂිත හා වෙනත් රජයේ වනාන්තර කොටස් තුලින් මෙම ඇල මාර්ගය ගමන් කිරීමේදී වන ජීවීන්ට ගමන් කිරීමට හැකිවන සේ හා වනාන්තර කොටස්වලට අවම හානියක් වන සේ අදාළ ඇල මාර්ගයේ ඉදි කිරීම සඳහා මූලික එකඟතාවය මෙයින් ලබා දෙමි. එසේ වුවද ඇල මාර්ගය සකස් කිරීමට භාවිතා කරනු ලබන මාර්ගය වනාන්තරයට හානි පමුණුවන බලවේග විසින් යථාකාලයේදී භාවිතා කරනු ලැබීම වැළැක්වීමට ශ්‍රී ලංකා මහවැලි අධිකාරිය හෝ අදාළ ව්‍යාපෘතියෝජක ආයතනය විසින් සියළුම පියවර ගනු ලබන බවට යන කොන්දේසියට යටත්ව මෙම එකඟතාවය ලබා දෙන බවද සලකන්න.

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நீர்ப்பாசனம் மற்றும் நீர் வளங்கள் முகாமைத்துவ அமைச்சு
MINISTRY OF IRRIGATION AND WATER RESOURCES MANAGEMENT

අංක 11, ජයවර්ධන පාර,
கொழும்பு - 05.
No. 11, Jawatta Road,
Colombo - 05.

My No: MIWRM/WRP/TRC/NCP-02
Your No:
Date: 12.03.2014

The Secretary,
Ministry of Ports and Highways

Implementation of Upper Elabera Canal (UEC) from Muragahakanda Reservoir of North Central Province Canal Project (NCPCP) of Mahaweli Development Program (MDP)

Dumping site for Tunnel excavations of Upper Elabera Canal

The Upper Elabera Canal is a component of North Central Province Canal Project (NCPCP) of Mahaweli Development Program (MDP) under the National Development Program- "Mahinda Chinthanaya Idiridaksma".

The implementation of Upper Elabera canal from Muragahakanda Reservoir is to be undertaken under the ADB funding shortly. The Upper Elabera canal of total length of 66.5km consists of 30 km of Tunnel excavation through hard rock.

The estimated quantity of rock excavation left out for disposal after using for lining of canal, tunnel sections, and construction of structures, reservoir riprap etc is estimated at 700,000 M^3 over a period of 3 years starting from mid 2016.

As the Upper Elabera canal is running through the environmentally sensitive areas (Forest and Wildlife reserves) both ADB and CEA is concern about the disposal of excess rock excavation from the canal.

As a solution to this issue the quarry site of Ganewalpola along the Ganewalpola –Kekirawa road belongs to Road Development Authority has been suggested by the concern parties as this has been a approved site for Quarry Products as well as Asphalt Concrete mixing plant where the rock excavated from the canal could be used by the prospective users of Road Development Authority.

I too agree with the suggestion as it minimizes the environmental impacts and also benefit the Country in its effort to develop infrastructure projects.

A map showing the Upper Elabera Canal in relation to ongoing Mragahakanda- Kaluganga reservoir projects are attached hereto for your reference.

Accordingly your consent to use the Ganewalpola Quarry site for the above purpose is solicited.
Your cooperation on this matter is highly appreciated.

Thanking you.
Yours faithfully,

Eng. K.W. Ivan de Silva
Secretary
Ministry of Irrigation and Water Resources Management

C/c:-
01. Director General, Central Environmental Authority
02. Team Leader -EIA Study Consultants

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நீர்ப்பாசனம் மற்றும் நீர் வளங்கள் முகாமைத்துவ அமைச்சு

MINISTRY OF IRRIGATION AND WATER RESOURCES MANAGEMENT

No. 11, Jawatta Road,
Colombo - 05

My No: MIWRM/WRP/TRC/NCP-02 Your No: Date: 12.03.2014

Conservator General of Forest,
Department of Forest Conservation

<u>Implementation of Upper Elahera Canal (UEC) and Kaluganga Moragahakanda Link Canal (KMTC) of North Central Province Canal Project (NCPCP) of Mahaweli Development Program (MDP)</u>

<u>Dumping site for excavations of Upper Elahera Canal and Kaluganga Moragahakanda Link Canal</u>

You are aware the EIA Study process has already begun on above Canal Projects. It is essential to complete the EIA approval process expeditiously as ADB has agreed to fund the implementation of these two canals.

In this connection a map showing the dumping sites for the excavated materials of Upper Elahera Canal and Kaluganga Moragahakanda Link Canal is attached hereto.

The table below illustrates the present status, intended usage, extent and proposed mitigation measures of these sites.

Site No	Location	Present status of location	Intended usage	Proposed Mitigation
A- Kaluganga-Moragahakanda Link Canal				
1	1st km of KMTC Canal from Kaluganga outlet structure	Cleared	**Temporary** dumping site within the open canal area	Not required, site will be converted to the permanent canal from Kaluganga outlet structure.
2	Location for dismantling / exit of TBM near 3+400 km of KMTC at Lel Oya Aquiduct	Jungle	**Temporary** site 200mX50m-1ha	Area used will be reinstated.
3	Location for assembly of TBM Moragahakanda out let of KMTC(Reservoir bed)	Jungle	**Temporary** dumping site 200mX50m-1ha	Area used will be reinstated. Excavated material will be dump above HFL of Reservoir
B-Upper Elahera Canal				
Site No	**Location**	**Present status of location**	**Intended usage**	**Proposed Mitigation**
4	At 1st km of UEC & 12th km of Naula-Elahera Road	Shrub Jungle	**Permanent** Dumping site-2 ha	Excavated material will be evenly spread and reforestation
5	Kongetiya Level crossing FSL area Near 5+00 km UEC	Existing reservoir	**Temporary** Dumping site-2 ha	Material will be used for Improvements of Reservoir to amalgamate with UEC Design & Canal bund formation
6	Malattewa Level Crossing FSL area near 17+00 km UEC	Existing reservoir	**Temporary** Dumping site-2 ha	Material will be used for Improvements of Reservoir to amalgamate with UEC Design & Canal bund formation
7	Location for dismantling / exit of TBM near 27+500km UEC outside Minneriya NP	UEC	**Temporary** site 200mX50m along the canal-1ha	Additional area used will be reforest after removing TBM
8	Location near EMYE Diyabeduma	Abandoned Borrow area	**Permanent** Dumping site	The abandoned borrow pits will be filled with excavated material, compacted and

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9	Location for assembly of TBM near 37+00km UEC outside Minneriya NP	UEC	**Temporary** site 200mX50m along the canal- 1 ha	Additional area used will be reforest after removing TBM.
10	Moragas wewa-Sigiriya road side	Presently LoggedTurpentine forest	**Permanent** Dumping site-2 ha	Excavated material will be evenly spread and reforestation
11	Location for dismantling / exit of TBM near 41+00km UEC	UEC-Shrub Jungle	**Temporary** site 200mX50m along the canal- 1ha	Additional area used will be reforest
12	Location for assembly of TBM near 56+00km UEC	UEC	**Temporary** dumping site 200mX50m along the canal- 1 ha	Additional area used will be reforest
13	Namalpura near 60+00 UEC	Shrub Jungle	**Temporary** Dumping site-2 ha	Material will be used for Canal bund formation. Additional area used will be reforest

Above locations and extents have been decided after careful analysis of construction process, quantity of material that will be excavated, reused in permanent works and quantity to be disposed. Already discussions has been initiated with Secretary –Ports and Highways for disposal of all excess hard rock excavated at their quarry site at Ganewalpola along Ganewalpola- Kekirawa road (Copy annexed).

Your observations/approval to include above sites in the EIA study report is solicited.

Thanking you,
Yours faithfully,

Eng. K.W. Ivan de Silva
Secretary
Ministry of Irrigation and Water Resources Management

Cc:-
i). Director General, Central Environmental Authority
ii). Team Leader ,EIA Study Consultants →

K. W. IVAN DE SILVA
Secretary
Ministry of Irrigation and Water Resources Management

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நீர்ப்பாசனம் மற்றும் நீர் வளங்கள் முகாமைத்துவ அமைச்சு
MINISTRY OF IRRIGATION AND WATER RESOURCES MANAGEMENT

අංක 11, ජවහර්ලාල් පාර, කොළඹ - 05
இல. 11, ஜவஹர்லால் வீதி, கொழும்பு - 05
No. 11, Jawatta Road, Colombo - 05

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ඔබේ අංකය / உமது இல. / Your No:
දිනය / திகதி / Date: 12.03.2014

Director General,
Department of Wildlife Conservation

Implementation of Upper Elahera Canal (UEC) and Kaluganga Moragahakanda Link Canal (KMTC) of North Central Province Canal Project (NCPCP) of Mahaweli Development Program (MDP)

Dumping site for excavations of Upper Elahera Canal and Kaluganga Moragahakanda Link Canal

You are aware the EIA Study process has already begun on above Canal Projects. It is essential to complete the EIA approval process expeditionsly as ADB has agreed to fund the implementation of these two canals.

In this connection a map showing the dumping sites for the excavated materials of Upper Elahera Canal and Kaluganga Moragahakanda Link Canal is attached hereto.

The table below illustrates the present status, intended usage, extent and proposed mitigation measures of these sites

i- Kaluganga-Moragahakanda Link Canal				
site No	Location	Present status of location	Intended usage	Proposed Mitigation
	1st km of KMTC Canal from Kaluganga outlet structure	Cleared	**Temporary** dumping site within the open canal area	Not required, site will be converted to the permanent canal from Kaluganga outlet structure.
	Location for dismantling / exit of TBM near 3+00 km of KMTC at Lel Oya Aquaduct	Jungle	**Temporary** site 200mX50m-1ha	Area used will be reinstated
	Location for assembly of TBM Moragahakanda out let of KMTC(Reservoir bed)	Jungle	**Temporary** dumping site 200mX50m-1ha	Area used will be reinstated. Excavated material will be dump above HFL of Reservoir
i-Upper Elahera Canal				
site No	Location	Present status of location	Intended usage	Proposed Mitigation
	At 1st km of UEC & 12th km of Naula-Elahera Road	Shrub Jungle	**Permanent** Dumping site-2 ha	Excavated material will be evenly spread and reforestation
	Kongetiya Level crossing FSL area Near 5+00 km UEC	Existing reservoir	**Temporary** Dumping site-2 ha	Material will be used for Improvements of Reservoir to amalgamate with UEC Design & Canal bund formation
	Madattewa Level Crossing FSL area near 17+00 km UEC	Existing reservoir	**Temporary** Dumping site-2 ha	Material will be used for Improvements of Reservoir to amalgamate with UEC Design & Canal bund formation
	Location for dismantling / exit of TBM near 27+500km UEC outside Minneriya NP	UEC	**Temporary** site 200mX50m along the canal-1ha	Additional area used will be reforest after removing TBM
	Location near EMYE Diyabeduma	Abandoned Borrow area	**Permanent** Dumping site	The abandoned borrow pits will be filled with excavated material, compacted and

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කාර්යාලය / அலுவலகம் / Office: 011-2554034
Fax: 011-2554009
E-mail: director@irrigationmin.gov.lk

9	Location for assembly of TBM near 37+00km UEC outside Minneriya NP	UEC	**Temporary** site 200mX50m along the canal-1 ha	Additional area used will be reforest after removing TBM
10	Moragas wewa-Sigiriya road side	Presently LoggedTurpentine forest	**Permanent** Dumping site-2 ha	Excavated material will be evenly spread and reforestation
11	Location for dismantling / exit of TBM near 43+00km UEC	UEC-Shrub Jungle	**Temporary** site 200mX50m along the canal-1ha	Additional area used will be reforest
12	Location for assembly of TBM near 56+00km UEC	UEC	**Temporary** dumping site 200mX50m along the canal-1 ha	Additional area used will be reforest
13	Namalpura near 60+00 UEC	Shrub Jungle	**Temporary** Dumping site-2 ha	Material will be used for Canal bund formation. Additional area used will be reforest

Above locations and extents have been decided after careful analysis of construction process, quantity of material that will be excavated, reused in permanent works and quantity to be disposed. Already discussions has been initiated with Secretary Ports and Highways for disposal of all excess hard rock excavated at their quarry site at Ganewalpola along Ganewalpola- Kekirawa road (Copy annexed).

Your observations/approval to include above sites in the EIA study report is solicited.

Thanking you,
Yours faithfully,

Eng. K.W. Ivan de Silva
Secretary
Ministry of Irrigation and Water Resources Management

Cc-
i. Director General, Central Environmental Authority
ii. Team Leader ,EIA Study Consultants

Minutes of the Public Consultation Programme Meetings held 2.00p.m. 21st and 22nd of April 2014 at Galenbindunuwewaand ElaheraGN divisions on the UEC Project

PRESENT:

- **UEC Staff:** Mr. P.D. Leelarathne– Sociologist
  Mr. U.K.A.C.Ukwatta – Engineering Assistant
  Mr.Y.K.V.Costa – Survey Assistant
- **Divisional Secretary Office:**
  Mrs. MCP EWijerathne GNKottapitiya, Yakalla
  Mr. J.S, Liyanage – GN Damanayaya
  Mr. J.M.A. Jayawardana- GN Galenbindunuwewa
  Mr. H.A. Darmapala – Land officer- Galenbindunuwewa

There were two meetings represented all the affected families. First meeting was held on 21st of April at a community hall in Yakalla GN division representing the Northern part of the UEC and 2nd meeting held on 22nd April at a community hall in Elahera GN division. The same field survey teams were engaged in both discussions and similar issues were discussed at both meetings. Thus, for the sake of convenience, the report below covers the issues raised in both instances in summary form.

GENERAL TOPICS

Efforts were made to create a suitable environment where all issues could be raised, discussed and dealt with in a cordial environment. The overview of the project including facts about the project, issues due to the project and the adverse impacts as well as solutions to these impacts were discussed.

Following that,theofficialrepresenting the projectpresent at the meeting explained the objective of the meeting. He also emphasized to the community the problems and issues related to the UEC that could be asked during the session to get answers. Subsequentlyan awareness programme was carried out.

The programmewas carried out under the two parts.

- The first part of the programme dealt with the awareness of the community about the UEC project. This included information about the canal trace, design, benefits of the project, Time period, Budget, etc.
- The second part was concerned with raising the awareness of the affected community about the resettlement and compensation programmers. This included the location, canal area, information related to the affected community, loss of houses, homesteads and paddy lands, families to be resettled, compensation system, relocation options etc.

The first part of the programme was conducted by an engineer of the UEC staff and explained clearly all the information regarding to the project. People asked to change the canal trace to minimize impacts to the community. Most them expressed the request to find ways and means to issue water for their lands. The provision of water for drinking and domestic purposes was also discussed.

Starting the second part Mr. P.D. Leelarathne, the Sociologist,explained the social and economic impacts to the affected community. This programme was carried out according to the participatory approach system. As a group exercise, the social and economic impacts to the community were identified and the mitigation measures were also discussed.

In this discussion, attention was paid to the following sectors:

- Families affected by impacts to their residence and home gardens
- Families affected by impacts to their home gardens only
- Families affected by impacts to their highlands
- Families affected by impacts to their Paddy lands
- Indirectly affected families

The community members 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 laborers. They have built their houses over a long period of time, step by step facing difficulties.Therefore they need a sufficient compensation package. All the participants expressed their agreement to this system of compensation. They stated that the social value should also be considered and not just the economic value, when compensating for the losses of the people. The ideas expressed by all involved were that compensation should also adequately take into consideration the disruption of their social lives and that a more generous package should be provided as a result. As such the factors discussed below should be taken into consideration by the project proponents.

- All the families that are able to do so unanimouslyexpressed their interest in locating themselves within the remnant parts of their lands which will not be affected by the project. Most of the 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.
- Some famers asked foropportunitiestogetwater for cultivation for agriculture and drinking and domestic purposes from the UEC. Since they traditionally face severe droughts in the Yale season, it would ease their problems very much if sufficient water was provided in the dry season.
- Some people 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 need a sufficient amount of compensation.
- No objections were expressed by the participants about the UEC. Their view was that after completion of the UEC, the land value of the existing land will go up
- Another issueput forward by the community was that due to relocationthey lose the connection with relatives, friends and neighbours that they now enjoy. The current relationships were builtover a long period of time and it is difficult to rebuild such relationships with the new families. In their current areas of residence their children have security due to existing relationships with neighbours and relations

- A few people also submitted that loss of access to religious places was a significant issue. Some explainedthat they will losethe membership in some village levels societies and therefore lose benefits.
- Regarding infrastructure, the people are of the opinion that they may be at a disadvantage where electricity and roads are concerned.When inquiries were raised about preferences pertaining to relocation and resettlement, there seemed to be no consensus among the members of the community as such, although a significant percentage opted to be resettled with the lands and compensation which is sufficient to cover ant losses they might incur totally.
- When the place of relocation is considered, , a slight pattern is discernible; the preference seems to be towards relocation *as near as possible* to their original area of residence.
- They asked for compensation for timber trees which are due to be removed; but also to be allowed to use remaining parts to build their houses.
- Provide facilities available now such as electricity for the newly build house as a case of relocation.
- Provide employment opportunities created by the construction of the UEC to them.
- The community was informed of the compensation package that they would receive.
- Construction would commence only after all compensation is done they have doubtsabout government valuation approaches, i.e. that it will be low and not pay sufficient amount and that it will be delayed.
- They requested that a representative of the community be included in the valuation committee and grievances committees.

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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2	W.A. [illegible]		118 [illegible]	[illegible]	[illegible]
3	W.A. [illegible]		118 [illegible]	[illegible]	[illegible]
4	M.J. [illegible]		265 [illegible]	072-5469535	[illegible]
5	[illegible]		[illegible] 130		[illegible] [illegible]
6	[illegible]		[illegible] 131		[illegible]
7	W.M. [illegible]		[illegible] 117/2		[illegible]
8	B.G. [illegible]		[illegible] 115/[illegible]	[illegible]	[illegible]
9	K.P. [illegible]		[illegible]		[illegible] 0718146
10	D.G. [illegible]		[illegible] 116		[illegible]
11	L.H. [illegible]		[illegible] 132		[illegible]
12	R.D.G. [illegible]		No 76	072 85 57742	[illegible]
13	K.G. [illegible]		[illegible]	077-52 1991	[illegible]
14	M. [illegible]		[illegible]	071 60 96292	[illegible]
15	M.H. [illegible]		[illegible]	072-46 33582	[illegible]
16	P.L. [illegible]		[illegible]	071-95 60534	[illegible]
17	M. [illegible]		[illegible]		[illegible]
18	J. [illegible]		[illegible]	075-069 2146	[illegible]
19	G.G. [illegible]		[illegible]		[illegible]
20	R.W. [illegible]		[illegible]		[illegible] 0710901
21	[illegible]		[illegible]		[illegible] 0412914
22	A.G. [illegible]		[illegible]	072-60 57270	[illegible]
23	J.A. [illegible]		[illegible]	071-61 99792	[illegible]
24	N.W.G.D. [illegible]		[illegible]	071-60 77010	Tharidu
25	A.C. [illegible]		[illegible]		A.C. [illegible]

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26	W.G. [illegible]		[illegible]		[illegible]
27	[illegible]		[illegible]	...3396797	[illegible]
28	D.M. [illegible]		[illegible]	0725810105	[illegible]
29	M. [illegible]		[illegible]	0721134745	[illegible]
30	M.G.P. [illegible]	[illegible]	10 [illegible]	0713057850	[illegible]
31	J.S. [illegible]	[illegible]	8 [illegible]	0713497143	[illegible]

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26	P [illegible]		[illegible]	0255796 705	[illegible]	
27	[illegible]		[illegible]	0772842 7774	[illegible]	
28	[illegible]		[illegible]	072517 9543	[illegible]	
29	[illegible]		[illegible]		[illegible]	
30	TB [illegible]		[illegible]		[illegible]	
31	M G C N [illegible]		〃 〃		[illegible]	
32	[illegible]		〃 〃		[illegible]	
33	[illegible]		〃		[illegible]	
33	S. [illegible]		[illegible]		[illegible]	
34	[illegible]		[illegible]		[illegible]	
35	K. [illegible]		[illegible]		[illegible]	
36	S. P. [illegible]		[illegible]		[illegible]	
37	M. [illegible]		[illegible]		[illegible]	
38	W. G. [illegible]		〃	072 590 3623	[illegible]	T.P
39	K D D [illegible]		[illegible]	0774477 1785	[illegible]	0767411
40	[illegible]		[illegible]		[illegible]	
41	[illegible]		[illegible]		[illegible]	
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44	[illegible]		[illegible]	[illegible]	[illegible]	
45	[illegible]	[illegible]	[illegible]	071-2270122	[illegible]	
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Minutes of the Stakeholder Meeting on ADB Funded Water Resources Development Investment Programme

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. AyahMaratha, Colombo 10.

Participants: The following officers/ organizations participated.

1.	Mr. K. W. Ivan de Silva	Secretary	MIWRM
2.	Mrs. Bard Kamaladasa	DGI	Irrigation Department
3.	Mrs. Udeni Wickramasinghe	Secretary	Ministry of Wildlife Resources Conservation
4.	Mr. N. C. M. Navaratne	Deputy Director General (Technical)	MASL
5.	Mr. W. Samaraweera	Addl. Secretary	Ministry of Disaster Management
6.	Mrs. N. R. Ranjani	Addl. Secretary (Development)	Ministry of Water Supply & Drainage
7.	Mr. Lance Gore	Mission Leader	ADB
8.	Mr. B. Freeman	Team Leader/ PPTA	LI
9.	Mr. Jayantha Peris	Consultant	ADB
10.	Ms. R. M. S. Swarnalatha	Communication Specialist	ADB
11.	Mr. Ahsan Tayyab	SLRM	ADB
12.	Mr.Andre Oosterman	Economist	ADB
13.	Mr. Jayantha Perera	Safeguards Specialist	ADB
14.	Mrs. Manjula Amarasinghe	Env. Specialist	ADB
15.	Mr. N. C. Gunasekara	Social Development & Gender Specialist	ADB
16.	Dr. Palitha Bandara	Focal Point	ADB
17.	Mrs. N. Jeyawadani	Director	Ministry of Economic Development
18.	Mrs. K. R. S. Perera	Director	Ministry of Wildlife Resources Conservation
19.	Mr. W. P. D. Rajamanthri	Deputy Chief Secretary (Engineering Services)	NW Provincial Council/ Chief Secretary of Kurunegala
20.	Mrs. Kanthi de Silva	Director (EIA)	CEA
21.	Mrs. N. K. Attanayake	DD (EIA)	CEA
22.	Mrs. Menaka Rajaguru	AD	ERD
23.	Mr. W. K. B. H. Prame	Deputy Director	GSMB
24.	Mr. D. Weerakoon	Professor (Fauna Specialist)	University of Colombo
25.	Mr. Varuna Dharmaratne	Project Specialist	JICA Sri Lanka
26.	Mr. Ayumu Ohshima	Rural Development Department	JICA HQ

27.	Mr. Kazu Shimazuki		JICA HQ
28.	Ms. Namiko Yamada		JICA Sri Lanka
29.	Dr. H. Manthrithilake	Head - SL Development Initiative	IWMI
30.	Mrs. Shermin de Silva	Director Udawalawe Elephant Research	EFECT
31.	Mr. S. P. Vidanage	Programme Coordinator	IUCN
32.	Ms. Lyu Lining	Asst. Commissioner	CDB
33.	Mr. Jayantha Jayawardena	Management Trainee	Biodiversity Trust
34.	Mr. Pubudu Weerarathna		Species Conservation Centre
35.	Mr. R. A. Jayawardena	Vice President	Wildlife & Nature Protection Society
36.	Mrs. Sunela Jayawardena		Federation of Environmental Organizations
37.	Mr. A. Perera	CID	
38.	Mr. B. A. S. S. Perera	Director (Kurunegala)/ PD NWPCP	Irrigation Department
39.	Mr. M. Thuraisingham	Addl. DGI	Irrigation Department
40.	Mr. W. L. H. M. T. Bandara	Addl. DGI	Irrigation Department
41.	Mr. G. M. R. A. Perera	DPD NWPCP	Irrigation Department
42.	Mr. S. Shanmugashivanandan	DI	Irrigation Department
43.	Mr. S. D. Medivaka	PD, MLBR	Irrigation Department
44.	Mr. A. M. R. B. Attanayake	Director (Forest)	MASL
45.	Mr. H. H. Leelarathna		MASL
46.	Mr. S. A. A. Dharmasiri	PD, UEC	MASL
47.	Mr. B. A. Liyanagama	System Analyst	MCB
48.	Mr. J. A. S. A. Jayasinghe	Consultant	MCB
49.	Mr. J. Jochimthasan	Consultant Engineer	MCB
50.	Mr. K. A. U. S. Imbulana	Consultant	MCB
51.	Mr. M. R. S. Wickramaratne	Consultant	MCB
52.	Mr. N. D. T. M. Amerasekara	TL, NWP	MCB
53.	Mr. P. W. C. Dayaratne	TL, NCP	MCB
54.	Mr. S. S. Ranatunga	Consultant	MCB
55.	Mr. N. A. Sisira Kumara	Addl. Sec. (WRP)/ Programme Director (WRDIP)	MIWRM
56.	Mr. R. M. W. Ratnayake	Addl. Sec (Technical)	MIWRM
57.	Mr. D. D. Ariyaratne	Director (PI)	MIWRM
58.	Ms. L. P. C. Fernando	Asst. Director (PI)	MIWRM
59.	Mr. M. M. S.R. Perera	Env. Consultant	MIWRM
60.	Mr. P. H. Jayawardena	Eng. Consultant	MIWRM
61.	Mr. M. N. Ismail	Engineer	MIWRM

Programme Director (WRDIP) Eng. N. A. Sisira Kumara explained briefly about the objectives of the meeting and welcomed all who attended to the meeting on the invitation of MIWRM.

Then PD (WRDIP) invited Eng. K. W. Ivan de Silva, Secretary of M of I & WRM to chair the meeting.

Secretary of MIWRM chaired and preceded the meeting. He explained that the objective of this meeting was to make aware the stakeholders with respect to proposed Moragahakanda – Kaluganga Transfer Canal Project (KMTC), Upper Elahera Canal Project (UEC), and North Central Province Canal Project (NCPCP).

The secretary MIWRM explain that the Government of Sri Lanka could not commence the balance construction works under Mahaweli Development Programme (MDP) due to internal conflict in the country for the last 30 years. Now time has come to complete the MDP with several modifications according to the current water resources planning. The ultimate target of implementation of NCP Canal Project is to provide additional volume of water for Agriculture, Drinking and Industrial purposes in NCP and NP including Iranamadu reservoir which is the source for drinking water for Jaffna district.

He further explained the human-elephant conflict issues in proposed project area and expects to take every possible step to prevent and minimize human-elephant issue when implementing above said projects. The construction of Moragahakanda-Kaluganga Project is in progress which is funded by the China Bank.

Now ADB has sent Project Preparatory Technical Assistance Mission to Sri Lanka to review proposals for provide funds for the implementation of UEC, NWPC, Minipe Left Bank Rehabilitation, and Moragahakanda – Kaluganga Transfer Canal (KMTC) projects.

A presentation was shown about the projects completed under the MDP and the balance work of the projects to be completed in future.

The main purpose of construction of Moragahakanda-Kaluganga Reservoir is to increase the cropping intensity, provide water for industries and drinking water etc to the area developed under Mahaweli Development Programme.

According to modified NCP Canal project about 75,000 Ha of existing lands receives water for agriculture and irrigation purposes.

Now ADB has identified the KMTC, UEC, NWPC and MLBR projects to provide with funds for implementation.

The Mahaweli Consultancy Bureau (MCB) has prepared the designs & estimation for UEC, NWPC and MLBR and KMTC Projects.

Mr. Lance Gore Mission Leader of ADB stated that the GOSL invited ADB to study the proposed projects of UEC, NWPC, MLBCR and KMTC to provide funds for implementation. The Project Preparatory Technical Assistance (PPTA) of ADB is now in Sri Lanka to review the proposals of above said projects.

Dr. Freeman Team Leader PPTA/ADB submitted a work schedule and program for deliverables on a presentation slide.

The work schedule included (A) Project Management, (B) Technical Assessment, (C) Safeguard Assessments (EIA/IEE) ,(D) Financial and Economic Appraisal (E) Project Packaging (F) Implementation Activities.

According to the work schedule the PPTA/ADB planned to submit the final report in November 2014. Dr. Freeman TL-PPTA explained the consultation,' participation and communication aspects of stakeholders' analysis and communications based assessment under phase I of PPTA. Development of a strategic communication programme under phase II.

He explained the critical path items as preparation of ADB Bid Documents and implementation of grievances address package.

Prof. Devaka Weerakoon (UOC) explained the environmental aspects of NCP Canal stage I, UEC, and KMTC. He stated that UEC passing through four (4) protected areas. Canal passes through five (5) natural habitats, dry mixed evergreen, forests and scrub lands.

NWPC passing mainly through developed areas. 02 storage tanks are located within Kahalla-Pallekele Sanctuary and. Canal passes through 03 natural habitats.

The Minipe Anicut is located within Victoria – Randenigala and Rantambe Sanctuary.

Major Impacts observed

i. NCP Canal

Elahara – Gritale sanctuary 150 Ha, Minneriya – Gritale sanctuary – 0 Ha, Minneriya National Park 15 Ha, Huruluwewa Forest – 0 Ha. The total affected area is 160 Ha. Restoration of degraded habitats and acquisitions of new area is necessary.

ii Disruption of movement, patterns and death or injuries of wild elephants due to falling into canal have to be considered.

iii A suitable solution for human-elephant conflict to be found.

MIWRM has commenced a separate study to develop a wildlife management plan to provide long term solution for the human – elephant conflict.

iv. Reduction in surface flow

An environmental flow has been agreed by the MIWRM.

Disturbances due to noises and vibrations emission of dust have to be solved.

Mr. Shamen P. Vidanage (Programme Coordinator) explained the approaches to develop a strategic environmental action plan to mitigate HE conflict as detailed below.

Stage I: He explained the procedure to develop a strategic action plan in consultation with all stakeholders. He further requested to finalize the concept act by mid August 2014. A cabinet approval is to be obtained for concept paper by September 2014.

Stage II: Implementation of the action plan covering the NCP and NWPC areas.

Stage III: Implementation of the UVA/SP strategic plan.

The MIWRM will take overall lead in commissioning the study, co-ordination whole process.

The Secretary, MIWRM stated that 02 committees will be formed, one at National Level and other at Ministry Level to monitor the above programme.

No new land will be developed under these new projects but provides additional volume of water for existing scheme to increase the cropping intensity. Secretary invited all the participants to express their view at this discussion stage.

Discussion Stage

Mr. R. A. Jayawardena – Vice President (WNPS) stated the human- elephant conflict which taken place in several projects earlier and he wants to know the method that will adopt in these new projects to prevent similar incidents.

Secretary, MIWRM replied that MIWRM is being implemented a programme to protect wild elephants by providing funds to the Wildlife Department. He said that his Ministry has already been provided funds to Moragahakanda, Yan Oya & Weheragala Projects.

Mrs. Sunela Jayawardena, Federation of Environmental Organizations questioned about the disturbances of wild elephants and other animals during the period of construction of the projects. Also she stressed that proposed elephant corridor in Moragahakanda project is not established yet.

Secretary replied that there may be disturbances during the period of construction but this problem will be solved after completion of the projects, and also mentioned that all the environmental activities that have been mentioned above will be implemented.

Mr. H. Manthrithilake (IWMI) requested an additional one MCM of water to release to d/s of the project area for use of wild animals. The Secretary mentioned that in overall study minimum environmental flow requirements have been considered.

Mrs. Shermin de Silva Director – Uda Walawe Elephant Research Project, EFECT stated the elephants in Uda Walawe area were not protected during the period of construction of Uda Walawe reservoir. Hence she requested to protect all the wildlife including elephants during the construction period of new projects.

Secretary, MIWRM replied that her request will consider and accommodate in the TOR.

N. R. Ranjani, Addl. Sec (Dev) of Ministry of Water Supply & Drainage

She stated that farmers who benefitted under Iranamadu Reservoir have opposed to allow water to convey to Jaffna District, as those farmers unable to do their cultivation in Yala season due to scarcity of water in the reservoir. Hence, she requested MIWRM to expedite the construction of NCP Canal project up to Iranamadu to enable to convey water to Jaffna District for drinking & industrial purposes.

Eng. B. A. S. S. Perera PD/ NWPC, pointed out the present quality of water is deteriorating due to utilization of chemical fertilizers and other weeds control chemicals for cultivation by the farmers.

Hence the people living in Galgamuwa area have been effected kidney diseases and it's become a major health issue. Therefore he requested from the Ministry to take suitable action to ensure the quality of water.

Mrs. Badra Kamaladasa DGI/ ID – Supporting above requested a base line survey to be done for ground water monitoring system and for preserve the quality of water.

Secretary MIWRM concluded the discussion thanking all who participated for the meeting.

Meeting adjoined at 5.15 p.m.

N. A. Sisira Kumara,

Programme Director (WRDIP)

Ministry of IWRM

Attendance Register for *Ministry of Irrigation & Water Resources Management [ADB Funded WRDIP]*

Stakeholder Meeting

Held at *Mahaweli Conference Room, No. 500, T.B Jayah Mw., Col-10* **on** *21.07.2014* **at** *14.30*

Name of Participant	Designation	Name of Organisation (if applicable)	Contact details (optional)		Signature
			Telephone	Email Address	
1. Jayantha Jayasundara	Managing Trustee	Biodiversity Fund	0777895770	romaljg@gmail.com	[signature]
2. Mrs K.R.S. Perera	Director	Ministry of Wildlife Res. Cons.	0718316918	ranperera09@gmail.com	[signature]
3 Mr. Varune Dharmaratne	Project Specialist	JICA	0777826720	DharmaratneVarune.SL @jica.go.jp	[signature]
4. Udeni Wickramasinghe	Secretary	Min. of Wildlife	0771510395	bkuaw@yahoo.com	[signature]
5 W. Samarawickrama	Addl. Sec.	M/Disaster Management	0716581076	wasasamarawickrama @gmail.com	[signature]
6 N.R. Ranjini	Addl. Sec (Dev)	Min. of Water Supply	0714067777	ranjisi@yahoo.com	[signature]
7 C.P.D. Rajamanthri	Deputy chief Secretary (Eng Ser).	Chief Secretary office, Kegalle	0773852197	cpd_raja@yahoo.com	[signature]
8 H. Manthrithilake	IWMI				[signature]
9 N.C. Gunasekara	Social Development & Gender Specialist	ADB			[signature]
10 Kanthi De Silva	Director (CEA)	CEA			[signature]
11 N K Attanayake	DD (CEA)	CEA			[signature]
Lance Gore	MISSION LEADER	ADB			[signature]
Manjula Amerasinghe	Env. Specialist	ADB			[signature]
A.L.R. Rafeek	CIA		0714457668		[signature]
15 W.A.B.M. PRAME	Dep. Director	Geological Survey and Mines Bureau	0777593408	bernardprame@yahoo.com	[signature]

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	Name of Participant	Designation	Name of Organisation (if applicable)	Contact details (optional)		Signature
				Telephone	Email Address	
1	P.W.C. Dayaratne	TL NCP	MCB	0777641630		
2	S.S. Ranty	Consultant	MCB			
3	M.M.A. Wickramasekara	Consultant	MCB			
4	K.A.U.S. [illegible]	Consultant	MCB	0773484551		
5	N.D.T.M. Amarasekara	TL/NWP	MCB	0714432107		
6	J.A.S.A. Jayasinghe	Cont: MCB	MCB	0716274152		
7	B.A. Liyanagama	Syst. Analyst	MCB	0775587151		
8	M.M.S.A. [illegible]	Env. Consultant	M.I & WRM	0773266646		
9	P.H. Jayawardena	Env. Consultant	M I & WRM	072 2229403		
10	J. Joachimthasan	Consultant Engr.	MCB	0716144030	j.joachim@yahoo.com	
11	B. Freeman	PPTA	PPTA		ben.freeman@de.lahmeyer.com	
12	S.D. Mediwake	PD - MLBR	Irrigation Dept.	071 8199519	mediwaka.susantha@yahoo.com	
13	N. Jeyawathany	Director	Ministry of Economic Development	0714500061	jeyawathani@gmail.com	
14	Menaka Rajaguru	AD - E	ERD		menaka@erd.gov.lk	
15	Ayuma Ohshima	Rural Dev't Dept.	JICA, HQ.		Ohshima.Ayumu@jica.go.jp	

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Name of Participant	Designation	Name of Organisation (if applicable)	Contact details (optional)		Signature
			Telephone	Email Address	
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N.C.M. Navaratne	MAN	[illegible]			[signature]
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G.M.R.A. Perera	PD NWPC	ID	0714432836	rajacoke3@yahoo	[signature]
[illegible] Bandara	Add DGI	ID	0776747265		[signature]
S. Shanmugarasa	DD (PP & D)	ID	0718287557	ditrck[illegible]@gm	[signature]

Attendance Register for *Ministry of Irrigation & Water Resources Management [ADB Funded WRDIP]*

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Name of Participant	Designation	Name of Organisation (if applicable)	Contact details (optional) Telephone	Email Address	Signature
D. D. Ariyaratne	Dir (PI)	M/IWRM	0773776542		[signature]
L. P. C. Fernando	Asst. Dir. (PI)	DO	0775423747		[signature]
LYU LINING	Asst. Commissioner	CDB	0717760800	lvlining@cdb.cn	[signature]
Badra Kamalad	DGE	ID	0718008037		[signature]
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Kazuo Shimazaki	JICA HQ				[signature]
Jayantha Perera	ADB/consultant				[signature]
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Attendance Register for *Ministry of Irrigation & Water Resources Management [ADB Funded WRDIP]*

Stakeholder Meeting

Held at *Mahaweli Conference Room, No. 500, T.B Jayah Mw., Col-10* **on** *21.07.2014* **at** *14.30*

	Name of Participant	Designation	Name of Organisation (if applicable)	Contact details (optional)		Signature
				Telephone	Email Address	
	SUNIL JAYASUNDARA	CHAIR	FEDERATION OF ENV. ORGS.	0777560869	sunetaj@gmail.com	
	1. A.C.C. Perera	Director Kurunegala	Irrigation	071/8070614		

ANNEX VI – COMPLETE SET OF RELEVANT MAPS, TABLES, CHARTS, LAYOUT PLANS AND OTHER DETAILS

Table 1 - Detail Profile for Upper Elahera Canal (Rev 34_Modified in October 2014)

Station (km)	Length (km)	Type of Structure / Canal Section	Bed Gradient	Head Loss due to Gradient (m)	Head Loss in Structure (m)	WS Elevation (m)	Bed Elevation (m)
0.0000						143.0000	139.920
0.1780	0.1780	**Rectangular Open Canal From MK Reservoir Outlet**	0.000100	0.017800		142.9822	139.902
0.1826	0.0046	**Bulk Head Gated Control with U/S Trash Rack**			0.1000	142.8822	139.802
0.6000	0.4174	**Rectangular Open Canal From MK Reservoir Outlet**	0.000100	0.041740		142.8405	139.760
0.6020	0.0020	Transition with Trash Rack (Rect Canal - Double Conduit)		0.000000	0.0201	142.8204	139.150
1.4200	0.8180	**Rect. Double Conduit**	0.000120	0.098160		142.7222	139.052
1.4260	0.0060	Transition(Double Conduit - Circular Conduit)		0.000000	0.0134	142.7088	137.959
3.8300	2.4040	**Circular Conduit: Cut & Cover**	0.000160	0.384640		142.3242	137.574
3.8350	0.0050	Transition(Circular Conduit - Level Crossing)		0.000000		142.3242	137.574
6.2100	2.3750	**Kongetiya Level Crossing**		0.000000		142.3242	137.574
6.2260	0.0160	Transition with Bulk Head Gates (Level Crossing - Trap Canal)		0.000000	0.1500	142.1742	139.024
6.5090	0.2830	**Trapezoidal Canal (Type 2)**	0.000100	0.028300		142.1459	138.996
6.5190	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	142.1415	138.992
6.8590	0.3400	**Trapezoidal Canal (Type 2)**	0.000100	0.034000		142.1075	138.958

6.8690	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	142.1031	138.953
7.1290	0.2600	**Trapezoidal Canal (Type 2)**	0.000100	0.026000		142.0771	138.927
7.1390	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	142.0727	138.923
7.5690	0.4300	**Trapezoidal Canal (Type 2)**	0.000100	0.043000		142.0297	138.880
7.5790	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	142.0253	138.875
7.9090	0.3300	**Trapezoidal Canal (Type 2)**	0.000100	0.033000		141.9923	138.842
7.9190	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.9879	138.838
8.4690	0.5500	**Trapezoidal Canal (Type 2)**	0.000100	0.055000		141.9329	138.783
8.4790	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.9285	138.779
8.9290	0.4500	**Trapezoidal Canal (Type 2)**	0.000100	0.045000		141.8835	138.734
8.9390	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.8791	138.729
9.4090	0.4700	**Trapezoidal Canal (Type 2)**	0.000100	0.047000		141.8321	138.682
9.4190	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.8278	138.678
9.7290	0.3100	**Trapezoidal Canal (Type 2)**	0.000100	0.031000		141.7968	138.647
9.7390	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.7924	138.642
10.2490	0.5100	**Trapezoidal Canal (Type 2)**	0.000100	0.051000		141.7414	138.591
10.2590	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.7370	138.587
10.5330	0.2740	**Trapezoidal Canal (Type 2)**	0.000100	0.027400		141.7096	138.560
10.5420	0.0090	*Transition(Trap Canal -Aqueduct)*		0.000000	0.0031	141.7065	137.917
10.7820	0.2400	***Aqueduct - Heerati Oya***	0.000110	0.026400		141.6801	137.890
10.7910	0.0090	*Transition(Aqueduct - Trap Canal)*		0.000000	0.0018	141.6783	138.528

11.0690	0.2780	**Trapezoidal Canal (Type 1)**	0.000100	0.027800		141.6505	138.500
11.0790	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.6461	138.496
11.4890	0.4100	**Trapezoidal Canal (Type 1)**	0.000100	0.041000		141.6051	138.455
11.4990	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.6007	138.451
11.7890	0.2900	**Trapezoidal Canal (Type 1)**	0.000100	0.029000		141.5717	138.422
11.7990	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.5673	138.417
12.0290	0.2300	**Trapezoidal Canal (Type 1)**	0.000100	0.023000		141.5443	138.394
12.0380	0.0090	*Transition(Trap Canal -Rect Canal)*		0.000000	0.0016	141.5427	138.463
12.3290	0.2910	**Rect. Open Canal {across Dambulla-Bakamuna Rd}**	0.000100	0.029100		141.5136	138.434
12.3380	0.0090	*Transition(Rect Canal - Trap Canal)*		0.000000	0.0027	141.5109	138.361
14.5260	2.1880	**Trapezoidal Canal (Type 3)**	0.000100	0.218800		141.2921	138.142
14.5420	0.0160	Transition(Trap Canal - Level Crossing)		0.000000		141.2921	138.142
14.8000	0.2580	**Level Crossing - Bogahawewa (Tank Exists)**		0.000000		141.2921	138.142
14.8160	0.0160	*Transition(Level Crossing - Trap Canal)*		0.000000	0.1500	141.1421	137.992
15.2090	0.3930	**Trapezoidal Canal (Type 1)**	0.000100	0.039300		141.1028	137.953
15.2190	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.0984	137.948
15.6290	0.4100	**Trapezoidal Canal (Type 1)**	0.000100	0.041000		141.0574	137.907
15.6390	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.0530	137.903
16.0290	0.3900	**Trapezoidal Canal (Type 1)**	0.000100	0.039000		141.0140	137.864
16.0390	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	141.0096	137.860
16.4830	0.4440	**Trapezoidal Canal (Type 1)**	0.000100	0.044400		140.9652	137.815

16.4990	0.0160	Transition(Trap Canal - Level Crossing)		0.000000		140.9652	137.815
17.8340	1.3350	**Level Crossing - Madhehthewa**		0.000000		140.9652	137.815
17.8390	0.0050	*Transition(Level Crossing - Cut & Cover)*		0.000000	0.1500	140.8152	136.135
17.9190	0.0800	**Cut & Cover (Horse-Shoe shape)**	0.000200	0.016000		140.7992	136.119
17.9890	0.0700	**Drill & Blast Tunnel**	0.000200	0.014000		140.7852	136.105
18.0290	0.0400	**Cut & Cover (Horse-Shoe shape)**	0.000200	0.008000		140.7772	136.097
18.0450	0.0160	Transition(Cut & Cover - Trap Canal)		0.000000	0.0251	140.7521	137.602
18.4690	0.4240	**Trapezoidal Canal (Type 1)**	0.000100	0.042400		140.7097	137.560
18.4790	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	140.7053	137.555
18.8090	0.3300	**Trapezoidal Canal (Type 1)**	0.000100	0.033000		140.6723	137.522
18.8190	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	140.6680	137.518
19.3490	0.5300	**Trapezoidal Canal (Type 1)**	0.000100	0.053000		140.6150	137.465
19.3590	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	140.6106	137.461
19.8090	0.4500	**Trapezoidal Canal (Type 1)**	0.000100	0.045000		140.5656	137.416
19.8190	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	140.5612	137.411
20.1890	0.3700	**Trapezoidal Canal (Type 1)**	0.000100	0.037000		140.5242	137.374
20.1990	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	140.5198	137.370
20.5090	0.3100	**Trapezoidal Canal (Type 1)**	0.000100	0.031000		140.4888	137.339
20.5190	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	140.4844	137.334
20.9690	0.4500	**Trapezoidal Canal (Type 1)**	0.000100	0.045000		140.4394	137.289
20.9790	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	140.4350	137.285

21.4690	0.4900	**Trapezoidal Canal (Type 1)**	0.000100	0.049000		140.3860	137.236
21.4790	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	140.3816	137.232
22.0090	0.5300	**Trapezoidal Canal (Type 1)**	0.000100	0.053000		140.3286	137.179
22.0190	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	140.3242	137.174
22.4130	0.3940	**Trapezoidal Canal (Type 1)**	0.000100	0.039400		140.2848	137.135
22.4290	0.0160	Transition(Trap Canal - Cut & Cover)		0.000000	0.0582	140.2266	135.547
22.4790	0.0500	**Cut & Cover (Horse-Shoe shape)**	0.000200	0.010000		140.2166	135.537
23.1690	0.6900	**Drill & Blast Tunnel**	0.000200	0.138000		140.0786	135.399
23.2690	0.1000	**Cut & Cover (Horse-Shoe shape)**	0.000200	0.020000		140.0586	135.379
23.2850	0.0160	Transition(Cut & Cover - Trap Canal)		0.000000	0.0251	140.0335	136.884
23.7090	0.4240	**Trapezoidal Canal (Type 1)**	0.000100	0.042400		139.9911	136.841
23.7190	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	139.9867	136.837
24.4290	0.7100	**Trapezoidal Canal (Type 1)**	0.000100	0.071000		139.9157	136.766
24.4390	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	139.9113	136.761
24.8290	0.3900	**Trapezoidal Canal (Type 1)**	0.000100	0.039000		139.8723	136.722
24.8390	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	139.8679	136.718
25.2090	0.3700	**Trapezoidal Canal (Type 1)**	0.000100	0.037000		139.8309	136.681
25.2190	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	139.8265	136.677
25.5990	0.3800	**Trapezoidal Canal (Type 1)**	0.000100	0.038000		139.7885	136.639
25.6090	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	139.7842	136.634
25.9890	0.3800	**Trapezoidal Canal (Type 1)**	0.000100	0.038000		139.7462	136.596

25.9990	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	139.7418	136.592
26.4490	0.4500	**Trapezoidal Canal (Type 1)**	0.000100	0.045000		139.6968	136.547
26.4590	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	139.6924	136.542
26.9290	0.4700	**Trapezoidal Canal (Type 1)**	0.000100	0.047000		139.6454	136.495
26.9390	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	139.6410	136.491
27.2940	0.3550	**Trapezoidal Canal (Type 1)**	0.000100	0.035500		139.6055	136.455
27.3090	0.0150	Transition(Trap Canal - Circular Conduit)		0.000000	0.0556	139.5498	134.800
27.7090	0.4000	**Circular Conduit: Cut & Cover**	0.000160	0.064000		139.4858	134.736
53.7490	26.0400	**Circular Tunnel (TBM)**	0.000180	4.687200		134.7986	130.029
55.7090	1.9600	**Circular Conduit: Cut & Cover**	0.000160	0.313600		134.4850	129.735
55.7150	0.0060	Transition(Circular Conduit - Rect. Double Conduit)		0.000000	0.0223	134.4627	130.793
57.0290	1.3140	**Rect. Double Conduit**	0.000120	0.157680		134.3050	130.635
57.0380	0.0090	Transition(Rect. Double Conduit - Trap Canal)		0.000000	0.0009	134.3041	131.154
57.9890	0.9510	**Trapezoidal Canal (Type 1)**	0.000100	0.095100		134.2090	131.059
57.9990	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	134.2046	131.055
58.3890	0.3900	**Trapezoidal Canal (Type 1)**	0.000100	0.039000		134.1656	131.016
58.3990	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	134.1612	131.011
58.8890	0.4900	**Trapezoidal Canal (Type 1)**	0.000100	0.049000		134.1122	130.962
58.8990	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	134.1078	130.958
59.4290	0.5300	**Trapezoidal Canal (Type 1)**	0.000100	0.053000		134.0548	130.905
59.4390	0.0100	Wild Animal's Escape - RB	0.000082	0.000820	0.0036	134.0504	130.900

59.7490	0.3100	**Trapezoidal Canal (Type 1)**	0.000100	0.031000		134.0194	130.869
59.7590	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	134.0150	130.865
60.1390	0.3800	**Trapezoidal Canal (Type 1)**	0.000100	0.038000		133.9770	130.827
60.1490	0.0100	Wild Animal's Escape - LB	0.000082	0.000820	0.0036	133.9726	130.823
60.1500	0.0010	**Trapezoidal Canal (Type 1)**	0.000100	0.000100		133.9725	130.823
60.3300	0.1800	**Trapezoidal Canal (Type 5)**	0.000100	0.018000		133.9545	130.805
60.3390	0.0090	Transition(Trap Canal - Rect. Double Conduit)		0.000000	0.0016	133.9530	130.803
60.3500	0.0110	**Rect. Double Conduit**	0.000120	0.001320		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**	0.000120	0.001200		133.9004	130.230
60.4690	0.0090	Transition(Rect. Double Conduit - Trap Canal)		0.000000	0.0009	133.8995	130.750
65.4400	4.9710	**Trapezoidal Canal (Type 5)**	0.000100	0.497100		133.4024	130.252
65.4510	0.0110	*Transition(Trap Canal - Rect. Open Canal)*		0.000000	0.0003	133.4021	130.252
65.4850	0.0340	**Rect. Open Canal {BW = 12.3m}**	0.000089	0.003026		133.3991	130.249
65.4918	0.0068	**Bulk Head Gated End Regulator with 150mm Drop**			0.1500	133.2491	130.099
65.5000	0.0082	**Rect. Open Canal {BW = 12.3m}**	0.000089	0.000730		133.2483	130.098

Annex VI - Table 2. Land Use Covering Along the Canal (L=65.5 km)

Chanage (Km)		Length (m)	Section Width(m)	Impact Area (Sqm)	Type of conveyance	Type of land cover *	Remarks **
Start	End						
10.57	10.81	240.00	12	2,952.00	Aqueduct	River	Heeratioya
1.36	4.61	3,250.00	26	84,500.00	Circular Conduit (Cut & Cover)	Forest	Elahera Giritale Sanctuary
17.87	17.87	5.00	33	165.00	Circular Conduit (Cut & Cover)	Forest	Elahera Giritale Sanctuary
22.46	22.51	50.00	26	1,300.00	Circular Conduit (Cut & Cover)	Forest	Elahera Giritale Sanctuary
23.20	23.30	100.00	33	3,300.00	Circular Conduit (Cut & Cover)	Forest	Elahera Giritale Sanctuary
27.34	27.74	400.00	33	13,200.00	Circular Conduit (Cut & Cover)	Forest	Elahera Giritale Sanctuary
		3,805.00		**102,465.00**			
18.02	18.06	40.00	33	1,320.00	Circular Conduit (Cut & Cover)		
53.78	55.75	1,966.00	33	64,878.00	Circular Conduit (Cut & Cover)	Forest	
		2,006.00		**66,198.00**			
55.75	56.70	954.00	25	23,850.00	Double Conduit	Scrub	
56.70	56.86	160.00	25	4,000.00	Double Conduit	Other Plantation	
56.86	57.06	200.00	25	5,000.00	Double Conduit	Scrub	
		1,314.00		**32,850.00**			

60.34	60.47	130.00	25	3,250.00	Inverted Siphon	Scrub	Proposed Huruluwewa Elephant Crossing
6.24	10.57	4,330.00	50	216,500.00	Open Canal	Forest	Elahera Giritale Sanctuary
14.22	14.59	370.00	50	18,500.00	Open Canal	Forest	Elahera Giritale Sanctuary
14.80	16.51	1,710.00	50	85,500.00	Open Canal	Forest	Elahera Giritale Sanctuary
18.06	22.46	4,400.00	50	220,000.00	Open Canal	Forest	Elahera Giritale Sanctuary
23.30	27.34	4,040.00	50	202,000.00	Open Canal	Forest	Elahera Giritale Sanctuary
		14,850.00		**742,500.00**			
65.18	65.50	320.00	50	16,000.00	Open Canal	Ab Tank	Yakalla Tank (End Regulator)
10.81	11.74	930.00	50	46,500.00	Open Canal	Settlement	
11.74	12.02	280.00	50	14,000.00	Open Canal	Forest	
12.02	13.42	1,400.00	50	70,000.00	Open Canal	Settlement	
13.42	13.52	100.00	50	5,000.00	Open Canal	Paddy	
13.52	14.22	700.00	50	35,000.00	Open Canal	Settlement	
57.06	57.20	140.00	50	7,000.00	Open Canal	Scrub	
57.20	57.53	330.00	50	16,500.00	Open Canal	Other Plantation	
57.53	57.60	70.00	50	3,500.00	Open Canal	Settlement / Paddy	

57.60	58.08	480.00	50	24,000.00	Open Canal	Scrub	
58.08	58.18	100.00	50	5,000.00	Open Canal	Paddy	
58.18	59.14	960.00	50	48,000.00	Open Canal	Scrub	
59.14	59.36	220.00	50	11,000.00	Open Canal	Paddy	
59.36	60.34	979.00	50	48,950.00	Open Canal	Scrub	
60.47	61.00	531.00	50	26,550.00	Open Canal	Scrub	
61.00	62.00	1,000.00	50	50,000.00	Open Canal	Chena	
62.00	63.10	1,100.00	26	28,600.00	Open Canal	Scrub	
63.10	63.34	240.00	50	12,000.00	Open Canal	Chena	
63.34	63.76	420.00	50	21,000.00	Open Canal	Scrub	
63.76	63.94	180.00	50	9,000.00	Open Canal	Paddy	
63.94	65.18	1,240.00	50	62,000.00	Open Canal	Scrub	
		11,720.00		**559,600.00**			
-	0.98	980.00	15	14,700.00	Rectangular Canal	Forest	Elahera Giritale Sanctuary
0.98	1.36	380.00	25	9,500.00	Rectangular Double Conduit	Forest	Elahera Giritale Sanctuary
4.61	6.24	-		-	Tank	Forest	Elahera Giritale Sanctuary - Kongetiya Res
14.59	14.80	210.00	-	-	Tank	Forest	Elahera Giritale Sanctuary Bogahawewa Res
16.51	17.87	1,355.00	-	-	Tank	Forest	Elahera Giritale Sanctuary Madeththawa Res

		1,565.00					
17.87	18.02	150.00	-	-	Tunnel (Controlled Blasting)	Forest	Elahera Giritale Sanctuary
22.51	23.20	690.00	-	-	Tunnel (Controlled Blasting)	Forest	Elahera Giritale Sanctuary
		840.00					
27.74	53.78	26,040.00	-	-	Tunnel (TBM)	Scrub / Forest /Settlement	

* Data Source – 1: 10000 Land Use Plan, Department of Survey Sri Lanka

** Data Source – Wild life department GIS layer

Annex VI Table 3. Identified Legislation Related to Water

1	Crown Lands Ordinance (1947)
2	Thoroughfares Ordinance (No 10 of 1861)
3	River Valleys D.B. Act (No. 6 of 1861)
4	Water Resources Board (No. 29 of 1964)
5	C.M.C. Water Works Ordinance (1907)
6	Fauna and Flora Protection Ordinance (1937)
7	Water Hyacinth Ordinance (1909)
8	Plant Protection Ordinance (1924)
9	Forest Ordinance (1907)
10	Fisheries Ordinance (1940)
11	Pearl Fisheries Ordinance (1925)
12	Fisheries and Aquatic Resources Act no. 2 of 1996
13	Town and Country Planning Ordinance (1946)
14	Tourist Development Act (14 of 1968)
15	Irrigation Ordinance (1900) and amendments, Irrigation (Amendment) Act no. 13, 1994
15	Ceylon Electricity Board Act (17 of 1967)
16	Atomic Energy Authority act (19 of 1969)
17	Mahaweli Development Board Act (14 of 1970)
18	National Water Supply and Drainage Board Act (2 of 1974)
19	National Science Council Law (19 of 1968)
20	Wells and Pits Ordinance (1864)
21	Control of Pesticides Act (33 of 1980)
22	Food Act (26 of 1980)
23	National Environmental Act (47 of 1980)
24	Coast Conservation Act (57 of 1981)
25	Maritime Pollution Prevention Act (59 of 1981)
26	National Aquatic Resources, Research and Development Agency Act (54 of 1981)
27	National Resources, Energy & Science Authority of Sri Lanka Act (78 of 1981)
28	Land Development Ordinance (1935)
29	Agrarian Services Act (58 of 1978), Agrarian Development Act no. 46 of 2000
30	The National Environmental Act. No. 47 of 1980 & its amendments
31	State land Ordinance Act No. 13 of 1949
32	The Coast Conservation Act No.57 of 1981 amended by Act No.64 of 1988

33	The Flood Protection Ordinance Act No.22 of 1955
34	The Fauna & Flora Protection Ordinance Act No. 49 of 1993 &its amendments
35	The Sri Lanka Land Reclamation & Development Corporation Act No.15 of 1968
36	The Urban Development Authority Act No.41 of 1978, Urban Development Authority (Amended) Act no. 36 of 2007
37	The Mines and Mineral Act No.33 of 1992
38	Local authorities (special provisions) act, 2006
	Municipal Council (MC) Act No. 19 of 1987
39	The Antiquities Ordinance, 1940 and amendments
40	Disaster Management Act no. 13 of 2005

(Source: Mosley 1994 and other sources)

Annex VI Table 4.Administrative boundaries of the UEC recommended trace

UEC trace (m)	District	DSD	GND
0 – 5+000	Matale	Naula	Thalagoda
5+000 – 9+500	Polonnaruwa	Elahera	Elehera
9+500 – 15+000	Polonnaruwa	Elehera	Damanayaya
15+000 – 18+500	Polonnaruwa	Elehera	Kottapitiaya South
18+500 – 22+000	Polonnaruwa	Elehera	Segala
22+000 – 24+500	Polonnaruwa	Elehera	Attanakadawala-south
24+500 – 29+000	Polonnaruwa	Elehera	Attanakadawala-west
29+000-31+000	Polonnaruwa	Elehera	Konduruwawa
31+000 – 36+000	Matale	Dambulla	Polattawa
36+000-38+000	Matale	Naula	Maillattawa
38+000 – 41+000	Polonnaruwa	Hingurakgoda	Mahasengama
41+000 – 46+000	Polonnaruwa	Hingurakgoda	Moragaswewa
46+000 – 48+500	Anuradhapura	Palugaswewa	Habarana
48+500 – 51+000	Anuradhapura	Palugaswewa	Kumbukwewa
51+000 – 54+500	Anuradhapura	Palugaswewa	Eppawela
54+500- 57+ 000	Anuradhapura	Palugaswewa	Madawala
57+000 – 61+500	Anuradhapura	Galenbindunuwewa	
61+500 - end	Anuradhapura	Galenbindunuwewa	Hurulumeegahapattiya
	Anuradhapura	Galenbindunuwewa	Yakalla
	Anuradhapura	Galenbindunuwewa	Mannankattiya

Annex VI - Table 05

Plant species recorded in the canal trace from Moragahakanda reservoir to Manankattiyawewa. Plant family, species name, life form and the taxonomic status TS (In– Indigenous; E – Endemic; I – Introduced and naturalized) and conservation status (VU- Vulnerable, En- Endangered, NT- Near Threatened) recorded from dry-mixed evergreen forest (DM), scrublands (Sc), riverine forest (Rv), and vegetation associated with rock outcrops (RO).

Family	Species	Life Form	Taxonomic Status	ConStatus (2012 Red List)	DM	Sc	Rv	RO
Acanthaceae	*Barleriaprionitis*	Herb	In		+	+	+	
Amaranthaceae	*Achyranthesaspera*	Herb	In		+		+	
Amaranthaceae	*Aervalanata*	Herb	In		+	+		
Amaranthaceae	*Alternantherasessilis*	Herb	In				+	
Amaranthaceae	*Gomphrenacelosioides*	Herb	I		+		+	
Anacardiaceae	*Lanneacoromandelica*	Tree	In		+	+		+
Anacardiaceae	*Spondiaspinnata*	Tree	In		+			+
Anacardiaceae	*Nothopegiabeddomei*	Tree	In		+			
Annonaceae	*Miliusaindica*	Shrub	In		+	+		
Annonaceae	*Polyalthiacerasoides*	Tree	In		+			+
Annonaceae	*Polyalthiakorinti*	Tree	In		+			
Annonaceae	*Polyalthialongifolia*	Tree	In				+	
Apocynaceae	*Carissa spinarum*	Shrub	In			+		+
Apocynaceae	*Ichnocarpusfrutescens*	Climber	In			+		
Apocynaceae	*Wrightiaangustifolia*	Tree	E		+	+		+
Asclepiadaceae	*Wattakakavolubilis*	Climber	In					
Asparagaceae	*Asparagus racemosus*	Climber	In		+	+		+
Asteraceae	*Ageratum conyzoides*	Herb	I			+		
Asteraceae	*Elephantopusscaber*	Herb	In			+		
Asteraceae	*Eupatorium odoratum*	Shrub	I		+	+		+
Asteraceae	*Mikaniacordata*	Climber	In			+	+	
Asteraceae	*Vernoniacinerea*	Herb	In		+	+	+	
Asteraceae	*Vernoniazeylanica*	Climber	E		+	+		
Asteraceae	*Xanthium indicum*	Herb	In			+	+	
Bignoniaceae	*Stereospermumcolais*	Tree	In		+			+
Boraginaceae	*Carmona retusa*	Shrub	In			+		
Boraginaceae	*Cordiadichotoma*	Tree	In		+			
Boraginaceae	*Ehretialaevis*	Tree	In			+		
Capparaceae	*Capparisrotundifolia*	Scrambling Shrub	In		+	+		+
Capparaceae	*Capparissepiaria*	Scrambling Shrub	In		+	+		+
Capparaceae	*Cratevaadansonii*	Tree	In		+			+
Celastraceae	*Maytenusemarginata*	Shrub	In		+	+		
Clusiaceae	*Garciniaspicata*	Tree	In				+	
Colchicaceae	*Gloriosasuperba*	Climber	In			+		+

Combretaceae	*Terminaliaarjuna*	Tree	In				+	
Connaraceae	*Connarusmonocarpus*	Woody Climber	In		+	+		+
Convolvulaceae	*Argyreiaosyrensis*	Climber	In			+		
Convolvulaceae	*Evolvulusalsinoides*	Herb	In		+	+		
Cycadaceae	*Cycascircinalis*	Tree	In		+			
Cyperaceae	*Cyperusrotundus*	Herb	In			+	+	
Cyperaceae	*Fimbristylis sp.*	Herb	In			+		+
Ebenaceae	*Diospyrosebenum*	Tree	In	EN	+			
Ebenaceae	*Diospyrosferrea*	Tree	In		+			
Ebenaceae	*Diospyrosoocarpa*	Tree	In	NT	+			
Ebenaceae	*Diospyrosmalabarica*	Tree	In	LC			+	
Ebenaceae	*Diospyrosovalifolia*	Tree	In	LC	+			
Euphorbiaceae	*Brideliaretusa*	Tree	In		+	+		+
Euphorbiaceae	*Cleistanthuspallidus*	Tree	E		+			
Euphorbiaceae	*Croton laccifer*	Shrub	In			+		+
Euphorbiaceae	*Croton officinalis*	Shrub	In			+		
Euphorbiaceae	*Dimorphocalyxglabellus*	Tree	In		+		+	
Euphorbiaceae	*Drypetessepiaria*	Tree	In		+	+		+
Euphorbiaceae	*Euphorbia antiquorum*	Tree	In			+		+
Euphorbiaceae	*Flueggealeucopyrus*	Shrub	In			+		+
Euphorbiaceae	*Givotiamoluccana*	Tree	In		+	+		+
Euphorbiaceae	*Mallotusrhamnifolius*	Tree	In		+			
Euphorbiaceae	*Margaritariaindicus*	Tree	In	VU	+			
Euphorbiaceae	*Mischodonzeylanicus*	Tree	In		+			
Euphorbiaceae	*Phyllanthuspolyphyllus*	Tree	In			+		
Euphorbiaceae	*Phyllanthusreticulatus*	Shrub	In			+		
Euphorbiaceae	*Sapium insigne*	Tree	In		+			
Euphorbiaceae	*Suregadalanceolata*	Tree	In		+			
Fabaceae	*Abrusprecatorius*	Climber	In			+		+
Fabaceae	*Acacia leucophloea*	Tree	In		+			
Fabaceae	*Bauhinia racemosa*	Tree	In		+	+		
Fabaceae	*Bauhinia tomentosa*	Shrub	In		+	+		
Fabaceae	*Cassia auriculata*	Tree	In		+	+		
Fabaceae	*Cassia fistula*	Tree	I		+	+		
Fabaceae	*Cassia occidentalis*	Herb	In			+		
Fabaceae	*Cassia roxburghii*	Tree	In		+	+		
Fabaceae	*Cassia tora*	Herb	In			+		
Fabaceae	*Crotalaria verrucosa*	Herb	In			+		
Fabaceae	*Derris parviflora*	Woody Climber	E		+	+	+	
Fabaceae	*Derris scandens*	Climber	In			+	+	
Fabaceae	*Desmodiumtriflorum*	Herb	In			+	+	
Fabaceae	*Dichrostachyscinerea*	Tree	In		+	+		+
Fabaceae	*Flemingiastrobilifera*	Shrub	In		+	+		
Fabaceae	*Mimosa pudica*	Herb	I			+		
Fabaceae	*Tamarindusindica*	Tree	I		+			
Fabaceae	*Tephrosiapurpurea*	Herb	In			+		
Fabaceae	*Tephrosiavillosa*	Herb	In			+		
Fabaceae	*Urariapicta*	Herb	In			+		
Flacourtiaceae	*Hydnocarpusvenenata*	Tree	E				+	
Hippocrateaceae	*Reissantiaindica*	Climber	In			+	+	

Hippocrateaceae	*Salaciareticulata*	Woody Climber	In		+	+		
Lamiaceae	*Ocimumamericanum*	Herb	In			+		
Lamiaceae	*Ocimumgratissimum*	Herb	In			+		
Lauraceae	*Alseodaphnesemecarpifolia*	Tree	In		+			
Linaceae	*Hugoniamystax*	Woody Climber	In		+	+		+
Loganiaceae	*Strychnosbenthamii*	Woody Climber	E		+			
Loganiaceae	*Strychnospotatotum*	Tree	In		+			
Loranthaceae	*Dendrophthoefalcata*	Epiphyte	In		+			
Malpighiaceae	*Hiptagebenghalensis*	Climber	In		+			+
Malvaceae	*Abutilon indicum*	Herb	In			+		
Malvaceae	*Hibiscus eriocarpus*	Tree	In		+	+		
Malvaceae	*Sidaacuta*	Herb	In			+		
Malvaceae	*Urenalobata*	Herb	In			+		
Melastomataceae	*Memecyloncapitellatum*	Shrub	E		+			
Melastomataceae	*Memecylonumbellatum*	Shrub	In		+			+
Meliaceae	*Aglaiaelaeagnoidea*	Tree	In	LC	+			
Meliaceae	*Azadirachtaindica*	Tree	In		+	+		
Meliaceae	*Munroniapinnata*	Herb	In	EN	+			
Meliaceae	*Walsuratrifoliolata*	Tree	In	LC	+			
Moraceae	*Ficusbenghalensis*	Tree	In		+			
Moraceae	*Ficusracemosa*	Tree	In		+			
Moraceae	*Ficus sp.*	Tree	In		+			+
Moraceae	*Streblusasper*	Tree	In		+			
Moraceae	*Streblustaxoides*	Shrub	In		+			
Myrtaceae	*Eucalyptus sp.*	Tree	I		+			
Myrtaceae	*Eugenia bracteata*	Tree	In		+			
Myrtaceae	*Syzygiumcumini*	Tree	In		+			
Ochnaceae	*Ochnalanceolata*	Tree	In		+	+		+
Oleaceae	*Jasminumangustifolium*	Climber	In					+
Oleaceae	*Jasminumauriculatum*	Climber	In			+		
Periplocaceae	*Hemidesmusindicus*	Climber	In		+			
Poaceae	*Bambusabambos*	woody plant	In		+			
Poaceae	*Cymbopogonnardus*	Herb	In		+	+	+	+
Poaceae	*Imperatacylindrica*	Herb	In		+	+		+
Poaceae	*Isachneglobosa*	Herb	In			+		
Poaceae	*Panicum maximum*	Herb	I		+	+	+	+
Poaceae	*Panicumrepens*	Herb	In			+		
Rhamnaceae	*Scutiamyrtina*	Climber	In		+			
Rhamnaceae	*Ventilagomadraspatana*	Woody Climber	In		+			
Rhamnaceae	*Ziziphusoenoplia*	Woody Climber	In		+	+		+
Rubiaceae	*Benkaramalabaica*	Shrub	In		+	+		
Rubiaceae	*Canthiumcoromandelicum*	Tree	In		+	+		
Rubiaceae	*Catunaregamspinosa*	Tree	In			+		
Rubiaceae	*Discospermumsphaerocarpum*	Tree	In		+			
Rubiaceae	*Haldinacordifolia*	Tree	In	LC	+			
Rubiaceae	*Ixoracoccinea*	Tree	In				+	
Rubiaceae	*Ixorapavetta*	Tree	In		+		+	
Rubiaceae	*Mitragynaparvifolia*	Tree	In	LC	+		+	

Rubiaceae	*Mussaendafrondosa*	Scrambling Shrub	In		+	+		
Rubiaceae	*Psydraxdicoccos*	Tree	In			+		+
Rubiaceae	*Tarennaasiatica*	Shrub	In			+		+
Rutaceae	*Acronychiapedunculata*	Tree	In		+	+		
Rutaceae	*Atalantiamonophylla*	Shrub	In		+	+		+
Rutaceae	*Chloroxylonswietenia*	Tree	In		+			
Rutaceae	*Clausenaindica*	Shrub	In		+			
Rutaceae	*Glycosmisangustifolia*	Shrub	In		+			
Rutaceae	*Glycosmismauritiana*	Shrub	In		+			
Rutaceae	*Limoniaacidissima*	Tree	In		+			
Rutaceae	*Murrayapaniculata*	Tree	In		+			
Rutaceae	*Pleiospermiumalatum*	Tree	In		+			
Rutaceae	*Toddaliaasiatica*	Woody Climber	In		+	+		+
Sapindaceae	*Allophyluscobbe*	Scrambling Shrub	In		+	+		+
Sapindaceae	*Dimocarpuslongan*	Tree	In		+			
Sapindaceae	*Filiciumdecipiens*	Tree	In		+			
Sapindaceae	*Glennieaunijuga*	Tree	E		+			
Sapindaceae	*Lepisanthessenegalensis*	Tree	In		+			
Sapindaceae	*Lepisanthestetraphylla*	Tree	In		+			
Sapindaceae	*Sapindusemarginata*	Tree	In		+			
Sapindaceae	*Schleicheraoleosa*	Tree	In		+			
Sapotaceae	*Madhucalongifolia*	Tree	In	NT	+		+	
Sapotaceae	*Manilkarahexandra*	Tree	In	VU		+		
Sterculiaceae	*Helicteresisora*	Tree	In		+			+
Sterculiaceae	*Pterospermumsuberifolium*	Tree	In		+	+		
Sterculiaceae	*Sterculiafoetida*	Tree	In		+			+
Sterculiaceae	*Waltheriaindica*	Herb	In		+			
Tiliaceae	*Berryacordifolia*	Tree	In		+			
Tiliaceae	*Diplodiscusverrucosus*	Tree	E		+	+		
Tiliaceae	*Grewiadamine*	Tree	In		+	+		+
Tiliaceae	*Grewiahelicterifolia*	Tree	In		+	+		+
Tiliaceae	*Grewiaorientalis*	Scrambling Shrub	In		+	+		+
Verbenaceae	*Lantana camara*	Shrub	I			+		
Verbenaceae	*Premna sp.*	Tree	In		+	+		
Verbenaceae	*Premnatomentosa*	Tree	In		+	+		
Verbenaceae	*Stachytarphetajamaicensis*	Herb	I			+		+
Verbenaceae	*Tectonagrandis*	Tree	I		+			
Verbenaceae	*Vitexaltissima*	Tree	In		+			+
Verbenaceae	*Vitexleucoxylon*	Tree	In				+	
Vitaceae	*Cissusheyneana*	Climber	E			+		+
Vitaceae	*Cissusquadrangularis*	Climber	In			+		+
Vitaceae	*Cissusvitiginea*	Climber	In			+		+

Annex VI - Table 6 -Activities Prohibited and Allowed within National Reserves and Sanctuaries

Class of PA								
	Entry[14]	***Hunting, killing, taking of animals***	***Damaging,, destroying, collecting plants***	***Taking, destroying eggs***[15] ***and nests***[16]	***Guns, explosives, traps, poisons***	***Developmental activities***	***Other land uses***	***Introduction of animals, plants***
Strict National Reserve	Prohibited[17] except Director[18] or with permit only for scientific research	Prohibited[19]	Prohibited[20]	Prohibited[21]	Possession or use prohibited[22]	Prohibited[23]	Clearing for cultivation, mining or any other purpose prohibited[24]	Prohibited[25]
National Park	For observation/ study only[26]	As above	Prohibited[27]	As above		As above		As above
Nature Reserve	Permit required[28]	As above		As above		As above		As above
Jungle Corridor		As above		As above		As above		As above
Refuge		As above		As above		As above		As above
Marine Reserve		As above		As above		As above		As above
Buffer Zone		As above		As above		As above		As above
Sanctuary		Prohibited[29]		Prohibited[30]	Prohibited[31]	Prohibited[32]	Prohibited[33]	

[14] S. 6(1) © - general provision applying to all National Reserves which prohibits any act that disturbs or is likely to disturb or which interferes or is likely to interfere with the breeding place of any animal

[15] Birds and reptiles

[16] Birds (what about reptiles and amphibia) – inconsistencies and gaps in the parts of organisms that are protected.

[17] S. 3 (1) (a)

[18] S. 4 (1). Others may enter (a) for discharging official duties as instructed by the Director in writing or (b) under a written permit for the Director.

[19] S. 3 (1) © and S. 6 (1) (a) apply to shooting, wounding, killing, hunting, taking, controlling any wild animal whether dead or alive, or their parts. S. 6A (1) prohibits fishing or taking of any aquatic animal or plant from waters within any National Reserve or Sanctuary that is on Crown land, except under a permit. The fee for such a permit, according to S. 6A (4) will be waived if the applicant wishes to catch fish for local consumption of a village whose occupants have by custom or usage fished in such waters. S. 8 further prohibits the hunting, shooting, taking of wild animals inside National Reserves from any road or land outside the PAs. Also see Sections 51- 52 and 53A – 53B.

[20] S. 3 (1) ©, S. 6 (1) (d) and S. 6 A (1)

[21] S. 6 (1) (b) - applies to eggs of birds and reptiles and nests of birds.

[22] S. 6 (1) (g)

[23] S. 3A prohibits the construction of "tourist hotel(s)" and "any services or facilities similar to those provided by a tourist hotel" within a one mile of the boundary. This is repeated in S. 6 (1) (k). S. 6 (1) (i) prohibits the construction or occupation of any structure inside a National Reserve without a permit. S. 6 (1) (j) applies the same to the construction of roads or paths. S. 9A (1) prohibits any "developmental activity of any description whatsoever" within one mile of the boundary of any National Reserve, except on the basis of a permit obtained from the Director. S. 9A (2) required any application for such a permit to be accompanied by an EIA or Initial Environmental Examination (IEE) as prescribed by the EPA.

[24] S. 6 (1) (e) and S. 6 (1) (h)

[25] S. 6 (2) – applies to the introduction of any animal. S. 6 (3) prohibits the introduction of domesticated animals into National Reserves. Such animals found in these Pas will be seized and released only on payment of a prescribed fine within 28 days of its seizure.

[26] S. 3 (1) (b) and S. 5

[27] S. 6 (1) (d) and S. 6 A (1)

[28] S. 3 (1) (a) and S. 5A. The former prohibits whilst the latter allows on a permit basis

[29] S. 3 (1) (d), S. 7 (1) © (i) and S. 6A (1) with regard to aquatic animals and plants. S. 7 (1) © (i) applies only to state land found within a Sanctuary

[30] S. 3 (1) (d) and S. 7 (1) (b) (iii)

[31] S. 3 (1A) On any Crown land or any part thereof in a Sanctuary. S. 7 (1) © (iv) – state land within a Sanctuary

[32] S. 7 (1) © (vi) as for National Reserves

[33] S. 7 (1) © (ii) – no clearing or breaking land for cultivation, mining or any other purpose

ANNEX VII - CUMULATIVE IMPACT ASSESSMENT

Cumulative Impacts of the Water Resources Development Investment Program

Introduction

Based on the findings of a Strategic Environment Assessment[34] undertaken by the government for the Mahaweli development program, the cumulative impacts of two key areas: biodiversity and hydrology were assessed for the investment program's projects and the under-construction Kaluganga and Moragahakanda Reservoirs, which are associated facilities. Mahaweli systems directly impacted by WRDIP include system E (Minipe), System IH (Nachchaduwa), system MH (Huruluwewa) System I (Mahakanadarawa).

A) Cumulative Impact on Sri Lanka's biodiversity

Even though Sri Lanka is a small island, its Biodiversity is significantly important both in a regional and global scale. Sri Lanka has the highest species density (number of species present per 10,000sq. km) for flowering plants, amphibians, reptiles, and mammals in the Asian region (NARESA, 1991). Furthermore, the wet zone of Sri Lanka is declared as one of the 25 "global biodiversity hotspots" of the world (Mittermeier, 2005; Myers *et al.,* 2000). Designation of the wet zone of Sri Lanka as one of the global biodiversity hotspots stems from the fact that many of the species found in Sri Lanka is restricted to the island or endemic to Sri Lanka. Second reason being that many of the species are threatened, especially the species that are endemic to Sri Lanka (see table 1).

Table 1. Species diversity and Conservation status of few selected taxonomic groups found within Sri Lanka (MOE, 2012)

Taxonomic Group	Species	Endemic	Exotic	CR	EN	VU	NT
Freshwater Crabs	51	50 (98%)	0	34 (34)	12 (11)		5 (5)
Land Snails	231	205 (89%)	22	80 (70)	76 (72)	23 (20)	12 (10)
Amphibians	111	95 (85%)	0	34 (34)	28 (27)	10 (9)	3 (3)
Reptiles	191	124 (65%)	1	38 (36)	50 (39)	18 (11)	15 (7)
Freshwater Fish	91	50 (55%)	24	19 (16)	19 (17)	5 (4)	5 (3)

[34] Ministry of Agriculture Development and Agrarian Services, *Dam Safety and Water Resources Planning Project: Strategic Environmental Assessment - Mahaweli Systems*, December 2012

Spiders	501	257 (51%)	0	41 (14)	21 (10)		8 (2)
Dragonflies	118	47 (40%)	0	26 (22)	18 (14)	17 (4)	17 (1)
Flowering plants	3154	894 (%)	1035	218 (102)	552 (272)	615 (220)	350 (83)
Mammals	95	21 (22%)	12	13 (6)	25 (8)	15 (4)	7
Ferns	336	49 (15%)	0	42 (10)	88 (11)	70 (12)	40 (9)
Birds	240	33 (14%)	4	18	18 (7)	31 (11)	35 (3)
Butterflies	245	26 (11%)	1	21 (5)	38 (10)	40 (7)	21

Abbreviations Used: CR - Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened.

Sri Lanka also has a rich history that dates back to 500 BC. As Sri Lanka's civilization is based on agriculture there has been extensive remodelling of natural habitats during this long history, first in the dry zone during the height of the hydraulic civilization, then in the wet zone during the colonial period and after regaining independence in 1948, again the focus have shifted to the dry zone. During the last century alone, Sri Lanka's natural forest cover has declined by about 50% (see figure 1). The resulting loss and fragmentation of habitat have been the major drivers that has resulted in many of the species to become extinct or driven toward the brink of extinction.

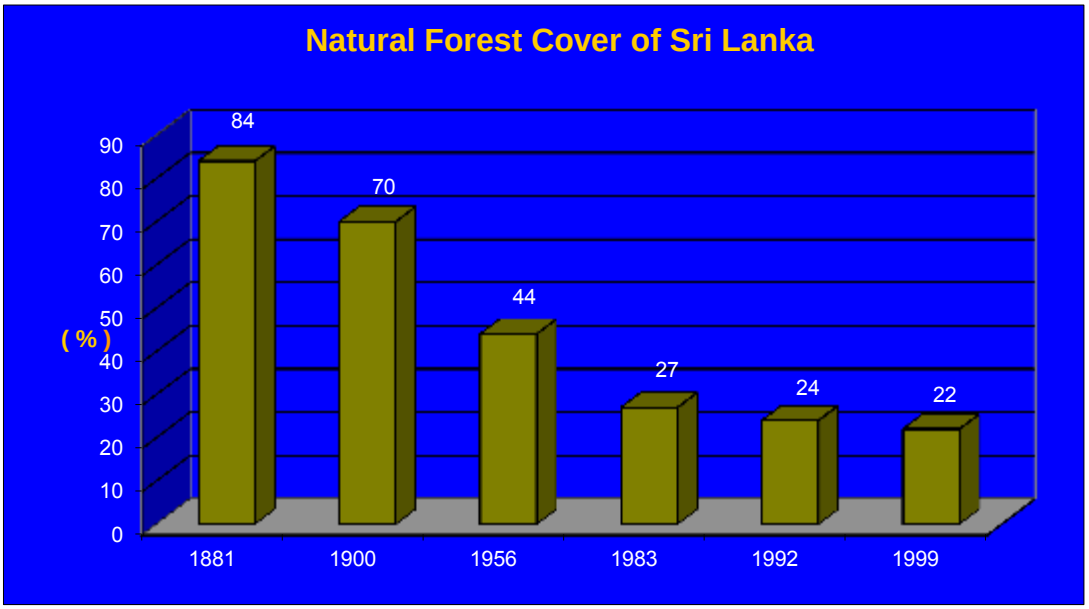

Figure 1. Change in the natural forest cover of Sri Lanka (Source: Forest Sector Master Plan, 1995).

The Mahaweli Ganga Development Programme that was drawn up during the period 1964 - 1968 in order to utilize a regulated flow 5200 MCM annually from Mahaweli Ganga and adjacent river basins (Maduru Oya, Malwathu Oya, Kala Oya, Yan oya, Kivul Oya *etc*.,) for water resources development in four major sectors, irrigation, water supply, industrial use and hydroelectric power generation, has been the major driver that has contributed to wide scale land use changes in the Intermediate and dry zone of Sri Lanka during the last few decades. The whole of the Mahaweli Ganga development programme could not be completed as planned due to the armed conflict that prevailed mainly in the Northern and Eastern province of Sri Lanka for over three decades. However, with dawn of peace in 2009, the Ministry of Irrigation and Water Resources Management once again has recognized that implementation of remaining parts of this project is a priority taking into considering the current problems faced by the people in the dry zone. Further, development of water resources in the dry zone has been identified as one of the key climate change adaptation measure.

The proposed ADB funded Water Resources Development Investment Program (WRDIP) is part of the ongoing water resource development work that has been undertaken by the Ministry of Irrigation and Water Resources Management. The project will involve three sub projects

1. **Upper-Elahera Canal Project** – this includes Kaluganga-Moragahakanda link canal and Upper-Elahera canal up to Hurulu wewa. The Moragahakanda reservoir and Kaluganga reservoir which are currently u nder construction (funded by other development partners) are considered as associated facilities to this project.

2. **North-westernCanal Project** – This includes a canal from Lenadora to Kaduruwewa and establishment of two storage tanks, Maha Kithula and Maha Kirula

3. Raising the Minipe Anicut and rehabilitation of the Minipe LB canal

Each of the three sub projects of the proposed WRDIP will have an impact on one or more protected areas that has been established under the Fauna and flora Protection Ordinance or Forest Ordinance managed by the Department of Wildlife Conservation (DWC) or Forest Department (FD) as shown in Table 2.

Table 2. The protected areas that will be impacted by the WRDIP

Name of the Protected Area	Category	Extent (ha)		Year of Declaration
		Total	Affected	
North Western Canal Project				
Kahalla- Pallekele	S	21,690	342 (1.6%)	1989

Upper Elahera Canal Project				
Elahera-Giritale	S	14,035	190 (1.4%)	2000
Minneriya- Giritale	NR block III	4,745	0	1995
Minneriya	NP	8,889	15 (0.2)	1997
Hurulu	FR	25,000	0	1942
Upper Elahera Canal Project				
Victoria-Randenigala-Rantambe	S	42,089	25 (0.1%)	1987

Note: The proposed project activities of Kalu Ganga, Moragaha Kanda and Kaluganga-Morgahakanda Tunnel will not take place inside any declared protected areas.

Data Sources: MIWRM, 2014a; MIWRM, 2014b; MIWRM, 2014c; NRM, 2008; TEAMS, 1998

Description of protected areas according to the IUCN categorization (Dudley, 2008)

1. **National Park (NP)**: A Category II protected area managed by DWC.
2. **Nature Reserves (NR):** ACategory IV protected area managed by DWC.
3. **Sanctuaries (S)**: ACategory VI protected area managed by DWC.
4. **Forest Reserve (FR):** ACategory IV protected area managed by FD.

The environment assessment reports of each of these sub projects have presented an analysis of the impact of the sub project on biodiversity and protected areas. The direct impact area of the WRDIP includes several protected areas. Further, Mahaweli river basin is the largest river basin in Sri Lanka with unique biogeographical attributes (there are several threatened endemic species that are restricted to Mahaweli River Basin). Therefore, the cumulative impact of the three proposed subprojects and their associated facilities on protected areas and critical species in the project affected areas was assessed. This report presents the findings of the cumulative impacts of the proposed WRDIP on the biodiversity in project impact area.

Habitat Diversity

Several natural habitat types were recorded in the project affected areas of WRDIP. These include tropical moist semi-evergreen forests, dry mixed evergreen forests, riverine forests and scrublands. A brief description of these habitat types are given below. Extents of these habitats that will be affected by each sub project is given in Table 3.

Tropical Moist semi-Evergreen Forest

These are closed canopy forest that generally consists of three layers, the canopy (20-25 m), sub canopy (5-10 m) and ground vegetation. The dominant plant species present in these forests include *Berrya cordifolia* (Hal Milla), *Pterospermumsuberifolium* (Welan), *Vitex altissima* (Milla), *Lepisanthes tetraphylla* (Dambu), *Stereospermum colais* (Dunu madala), *Haldina cordifolia* (Kolon), *Mitragyna parvifolia* (Helamba), *Ventilagomadraspatana* (Yakada Wel), *Holoptelea integrifolia* (Goda Kirilla), *Cipadessabaccifera* (Hal Bebiya), *Trema orientalis* (Gadumba), *Schleichera oleosa* (Koon), *Morinda coreia* (Ahu), *Azadirachta indica* (Kohomba), *Ficus* sp. (Nuga), *Ficus microcarpa*, *Ficus hispida* (Kota Dimbula), *Hibiscus vitifolius* (Maha Epala), *Careyaarborea* (Kahata), *Peltophorum pterocarpum*, *Bauhiniaracemosa* (Maila), *Flueggea leucopyrus* (Heen Katu Pila), *Croton aromaticus* (Wel Keppetiya), *Bridelia retusa* (Ketakala), *Merremia umbellata* (Kiri Madu) and *Alstoniascholaris* (Ruk Attana)

Dry-mixed Evergreen Forest

These are typical dry zone climax forest formations where the canopy reaches between 20-30 m beneath the canopy layer, the sub canopy (15 m), a shrub layer (5 m) and a herbaceous plant layer (1 m) can be seen. The canopy consists of tree species such as *Manilkara* (Palu), *Drypetes* (Wira), *Chloroxylon* (Burutha), *Alseodaphne* (Wewarana), *Berrya* (Halmilla), *Diospyros* (Kaluwara), *Schleichera oleosa* (Kon), *Pterospermum canescens* (Welan), and *Vitex altissima* (Milla). The sub canopy of the forest is dominated by *Drypetes* (Wira) and other medium sized trees such as *Diospyros ovalifolia, D. ferrea, Feronia acidissima, Xylopia nigricans, Nothopegia beddomei, Pleiospermium alatum, Cassia fistula*, *Bauhinia racemosa* can also be seen in this layer. The shrub lyer comprise of species such as *Ochna lanceolata, Tarenna asiatica, Memecylon angustifolium, M. capitellatum, M. umbellatum, Mallotus resinosus, Croton laccifer,* and *Dimorphocalyx glabellus.*

Riverine Forest

These are narrow strips of tall forests found along the banks of streams and rivers. This habitat is dominated by water loving trees such as *Terminalia arjuna* (Kumbuk), *Madhuca longifolia* (Mi), *Pongamiapinnata* (Magul Karanda), *Ficusracemosa* (Attikka),and *Naucleaorientalis* (Bakmi).Other species such as *Polyalthia longifolia* (Owila)*, Diospyros malabaricum* (Timbiri)*, Mangifera zeylanica* (Etamba)*, Nothopegia beddome* (Bala)*, Garcinia spicata* (Ela gokatu)*, Diospyros ferrea, Diospyros montana, Diospyros ovalifolia* (Kunumella)*, Homonoia riparia, Cynometra zeylanica, Hydnocarpus venenata* (Makulu)*, Barringtonia acutangula,* and *Vitex leucoxylon,* are found in these forests. *Dimorphocalyx glabellus* (Weliwenna) is the common understorey species found in the riverine forests.

Scrublands

Scrub vegetation forms in places where chena (shifting cultivation) have been abandoned. Soon after a chena plot is left to fallow, various herbaceous pioneer species begin to appear followed by woody species in a series of succession leading to the appearance of a secondary forest. It is found in areas where the climax forest is degraded. The degraded areas takes a long time to be converted back to closed-canopy forests through natural succession. The early seral stages of this natural succession are regarded as scrublands. These scrublands are comprise of a mixture of tree, herbaceous and shrub species such as *Azadirachta indica, Bauhinia racemosa, Carissa spinarum, Catunaregam spinosa, Dichrostachys cinerea, Flueggea leucopyrus, Gmelina asiatica, Grewia orientalis, Hugonia mystax, Ichnocarpus frutescens, Lantana camara, Limonia acidissima, Memecylon umbellatum, Phyllanthus polyphyllus, Scutia myrtina, Syzygium cumini, Toddalia asiatica* and *Ziziphus oenoplia*.

Table 3.The main naturalhabitats that will be affected by the WRDIP including the two associated facilities Moragahakanda and Kalu ganga reservoirs

Type of Ecosystem	Extent (ha)		Name of the Sub Project
	Total	Affected	
Moist semi-evergreen forests	24,191,640	3,540 518	Moragahakanda* Kalu Ganga*
Dry mixed evergreen forests	108,108,440	149 300 1,804 4,990	UE Canal NWP canal Moragahakanda* Kaluganga*
Riverine forests	2,229,040	25 5 61	Minipe Raising Kaluganga Link tunnel Kaluganga*
Scrublands	45,957,560	56 50 108	UE Canal NWP canal Moragahakanda*

Abbreviations Used: **UE** - Upper Elahera, **NWP** - North-western Province
Data Sources: MIWRM, 2014a; MIWRM, 2014b; MIWRM, 2014c; NRM, 2008; TEAMS, 1998.

*Moragahakanda and Kaluganga reservoirs are currently under construction and will not be funded by WRDIP but are considered as associated facilities

Total amount of natural habitats that will be affected by the WRDIP and associated facilities is approximately 11,606 ha. Out of the total extent of natural habitat lost, the WRDIP projects will only contribute to about 5% (585 ha) while the remaining 95% of the habitat loss will result due to Moragahakanda and Kaluganga projects that include two large reservoirs and large scale resettlements. Compared to the total extent of the available habitat in Sri Lanka,

the area affected by the WRDIP and associated facilities is estimated to be approximately 0.006%.

Species Diversity

The species diversity was found to be highest in the Moragahakanda and Kaluganga projects compared to other sub projects. This could be attributed to the fact that the area impacted by these two projects is much greater than the other sub projects. A summary of the fauna and flora recorded in the project impacted area of each sub project is given in table 4.

Table 4. A summary of the fauna and flora recorded in each the project affected areas of each sub project of WRDIP and associated facilities.

Project Name	Total	Endemic	Exotic	Migrant	CR	EN	VU	NT
KGP - Flora	401	29	43	0	0 (1)	7 (0)	16 (6)	14 (0)
KGP - Fauna	327	51	1	16	5 (0)	5 (11)	17 (1)	19 (3)
MKP - Flora	456	29	71	0	0 (0)	7 (2)	13 (7)	11 (0)
MKP - Fauna	272	45	2	12	6 (1)	6 (11)	10 (1)	22 (8)
KMT - Flora	130	13	10	0	0 (0)	3 (0)	7 (4)	10 (0)
KMT - Fauna	136	9	0	7	0 (0)	1 (1)	2 (0)	2 (1)
UEC - Flora	174	10	10	0	0 (0)	2 (0)	2 (1)	1 (0)
UEC - Fauna	240	17	1	16	0 (0)	3 (4)	3 (4)	7 (4)
NWP - Flora	133	9	3	0	0 (0)	0 (1)	0 (0)	0 (0)
NWP - Fauna	181	15	1	9	0 (0)	5 (4)	2 (2)	6 (8)
MAR - Flora	240	17	62	0	0 (1)	3 (0)	14 (5)	16 (0)
MAR - Fauna	147	14	1	1	0 (0)	1 (4)	6 (0)	7 (5)

Abbreviations used: KGP – Kalu Ganga Project, **MKP** – Moragaha Kanda Project, **KMT** – Kaluganga-Moragahakanda Tunnel, **UEC** – Upper Elahera Canal, **NWP** –North-western Province Canal, **MAR** – Minipe Anicut Raising, **CR** – Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened.

Data Sources: EML, 2011; IUCN, 2007; MIWRM, 2014a; MIWRM, 2014b; MIWRM, 2014c; NRM, 2008; TEAMS, 1998

Threatened and Endemic Species

Altogether 46 endemic plants species were recorded in the project impact areas of all the sub projects (see annex I). These included 10 species listed as Endangered, 22 species listed as

Vulnerable, 22 species listed as Near Threatened and 26 species listed as Least Concern in the National List of Threatened Species (MOE, 2012). Further, out of the 46 endemic species recorded 1 species is listed as Critically Endangered, 3 species as Endangered, 7 species as Vulnerable in the Global List of Threatened Species (IUCN, 2014). It should also be noted that all but 1 species has been evaluated using an old version of the Global Criteria (version 2.3 in 1996) and the status given in the global list is outdated for Sri Lankan flora. Further 35 out of the 46 endemic species have not been evaluated in the Global list. Therefore, the listing provided in the national list is a more reliable depiction of the present conservation status of Sri Lankan flora. In addition to these threatened endemic fauna 17 species of native plants (5 - Endangered and 12 - Vulnerable) listed as Nationally threatened and 17 species as Nationally Near Threatened has been recorded from the project affected areas of WRDIP. Likewise 2 native species of plants listed as Globally Vulnerable has also been recorded from project affected areas of WRDIP.

Among the fauna recorded in the project impacted areas of each of the three sub projects of WRDIP, 66 are endemic to Sri Lanka (see annex I). These 66 endemic species included 7 species listed as Critically Endangered, 9 species listed as Endangered, 26 species listed as Vulnerable, 32 species listed as Near Threatened and 32 species listed as Least Concern in the National List of Threatened Species (MOE, 2012). Further, out of the 66 endemic species, 1 species is listed as Critically Endangered, 12 species as Endangered, 11 species as Vulnerable, 4 species as Near Threatened and 38 species as Least Concern in the Global List of Threatened Species (IUCN, 2014). As in the case of flora, the status indicated in the Global List are outdated for Sri Lankan fauna, especially for the endemic species where the listing provided in the national list is a more reliable depiction of their present conservation status. Further 39 out of the 66 endemic species have not been evaluated in the Global list. In addition to these threatened endemic fauna 12 species of native plants (4 - Endangered and 8 - Vulnerable) listed as Nationally threatened and 23 species as Nationally Near Threatened has been recorded from the project affected areas of WRDIP. Likewise 6 native species of plants listed as Globally threatened (3 - Endangered and 3 - Vulnerable) and 9 species as Globally Near Threatened has also been recorded from project affected areas of WRDIP.

Restricted Range Species

Mahaweli River, the largest river basin in Sri Lanka with a watershed area of 10,448 km^2 represents ca. 16% of the land area of the Island. The upper catchment of the Mahaweli river supports one of the most high biodiverse areas in Sri Lanka, the Knuckles Conservation Forest. Further, Mahaweli River and some of the sub catchments (Raththota oya, Kalu ganga, Theligamu oya and Kambarawa oya) of the Amban ganga, one of the main tributaries of

Mahaweli river, is inhabited by number of fish that are endemic to Sri Lanka and restricted to these sub catchments. Altogether 11 endemic species are restricted to the Mahaweli river. In addition, there appears to be number of yet undescribed species of fish inhabiting Mahaweli river. A list of species that are restricted to Mahaweli river are shown in table 5 along with comments on the impact of the proposed WRDIP on these species.

Table 5. List of species that is restricted to the Mahaweli river basin

Family	Scientific Name	Common Name	TS	NCS	GCS	Remarks
Cyprinidae	*Devario aequipinnatus*	Knuckles Danio	E	CR	LC	KG and MK
Cyprinidae	*Labeo fisheri*	Common Labeo	E	CR	EN	MK
Cyprinidae	*Laubuca insularis*	Knuckles labuca	E	CR	NE	KG and MK
Cyprinidae	*Puntius martenstyni*	Martenstyni's barb	E	CR	EN	KG and MK
Cyprinidae	*Puntius srilankensis*	Blotched filamented barb	E	CR	NE	KG and MK
Dicroglossidae	*Nannophrys marmorata*	Sri Lanka rock frog	E	EN	VU	Not affected
Agamidae	*Ceratophora tennentii*	Leafnose lizard	E	CR	EN	Not affected
Agamidae	*Cophotis dumbara*	Knuckles pygmy lizard	E	CR	CR	Not affected
Agamidae	*Calotes pethiyagodai*	Pethiyagoda's crestless lizard	E	NE	NE	Not affected
Scincidae	*Chalcidoseps thwaitesii*	Fourtoe snakeskink	E	CR	NE	Not affected
Gekkonidae	*Cyrtodactylus soba*	Knuckles forest gecko	E	CR	NE	Not affected

Abbreviations used:TS - Taxonomic Status, **E** - Endemic, **NCS** - National Conservation Status, **GCS** - Global Conservation Status, **CR** - Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NE** - Not Evaluated, KG – Kaluganga reservoir (associated facility to WRDIP), MK-Moragahakanda reservoir (associated facility to WRDIP)

Data Sources: Amarasinghe *et al*., 2014; ARROS, 2005; IUCN, 2014; MOE, 2012; Pethiyagoda, 1991; Pethiyagoda *et al*., 2008; Samarawickrama *et al*., 2006.

Out of the 11 restricted range species that occur in the Mahaweli river basin five species of freshwater fish has been recorded in the areas to be inundated under the Moragahakanda and Kaluganga reservoirs. None of these species have been recorded in the project impacted area of the three subprojects coming under the WRDIP. The Mahaweli Authority of Sri Lanka with the assistance of IUCN Sri Lanka has already completed a translocation programme where the fish species identified to be impacted by the proposed Moragahakanda and Kalu ganga development projects have been relocated to suitable locations in the upper catchment of the Mahaweli River.

Mitigation Measures: Mitigation measures for the ongoing constructions of Kaluganga and Moragahakanda reservoir are currently being implemented (includes reforestation in degraded areas, introduction of community forestry programs in buffer zones and canal reservations, forestry programs in upper watershed areas, control of invasive species in existing protected areas, habitat enrichment in the protected area network in the immediate vicinity, and declaration of two new protected areas and establishment of elephant corridors to ensure free movement of wildlife and translocation of critical species from project affected areas into safe and suitable sites). The following discusses the overall measures in place to address the key issues for the for the three sub projects that comes under the proposed WRDIP. These include loss of habitat, disruption of movement patterns and death or injury to animals from falling into the canal (applies only to NWP and UEC sub projects), escalation of human-elephant conflict and reduction of downstream flow (applies only to Minipe raising project).

Loss of Habitat: A habitat enrichment programme will be undertaken with the aim of reforesting/ enriching approximately 1000 ha under the three sub projects (500 ha under Upper Elahara Canal, 350 ha under North-western Province Canal and 145 ha under the Minipe LB canal rehabilitation project) to achieve an overall biodiversity offset ratio of 2. The main aim will be to restore degraded areas or undertake reforestation of plantation forests within protected areas (250 ha in Minneriya-Giritale and 350 ha in Kahalla-Pallekelle Sanctuary). This will lead to increased habitat complexity and thereby enhance the carrying capacity of these protected areas which will compensate for the habitat loss. In addition to these efforts restoration of tank catchments will be undertaken with the aim of reducing the sedimentation of tanks as well as enhance their carrying capacity. Third aim of the reforestation programme is to link existing protected areas to prevent fragmentation of habitats. Such an opportunity is only presented in the Minipe LB canal where it has been proposed to undertake reforestation of the canal reservation to create a riverine forest that can link three important protected areas, namely Victoria-Randenigala-Rantembe Sanctuary, Knuckles Conservation forest and Wasgomuwa National Park.

Disruption of movement patterns and death or injury due to animals from falling into the canal: Since the upper Elahera canal and north–western province canal project involves establishment of long stretches of open lined canals it will result in disruption of movements

of animals, especially less mobile species. Further, animals falling into the canal resulting in death or injury have been identified as a one of the main impacts of some of the long lined canals that are already being operated by the MIWRM. Therefore, thecanal design has incorporated structures in the open sections of the canal at 500 m intervals to ensure safe passage of animals across the canal as well as to facilitate those animals that fall into the canal to exit the canal safely.

Escalation of Human-Elephant conflict:Under each of the three sub projects of WRDIP money is set aside to provide short term solutions for human-elephant conflict that will arise due to the project. However, it should be noted that human-elephant conflict is wide spread socio-political problem that requires a long term solution. Therefore, MIWRM has already commissioned a study through IUCN Sri Lanka to develop and institute a long term human-elephant conflict management strategy within the entire area that will undergo a change in the cropping pattern under the proposed WRDIP to ensure that human-elephant conflict will not prevent accruing the overall benefits envisaged through the proposed water resource development under the WRDIP.

Reduction in downstream flow: This impact will take place only in one of the three sub projects of WRDIP (the Minipe raising) as the proposed project will result in diversion of more water in to Minipe LB and RB canals. As a result a stretch of about 6.5 km between the Minipe anicut and the confluence between Mahaweli river and Badulu oya will be subjected to low flows. Further, this will result in the reduction of the wetted perimeter of the river. These two impacts will result in a reduction of population densities of aquatic fauna and flora inhabiting this stretch of the river. Therefore an e-flow shall be released to meet the ecological demands of the river. According to the water balance study, taking into account the water flow in this affected section of the river for the past 50 years, the e-flow along with spillages from Minipe anicut will ensure that at least 28% of the Mean Annual Flow of the river will be released into the river. Further, a short (0.5 m) weir will be constructed across the Mahaweli river downstream of the Minipe Anicut so that the e-flow released will be dispersed across the river bed to ensure that the wetted perimeter of the river shall not decrease drastically from its present day level. This will ensure that the aquatic species present in the river will not decline in their distribution and deep pools within the river that can support large fish species such as the Marsheer, are continuously refreshed and therefore the quantity and quality of water in such pools will not decline even with the increase in the diversion of water from the main river after completion of the Minipe raising.

Conclusions: The proposed sub projects of the WRDIP will not have any impacts on the endemic and Critically Endangered or Endangered faunal species that are restricted to the Mahaweli River Basin. *Semnopithecus vetulus* (Purple-faced leaf monkey) is the only endemic Endangered species that was recorded in the project impacted area of WRDIP

projects. This species was recorded in the command area of the North-western Province Canal sub project and the proposed development activities will not have an impact on this species as it will not result in any habitat loss of the species. In addition to this four non endemic Endangered species, *Elephas maximus* (Asian Elephant), *Prionailurus viverrinus* (Fishing cat), *Panthera pardus* (Leopard) and *Melursus ursinus* (Sloth bear). Other than the Asian Elephants rest of the endangered species occur primarily in protected areas and the proposed development activities will not result in a significant habitat reduction of any of these species.

References

Amarasinghe, A. A. T., Karunarathna, D. M. S. S., Hallermann, J., Fujinuma, J., Grillitsch, H. and Campbell, P.D. (2014). A new species of the genus *Calotes* (Squamata: Agamidae) from high elevations of the Knuckles Massif of Sri Lanka. *Zootaxa* 3785 (1)59-78.

Dudley, N. (Editor) (2008). *Guidelines for Applying Protected Area Management Categories*.Gland, Switzerland: IUCN. x+86pp.

EML (2011). Detailed Biodiversity Study on Abundance & Behavioural Patterns/ Wildlife in the Project Area - Kaluganga Reservoir & Agricultural Extension Project

IUCN (2007).Biodiversity Assessment of the Moragahakanda Agriculture Development Project.

IUCN (2014).Global list of threatened species. www.iucnredlist.org

Mittermeier, R.A., Gil, P.R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J., & da Fonseca, G.A.B. (2005). Hotspots revisited: Earths biologically richest and most threatened ecoregions. Conservation International, Washington D.C. 392 pp.

MIWRM (2014a). Initial Environment Examination Report of the proposed raising of Minipe anicut project in Kandy District.

MIWRM (2014b). Environment Impact Assessment Report of the modifications to configurations of Moragahakanda-kaluganga projects proposed Upper Elehara canal (UEC), canal from Mannakkattiya tank to Mahakanadarawa tank and Kaluganga-moragahakanda link canal project.

MIWRM (2014c). Environment Impact Assessment Report of the diversion of Mahaweli water to upper Mi oya and Hakwatuna oya basins in Kurunegala district.

MOE (2012).The National Red List 2012 of Sri Lanka; Conservation Status of the Fauna and Flora.Ministry of Environment, Colombo, Sri Lanka.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000).Biodiversity hot spots for Conservation Priorities.*Nature*. 403: 853-858

NARESA (1991). Natural resources of Sri Lanka: conditions and trends. Natural Resources, Energy and Science Authority, Colombo pp. 280.

NRM (2008).Environmental Impact Assessment report of the Kalu Ganga Reservoir and Agricultural Extension project.

TEAMS (1998). Environment Impact Assessment Report of the Moragahakanda agricultural development project.

Annex I. The endemic and threatened species (Nationally and Globally) of plants and animals recorded in the project affected areas of each sub project of WRDIP and associated facilities.

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Butterflies										
Appias galena	Lesser albatross	E	LC	NE	+	+	+	+	+	+
Charaxes solon	Black rajah	N	NT	NE	+	+				
Graphium nomius	Spot swordtail	N	VU	NE	+	+				
Hasora taminatus	White banded Awl	N	NT	NE	+	+	+	+		
Ideopsis similes	Blue glassy tiger	N	VU	NE		+				
Pantoporia hordonia	Common lasker	N	NT	NE						+
Papilio crino	Banded peacock	N	VU	LC	+	+	+		+	+
Tirumala septentrionis	Dark blue tiger	N	NT	NE	+	+				
Troides darsius	Ceylon birdwing	E	LC	NE	+	+				+
Dragonflies										
Anax immaculifrons	Fiery Emperor	N	VU	LC						+
Euphaea splendens	Shining Gossamerwing	E	NT	NE	+	+				
Elattoneura centralis	Dark-glittering Threadtail	E	VU	NE						+
Ictinogomphus rapax	Rapacious Flangetail	E	LC	LC						+
Libellago adami	Adam's Gem	E	VU	NE		+				+
Libellago greeni	Green's Gem	E	EN	NE		+				
Orthetrum pruinosum	Pink Skimmer	N	NT	LC		+		+		+
Trithemis festiva	Indigo Dropwing	N	VU	LC		+		+		+
Vestalis apicalis	Black-tipped flashwing	E	VU	LC		+				
Freshwater Fish										
Belontia signata	Combtail	E	NT	LC	+					+
Channa orientalis	Smooth-breasted snakehead	E	VU	NE		+				
Devario cf . aequipinnatus	Knuckles Danio	E	CR	LC	+	+				
Esomus thermoicos	Flying barb	E	LC	LC		+		+		
Garra ceylonensis	Stone sucker	E	VU	EN	+	+		+		+

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Laubuca insularis	Knuckles labuca	E	CR	NE	+	+				
Laubuca lankensis	Lanka labuca	E	VU	NE		+				
Labeo fisheri	Common Labeo	E	CR	EN	+					
Puntius kelumi	Kelums Long snouted barb	E	EN	NE		+				
Puntius martenstyni	Martenstyni's barb	E	CR	EN	+	+				
Puntius singhala	Filamented Barb	E	LC	LC	+	+		+	+	
Puntius srilankensis	Blotched filamented barb	E	CR	NE	+	+				
Tor khudree	Mahseer	N	NT	EN	+	+				+
Frogs										
Adenomus kelaartii	Kelaart's dwarf toad	E	VU	EN		+				
Fejervarya kirtisinghei	Montain paddy field frog	E	VU	EN	+	+				
Hylarana gracilis	Wood frog	E	LC	LC	+					
Hylarana temporalis	Bronzed frog	E	NT	NT		+				
Ichthyophis glutinosus	Ceylon caecilian	E	VU	LC	+					
Lankanectes corrugatus	Corrugated water frog	E	VU	LC		+				
Nannophyrus marmorata	Marbled rock frog	E	CR	CR	+					
Philautus cavirostris	Tubercle tree frog	E	EN	EN	+	+				
Pseudophilautus fergusonianus	Ferguson's shrub frog	E	VU	LC	+					
Pseudophilautus popularis	Common shrub frog	E	NT	EN	+					
Pseudophilautus regius	Polonnaruwa shrub frog	E	VU	DD	+					
Polypedates cruciger	Common hour-glass tree frog	E	LC	LC	+	+		+		
Reptiles										
Aspidura brachyorrhos	Boie’s roughside	E	VU	NE		+				
Boiga forsteni	Forsten’s cat snake	N	NT	LC	+	+		+		
Calliophis haematoetron	Bloody vented coral snake	E	CR	NE		+				
Calotes ceylonensis	Painted lip lizard	E	NT	NE	+	+				
Calotes liolepis	Whistling lizard	E	NT	NE	+	+				
Chrysopelea taprobanica	Striped flying snake	E	LC	NE						
Cnemaspis podihuna	Dwarf day gecko	E	VU	NE	+	+				

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Crocodylus palustris	Marsh Crocodile	N	NT	VU				+		
Dendrelaphis bifrenalis	Boulenger's bronze back	E	NT	LC	+	+		+		
Dasia halianus	Haly's treeskink	N	NT	NE						
Cyrtodactylus triedra	Spotted bowfinger gecko	E	VU	NE						
Geckoella yakhuna	Blotch bowfinger gecko	E	VU	NE		+				
Geochelone elegans	Indian star tortoise	N	NT	LC	+				+	
Hemidactylus depressus	Kandyan gecko	E	LC	NE	+	+				
Lankascincus fallax	Common lankaskink	E	LC	NE	+	+				
Lissemys ceylonensis	Flapshell turtle	E	LC	NE					+	
Lyriocephalus scutatus	Hump-snouted lizard	E	VU	NT	+					
Nessia bipes	Smith's snakeskink	E	EN	NE	+					
Otocryptis nigristigma	Black spotted kangaroo lizard	E	LC	NE	+	+		+	+	
Otocryptis wiegmanni	Sri Lankan kangaroo lizard	E	NT	NE	+	+				
Trimeresurus trigonocephalus	Green pit viper	E	LC	NE	+	+				
Xenochrophis asperrimus	The checkered keelback	E	LC	NE		+				
Xenochrophis cf. piscator	Checkered Keelback	E	LC	NE		+			+	
Birds										
Anhinga melanogaster	Darter	N	LC	NT	+			+	+	
Anthracoceros coronatus	Malabar Pied Hornbill	N	NT	NT	+				+	+
Cacomantis sonneratii	Banded Bay Cuckoo	N	NT	LC				+		
Ceryx erithaca	Oriental Dwarf Kingfisher	N	NT	NE		+		+		
Charadrius alexandrinus	Kentish Plover	N/M	VU	LC				+		
Charadrius dubius	Little Ringed Plover	N/M	VU	LC				+		
Ciconia episcopus	Woolly-necked Stork	N	NT	LC	+			+		+
Dendrocopos mahrattensis	Yellow-crowned Woodpecker	N	NT	LC		+				
Elanus caeruleus	Black-shouldered Kite	N	NT	LC		+				
Galloperdix bicalcarata	Sri Lanka Spurfowl	E	NT	LC	+	+				
Gallus lafayetii	Sri Lanka Junglefowl	E	LC	LC	+	+	+	+	+	+
Hirundapus giganteus	Brown-backed Needletail	N	NT	LC		+				

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Hirundo hyperythra	Red-rumped Swallow	N	NT	NE	+	+	+	+		+
Ichthyophaga ichthyaetus	Grey-headed Fish-eagle	N	NT	NE	+			+	+	
Loriculus beryllinus	Sri Lanka Hanging Parakeet	E	LC	LC	+	+	+			+
Megalaima flavifrons	Sri Lanka Yellow-fronted Barbet	E	LC	LC	+	+				
Megalaima rubricapillus	Sri Lanka Crimson-fronted Barbet	E	LC	LC	+	+	+	+	+	
Ocyceros gingalensis	Sri Lanka Grey Hornbill	E	LC	LC	+	+	+	+	+	+
Pelecanus philippensis	Spot-billed Pelican	N	LC	NT						+
Pellorneum fuscocapillus	Sri Lanka Brown-capped Babbler	E	LC	LC	+	+	+	+	+	+
Phaenicophaeus pyrrhocephalus	Sri Lanka Red-faced Malkoha	E	VU	VU		+				
Pomatorhinus melanurus	Sri Lanka Scimitar Babbler	E	LC	LC	+	+				
Pycnonotus melanicterus	Black-crested Bulbul	E	LC	LC	+	+		+	+	
Threskiornis melanocephalus	Black-headed Ibis	N	LC	NT					+	+
Tephrodornis pondicerianus	Common Woodshrike	E	LC	LC	+	+	+	+	+	+
Treron pompadora	Pompadour Green-pigeon	E	LC	LC	+	+	+	+	+	
Mammals										
Cervus unicolor	Sambur	N	NT	VU	+			+	+	
Elephas maximus	Elephant	N	EN	EN	+	+	+	+	+	+
Loris lydekkerianus	Grey slender loris	N	NT	LC	+	+			+	
Lutra lutra	Otter	N	VU	NT	+	+	+	+	+	
Macaca sinica	Sri Lanka toque monkey	E	LC	EN	+	+		+	+	+
Moschiola meminna	Sri Lanka mouse-deer	E	LC	LC	+	+	+	+	+	
Manis crassicaudata	Pangolin	N	NT	NT	+				+	
Melursus ursinus	Sloth bear	N	EN	VU					+	
Muntiacus muntjak	Barking deer	N	NT	NE	+			+		
Panthera pardus	Leopard	N	EN	NT	+			+	+	
Prionailurus viverrinus	Fishing cat	N	EN	EN	+	+		+	+	
Ratufa macroura	Giant squirrel	N	LC	NT	+	+	+		+	+
Semnopithecus priam	Grey langur	N	LC	NT	+			+	+	+
Semnopithecus vetulus	Purple-faced leaf monkey	E	EN	EN	+	+			+	

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Flowering Plants										
Alangium salviifolium	Ruk Anguna	N	NT	NE			+			+
Alseodaphne semecarpifolia	Wewarana	N	VU	NE	+	+				+
Anodendron paniculatum	As Wel	N	VU	NE						+
Anthocephalus chinensis		N	NT	NE		+				
Argyreia populifolia	Giritilla	E	LC	NE	+	+				
Artocarpus nobilis	Bedi Del	E	LC	VU	+					+
Calamus rotang	Heen-wewel	N	NT	NE	+	+				
Calamus thwaitesii	Ma-Wewel	N	VU	NE		+	+			
Calophyllum tomentosum	Tel Keena	E	VU	VU	+	+	+			
Carallia brachiata	Dawata	N	NT	NE	+	+	+			+
Cassine balae	Neraloo	E	LC	NE	+					
Chloroxylon swietenia	Satin Wood (E), Burutha (S)	N	VU	VU	+	+	+			+
Cissus heyneana	Wal-muddarappalam	E	LC	NE	+			+		
Cleistanthus pallidus		E	LC	NE				+		+
Coix gigantea	Heen Kirindi	N	NT	LC						+
Combretum albidum	Kaduru Ketiya Wel	N	NT	NE						+
Cryptocoryne beckettii	Athiudayan	E	VU	NE	+	+	+			+
Cryptocoryne parva		E	EN	NE	+	+	+			+
Cynometra zeylanica		E	NT	NE		+				+
Derris parviflora	Kala Wel	E	LC	NE	+	+	+	+	+	+
Dioscorea trimenii	Dahaiya-ala	E	EN	NE	+		+			
Diospyros ebenoides	Kalu-habaraliya	E	EN	EN	+					
Diospyros ebenum	Ebony (E) Kaluwara (S)	N	EN	DD	+	+		+	+	+
Diospyros nummulariifolia		E	LC	EN					+	
Diospyros oocarpa	Kalu-kudumberiya	N	NT	NE	+	+	+			
Diplodiscus verrucosus	Dikwenna	E	LC	NE		+		+	+	
Diyaminauclea zeylanica	Diya-mi	E	EN	NE		+				
Drypetes gardneri	Gal Wira	E	NT	NE	+	+	+			+

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Dysoxylum ficiforme		N	NT	VU		+				+
Epipogium roseum		N	EN	NE	+					
Erythrina fusca	Yak-erambadu	N	NT	NE						+
Erythroxylum zeylanicum		E	LC	NE		+	+		+	
Garcinia quaesita	Goraka	E	LC	VU		+				
Garcinia spicata	Ela Gokatu	N	NT	NE	+	+	+			+
Garcinia terpnophylla		E	EN	NE		+				
Glenniea unijuga	Wal mora	E	LC	VU	+	+		+		
Helicteres isora	Screw tree (E), Lihiniya (S)	N	NT	NE	+	+	+			+
Holoptelea integrifolia	Indian Elm (E) Goda kirilla (S)	N	NT	NE	+		+			+
Homonoia riparia	Willow-levaed Water Croton	N	NT	LC		+	+			+
Horsfieldia iryaghedhi	Ruk Gedhi	E	VU	CR		+				+
Hydnocarpus venenata	Makulu	E	LC	NE	+	+	+	+	+	+
Ixora jucunda	Wal-rathmal	E	LC	VU	+					
Knoxia hirsuta		E	VU	NE	+					
Lagenandra praetermissa	Kethala	E	LC	NE		+				+
Madhuca longifolia	Mousey Mi (E), Mi (S)	N	NT	NE	+	+	+			+
Mallotus eriocarpus	Val-keppetiya	E	LC	NE	+					
Mangifera zeylanica	Etamba	E	LC	VU	+	+	+			+
Manilkara hexandra	Palu	N	VU	NE	+	+		+		
Margaritaria indicus	Karavu	N	VU	NE	+	+	+	+		+
Memecylon angustifolium	Blue Mist (E), Kora kaha (S)	N	EN	NE		+				
Memecylon capitellatum	Wal-kaha	E	LC	NE	+	+		+	+	
Micromelum minutum	Wal-karapincha	E	LC	NE		+				
Munronia pinnata	Bin-kohomba	N	EN	NE	+	+		+		
Ochna jabotapita	Bo-kera	E	LC	NE	+					
Painteria nitida	Diya-Mmara	E	VU	NE		+				
Pandanus ceylanicus	Weta Keyiya	E	VU	NE	+	+	+			+
Phyllanthus myrtifolius		E	VU	NE	+	+				+

Species Name	Common Name	TS	NCS	GCS	MO	KG	LK	UE	NW	MI
Pisonia aculeate	Vavul Lairitiya	N	NT	NE						+
Premna alstoni		E	LC	NE					+	
Psilanthus wightianus		N	VU	NE	+	+				
Pterygota thwaitesii	Gal Nawa	E	VU	NE		+				
Rhinacanthus flavovirens		E	VU	NE						+
Salacia reticulata	Kotala Himbutu	N	EN	NE	+	+	+			+
Sansevieria zeylanica	Blow-string hemp (E), Niyanda	N	NT	NE		+				+
Sapium indicum	Kiri Makulu	N	VU	NE						+
Schefflera heterobotrya	Itha	E	NT	NE	+					
Scolopia pusilla	Katu Kenda	E	LC	NE	+	+	+			
Semecarpus nigro-viridis	Badulla	E	LC	VU	+	+	+			+
Strychnos benthamii		E	NT	NE				+		
Strychnos nux-vomica	Nux-vomica (E), Godakaduru	N	VU	NE	+	+				+
Strychnos potatorum	Ingini	N	VU	NE						+
Strychnos trichocalyx	Thelatiya	E	VU	NE	+					
Syzygium spathulatum		E	LC	EN	+					
Syzygium zeylanicum		N	VU	NE		+	+			+
Uvaria sphenocarpa		E	LC	NE	+	+	+			+
Vanda tessellata		N	VU	LC	+	+				+
Vernonia zeylanica	Pupula	E	LC	NE	+	+		+	+	+
Vitex altissima	Milla	N	NT	NE	+	+	+			+
Wrightia angustifolia		E	LC	NE	+	+		+	+	
Xylopia nigricans	Heen-kenda	E	NT	NE		+				

Abbreviations used:TS - Taxonomic Status, **E** - Endemic, **N** - Native, **NCS** - National Conservation Status, **GCS** - Global Conservation Status, **CR** - Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **NT** - Near Threatened, **NE** - Not Evaluated, **LC** - Least Concern, **MO** - Moragaha Kanda, **KG** - Kalu Ganga, **LK** - Moragakanda-Kaluganaga Tunnel, **UE** - Upper Elahera Canal, **NW** - North-western Province Canal, **MI** - Minipe Raising.

Data Sources: EML, 2011; IUCN, 2007, MIWRM, 2014a, MIWRM, 2014b, MIWRM, 2014c, NRM, 2008, TEAMS, 1998

B) Cumulative Impacts: Hydrology and Water Sharing

a. Current situation

Mahaweli water resources system as at present consists of the Upper Kotmale and Kotmale hydropower projects with 150 MW and 201 MW installed capacity and 4.5 MCM and 172 MCM of storage capacity on the upper reach. The Polgolla diversion barrage in Kandy across the Mahaweli River diverts 875 MCM for irrigation purposes in existing irrigation systems on Amban Ganga (Systems G, D1 and D2) and Kala Oya (System H), Malwathu Oya (IH) and Yan Oya (MH) for an extent of 86,760 ha at 186% Cropping Intensity, with hydropower generation at Ukuwela and Bowatenna 40MW each. The Victoria, Randenigala and Rantembe reservoirs are located downstream of the Polgolla barrage, with installed capacities of 210 MW, 126 MW and 50 MW, have 721 MCM, 861 MCM and 15 MCM storage capacities respectively. The low weir (anicut) at Minipe downstream of Rantembe reservoir diverts water to the LB canal feeding system E, the RB canal feeding system C and B and system A on the downstream totalling 55,580 ha irrigable land at 187% CI. Please refer Figure 2 for locations of the Mahaweli systems (both proposed and implemented) under Mahaweli Development Project Master Plan.

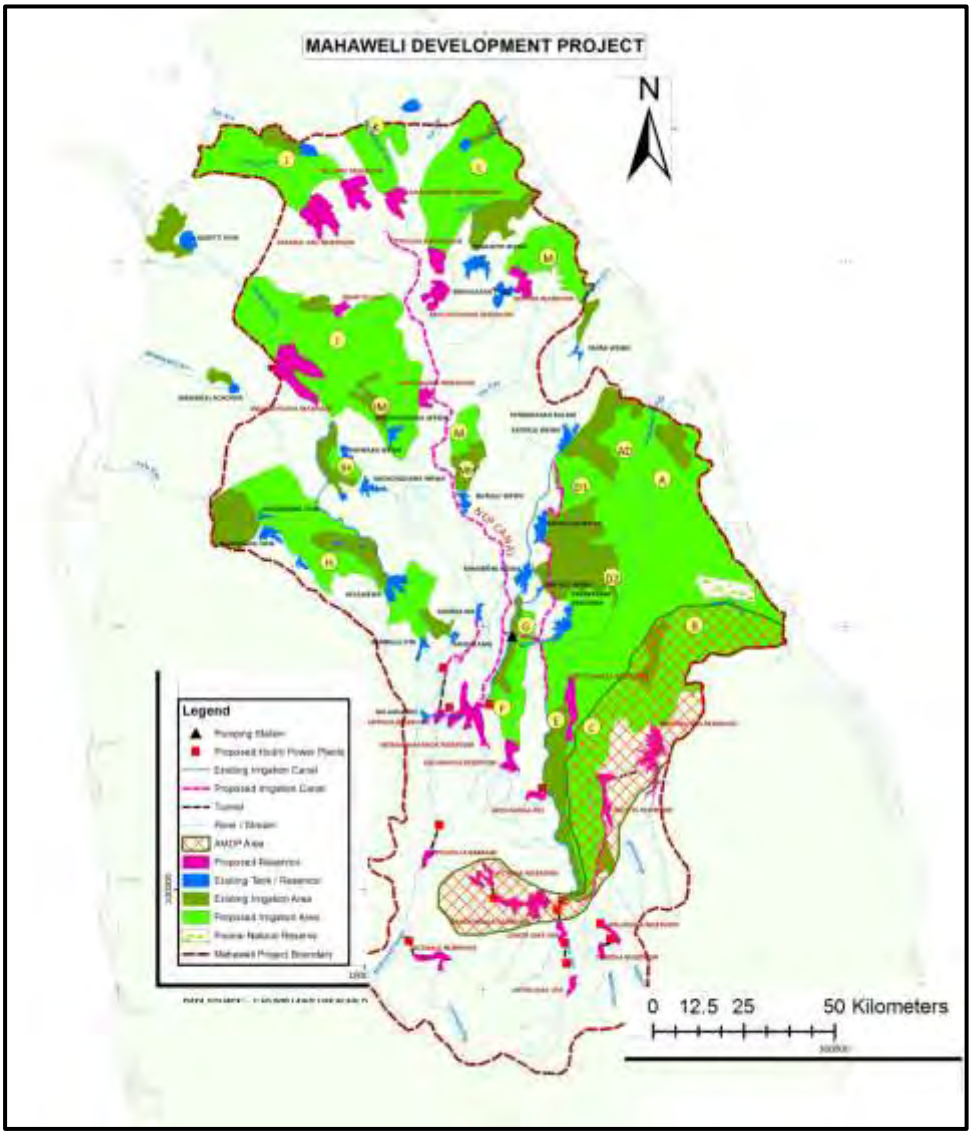

Figure 2.locations of the Mahaweli systems (both proposed and implemented) under Mahaweli Development Project Master Plan.

b. Proposed project and associated projects

The proposed Moragahakanda and Kalu Ganga projects envisage regulating and storing of unutilized water resource of Amban Ganga and Kalu Ganga river basins, and thereby providing much needed irrigation water for cultivation with an increase of 200% cropping intensity (CI) in Mahaweli systems (Systems G, D1, D2 and F), 180% cultivation in Kala Oya, Malwathu Oya (System IH), Yan Oya (system MH) and additional area in Malwathu Oya (system I) benefitting 94,560 ha with an overall increase in the Cropping Intensity (CI) from 186% to 193%. In addition drinking water needs of Matale, Anuradhapura, Polonnaruwa and Trincomalee districts will be met up to year 2032. These two reservoir projects would improve socio-economic standards of the existing areas with some degree of strengthening of associated eco-systems through the improved water availability.

After identifying the importance of Moragahakanda and Kalu Ganga projects to the Mahaweli Water Resources System, the final stage of the MDP launched as the NCP Canal Project will utilize these two reservoirs to transfer unutilized water resources of main Mahaweli River and its tributaries of Uma Oya, Hasalaka and Heen Ganga from the water rich central wet zone of Sri Lanka to the water scarce North Central (NCP) and Northern Province (NP) for agriculture and domestic water needs.

The proposed project (Water Resources Development Investment Program-WRDIP) includes three major conveyances namely, Kaluganga-Moragahakanda Transfer Canal (KMTC) of capacity 35 cumec from Kalu Ganga reservoir to Moragahakanda reservoir, and Upper Elehera Canal (UEC) of capacity 40 cumec from Moragahakanda to NCP canal downstream of Huruluwewa supply point and North Western Province Canal (NWPC). These diversions are made possible by other proposed diversions beyond the this project scope, such as Randenigala-Kalu Ganga transfer of water, and diversions of water at Kalinga Nuwara (which will be considered in phase 2).

The Randenigala reservoir will be the first diversion point of the Project. This project proposes to make use of 180 MCM of Uma Oya water diverted to Randenigala in the total diversion of 555 MCM to the proposed Randenigala-Kaluganga Transfer Canal (RKTC) and which is only 24% of total flow available at diversion point. It is also proposed to augment RKTC from flows after power generation at Hasalaka and Heen Ganga reservoirs, to increase the total diversion to Kalu Ganga to 660 MCM annually. The proposed pumping station will extract 10% of the flow at Kalinga Nuwara (located downstream of Minipe on the Mahaweli river). This extraction will utilize the excess flow at Angamedilla and will transfer 245 MCM to Elehera-Minneriya Yoda Ela.

The Minipe Anicut located downstream of Rantambe reservoir diverts water released from Rantambe after power generation, to Minipe Left Bank and Minipe Right Bank Canals for irrigation purposes. Minipe LB canal currently faces water distribution difficulties due to fluctuating flows from Rantambe reservoir and deteriorated condition of the LB Canal. Diversion of excess water in Mahaweli Ganga upstream of Minipe anicut, extraction of Hasalaka and Heen Ganga flows to the above diversion and adoption of Mahaweli

hydropower stations for peaking operation in the future would require a part of the currently spilling water at the Minipe Anicut to be stored, to reduce flow fluctuation at Minipe LB and RB canals. Therefore, it is proposed to raise the Anicut by 3.5 meters to create a water storage that will stabilize flow fluctuation and to rehabilitate the LB Canal (Minipe Left Bank Canal Rehabilitation -MLBCR) for more efficient water distribution. On the other hand, proposed Hasalaka and Heen Ganga reservoirs are designed in such a way to release their power flows directly to the Minipe LB in case of shortage of water towards end of canal during peak periods.

The four subprojects (MLBCRP, KMTC, UEC and NWPC) selected under WRDIP are of paramount importance as prerequisite projects in the NCPCP. The KMTC and UEC are important as the main conveyance routes, NWPC as the most benefited project outside original MDP and MLBCR identified as to be most affected irrigation project in main Mahaweli due to future peak power operations at Rantembe.

C.Impacts on the downstream users

This project proposes to make use of 180 MCM of Uma Oya water diverted to Randenigala (by Lower Uma Oya Development Project) in the total diversion of 555 MCM to the proposed Randenigala-Kaluganga Transfer Canal (RKTC). Water diverted at Randenigala is only 24% of total flow available at that diversion point.

It has been observed that more than 900 MCM (2005-2010) of water spills over at Minipe anicut annually. The long-term average spillage is estimated to be more than 1,000 MCM per annum (1970-2010). Water flowing downstream of Randenigala and Rantambe reservoirs after power generation form a part of this spillage. Most of these water flow to the sea unutilized except for water supply needs of the extraction point at Manampitiya, needs of System A for irrigation and water for recharging the water table in the downstream mahaweli flood plain together with river maintenance flow required for maintaining the valuable eco-system downstream.

The above mentioned water supply requirements are known through calculations and only the flows in excess of this requirement will be diverted at Randenigala, upstream of Minipe. Accordingly, annual spills over the Minipe Anicut will be reduced to 278 MC after the project (MCB, 2012b). Reference to the recommendations of the IEE report of Minipe Anicut Raising, a minimum of 8 cumecs will be released from the silt ejectors incorporated to the Minipe anicut, as well. This is further discussed under the section on environmental flows.

This study also proposes to augment RKTC from the proposed Hasalaka reservoir and Heen Ganga reservoir power flows to increase the total diversion to Kalu Ganga to 660 MCM annually. Currently, waters of Hasalaka Oya and Heen Ganga are intercepted by Minipe LB Canal, but most of the flows are confined to rainy periods, during which Minipe LB Canal command area also receives a substantial amount of rainfall. With the project, a part of the power flows from Hasalaka reservoir and Heen Ganga reservoir will be diverted to Minipe LB canal during any emergency and during peak-demand periods, thus making water availability more equitable.

The operation of Kalu Ganga reservoir will be such that there would be sufficient releases from the reservoir to Parakrama Samudra Scheme (PSS) to maintain its water level above

50% storage level and to maintain its CI at 200% level. The KMTC crosses Lel Oya, a tributary of the Kalu Ganga through an aqueduct, while UEC crosses three level-crossing namely, Kongetiya, Bogahawewa and Madeththewa having sufficient spillway lengths to discharge 67 cumec, 9.1 cumec and 43.2 cumec respectively for the design flood of 50 year frequency. Historically the flows of Kongetiya, Bogahawewa and Madeththewa which discharge in to Elehera-Minneriya Yoda Ela (EMYE) fill up Minneriya and Giritale reservoirs during the floods.

Therefore, after the implementation of the project, these three level-crossings will discharge entire floods flows in to the EMYE up to a maximum of EMYE conveyance capacity of 56.6 cumec.. In the water balance study (WBS) these three ponds would operate as level-crossings without any abstractions in to canal. This infers that there is no negative effect on the system prevailing at present in terms of water availability to the ecosystems as well as irrigation needs under the streams going across the level crossings, due to the proposed diversion.

The UEC will divert about 128 MCM of water to Huruluwewa and this will be utilized in the Yan Oya Basin. Apart from Huruluwewa command area, the small tank systems under Ilukwewa, Ellepothana and proposed Brahmanayagama anicut systems will be benefited by this diversion. In addition, return flows produced by these directly-benefited irrigation systems will enhance water availability within the river basin. As the regolith aquifer in these parts of the country is heavily dependent on surface water, additional water retained in small tanks will enhance groundwater resources, as well.

The proposed pumping station at Kalinga Nuwara will abstract 10% of the Mahaweli flow at that location (located downstream of Minipe). This amount of water will be extracted out of the excess flow at Angamedilla, which spills during the rainy season each year. As such the existing rights for Amban Ganga water users would not be affected by the NCPCP but would be secured and strengthened by the Project. River maintenance flow allowed in the designs at Kalinga Nuwara is a minimum of 4.25 cumecs (MCB, 2012c). Angamedilla flows will be reduced from 398 MCM to 306 MCM/annum, due to these diversions (MCB, 2012b), and this would not affect the river maintenance flows.

Diversions of Mahaweli water to Anuradhapura city tanks (IH) via Nachaduduwa Feeder canal from the Kalawewa RB canal and to Huruluwewa (MH) via Kandalama-Huruluwewa Feeder Canal (KHFC) from Bowatenna-Dambulu Oya canal were two temporary measures taken at the time of Mahaweli Development Project during mid-seventies. As such these two systems; IH and MH have the lowest CI within existing irrigation systems. Rerouting of these two diversions via UEC would fulfil the requirements of the original Master Plan while providing a better opportunity to feed these two cascades of reservoirs directly from the UEC. The existing feeder canal would continue to supply excess water in Kala Oya basin as in the past.

Under the NWP Canal project it is proposed to transfer Mahaweli waters from downstream of the Bowatenne reservoir to the water scarce river basins of NWP. This transfer is to be made possible by re-routing the supply to Anuradhapura city tanks and Huruluwewa reservoir, from Bowatenna diversion to UEC. This would not only add operational flexibility to the Bowatenne-Kala Oya system but also facilitate in augmenting 12,000 ha of agricultural land

and drinking water requirements of the NWP consisting of water scarce upper reach of Mi Oya basin and Hakwatuna Oya reservoir scheme of the Deduru Oya basin, leading to enrichment of the three basins in water resources.

The availability of water and its reliability of supply has been analysed in the Feasibility Study 2012 by the MCB consultants (MCB, 2012a). It has shown that diversion of 555 MCM annually above Minipe anicut (at Randenigala) together with 140 MCM at Hasalaka and Heen Ganga crossings en-route to Kalu Ganga, and 250 MCM annually downstream of Minipe (at Kalinga Nuwara) through pumping would benefit 73,000 ha of existing irrigable area and domestic supply of 70 MCM in the project area under average hydrologic situation. Allocations are always done at proposed diversion points after allowing for river maintenance flow which would include downstream consumptive use with provisions for the future demands and the environmental needs.

A project of this nature is potentially sensitive to climate change (CC) impacts, especially the rise in irrigation water demands due to global warming and diversion volumes due to changes to the rainfall patterns. The consultants have taken adaptation measures to overcome the CC impacts via taking the main diversion route through Victoria, Randenigala, Kalu Ganga and Moragahakanda reservoirs having more than 2000 MCM storage for regulation and storage, introduction of more than one diversion routes (alternative routes) for all major irrigation systems except for system H, designing the transfer canal system and diversion structures for paddy in both maha and yala seasons pattern at 180% CI for over and above average hydrologic situation, by facilitating to adopt paddy-cash crops cropping pattern during Yala under dry hydrologic situation for the same CI, and emphasizing the need for effective water management programs. Lastly, the provisions are there to extend pumping at Kalinga Nuwara to the Maha season under drought situation to maintain safe water levels in main storage reservoirs.

d. Environmental Flows

In the NCP Canal Project designs, the concept of environmental flow has been incorporated as “river maintenance flow”. It is defined as “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.” (MCB, 2012C). The river maintenance flow consists of minimum environmental flow, existing irrigation and water supply demands downstream along with sufficient flow requirements necessary in the river to supply the said demands. If there is a hydropower reservoir upstream, the power release under firm energy generation should normally cover the river maintenance flow.

To define river maintenance flow criteria, the methods used by different researchers and water resources engineers to calculate environmental flows were studied. Tenant’s method described in Subramanya (2013) recommends a 10% of mean annual flow to be released in the low flow periods of a river, and this was adopted as one of the criteria. In addition, minimum monthly flows were also studied to ensure historical minimum values are exceeded after the project. An additional criterion was adopted by using 20% of the average minimum monthly flows. This criterion was adopted because in smaller streams, the minimum monthly flow in a dry season month can be negligible, but the low stream flow in such a month is compensated by flows in other dry season months.

Considering hydrological factors specific to the diversion points of NCP Canal Project, the MCB Consultants developed a methodology to calculate river maintenance flow for this project. In this methodology, the uncertainties and inadequacy of data in such places as Kalinga Nuwara, where there is no long term river gauging data available, have been considered. The adopted process of calculation of river maintenance flow from 40 years of computed inflow time series is described step-wise, as follows:

1. Minimum monthly flows at the diversion point were tabulated and the lowest value was identified
2. From the above mentioned tabulation average monthly values were calculated, minimum of the monthly values was selected, 20% of minimum monthly average flow of the time series was calculated
3. Mean annual flow was calculated and 10% of the mean annual flow was calculated
4. Highest value of the (a), (b) and (c)(above) was selected as the river maintenance flow.

The minimum environmental flows/river maintenance flows (in cumecs) adopted in the designs at the major diversion points are as follows:

Location	**River**	**Minimum monthly value cumecs (Step 1)**	**Month**	**20% of minimum monthly average cumecs (Step 2)**	**Month and year of occurrence**	**10% of Mean annual flow (Step 3)**	**Maximum of Steps 1-3 (Step 4)**	**Allowable minimum river maintenance flow cumecs**
Lower Uma Oya	**Uma Oya**	1.39	March 1988	0.47	August	0.54		0.75
Kalinga Nuwara	**Mahaweli**	0.79	Oct. 1976	2.09	June	3.16		4.25
Hasalaka*	**Hasalaka Oya**	0.00	June 1994	0.01	Aug	0.24		0.5
Heen Ganga**	**Heen Ganga**	0.00	June, August	0.02	August	0.29		0.3

*0.5 cumecs would be released as environmental and irrigation requirements

** 2.4 and 0.4 cumecs to be released to Minipe LB during June and July respectively each year from RKTC

Source: MCB, 2012C

It can be seen that the river maintenance flow allowed at Kalinga Nuwara is more than the value obtained from minimum monthly flow criteria. A larger flow is allowed considering:

a. Irrigation requirements in the downstream including Mahaweli System A
b. Drinking water requirements in the downstream, which have to be satisfied its fullest (100%)

In the case of the Minipe Anicut, the current situation is governed by power generation at Rantambe and irrigation releases to Minipe LB and RB canals. As such, power flow from one turbine of Rantambe is spilled over at Minipe during power demand peaking periods. The objective of heightening of Minipe anicut is to regulate and store major part of this spillage

and to issue to LB and RB irrigation systems. Since the natural habitats in the stretch between Minipe anicut and the Badulu Oya confluence (which is 6.5 km downstream) is going to be affected by the flow pattern after the project is implemented, environmentalists working on the IEE study requested to release a minimum of 8 cumecs during the peaking period. Hence, the environmental flow that will be released from the Minipe Anicut will be 8 m^3/sec and 16 m^3/sec during the peaking period and during the cultivation and non-cultivation season (30th January to 15th April and 25th August to 15th November) respectively.

Further, this e-flow will be released for a period of 5 hours per day in two segments (2 hours from 1900 to 2100 and 3 hours from 0600 to 0900) to simulate the current flow regime of the river. The flow downstream of the Minipe Anicut is a regulated flow resulting mainly due to release of water after power generation from the Rantambe Power House. By adopting this procedure, it was found that e-flow along with spillages from Minipe anicut will ensure that at least 28% of the Mean Annual Flow of the river will be released into the river to meet the ecological demands downstream of the Minipe Anicut. This amount is in accordance with the method proposed by Tenanant, quoted in the draft Initial Environmental Examination Report of the Minipe Anicut Raising and LB Canal Rehabilitation Project (MCB, 2014).

In addition to the major diversions, the UEC and NWPC intercept several small streams. The Water Balance study was prepared without expecting any inflow from these streams. In most cases, these streams are by-passed by drainage under-crossings, drainage over-crossings and aqueducts on the conveyance canal. Wherever level-crossings occur, the spillways of such level crossings have been designed to pass the stream flow without abstraction by the conveyance canals.

a. Return flows and groundwater

Both the NCP Canal and NWP Canal will augment the water supply to small tank cascade systems located in the NCP and the NWP. The small tank cascade systems are defined as Madduma Bandara (1985), is a "connected series of tanks organized within the meso-catchments of theDdry Zone landscape, storing, conveying and utilizing water from an ephemeral rivulet" (Maddumabandara, 1985, quoted by Panabokke *et al*, 2002). From the ancient times, these tanks have utilized the return flows from upstream tanks to store and supply to the crops in the command area.

The NCP and NWP canals will directly augment a set of small tank irrigation systems in the Malwathu Oya, Paranki Aru, Pali Aru, Kanakarayan Aru, Ma Oya and Yan Oya (UEC and NCP Canals) and Mi Oya, Hakwatuna Oya/Deduru Oya (NWP Canal). The water availability in these river basins will be enhanced due to direct diversions as well as return flow resulting after crop water use in the directly benefited schemes. However, it is unlikely that there will be any excessive return flow during yala season because the water balance studies carried out by the MCB shows that water supply by the NCPC and NWPC will be sufficient only for 80% of the command area in that season.

The regolith aquifer in these parts of the country is heavily dependent on surface water (Panabokke et al, 2002), and additional water retained in small tanks and the return flows will enhance groundwater resources as well, especially in the dry season. In the Maha season when there is a lot of rain, groundwater is recharged by both rainfall and surface water in the tanks. As such, groundwater levels are generally high during Maha season, and NCP/NWP

Canal diversions are unlikely to make a significant change during the rainy period. However, NCP/NWP canal diversions can increase the groundwater levels in the Yala season. The beneficial aspect of this ground water source is that, some tail-end farmers on the field canals who suffer from water shortages tap this water source through agro-wells during the Yala season. In addition, groundwater is used for domestic purposes. Studies carried out in similar diversion projects such as Weli Oya Project have shown that groundwater levels are enhanced after diversions, but they fall down in the command areas after irrigations(Imbulana et al, 2009). Command areas of small tank cascades benefitted by NCP and NWP canals can be expected to perform in the same manner. Tank water levels are also likely to fall during the end of yala season. Therefore, high groundwater levels cannot be expected throughout the year. Problems such as water-logging, and salinisation have not been reported from similar diversion and small tank augmentation projects such as Weli Oya and Mau Ara. However, it is recommended that the quality of return flow is periodically monitored, considering the increased cropping intensity and promotion of crop diversification, after the project implementation.

References

- MCB, 2012a. Prefeasibility Study of the NCP Canal Project. MCB
- MCB, 2012b. Water Balance Study of the NCP Canal Project.
- MCB, 2012c.Interim Report: Consultancy Services for Feasibility Study on Proposed Randenigala – Kalu Ganga Transfer Canal Complex Enroute Hasalaka and Heen Ganga together with Lower Uma Oya Complexes with a Comprehensive Hydrological/Water Balance Study. MCB
- Panabokke, C. R. ; R. Sakthivadivel; A. D. Weerasinghe. 2002. Evolution, present status and issues concerning small tank systems in Sri Lanka. Colombo, Sri Lanka: International Water Management Institute.
- SMEC, 2012. Dam Safety & Water Resources Planning Project. Component 3 - Multi-Sector Water Resources Planning. Strategic Environmental Assessment, Mahaweli Systems. Ministry of Agriculture Development and Agrarian Services
- Imbulana, K.A.U.S., Ratnayake, U.R., Herath, G.B.B., Koncagul, E. and Neupane, B.R. (eds.), (2009) Case Study in Walawe Basin Sri Lanka, A contribution to the United Nations World Water Assessment Programme, UN-WWAP, Paris; UNESCO; Ministry of Agricultural Development and Agrarian Services, Sri Lanka

ANNEX VIII – IUCN MASTER PLAN FOR INTEGRATING WILDLIFE MANAGEMENT INTO THE WATER RESOURCES DEVELOPMENT - ADDRESSING HUMAN ELEPHANT CONFLICT

Master Plan for Integrating Wildlife Management into the Water Resources Development: Addressing human elephant conflict

Proposed Strategic Approach for Achieving the Task[1]
(Draft dated 16th July 2014 for discussion)

1. Development of a **concept note** in consultation with MIWRM - one month of appointing IUCN (**mid August 2014**)
    a. Development of a draft concept note by IUCN [covering stage 1 (NWP, NCP, EP and NP) and Stage 2 (Uva and SP)]
    b. Discussions with MIWRM
    c. Draft concept note presented for discussion with a wider stakeholder group, including state agencies, academia, experts and civil society that are directly or indirectly involved in mitigating human-elephant conflict
    d. Modify the draft concept based on comments raised by MIWRM and stakeholder group and develop the final concept and present back to MIWRM and the Stakeholder group
    e. Prepare the Final form of the concept note and develop the implementation modalities

2. Obtain **Cabinet approval** for the concept covering both Stages 1 and 2, implementation modality and appointment of IUCN as the technical lead and the convener of the process – one month of finalizing the concept (**mid September**)

3. Convert concept into a full blown **strategic action plan** - four months of Cabinet approval (**end January 2015**)
    a. Review all available statistics and research data available on Asian elephants that is needed to convert the concept to a full blown strategic action plan
    b. Conduct field surveys to obtain data to fill identified information gaps
    c. Develop a strategic action plan that would enable achievement of the objectives identified in the concept
    d. Identification of indicators to measure the outcomes of implementing the strategic plan, agencies to be involved, budgetary requirements and time frames for implementation (the indicators will inform the monitoring which in turn will support to bring adoptive changes of the strategic action plan)

[1] Prepared by IUCN Sri Lanka Office in consultation with the Ministry of Irrigation and Water Resources Management (MIWRM) on invitation of the Secretary, MIWRM.

e. Presenting the strategic action plan to Government Conservation agencies, Development oriented agencies, Academia, Other technical agencies, Civil Society and people from affected areas. Donors where necessary
f. Finalization of the strategic action plan

4. Implementation of the strategic action plan and providing adaptive changes to fine tune the actions - 4 years of approval of the strategic action plan (**end 2019**)
    a. Monitoring the implementation of proposed actions
    b. Provide adaptive changes to the plan to improve the outcomes

5. Based on the same principle prepare an strategic action plan for the Uva and Southern Province and implement - four years starting after two years of implementing the Stage 1 Plan (**2017 - 2021**)

Role and responsibilities (tentative)

MIWRM – Overall lead in commissioning the study, coordination and mobilization of funds

National Steering Committee – Steer the process, comprise of MIWRM, DWC, FD, MoE, MoWM, MoD, MASL, District Secretaries (GA's) of the relevant districts, CEA, Chief Secretary or representatives (NCP, NWP, EP, NP, Uva and SP)

IUCN – Overall technical lead and the convener on the consultative process. Lead technical agency in setting up the plan/s and M&E and Learning of implementation, documentation and communication

Donor agencies, ongoing and completed large water sector projects/agencies: Financing the plan preparation and implementation

GAs, Chief Secretaries, CBOs, DWC, FD – Implementing partners of the Strategic Action Plan

Universities and other technical agencies – M&E for assessing the effectiveness of the plan in addressing the human wildlife conflict in selected areas

Duration of the full programme eight years (08) years

Outputs

Stage 1

1. Final Concept note (covering both stages) – Mid August 2014
2. Cabinet Approval for the concept note and implementation modality – Mid September 2014
3. Final Strategic action plan covering NCP, NWP, EP and NP – January 2015

Stage 2

4. Commencement of the implantation of the Strategic Action Plan covering NCP, NWP EP and NP – February 2015
5. Completion of the implementation of the above – February 2019
6. Prepare Strategic Action Plan for Uva and SP – 2017

Stage 3

7. Implementation of the Uva and SP Strategic Action Plan – December 2017 – 2021
8. Drawing National WMP based on the above – 2021

ANNEX IX - NATIONAL AGENCIES WITH A MANDATE FOR ENVIRONMENTAL MANAGEMENT AND PROTECTION

The Forest Department, Department of Wildlife Conservation, Department of Archeology, Department of Coast Conservation, Disaster Management Center and Geological Survey and Mines Bureau are some of them and have their regional offices and staff to cater to and monitor the environmental safeguards.

Local Authorities (LA) are also having provisions under their respective acts to safeguard and maintain the environment for the benefit of the public in their respective areas. Further the respective local authorities have mandate regionally to implement the project activities and monitor the progress of compliance work.
The national level institutions in the water sector that could be involved in the EIA process are as follows:

Government Ministries

- **Ministry of Irrigation and Water Resources Management***:* Responsible for the operation and maintenance of major irrigation schemes including the areas under MASL, drainage and flood protection schemes and salt water exclusion schemes.

- **Ministry of Water Supply and Drainage***:* He task of policy formulation, the implementation of water supply and sanitation, and the provision of pipe-borne water and sewerage to people at affordable prices whilst maintaining service levels and quality standards.

- **Ministry of Power and Energy***:* the Ministry of Power and Energy is responsible for the implementation of policies, plans and programs in respect of power and energy sector and the investigation, planning and development of electricity.

- **Ministry of Fisheries and Aquatic Resource Development***:* this Ministry is responsible for the development of national aquatic resources, marine brackish water and freshwater fisheries, coast conservation and protection, development of fishery harbours and anchorages, fisheries research and development

- **Ministry of Environment and Renewable Energy**

The key functions of this are:

- Conservation of river catchments and major reservoirs
- Environment protection and management
- Conservation and sustainable development of natural resources
- Prevention of marine pollution
- Protection and conservation of forest, fauna and flora
- Formulation and implementation of policies and programmes

- Environment projection and management conservation and suitable development of natural resources prevention of marine pollution
- Conservation of river catchments and major reservoirs

- **Ministry of Local Government and Provincial Councils***:* Responsible for coordination between the centre and the Provincial Councils and promoting good governance among Provincial Councils and Local Authorities

- **Ministry of Agriculture:** The goals include:
    - Supportive agricultural policy for food, spices and allied agricultural crops.
    - Established food and nutrition security.
    - Increase production in selected crops.
    - Efficient and effective implementation of accelerated food production programme

- **Ministry of Land and Land Development***:* Responsible for (*inter-alia*)
    - Acquisition of lands for national requirements
    - Issue grants to ensure the ownership of state lands
    - Long term and short term leases of state land for public purposes
    - Surveying, mapping and preparation of advance tracings to national planning

<u>Departments and statutory bodies</u>

- **Forest Department:**
    - To maintain, conserve and create forests for the preservation and amelioration of the environment, soil and water resources, and for the protection of the local fauna and flora when they are required for aesthetic, scientific, historical and socio-economic resources;
    - To ensure and increase, as far as possible, the supplies of small wood for agricultural requirements and fuel wood for domestic consumption;
    - To maintain as far as possible a sustained yield of timber and other forest produce for general housing, industrial, communication and defense requirements of the country;
    - To work the forest to the highest possible economic advantage as is consistent with the foregoing objectives;
    - To involve the local community in the development of private woodlots and forestry farms through a programme of social forestry.

- **Department of Wildlife Conservation**: The mission statement of this organization is as follows:"To conserve wildlife and nature by the sustainable utilization of men, material and land through participatory management, research, education and law enforcement and ensure the maintenance of biodiversity and forest cover as exist today"

The main objectives of the National Wildlife Policy (approved by the cabinet of ministers (Cabinet Paper 00/1034/34/019), are:

1. To conserve wildlife resources, through protection, research, education, sustainable use and benefit sharing, for the benefit of present and future generation.
2. To maintain ecological processes and life-sustaining systems, with particular regard to primary production, hydrological balance, nutrient cycles, and prevention of erosion, siltation, drought and flood.
3. To manage all components of genetic diversity, as resources to improve crop plant and farm animal, and to develop in a fair and equitable manner new product and processes through bio-prospecting.
4. To ensure sustainable use and equitable sharing of benefits, arising from the direct and indirect use of wildlife resources and ecosystems.
5. To conserve native and endemic species and their habitats, so as to maintain the overall species richness and ecological integrity of the country.
6. To encourage the development of biological repositories, for the purposes of conservation education and science.
7. To encourage the private sector and communities to join as a full partners in all aspects of the wildlife-conservation process.

The Irrigation Department*:*

Established under the Irrigation Ordinance, the Irrigation Department is in charge of the operation and maintenance of all irrigation works. Until the creation of the National Water Supply and Drainage Board (NWSDB) in 1974, the supply of drinking water too came under the purview of the Irrigation Department. Its groundwater exploration and development functions were transferred to the Water Resources Board in 1964. The major emphasis of the department is the provision of water for agriculture. Maintenance of water quality and ambient standards of water is not included in the mandate of the department.

The Irrigation Department has the following main objectives:

- Development of land and water resources for irrigated agriculture, hydropower and flood control;
- Provision of irrigation and drainage facilities for cultivable land in irrigation and drainage projects;
- Water management for production of crops.

The functions arising from these objectives are:

- Preparation of master plans for development of river basins for the optimum utilization of land and water resources;
- Project formulation and detail designs of irrigation, hydropower, 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;
- Construction of drainage, flood protection and salt water exclusion schemes for the protection of cultivable land;
- Research in hydraulics, hydrology, soil mechanics, engineering geology, engineering materials and land use as applied to water resource development projects.

- **Department of Agriculture***:*

It is responsible for the development of crops, other than tea, rubber, coconut, sugar and spice crops, with emphasis on coarse grains, grain legumes, yams, tubers, oil seeds, fibre crops and condiments. Vegetables and fruits also receive attention in view of the export potential. The responsibility of implementing and administering the Soil Conservation Act is also lies with the Department of Agriculture.

- **National Water Supply and Drainage Board (NWSDB***)*:

This organization had its origin as a sub-department called Water Supply and Drainage under the Public Works Department. 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 until the passages of the Act. No. 13 of 1992 which created the NWSDB. This organization is mandated to purchase water in bulk, carry out investigation, and collect and record data concerning the development of water supply and sewerage services. The Board undertakes several functions as a regulator, a planner, a designer, an implementer and as an operator of the water supply systems. As a regulator, it monitors its own physical and financial performance. Physical performance is in terms of service levels provided to customers such as reliability, water quality and pressure; financial performance is with respect to the tariff limits. It also performs a role in the planning, design, operation and maintenance of water supply schemes.

- **Water Resources Board**:

Established in 1966 as an advisory body relating to the water resources in Sri Lanka with emphasis on groundwater, its skills include hydrogeology, geophysics and geo-structural analyses towards identification of groundwater resource distribution island-wide. It is particularly responsible for the investigation and monitoring groundwater. The search for groundwater has been done in a somewhat haphazard manner until recently, with other institutions playing varying roles, and it had been confined to the north-western region covered by Miocene limestone. Its objectives are:

- Identification, investigation and development of groundwater resources in the country.
- Establishment and maintenance of a well-equipped scientific unit with a view to upgrade the scientific services for groundwater exploitation and also to improve the advisory capacity in water resources development, mainly of the groundwater resources.

- Systematic collection and maintenance of scientific data necessary to establish a comprehensive groundwater data bank and to prepare groundwater maps.
- Advise on water resources development in general and groundwater resources in particular.

- **Department of Agrarian Development***:*

The Paddy Lands Act of 1958 established the Department of Agrarian Services. While the main function of the department was the protection of rights of tenant paddy fields, the subject of minor irrigation was also vested with it. The Department of Agrarian Development Act No. 46 of 2000 repealed the Agrarian Services Act No. 58 of 1979 and provided 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), management of irrigation water within the area of authority of FOs.

- **Mahaweli Authority of Sri Lanka (MASL)**:

The Mahaweli Authority of Sri Lanka was created by Act No. 23 of 1979 to plan, implement and coordinate all development activities within its areas of operations. The Authority has responsibility to develop the resources of the *Mahaweli Ganga* and adjacent river basins for the irrigation of 360,000 hectares in the dry zone of the country. It also has the powers to declare any other river basin in the country a Special Area with the objective of optimum development. Sri Lanka's model integrated river basin authority responsible for water resources development in a large area of the country, it not only aims within the Mahaweli Basin but also covers many other major river basins. The Authority looks after infrastructure facilities such as reservoirs, road networks, and buildings. The water management secretariat of the MASL has the necessary technical resources to plan water resources utilization in the basin.

- **Central Environmental Authority(CEA)**:

  Established by the National Environment Act No. 47 of 1980, the Authority had a general mandate to protect and manage the environment. By a 1988 amendment, the Authority was transformed into a national pollution control board. It is also thus a national level regulating institution to prevent and control pollution of water resources.

- **National Aquatic Resource Agency (NARA)**:

  Established by Act No. 54 of 1981, the NARA "ensures the application and utilization of scientific and technological expertise for the implementation of the national development programme on the subject of aquatic resources". Thus, its main responsibility is to promote and conduct research activities directed towards the identification, assessment, management and development of aquatic resources. As the premier organization for aquatic resources and ocean research development, it undertakes expanded multi-disciplinary

research and development programmes in collaboration with foreign agencies for the exploration and exploitation of living and non-living resources in the extensive inland waters, 200 miles exclusive economic zone and in deep sea areas. The more important objectives are to promote and conduct research activities directed towards the identification, assessment, management and development of aquatic resources, and in particular in the following fields:

- **Oceanography;**

  Improvement and development of fishing craft, fishing gear and equipment and fishing methods; Social and economic aspects of fishing industry, including the welfare of fishermen and their dependents

- **Sri Lanka Land Reclamation and Development Corporation**:

Established under Act No. 52 of 1982, the Sri Lanka Land Reclamation and Development Corporation is responsible for reclaiming and developing areas declared by the Minister as reclamation and development areas, which are defined on low lying, marshy or swampy areas for construction, commercial and agricultural purposes. It is also the authority responsible for the maintenance of the greater Colombo canals system.

- **Geological Survey and Mines Bureau**:

It is responsible for geological mapping including publication of maps, bulletins and papers. It implements the Mines and Minerals Law No 4 of 1973 and is mandated to prospect for minerals and explore and appraise the island's mineral resources.

- **The Ceylon Electricity Board**:

  The Ceylon Electricity Board (CEB) is responsible for generation, transmission and distribution of electrical energy. In Sri Lanka, the electricity generation and distribution is owned or largely controlled by the government (CEB). CEB has to share the water with other sectorial water use agencies in producing hydro-electricity (Source, Imbulana *et al* 2010).

- **The Urban Development Authority**:

  This organization under the Ministry of Defense and Urban Development has the following among its activities:

  - Carrying out integrated planning and physical development of declared urban areas
  - Undertaking the execution of development projects and schemes
  - Formulating and implementing urban land use policy
  - Developing environmental standards and preparing schemes for the environmental improvement of urban areas.

  Other government ministries that can be involved are:

- Health
- Livestock and Rural Community Development
- Disaster Management
- Technology, Research and Atomic Energy
- Ministry of Defense & Urban Development