Initial Environmental Examination

August 2015

SRI: Greater Colombo Water and Wastewater Management Improvement Program (Project 3)– Wastewater Improvement Project

Prepared by the Colombo Municipal Council Government of Sri Lanka for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 3 August 2015)

Currency unit	–	Sri Lanka rupee/s (SLRs)
SLRs1.00	=	$0.00747
$1.00	=	SLRs133.760

ABBREVIATIONS

ADB	–	Asian Development Bank
AIA	–	Archaeological Impact Assessment
AP	–	affected person
CBD	–	central business district
CCD	–	Coast Conservation Department
CEA	–	Central Environment Authority
CHSP	–	Community Health and Safety
CIA	–	Cumulative Impact Assessment
CMC	–	Colombo Municipal Council
CNC	–	Colombo North Catchment
CSC	–	Colombo South Catchment
CSS	–	Colombo Sewerage System
DBO	–	design-build-operate
DMA	–	district metered areas
DMMC	–	Dehiwala Mount Lavinia Municipal Council
DSC	–	Design and Supervision Consultants
DSIDC	–	Design Supervision and Institutional Development Consultant
EMP	–	environmental management plan
EMoP	–	environmental monitoring plan
EPL	–	Environmental Protection License
GCSP	–	Greater Colombo Sewerage Project
GCWWMIIP	–	Greater Colombo Wastewater Management Improvement Investment Program
GRC	–	Grievance Redressal Committee
GRM	–	Grievance Redress Mechanism
ICB	–	International Competitive Bidding
IEE	–	Initial Environmental Examination
KUC	–	Kolonnawa Municipal Urban Council
LHI	–	Lanka Hydraulic Institute
MBBR	–	Moving Bed Biological Reactor
MPALG&DG	–	Ministry of Public Administration, Local Government and Democratic Governance
MPPA	–	Marine Pollution Prevention Authority
MUD&WSD	–	Ministry of Urban Development, Water Supply and Drainage
NEA	–	National Environment Act
NEP	–	National Environment Policy
NWSDB	–	National Water Supply and Drainage Board
OHSP	–	Occupational Health and Safety Plan
PMU	–	Project Management Unity
PS	–	pumping station
PSC	–	Program Steering Committee
REA	–	Rapid Environmental Assessment Checklist

SBD	–	Standard Bidding Documents
SPS	–	Safeguard Policy Statement
STP	–	Sewage Treatment Plant
UDA	–	Urban Development Authority
WWTP	–	Water Wastewater treatment plant

WEIGHTS AND MEASURES

km	–	kilometer
km^2	–	square kilometer
m^2	–	square meter
mm	–	millimeter
m^3/day	–	cubic meter per day
MLD	–	million liters per day

NOTE{S}

In this report, "$" refers to US dollars.
“SLRs” refer to Sri Lankan rupees.

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, ADB does not intend to make any judgments as to the legal or other status of any territory or area

CONTENTS

LIST OF APPENDICES

EXECUTIVE SUMMARY

1. The Greater Colombo Water and Wastewater Management Improvement Program (GCWWMIP) will complement the past and ongoing efforts of the government to improve water supply availability and wastewater services to the residents of Greater Colombo to unleash its economic growth potential. It will also assist the government in introducing institutional and regulatory reforms in the sector, particularly in Greater Colombo.

2. GCWWMIP uses a multitranche financing facility (MFF) and being implemented from 2013 to 2020. Investments under the MFF will be delivered in 3 projects.[1] The executing agencies are the Ministry of Urban Development, Water Supply and Drainage (MUD&WSD) and the Ministry of Public Administration, Local Government and Democratic Governance (MPALG&DG). The implementing agencies are the National Water Supply and Drainage Board (NWSDB) for water supply components and the Colombo Municipal Council (CMC) for wastewater components.

3. ADB requires consideration of environmental issues in all aspects of its operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. According to the SPS, environmental assessment is required for all projects under the MFF. An environmental assessment and review framework (EARF) has been prepared to guide environmental assessment throughout the entire MFF period.[2]

4. **Categorization**. The project includes civil works, capacity building activities, and project management and implementation. The project area covers the south catchment area of Colombo City. The environmental impacts of the project have been identified and assessed using ADB's Rapid Environmental Assessment (REA) Checklist for Water Supply (Appendix 1) as part of the planning and design process. Results of the assessment indicate the project is unlikely to cause significant adverse impacts thus this initial environmental examination (IEE) has been prepared to meet ADB SPS requirements for environment category B. This draft IEE is based on the feasibility study and preliminary engineering designs and will be finalized during detailed design stage to reflect any changes and latest project designs.

5. Based on Sri Lanka's National Environment Act, this IEE will be considered as preliminary information to be submitted to the Central Environmental Authority to comply with the necessary permits and clearances of the project. Approval will be obtained by CMC project management unit (PMU) prior to award of civil works contract to the sewer network construction and rehabilitation and the design-build-operate contract (DBO) for the construction of the wastewater treatment plant.

6. **Subproject Scope**. The components of the subproject are: (i) rehabilitation, replacement, repair and cleaning of sewer reticulation system of 15.61 km in South catchment area of Colombo to address sewer damages, blockages and siltation problems, under-capacity issues and realignment needs; (ii) laying 29.40 km of sewer network and constructing three pump stations to cover currently unsewered Kirulapone area in the south catchment area of Colombo; (iii) laying 6.22 km of sewer network and the construction of three pump stations to

[1] Projects 1 and 2 focus on reducing NRW and improving water service efficiency in Colombo City. Projects 3 and 4, combined as Project 3, will include improvements in wastewater services and expand the service coverage to other areas of Greater Colombo.

[2] Available online at http://www.adb.org/projects/documents/greater-colombo-water-and-wastewater-management-improvement-program-earf

cover two other un-served areas in the south catchment area of Colombo; and (iv) construction of a wastewater treatment plant.

7. **Implementation Arrangements**. The executing agency (EA) for the project is the Ministry of Public Administration, Local Government and Democratic Governance (MPALG&DG). The implementing agency is CMC. Project Management Unit (PMU) will be established within the implementing agency. A team of senior technical, administrative and financial officials, including safeguard specialists, will assist the PMU in managing and monitoring implementation activities. Consultant teams are responsible for (i) evaluation of the detailed engineering design, contract documents preparation and safeguards facilitation and monitoring; (ii) project management and support; and (iii) assistance in supervising construction; (iv)conducting studies/surveys.

8. **Description of the environment**. Project components are located in the south catchment area of Colombo District. The proposed developments are located on existing properties of CMC and no land acquisition is required. However, the location for the development of sewerage network collection and rehabilitation will involve the relocation of some families to the UDA high-rise buildings. The mitigation measures and compensation associated to their relocation is discussed in details in the Resettlement Plan of the project. The identified sites are not located or adjacent to on ecologically and culturally protected areas.

9. **Environmental Management**. An environmental management plan (EMP) is included as part of this IEE, which includes (i) mitigation measures for environmental impacts during implementation; (ii) an environmental monitoring program, and the responsible entities for mitigating, monitoring, and reporting; (iii) public consultation and information disclosure; and (iv) a grievance redress mechanism. A number of impacts and their significance have already been reduced by amending the designs. The EMP will be included in civil work bidding and contract documents.

10. Locations and siting of the proposed project were considered to further reduce impacts such as avoiding sewer pipeline arrangement that will result in destruction/ disturbance of historical and cultural places/values. Also, appropriate routing and sizing of sewer pipelines will follow applicable national and international guidelines and environmental considerations and specifications will be incorporated in the final technical design in both of the sewer network construction and rehabilitation and for the construction of the wastewater treatment plant.

11. During the construction phase, the anticipated impacts on the physical and biological environment are temporary, localized and can be easily avoided or minimized with the implementation of mitigation and monitoring measures which are detailed in the environmental mitigation plan (EMP) and environmental monitoring plan (EMoP), respectively. The following are the anticipated impacts and corresponding mitigation measures during the construction phase of the project: (i) air pollution from dust emissions during on-site excavation, movement of earth materials and emission from movement of heavy equipment and construction vehicles which will be mitigated by good construction practices such as water spraying on road surface and work areas, covering all materials during transportation, and proper maintenance of construction vehicles and equipment; (ii) water pollution from run-off or soil erosion from stockpiled construction materials and wastewater from domestic sewage of construction workers and accidental spillage of oil and other lubricants from washing of construction equipment, which will be mitigated by covering exposed soils, construction of temporary silt traps, and provision of adequate and on-site sanitation facilities; (iii) noise pollution from the construction activities resulting to nuisance to the community, which will be mitigated with

continuous consultation with the community on the schedule and time of construction activities and the use of noise suppression on construction equipment; (iv) generation of construction wastes, which will be mitigated by the provision of waste bins in the construction site and the proper segregation, collection and disposal of solid wastes will be strictly observed; (v) occupational health and safety in the construction site causing harm and danger to the lives and welfare of workers, which will be mitigated with the implementation of occupational and health safety plan including the provision of personal protective equipment to all workers; and (vi) community health and safety such as the disruption of normal traffic patterns, damage or degradation of national roads from the transport of materials and risks from unauthorized entry to the construction areas resulting to accidents. This will be mitigated with the implementation of community health and safety plan which will includes the provision of fence to enclose the area of civil works and posting warning signs and information in the construction area.

12. In the operational phase of the project, all facilities and infrastructure will operate with routine maintenance, which should not affect the environment. Facilities will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period. For the wastewater treatment plant, the contractor will be responsible to the sludge management program to ensure that the collection, treatment, transport and final disposal of the sludge will be in compliance with applicable environmental standards. The contractor of the wastewater treatment plant will be responsible during its operation and maintenance for a period of 15 years and then it will be transferred to the supervision of the CMC.

13. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation phases of the project to ensure that all measures in the EMP are implemented and to determine whether the environment is protected as intended. This will include observations on-and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the CMC PMU.

14. The stakeholders were involved in developing the IEE through face-to-face discussions on site and public meeting held in the city, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation. This IEE will be updated, if necessary upon completion and finalization of the technical design of the Project.

15. Based on this initial environmental examination, the projects is unlikely to cause significant adverse impacts. Negative impacts during the construction activities are short-term, localized, and in relatively small area, which can be minimized with the implementation of the mitigation measures in the environmental management plan. The positive impacts of the project are (i) improvement in sanitation from the rehabilitation of the sewer network may result to an improvement in public health such as the decrease in the number cases of diarrhea and other water-related diseases in the area; and (ii) water quality and the concentration of pollutants, specifically faecal coliform in the sea outfall will be improved with the construction of the wastewater treatment plant.

16. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. Based on the findings of the IEE, the classification of the Project as Category B is

confirmed, and no further special study or detailed Environmental Impact Assessment (EIA) needs to be undertaken to comply with ADB's SPS (2009).

I. INTRODUCTION

A. Background

1. The Greater Colombo Water and Wastewater Management Improvement Investment Program (GCWWMIP) will complement the past and ongoing efforts of the government to improve water supply availability and wastewater services to the residents of Greater Colombo to unleash its economic growth potential. It will also assist the government in introducing institutional and regulatory reforms in the sector, particularly in Greater Colombo.

2. GCWWMIP uses a multi-tranche financing facility (MFF) and being implemented from 2013 to 2020. Investments under the MFF will be delivered in 3 projects.[1] The executing agencies are the Ministry of Urban Development, Water Supply and Drainage (MUD&WSD) and the Ministry of Public Administration, Local Government and Democratic Governance (MPALG&DG). The implementing agencies are the National Water Supply and Drainage Board (NWSDB) for water supply components and the Colombo Municipal Council (CMC) for wastewater components.

3. Project 3 conforms to selection criteria approved under the Framework Financing Agreement (FFA), including technical, environmental, social, institutional, economic and financial criteria. Project 3 provides financing gap for the rehabilitation and expansion in water supply system and reduction in non-revenue water (NRW); supports the rehabilitation and expansion in wastewater collection and treatment, and shall strengthen institutional structure and capacity service in Greater Colombo. Project 3 outputs are:

> **Output 1: Rehabilitated and Expanded Water Supply System and Reduced NRW in the North Part of Colombo City (financing gap for Project 1):** The following additional activities will be included, in order to strengthen Project 1: (i) construction of a 1.9 km additional transmission line from Ambatale to Ellie reservoir in the north part of Colombo city; (ii) formation of 7 additional district metered areas (DMAs) in the north part of Colombo city, and (iii) increasing the area engineering office from 800 m^2 to 1400 m^2.
>
> **Output 2: Rehabilitated and Expanded Water Supply System and Reduced NRW in the South Part of Colombo City (financing gap for Project 2):** The following additional activities will be included, in order to strengthen Project 2 (i) formation of 7 additional district metered areas (DMAs) in the south part of Colombo city; (ii) construction of a new training center (5400 m^2) in place of rehabilitating the existing center; and (iii) rehabilitation of Ellie house pump station.
>
> **Output 3: Rehabilitated and Expanded Wastewater Network in South Catchment Area of Colombo City**: (i) rehabilitation, replacement, repair and cleaning of sewer reticulation system of 15.61 km in South catchment area of Colombo to address sewer damages, blockages and siltation problems, under-capacity issues and realignment needs; (ii) laying 29.40 km of sewer network and constructing three pump stations to cover currently unsewered Kirulapone area in the south catchment area of Colombo;

[1] Projects 1 and 2 focus on reducing NRW and improving water service efficiency in Colombo City. Projects 3 and 4, combined as Project 3, will include improvements in wastewater services and expand the service coverage to other areas of Greater Colombo.

and (iii) laying 6.22 km of sewer network and the construction of three pump stations to cover two other un-served areas in the south catchment area of Colombo.

Output 4: Secondary Wastewater Treatment Plant constructed in South Catchment Area of Colombo City: (i) construction of 50,000 cubic meters per day capacity secondary treatment plant at Wellawatta on Design-Build-Operate (DBO) basis.

Output 5: Strengthened Institutional Structure and Capacity of Service Provider: (i) a separate wastewater unit is established within the CMC; (ii) establishment of GIS-based asset management system for wastewater system, to strengthen the operation of the wastewater unit; (iii) strengthening of CMC's staff and institutional capacity for increased operational efficiency in wastewater management; (iv) awareness of shared responsibility in wastewater management by new sewerage users in the south catchment area; (v) training and capability building to improve the operating performance of CMC; and (vi) initiating the collection of volumetric sewerage tariff in the CMC area.

B. Purpose of Report

4. ADB requires consideration of environmental issues in all aspects of its operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. According to the SPS, environmental assessment is required for all projects under the MFF. An environmental assessment and review framework (EARF) has been prepared to guide environmental assessment throughout the entire MFF period.[2]

5. This initial environmental examination (IEE) is prepared for GCWWMIP Project 3 wastewater improvement project (the project) following the EARF. The project includes civil works[3], capacity building activities, and project management and implementation. A detailed description of the components is provided in Section II. The project area covers the south catchment area of Colombo City. This draft IEE is based on the feasibility study and preliminary engineering designs and will be finalized during detailed design stage to reflect any changes and latest subproject designs.

6. The environmental impacts of the project have been identified and assessed using ADB's Rapid Environmental Assessment (REA) Checklist for Sewage Treatment (Appendix 1) as part of the planning and design process. Results of the assessment indicate the project is unlikely to cause significant adverse impacts thus this IEE has been prepared to meet ADB SPS requirements for environment category B. The objectives of this IEE are to:

(i) provide critical facts, significant findings, and recommended actions;
(ii) present the national and local legal and institutional framework within which the environmental assessment has been carried out;

---

[2] Available online at http://www.adb.org/projects/documents/greater-colombo-water-and-wastewater-management-improvement-program-earf

[3] The components of the subproject are: (i) rehabilitation, replacement, repair and cleaning of sewer reticulation system of 15.61 km in South catchment area of Colombo to address sewer damages, blockages and siltation problems, under-capacity issues and realignment needs; (ii) laying 29.40 km of sewer network and constructing three pump stations to cover currently unsewered Kirulapona area in the south catchment area of Colombo; and (iii) laying 6.22 km of sewer network and the construction of three pump stations to cover two other un-served areas in the south catchment area of Colombo.

(iii) provide information on the existing geographic, ecological, social, and temporal contexts, including associated facilities within the project's area of influence;
(iv) assess the project's likely positive and negative direct and indirect impacts on physical, biological, socioeconomic, and physical cultural resources in the project's area of influence;
(v) identify mitigation measures and any residual negative impacts that cannot be mitigated;
(vi) describe the process undertaken during design phase to engage stakeholders, the planned information disclosure measures, and the process for carrying out consultation with affected people and facilitating their participation during project implementation;
(vii) describe the project's grievance redressal mechanism for resolving complaints about environmental performance;
(viii) present the set of mitigation measures to be undertaken to avoid, reduce, mitigate, or compensate for adverse environmental impacts;
(ix) describe the monitoring measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures; and
(x) identify who is responsible for carrying out the mitigation and monitoring measures.

7. Required data and information for the preparation of the IEE were obtained from different sources. These include:

(i) data collected by the Design and Supervision Consultant team of the on-going ADB-funded Greater Colombo Wastewater Management Project (GCWMP)[4] and pre-feasibility study (PFS)[5] teams
(ii) discussions with Feasibility Study team
(iii) neetings with the CMC engineers and other stakeholders
(iv) meetings with the beneficiaries and affected people,
(v) meetings and discussions with key agencies having environmental data pertaining to the city
(vi) secondary data from previous project reports and published articles, and
(vii) public consultations

[4] ADB Loan Nos. 2557 and 2558 approved in 28 Sep 2009. GCWMP supports (i) upgrading the sewerage infrastructure, including pumping stations, sewer pipes, and discharge outfalls; (ii) strengthening institutional and operational capacity in asset management, financial management, operational performance monitoring, environmental regulatory compliance, customer services, and pro-poor sanitation services; and (iii) project management and implementation. GCWMP components include: (i) rehabilitation of main sewerage system – pumping stations, pumping mains, fine screens; (ii) rehabilitation of gravity sewers; (iii) rehabilitation of sea outfalls; (iv) supply of non-fixed operational plant equipment for CMC (sewer cleaning equipment such as mobile jetting and vacuum truck) together with the on-site training of appropriate staff in the operation and maintenance of the equipment supplied; and (v) strengthening institutional and operational capacity.

[5] In order to prioritize the needed wastewater management investments, the Cities Development Initiative for Asia (CDIA) supported a Pre-Feasibility Study (PFS) to provide an overall framework for GCWWMIP Projects 3 and 4 by analyzing the wastewater collection and treatment facilities, as well as the management services, in Greater Colombo and providing recommendations for their improvement. This included the problem contributed by storm water drainage and solid waste management in the overall wastewater context in Greater Colombo/Colombo City.

II. DESCRIPTION OF THE PROJECT

A. Project Area

8. Colombo is Sri Lanka's economic and administrative center and is located within the Western Province of the country. The Greater Colombo Area comprises CMC and eight peripheral local authorities, the neighboring Municipal Councils of Dehiwala-Mt Lavinia, and Sri Jayawardenapura-Kotte, the Kolonnawa and Maharagama Urban Councils (UCs), and the Pradeshiya Sabhas of Kotikawatta, Mulleriyawa, and Kaduwela. More than 1.6 million inhabitants of the Greater Colombo Area account for more than 50 percent of Sri Lanka's urban population.

9. CMC is the largest local authority in Sri Lanka and one of the oldest in South Asia. It was established in 1865 and it has developed into a large organization which serves various needs of the resident population of 647,100[6] as well as a floating population of 500,000. At the time of establishment of CMC, the population in the region was only 80,000.

10. The Western Region Structure Plan[7], which sets out the long term development for Western Province, divides the Province into three zones, of which the Colombo Core Area is one such zone.

B. Existing Condition

11. Total area of Colombo City is 37 km^2. Approximately 80% of the area is presently covered by the Colombo Sewerage System (CSS). The remaining 20% is consisting of 11 unsewered areas. Figure 2.1 shows the unsewered and un-sewered areas of Colombo City. Much of the CSS was constructed between 1902 and 1925. CSS can be divided into two major catchments as Colombo North Catchment (CNC) and Colombo South Catchment (CSC). Figure 2.2 depicts the catchment areas. In addition, sewage from two adjoining municipalities, Dehiwala-Mt Lavinia and Kolonnawa as well as from another 11 locations, including the Parliament Complex in Sri-Jayawardenapura, is pumped into the CSS. The CMC Drainage Division which functions under the Municipal Engineers Department is mainly responsible for operation and maintenance of the CSS and local storm water network.

12. CSS infrastructure consists of approximately 254 km of sewer, 13 main pumping stations (PS), six manhole type small PS, approximately 25 km of force mains, 5 siphons, approximately 5,000 manholes and two long sea outfalls.[8] Nearly 80% of the sewers are small diameter pipes less than or equal to 300 mm. Figure 2.3 depicts the trunk sewers, main pump stations, force mains and outfalls. The long outfalls provide the most cost effective option taking the advantage of the ocean's capacity to absorb and process wastewater.[9]

---

[6] Based on 2001 census. A census was conducted in 2011 but the data has not yet been published. CMC 2014 budget lists the 2012 population of the CMC area as 555,031, a reduction of 92,069 from the 2001 census population. The source of this 2012 population is the Department of Census and Statistics, 2012. This needs to be validated, although it is possible that the CMC population did reduce in this period due to a movement of government offices from the CMC area and an increase in high-rise commercial developments.

[7] CESMA 2004, Regional Structure Plan of the Western Region Megopalis, Colombo.

[8] There are two sewage treatment plants (STP) at Madampitiya and Wellawatte however were abandoned around 1956. In lieu of treatment, two long sea outfalls were built in 1981-1983 with joint funding from the World Bank and Saudi Special Fund.

[9] The present disposal method is in conflict with the existing wastewater disposal standards of Sri Lanka particularly removal of floatable solids that are more than 3 mm size.

13. Figures 2.4 and 2.5 illustrate the network flow arrangement for the CNC and CSC respectively. As illustrated from these two diagrams the flow cascades from one pump station to the other until it is transferred to one of the two outfalls. Flow from Dehiwala Mount Lavinia Municipal Council (DMMC) area is received by the Wellawatta outfall and flow from Kolonnawa Urban Council (KUC) area is received by the Mutwal outfall. These are trans-boundary flows to the CSS.

14. During 1983-1987 modifications to CSS network arrangement were made. Accordingly part of the flow discharging to Madampitiya (northern catchment) was diverted to southern outfall. Flows collected at Borella and Polwatta pumping stations (PS) were diverted to S8 PS. Flows at Harbour and Vystwyke which was earlier discharged into Madampitiya were diverted directly to Mutwal outfall. Madampitiya flow was discharged into Mutwal outfall and the disposal of untreated wastewater into Kelani River was completely stopped.

15. Rehabilitation and extension of the sewerage system has occurred progressively following master plans prepared in 1972 and 1993. Nevertheless, the system still suffers from many technical deficiencies including the following:

(i) Some sewers are in poor condition or are under-capacity and experience collapses, serious blockages and overflows.
(ii) Recent rapid development of the city from commercial developments in the central business district (CBD), proposed Port City, and on-going program of resettlement of poor communities into high-rise developments requires upgrading of a number of sewers.
(iii) Although 80% by area of Colombo is served by the CSS, it is reported that up to 50% of the population is not connected or has irregular connections.
(iv) There are many cross-connections between the surface and foul water drainage systems. Sewers are purposely allowed to flow into storm water system to overcome capacity problems and as diversions to overcome the sewer blockages and collapses.

16. The 1999 the Greater Colombo Sewerage Project (GCSP) analyzed the wastewater system and determined that in general the network had sufficient capacity to serve the fully developed city in the CMC. However, capacity was assessed as being constrained by poor pumping station operation, significant siltation of the pipelines and cross-connections with surface water drains. The emphasis was therefore on rehabilitation works addressing sewers that were in need of structural rehabilitation such as the Main Sewer, N1 sewer, C1 sewer, A1 sewer, CS 17 sewer and the W1 sewer. Subsequently, some of these rehabilitation projects, in particular improvements to the main sewer, the N1 sewer and the W1 sewer were undertaken through projects financed by Denmark and Austria.

17. Rehabilitation of pumping stations has been a critical element of the works proposed both under GCSP and GCWMP. CMC comprises 18 pumping stations; thirteen operated by CMC and five by National Water Supply and Drainage Board (NWSDB) and the Dehiwala-Mt Lavinia Municipal Council (DMMC). Five of the pumping stations have been re-constructed/rehabilitated since 1999 – Slave Island and Polwatta under World Bank funding in 1999-2001 and Madampitiya, Wellawatta and Peterson's Lane (S-8) under Danish International Development Agency (DANIDA) funding. Of the remaining 13 pumping stations, five, Maligawatta, Bambalapitiya, Borella, Wannathamulla and Vystwyke will be re-constructed under ADB-funded GCWMP. These pumping stations are considered ineffective due to the relative levels of their wet wells and the invert levels of incoming sewers which cause the sewers to

back up with the resulting deposition of silt. A new pumping station is also proposed at Fort to address the problems associated with the Fort syphon. Most of these pumping stations are in poor condition requiring major electrical and mechanical rehabilitation. Screen and grit removal facilities are generally not operational. For these stations the following refurbishment works included in GCWMP:

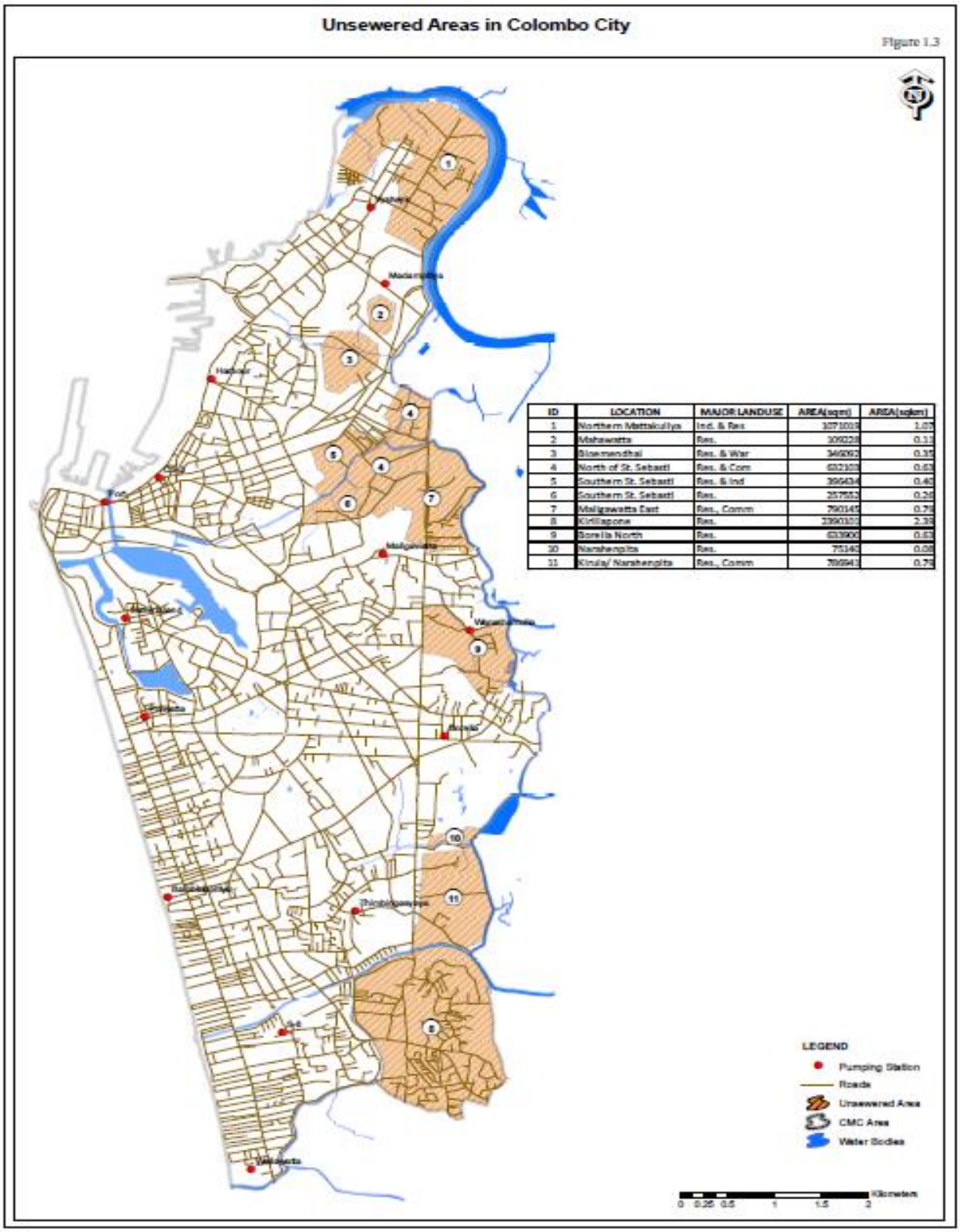
(i) Replacement of all pumps. Submersible pumps are proposed to avoid priming issues which in the past has resulted in backing up of sewers to provide sufficient head for pump prime.
(ii) Installation of grit removal equipment and 25mm screens
(iii) New Motor Control Centres (MCCs)
(iv) New ventilation
(v) Refurbishment/replacement of penstocks
(vi) Building repairs

18. **Status of Operation/Construction or Implementation Progress of GCWMP.** CMC is being supported by ADB in the rehabilitation and upgrading of the CSS through the GCWMP which was approved in 28 Sep 2009. GCWMP components include: (i) rehabilitation of main sewerage system – pumping stations, pumping mains, fine screens; (ii) rehabilitation of gravity sewers; (iii) rehabilitation of sea outfalls; (iv) supply of non-fixed operational plant equipment for CMC (sewer cleaning equipment such as mobile jetting and vacuum truck) together with the on-site training of appropriate staff in the operation and maintenance of the equipment supplied; and (v) strengthening institutional and operational capacity. Table 2.1 provides the summary of GCWMP components and status of works. Out of the 17 pumping station package, six (6) under the NWSDB have been awarded and the works ongoing. Contract for the 11 stations under the CMC is being awarded. Civil Works of 10 km sewer line rehabilitation, 125 km line condition assessment and 2 km line upgrading, all are ongoing. Sea outfall rehabilitation works are completed. Institutional and operational capacity of CMC is also strengthened. While components of asset management and business support system had been extended until mid 2015 with smaller consultancy inputs, all other activities are completed in 2014. Project management and implementation capacity of CMC is improved and PMU is fully established and various training programs are ongoing.

Table 2.1: Details of On-going GCWMP (as of June 2015)

Package No.	Detailed Component	Status of Works
GCWMP/ADB/GS/01/ICB/Works/02/2012	Rehabilitation of the10 km sewer lines and condition assessments of 125 km of sewer lines within CMC area	Ongoing project 5% of work completed
GCWMP/ADB/GS/02/ICB/Works/02/2013	Upgrading of Wanathamulla gravity sewer network for CMC	Ongoing project. 22% of work completed
GCWMP/ADB/OF/01/ICB/Works/01/2012	Rehabilitation of sea outfalls	Completed project: 100% completed (for commissioning phase upon completion of sewer network rehabilitation and upgrade)
GCWMP/ADB/PS/01/ICB/Works/03/2013	Designing construction, installation &rehabilitation of waste water pumping stations at CMC	Contract Awarded Agreement to be signed

Figure 2.1: Sewered and Unsewered Areas in Greater Colombo



ID	LOCATION	MAJOR LANDUSE	AREA(sqm)	AREA(sqkm)
1	Northern Mattakuliya	Ind. & Res	1071033	1.07
2	Mahawatta	Res.	109228	0.11
3	Slavemendhal	Res. & War	346091	0.35
4	North of St. Sebasti	Res. & Com	632103	0.63
5	Southern St. Sebasti	Res. & Ind	399434	0.40
6	Southern St. Sebasti	Res.	257552	0.26
7	Maligawatta East	Res., Comm	790145	0.79
8	Kirillapone	Res.	2390101	2.39
9	Borella North	Res.	603900	0.61
10	Narahenpita	Res.	75145	0.08
11	Kirula/ Narahenpita	Res., Comm	786941	0.79

Figure 2.2: Catchment Areas of Greater Colombo Sewerage System

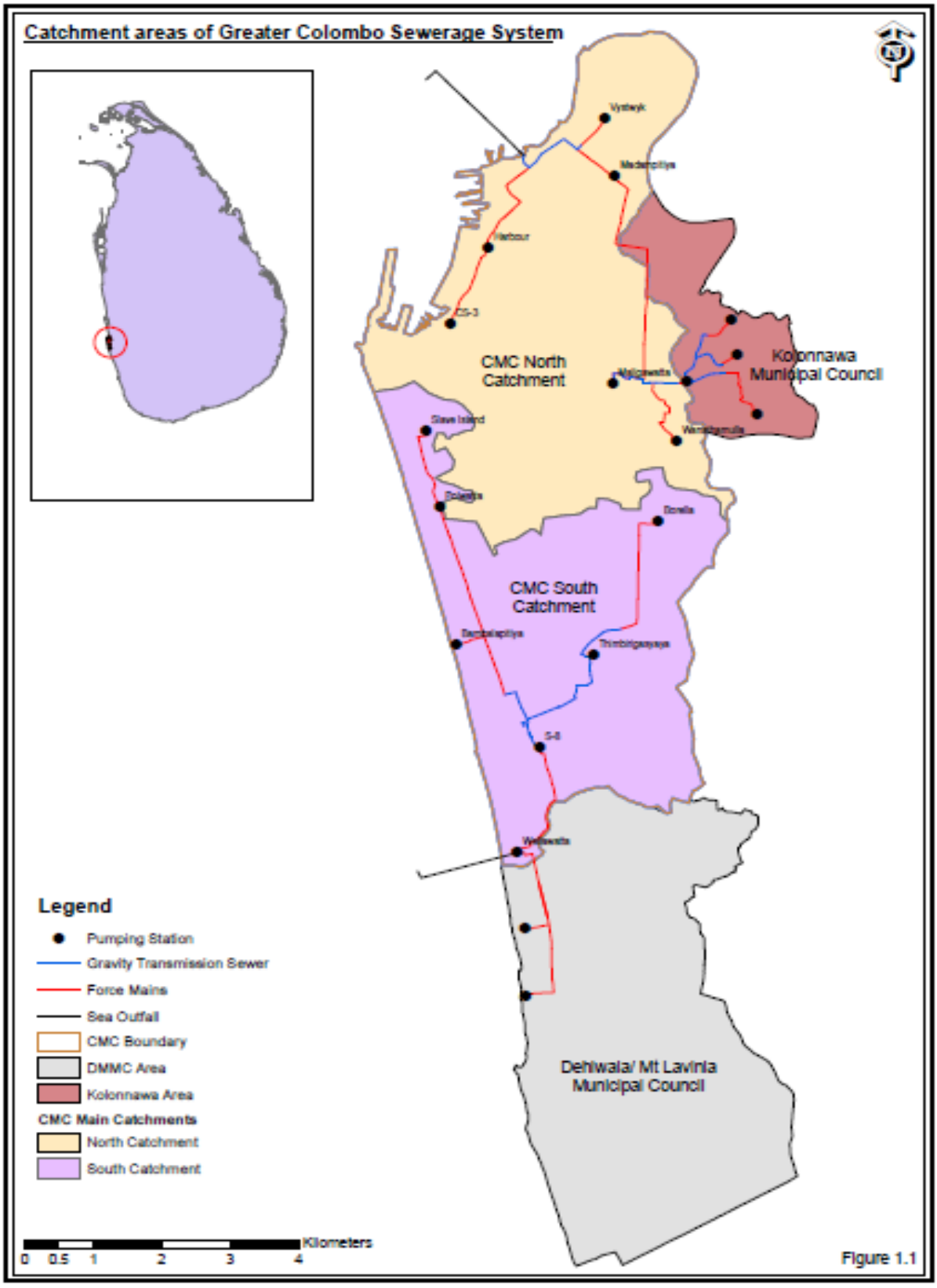


Figure 2.3: Locations of Pump Stations, Trunk Sewers, Force Mains and Outfalls

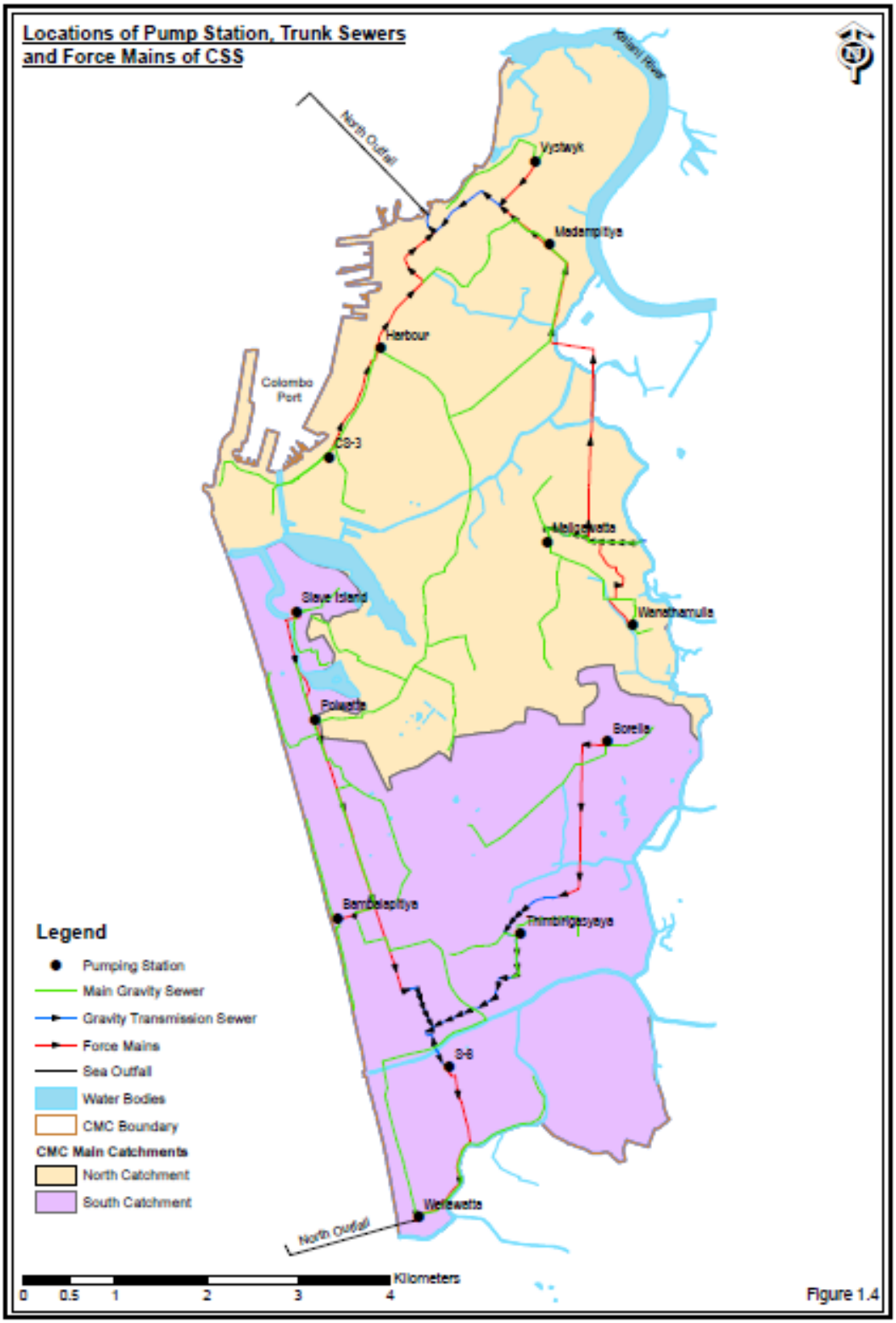


Figure 2.4: Network Arrangement in Colombo North Catchment

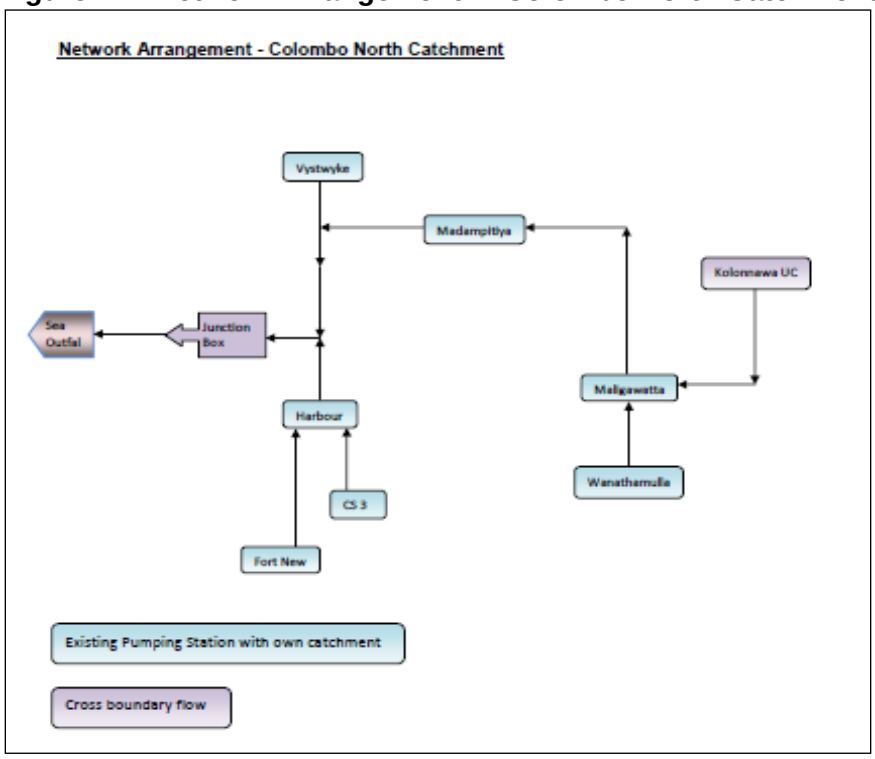
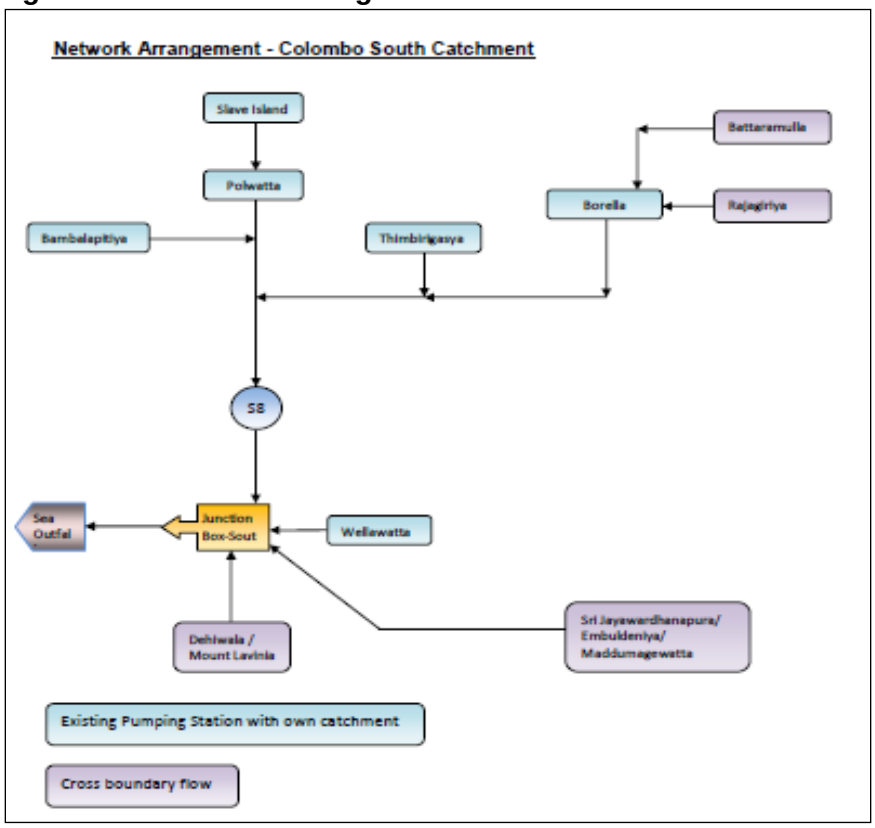


Figure 2.5: Network Arrangement in Colombo South Catchment



C. Proposed Project

19. The GCWMP design and supervision consultants (DSC) conducted a study in August 2011 to estimate the quantity of wastewater generated in the CMC area for the period up until 2040. After 2040, it was considered that population in the CMC area would reach saturation and wastewater volumes would not be expected to increase significantly. The estimated wastewater flows in 2040 are 132 million liters per day (MLD) for CNC and 55.2 MLD for CSC.[10] The existing sewerage system suffers in parts from blockages, collapsed or leaking sewers and is under-capacity in areas where new developments are occurring. Table 2.2 provides the summary of proposed components with civil works under GCWWMIP Project 3 (Outputs 3 and 4). The project will rehabilitate and expand wastewater network and construct a 50 MLD sewage treatment plant (STP) in Wellawatta to manage wastewater in the south catchment area of Colombo City

Table 2.2: Details of Proposed GCWWMIP Project 3 Components

No	Proposed Intervention	Components
1.	Existing network repair, rehabilitation, and improvement including upsizing to cater to new development in Colombo central business district and Urban Development Authority (UDA) developments in the south catchment area	4.2 km of under capacity sewer 4.06 km for spot repair
2.	Development of sewerage collection network for Kirulapone unsewered area	Construction of two new pump stations and force mains and rehabilitation of S8 pump station and connecting the Kirullpone new sewer network to S8 pump station
3.	Construction of new sewerage networks for Narahenpita and Kirula-Narahenpita unsewered areas and connecting them to the existing Colombo Sewerage System	Provision of sewerage to unsewered areas of Narahenpita and connecting to Colombo Sewerage System
4.	Construction of secondary wastewater treatment plant at Wellawatta	Wastewater treatment plant (WWTP) using moving ben biological reactor (MBBR) technology and rehabilitation and conversion of the existing Wellawatta pumping station as the head-works pumping station for the treatment plant

20. **Existing Network Improvement and Rehabilitation.** Altogether 4.2 km of under-capacity sewer were identified as under capacity (Table 2.3) and 4.06 km of sewer were selected for spot repair and cleaning (Table 2.4). Table 2.5 shows the siphons identified for rehabilitation. Figure 2.6 shows the locations of sewers and siphons identified for rehabilitation.

Table 2.3: Problematic Sewers (Under Capacity) Identified for Rehabilitation

District	Sewer Name	Exceed Capacity	From MH	To MH	Length (m)	Existing Diameter (mm)	Proposed Diameter (mm)	Recommendation
2B	M13 main sewer	Yes	M13-5	Mainsewer-7	372	225	300	Upsize
2B	M2	Yes	M2-4	M1-6	279	225	300	Upsize
2B	R50 / R57	No	R50-19	R50-12 and R58-1	178	225	225	Retrace the sewers on Wekanda Road.
2B	M26C	Yes	M26C-1	M26C-	50	225	225	The downstream invert of the sewer

[10] Greater Colombo Wastewater Management Project, Design and Supervision Consultants.

District	Sewer Name	Exceed Capacity	From MH	To MH	Length (m)	Existing Diameter (mm)	Proposed Diameter (mm)	Recommendation
								need to lower from (-0.72) to (-0.80) m by replacing the sewer
2B	S6	No	S6-9	S3-1	600	225	225	Retrace the sewer on Perahara mawatha
2B	S8	No	S6-4	Retraced S6	40	225	225	Extend to Perahera Mawatha
2B	S9	No	S6-5	Retraced S6	50	225	225	Extend to Perahera Mawatha
3	O5	Yes	O5-7	O1-6	550	225	375	Upsize
3	O17	Yes	O17-6	REF-6	450	225	300	Upsize
4	V11	Yes	V11 15	V11 4	648	225	375	Upsize
			V11 4	V20 1A	285	300	450	Upsize
4	V6	Yes	V6-3	V4-5	290	300	375	Upsize the last three sections
4	V27	Yes	V27-6	V20-6	365	225	300	Upsize dowstrem 9 in pipes to match with upstream sections.
4	O3A	Yes	O3A-6	O1-5	500	225	300	Upsize
4	CS-17	Yes	CS-17 36	CS-17 25	893	600	750	Upsize
4	CS-17	Yes	CS-17 25	CS-17 18	567	1000	1200	Upsize. Syphon along the line shall be cleaned and repair (as needed)
5	CS-17	Yes	CS-17 18	CS-17 8	1108	1000 & 1125	1200	Upsize
5	W26	No	W26-10	W26-2	577	225	225	Retrace to Marine Drive
5	W56	Yes	W56-5	W1-23	210	225	300	Upsize
		Total length to be modified			**4220**			

Table 2.4: Problematic Sewers Identified for Spot Repair and Cleaning

District	Sewer Name	Exceed Capacity	From MH	To MH	Length (m)	Recommendation
3	N1	No	N24-1	MS N1-12	1525	Repair the damaged sewer and clean
3	N10	No	N10-12	N1-15	740	Repair the damaged sewer and clean
3	M72	No	M72-9	M64-2	390	Repair the damaged sewer and clean
3	M76	No	M76-3	M75-2	193	Repair the damaged sewer and clean
5	W28	No	W28-3	W26-10	615	Repair the damaged sewer and clean
5	CS-17	No	CS-17 8	S8 PS	600	Syphon along the line crossing the wellawatta canal shall be cleaned and repair (as needed)
		Total length to be modified			**4063**	

Table 2.5: Details of Syphons to be Rehabilitated

Syphon Location	Sewer Name	Diameter (mm)	Remarks from Pre-Feasibility Study Report	Recommendation
Wellawatta Canal by St. Peters College	CS17	2x700	-	Syphon needs to clean and repair (as needed)
Isipathana Mawatha Culvert Crossing	CS17	2x400 & 2x700	-	Syphon needs to clean and repair (as needed)
Sanchiarachchiwatta (Parallel to Adhikarana Mawatha and in front of St. Sebastian Church)	L2	225	Blocked	Syphon needs to clean and repair (as needed)
Havelock Road-Welawatta Canal Bridge	CS21	400	Defective	Syphon needs to clean and repair (as needed)

21. The civil work activities will include:

(i) Open cut pipe laying (trenching) in roads for sport repairs of pipes
(ii) Investigation work including bore hole construction along roads; utility identification using ground probing radar
(iii) Construction of shafts for micro tunnelling work
(iv) Road barricading for micro-tunnelling work/ travel and transport restrictions
(v) Muck collection and disposal
(vi) Trenchless rehabilitation and repair of pipes
(vii) Sewer pipe cleaning using jetting machines and other devices
(viii) Collection and disposal of grit from sewer system
(ix) Back filling
(x) Road reinstatement
(xi) Dewatering
(xii) Sheet pile driving

22. **Development of sewerage collection network for Kirulapone unsewered area.** This component includes new collection network and rehabilitation works for S8 pump station located in Peterson Lane and Wellwatta pump station. The details are given in Table 2.6. Map of the proposed works in Kirilapona unsewered area is provided in Figure 2.7. Pipe alignments and pump station locations are shown in Figure 2.8. Pump station layout and internal arrangement for Thalakotuwa Garden and Kalinga Mawatha pump stations are shown in Figures 2.9 and 2.10 respectively.

Table 2.6: Details of Proposed Kirulapone Collection Network

Item	Details	
Total area served	240 hectares and approximately 45 ha will be underserved after the construction of the gravity system until the pressure sewer systems are build	
Length of gravity sewer system	**Pipe Diameter**	**Length**
	225mm pipes	22,129 meters
	250mm pipes	275 meters
	300mm pipes	733 meters
	400mm pipes	1524 meters
	500mm pipes	642 meters
	600mm pipes	1134 meters
	750mm pipes	489 meters
	900mm pipes	1238 meters
	1200mm pies	1142 meters
	Total Length = 29.3 kms	
Manholes	**No of Manholes**	756
	Average depth of manholes	3.25 meters

Item	Details		
Pump Stations and Force Mains	**No of Pump Stations**		2
		Kalinga Mw PS	**Talakotuwa Gr PS**
	Design Flow	400 l/s	750 l/s
	No of Pumps	-	-
	Invert	-4.0 meters	-4.2 meters
	Features	Screens; Grit removal SCADA	Screens; Grit removal SCADA
	FM Diameter	500mm	700mm
	FM Length	560 meters	1100 meters
Connection to Colombo Sewer System	To S8 – Peterson Lane Pump Station		

Figure 2.6: Locations of problematic sewers and siphons identified for inclusion in the rehabilitation Package

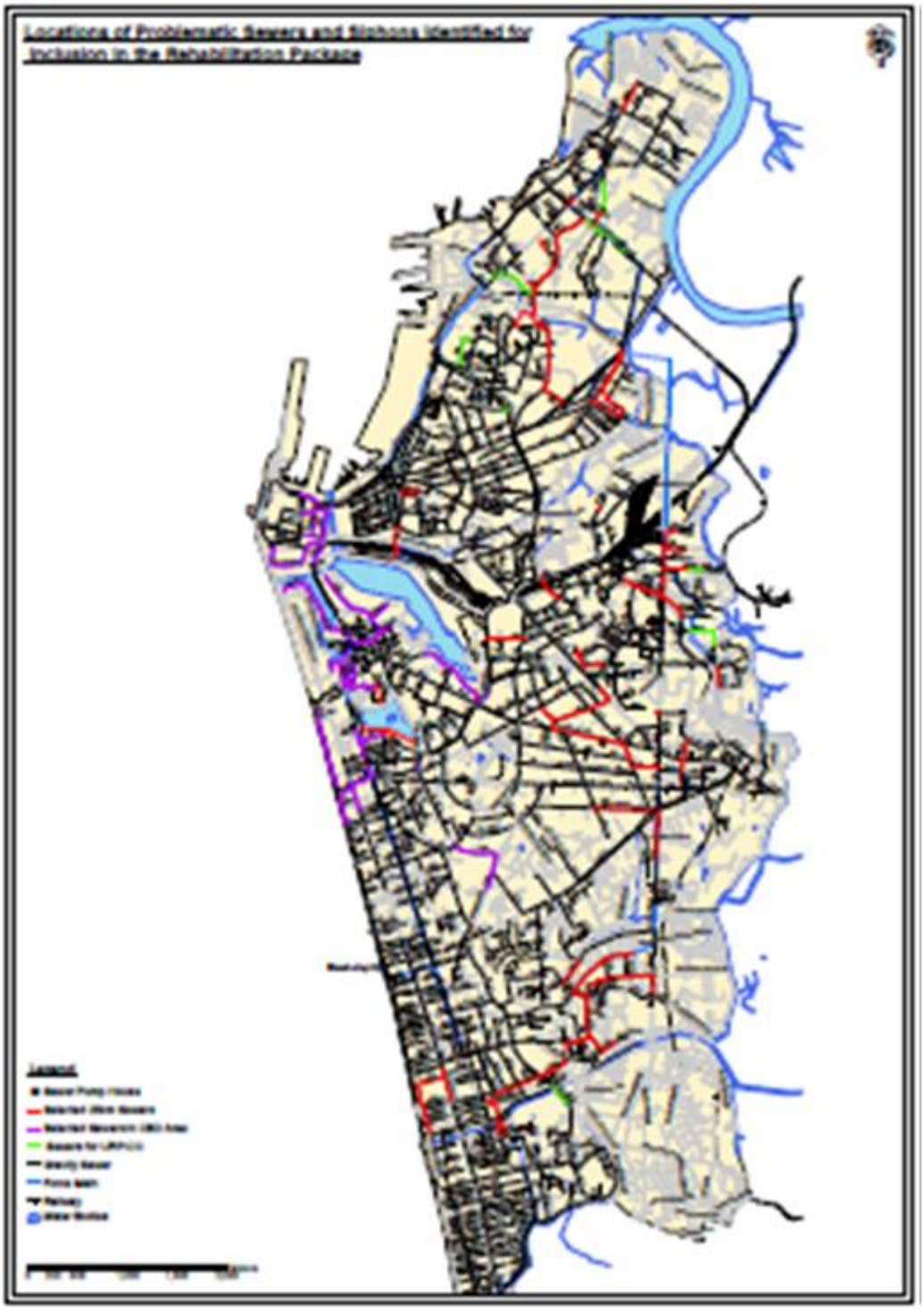


Figure 2.7: Proposed Works in the Kirulapone Unsewered Area

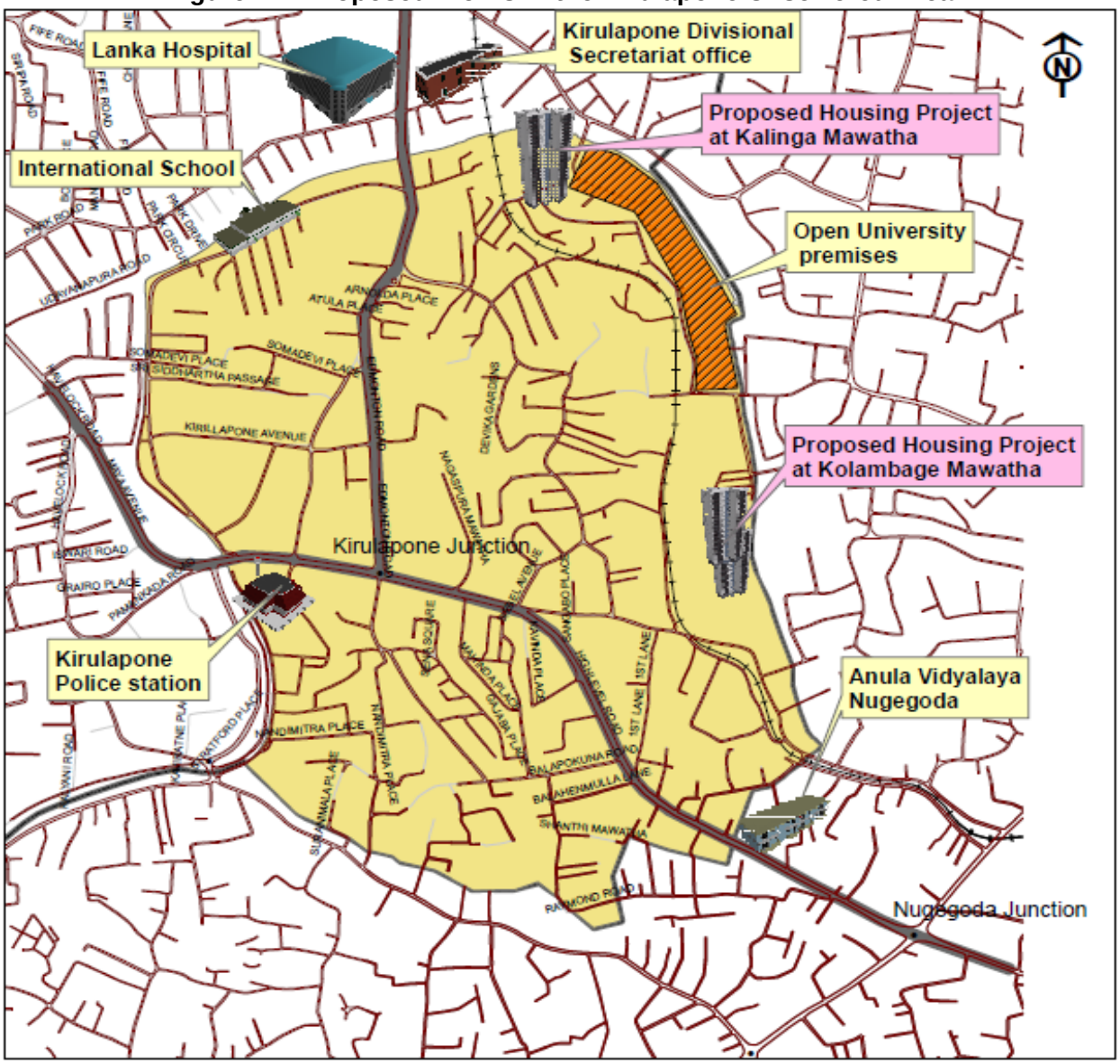


Figure 2.8: Proposed Pipe Alignments and Pump Station Locations in Kirulapone Unsewered Area

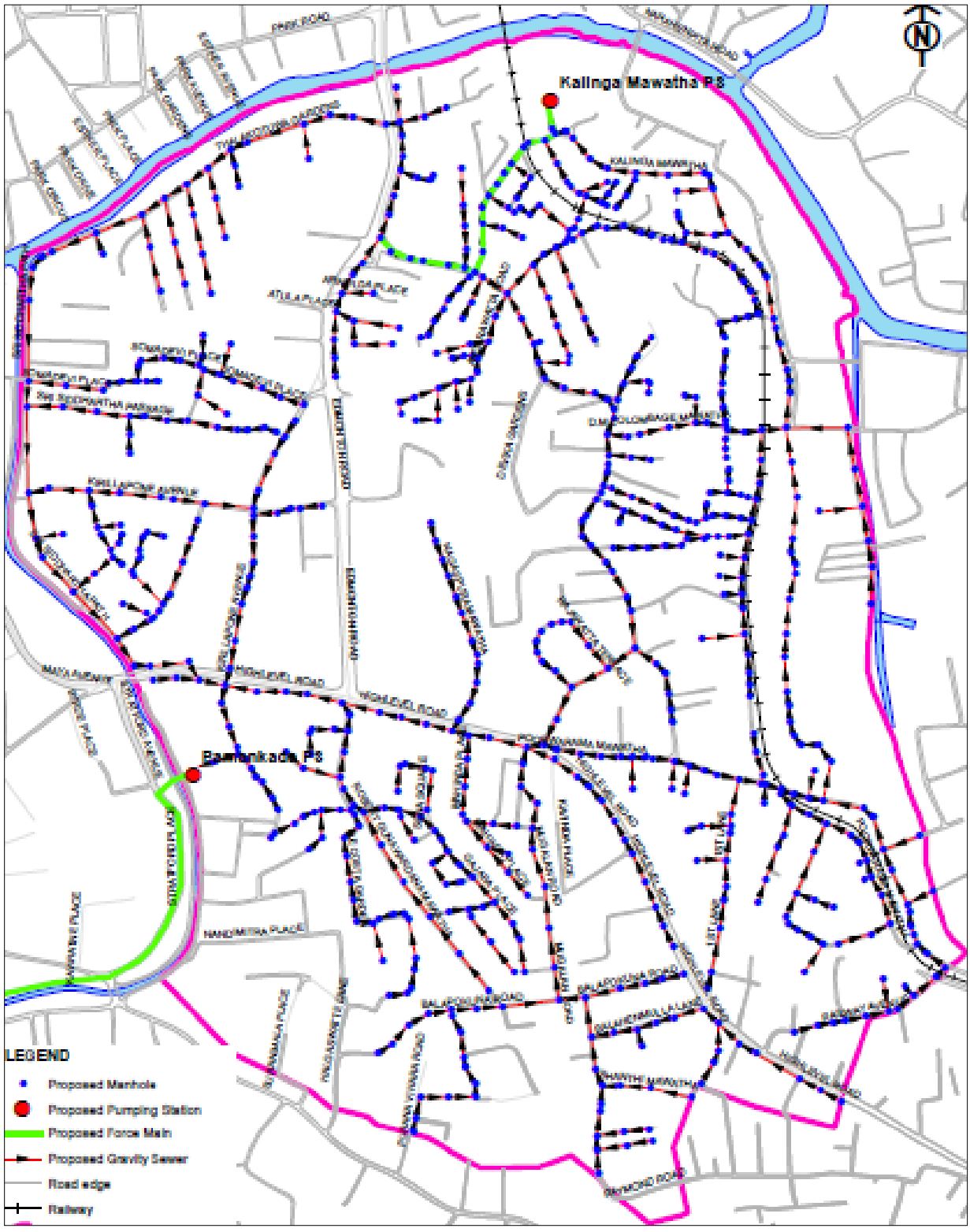


Figure 2.9: Proposed Layout and Internal Arrangement for Thalakotuwa Garden Pump Station

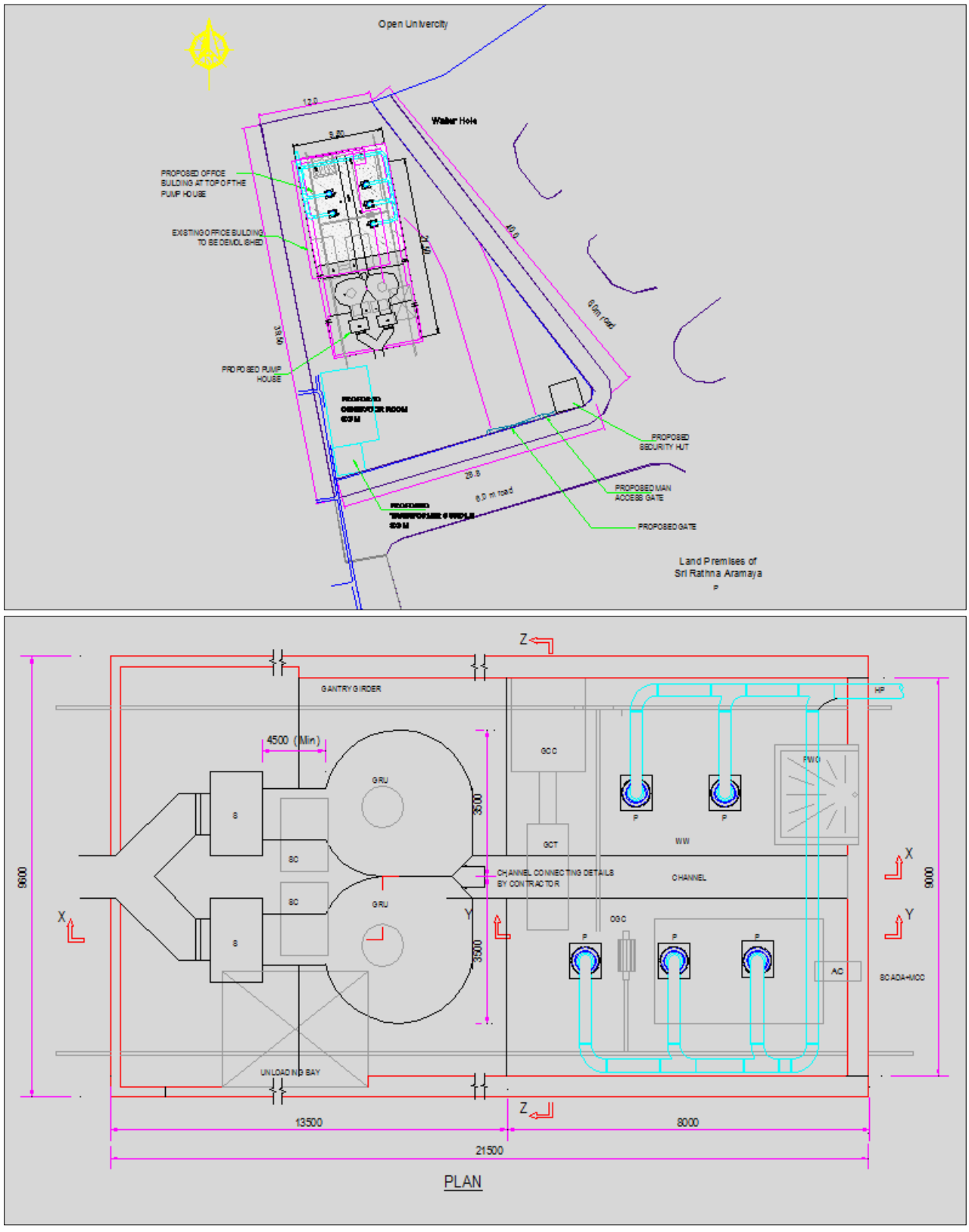
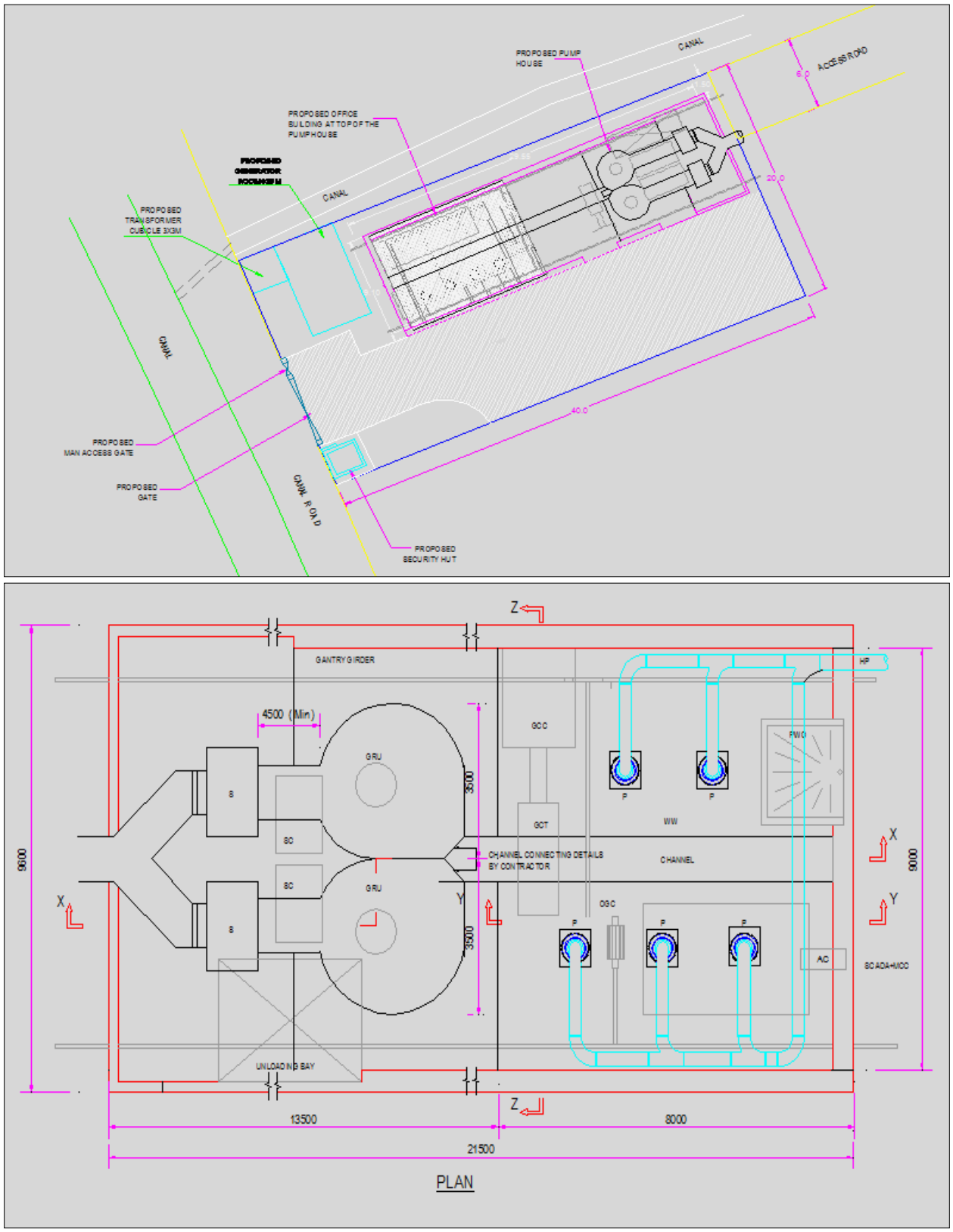


Figure 2.10: Proposed Layout and Internal Arrangement for Kalinga Mawatha Pump Station



23. For the unsewered area network development, the civil work activities will include:

(i) Trench excavation for open cut pipe laying
(ii) Spoil removal
(iii) Trench back filling
(iv) Road reinstatement
(v) Construction of shafts for micro tunnelling
(vi) Manhole construction (excavation and concrete work)
(vii) Shaft backfilling
(viii) Pile driving
(ix) Dewatering
(x) Micro-tunnelling
(xi) Muck separation and removal
(xii) Excavation work
(xiii) Concrete works
(xiv) Construction of a building for pump station and new generator units

24. For rehabilitation of the pump stations, the civil work activities will include:

(i) Wastewater bypassing to facilitate the work
(ii) Dismantling and removal of equipment: gates, screens, grit separation units and pumps and all other items identified for removal
(iii) Modifications to main inlet and approach channel as necessary to install the new main penstock or modified main penstock system as necessary to have effective flow control
(iv) Minor civil work related to the installation of new mechanical equipment
(v) Repair, replacement and rehabilitation of pump station roof, walls, floor, doors and windows and painting as necessary
(vi) Civil repair works around buildings, roads and boundary walls, gates as necessary including landscaping, site drainage
(vii) Supply and installation work involved with mechanical and electrical equipment

25. **Construction of new sewerage networks for Narahenpita and Kirula-Narahenpita unsewered areas and connecting them to the existing CSS.** This component includes new collection network in Narahenpita and Kirula-Narahenpita unsewered areas. The details are given in Table 2.7. Pipe alignments for each area are shown in Figures 2.11 and 2.12 respectively.

Table 2.7: Details of Proposed New Collection Network in Narahenpita and Kirula-Narahenpita Unsewered Areas

	Pipe Diameter (mm)									
Unsewerd Area	225	300	400	450	500	600	700	Pipe Costing (Rs.)	Pipe Costing (USD)	Cost for Pump stations (USD)
	Total Length (m)									
Kirula/ Narahenpita	1470.6	1867.4	1310		27.2	217.5		310,092,250	2,314,421	4,468,441
Narahenpita	1106.7	227.7						68,737,342	513,032	N/A

Figure 2.11: Layout Arrangement of Narahenpita Unsewered Area

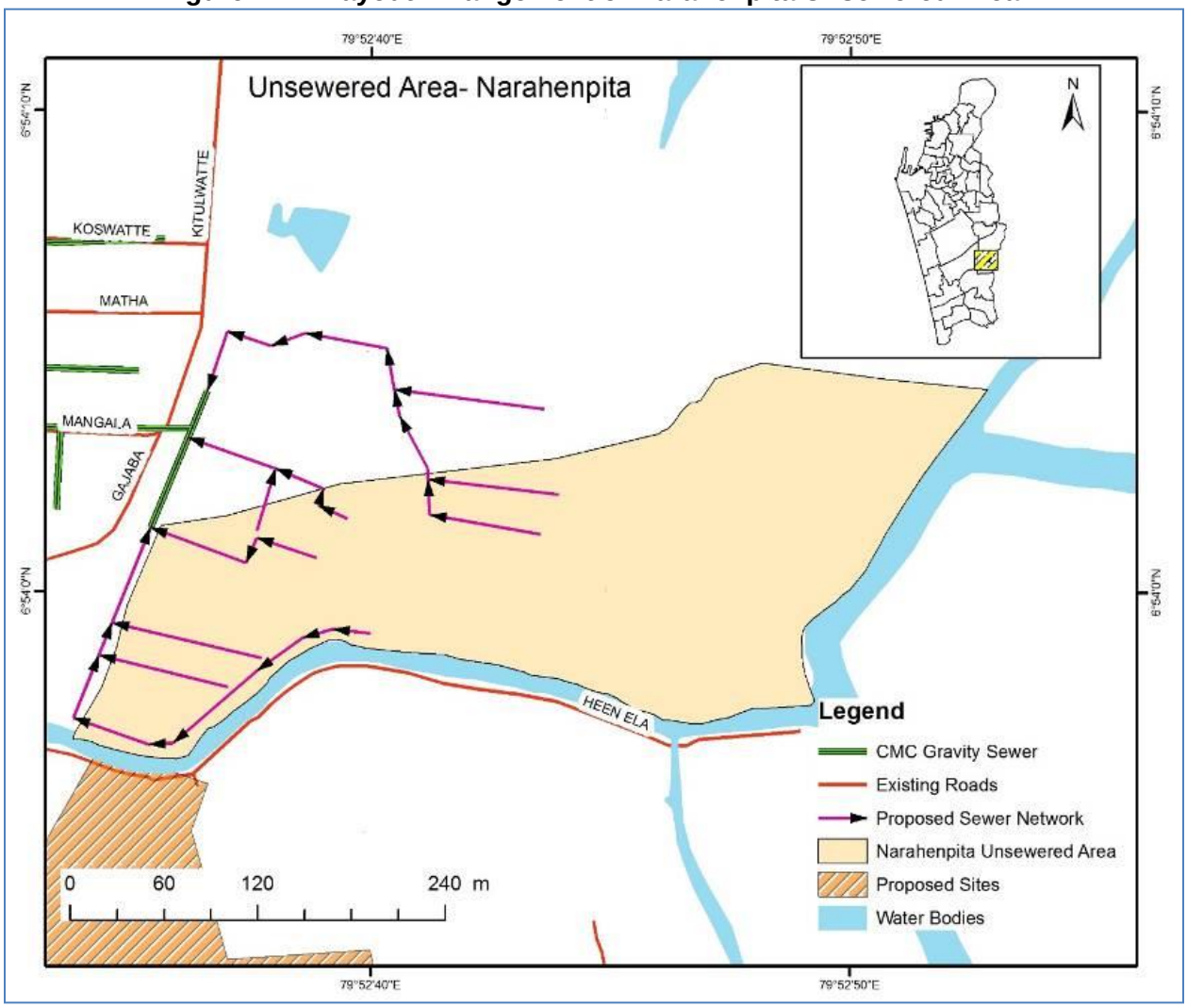
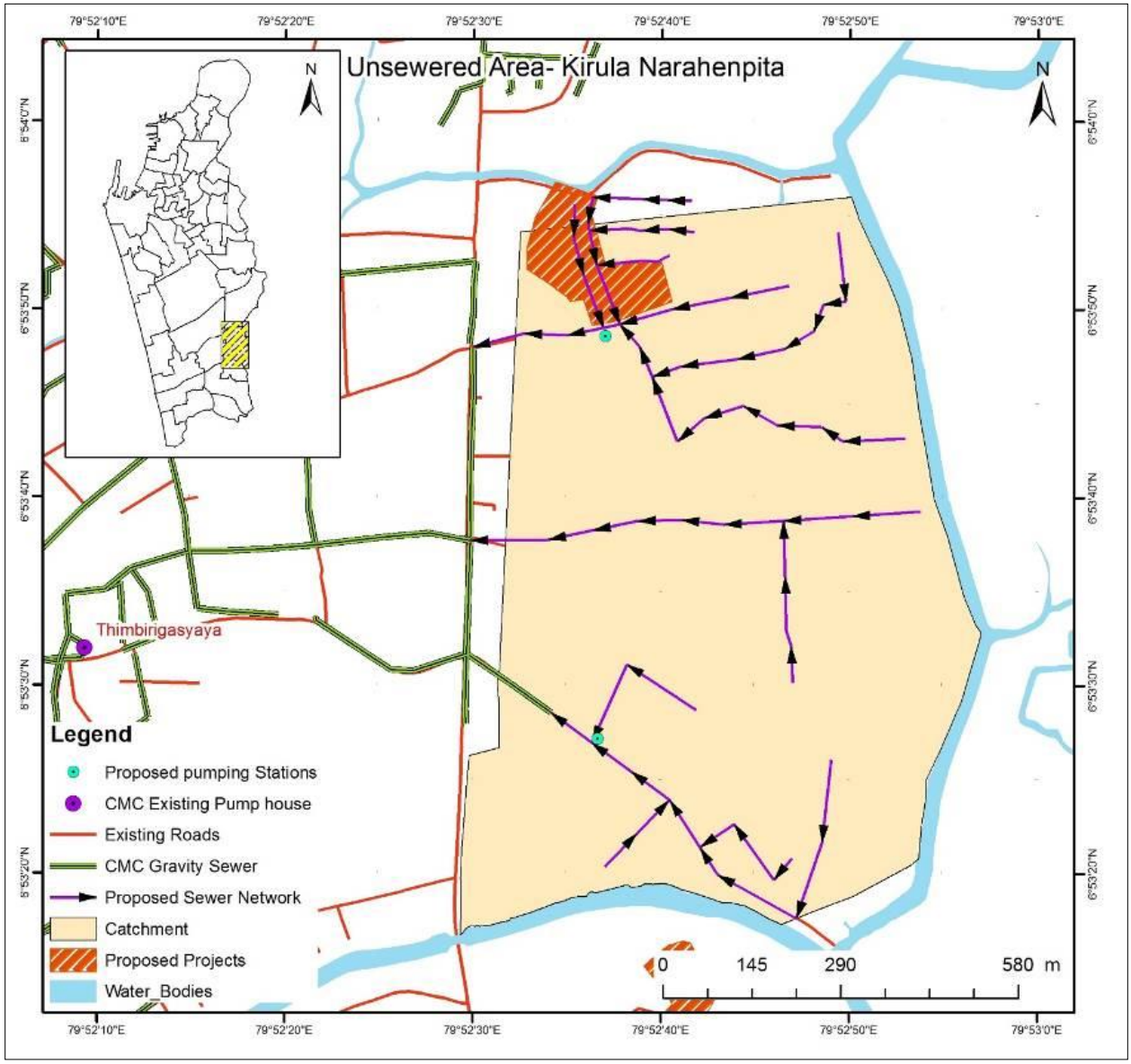


Figure 2.12: Layout Arrangement of Kirula-Narahenpita Unsewered Area



26. For the unsewered area network development, the civil work activities will include:

(i) Trench excavation for open cut pipe laying
(ii) Spoil removal
(iii) Trench back filling
(iv) Road reinstatement
(v) Construction of shafts for micro tunnelling
(vi) Manhole construction (excavation and concrete work)
(vii) Shaft backfilling
(viii) Pile driving
(ix) Dewatering
(x) Micro-tunnelling
(xi) Muck separation and removal
(xii) Excavation work

(xiii) Concrete works
(xiv) Construction of a building for pump station and new generator units

27. **Construction of secondary wastewater treatment plant at Wellawatta.** This component includes construction of a WWTP using Moving Bed Biological Reactor (MBBR) technology and rehabilitation and conversion of the existing Wellawatta pumping station as the head-works pumping station for the WWTP. Description of the MBBR technology is attached in Appendix 2. The WWTP location is near the existing Wellawatta Pump Station which allows the integration of the pump stations as the head works pump station for the treatment plant. Also, this is the most appropriate location as it is the most downstream location of the south catchment. Domestic wastewater in the south catchment area will be treated in the treatment plant and the effluent will be discharge to the Wellawatta sea outfall. Figure 2.13 shows the WWTP location using Google Earth.

D. Implementation Schedule

28. Table 2.8 provides the implementation schedule per preliminary design. More detailed information will be provided during detailed design stage.

Table 2.8: Indicative Implementation Schedule as per Preliminary Design

No	Proposed Intervention	Components	Type of Contract	Indicative Implementation Schedule
1.	Existing network repair, rehabilitation, and improvement including upsizing to cater to new development in Colombo central business district and Urban Development Authority (UDA) developments in the south catchment area	4.2 km of under capacity sewer 4.06 km for spot repair	International Competitive Bidding (ICB) Standard Bidding Documents (SBD) works	Detailed Design Stage: March 2015-Sep 2016 Construction period: March 2017-December 2018 Start of commissioning: Jan 2019 Start of operations: Jan 2019
2.	Development of sewerage collection network for Kirulapone unsewered area	construction of two new pump stations and force mains and rehabilitation of S8 pump station and connecting the Kirullpona new sewer network to S8 pump station	ICB SBD works	Detailed Design Stage: March 2015-Sep 2016 Construction period: June 2016-December 2018 Start of commissioning: January 2018 Start of operations: January 2018
3.	Construction of new sewerage networks for Narahenpita and Kirula-Narahenpita unsewered areas and connecting them to the existing Colombo Sewerage System	Provision of sewerage to unsewered areas and Kirula-Narahenpita and connecting to Colombo Sewerage System	ICB SBD works	Detailed Design Stage: March 2015-September 2016 Construction period: 2016-December 2018 Start of commissioning: January 2019

No	Proposed Intervention	Components	Type of Contract	Indicative Implementation Schedule
				Start of operations: January 2019
4.	Construction of secondary wastewater treatment plant at Wellawatta	Wastewater treatment plant (WWTP) using MBBR technology and rehabilitation and conversion of the existing Wellawatta pumping station as the head-works pumping station for the treatment plant	DBO	Detailed Design Stage: March 2015-September 2016 Construction period: April 2017-March 2019 Start of commissioning: April 2019 Start of operations: April 2019

Figure 2.13: WWTP Location using Google Earth

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

29. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires environmental assessment of all ADB investments.

30. **Screening and categorization.** The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature, and magnitude of its potential impacts; and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts, and are assigned to one of the following four categories:

(i) **Category A.** Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.
(ii) **Category B.** Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
(iii) **Category C.** Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.
(iv) **Category FI.** Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all projects will result in insignificant impacts.

31. **Environmental management plan.** An EMP, which addresses the potential impacts and risks identified by the environmental assessment, shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the project's impact and risks.

32. **Public disclosure.** ADB will post the safeguard documents on its website as well as disclose relevant information in accessible manner in local communities:

(i) for environmental category A projects, draft EIA report at least 120 days before Board consideration;
(ii) final or updated EIA and/or IEE upon receipt; and
(iii) environmental monitoring reports submitted by the Project Management Unit (PMU) during project implementation upon receipt.

B. National Laws

33. **Responsibility of environmental management in Sri Lanka.** The National Environmental Act (NEA) was passed in 1981, and in 1982 the Central Environmental Authority (CEA) as a regulatory and enforcement agency was created. A cabinet-level ministry with the appointment of a Minister of Environment was created in 1990 to handle the subject of environment and to ensure that environmental issues are given the required attention. The Ministry of Environment and Natural Resources (MENR) was set up in 2001 and formulated a National Environment Policy (NEP) in 2003, which is now being implemented. This policy set

out the course of action needed in order to maintain Sri Lanka's natural resources and the living environment whilst allowing development to occur: Ministry of Mahaweli Development and Environment has established on January 2015 and the mandate of environmental management of the country is now being with this new Ministry.

34. The Marine Pollution Prevention Act of 1981 provides for the prevention, reduction and control of pollution in Sri Lanka waters and gives effect to international conventions for the prevention of pollution of the sea. The Act also establishes the Marine Pollution Prevention Authority (MPPA), criminal and civil liability. preventive measures against pollution, maritime casualties and implementation of international conventions.

35. **Applicable environmental legislations.** The implementation of the project will be governed by Government of Sri Lanka environmental acts, rules, regulations, and standards. These regulations impose restrictions on the activities to minimize/mitigate likely impacts on the environment. It is the responsibility of the project executing and implementing agencies to ensure projects are consistent with the legal framework, whether national, state, or municipal/local. Compliance is required in all stages of the project, including design, construction, and operation and maintenance.

1. EIA Requirement

36. NEA, 1988 established the requirement for environmental assessment of projects as originally gazetted in 1993 (Gazette (Extra Ordinary) No. 772/22 of June 24)) and updated in 1995 (859/14 of Feb. 23). The gazettes list development activities requiring approval under NEA's "Prescribed Projects". Of relevance to the project, the list includes (i) laying of gas and liquid (excluding water) transfer pipelines of length exceeding 1 km, and (ii) "construction of waste treatment plants treating toxic or hazardous waste. The project is required to undertake environmental assessment as pipes to be laid exceed 1 km and sewage is considered as hazardous waste as it is defined in NEA as any waste which has infectious characteristics.

37. Under the environmental assessment procedures, projects are assessed by the relevant project approving agency (PAA). These are the line agencies for energy, water, transport etc., together with statutory authorities such as the CEA, the CCD, the UDA, and the BOI. Where there is joint responsibility, the project proponent submits Preliminary Information to the CEA which decides on the appropriate PAA to lead the environmental approval process.

38. Following the submission of preliminary information, the PAA decides whether an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) is required, based on the likely significance of the proposed project's impacts on the environment. The PAA issues terms of reference for the IEE or EIA, which is then carried out by the proponent following normal methodologies including public consultation and with formal hearings after completion of the IEE or EIA report.

39. All costs associated with domestic environmental impact assessment must be borne by the project proponent.

40. **Status of project's environmental assessment as per NEA requirement.** The aim is to produce a single document which will comply both ADB SPS and NEA requirements. This IEE will be attached to the preliminary information to be submitted to CEA. If necessary, presentations will be provided by CMC PMU to facilitate discussions on gaps and further studies

required to meet NEA requirements. Approval will be obtained prior to award of civil works contracts.

2. Clearance from Coastal Conservation Department

41. The CCD has a mandate to conserve and manage the coastal zone, defined in the Coast Conservation Act of 1981 as the area lying within a limit of 300 m landward of the Mean High Water Line (MHWL) and a limit of 2 km seaward of the Mean Low Water Line (MLWL); in the case of rivers, streams, lagoons, or any other body of water connected to the sea either permanently or periodically, the landward boundary extends to a limit of 2 km measured perpendicular to the straight base line drawn between the natural entrance points thereof and includes the waters of such rivers, streams and lagoons or any other body of water so connected to the sea. All beaches in Sri Lanka are public property in accordance with the Coast Conservation Act. The location of the proposed WWTP in Wellawatta is within the coastal area defined by CCA, therefore CCD permit needed.

42. **Status of CCD permit.** CMC PMU will ensure that the CCD permit will be obtained prior to award of the DBO contract.

3. Archaeological Impact Assessment

43. An Archaeological Impact Assessment (AIA) is required to be carried out for development projects which utilize land plots exceeding 0.25 ha for each such land plots under Section 47 [read with Section 43(b)] of the Antiquities (Amendment) Act No. 24 of 1998 and published in Gazette No. 1152/14 dated 04 October 2000. Written permission from the Department of Archaeology must be obtained before conduct of excavations exceeding 500 m in length for laying pipes and conduits for drainage, water, gas, electricity, and telephone facilities. The purpose of the AIA is to examine whether or not there are antiquities in the land in which the development project is proposed to be carried out and if there are antiquities in the land, to identify the impact of the proposed project on the antiquities and to report alternative measures to be taken. Archaeological Department is the authorized approving agency under the Act. The area required for the proposed WWTP in Wellawatta exceeds 0.25 ha therefore AIA is required.

44. **Status of AIA.** CMC PMU will ensure AIA is conducted and approved by the Archaeological Department prior to award of the DBO contract.

4. Environmental Protection License

45. Discharge of waste to the environment is controlled by the National Environmental (Protection & Quality) Regulations No. 01 1990 (Gazette 595/16, 1990) and the amendments published in Gazette 1159/22 of 2000, under the NEA. These regulations establish the need for any person discharging waste to do so only under a license (Environmental Protection License or EPL) issued by the CEA, and in accordance with the gazetted discharge standards and criteria. The EPL can be issued up to three years (Gazette 1159/22).

46. Activities for which an EPL is required were listed in an Order under Section 23A of the NEA, gazetted in 2000 (Gazette 1159/22). The list includes (#65) “Any common wastewater (industrial or sewage) treatment plants” and (#67) “All hazardous waste disposal areas”.

47. **Status of EPL.** Based on the CEA regulations, the construction of the WWTP is required to secure and EPL. CMC PMU will ensure that EPL is obtained prior to the award of the DBO contract.

5. Environmental Standards

48. **Discharge Standards.** Gazetted standards cover (i) discharge to inland waters, (ii) discharge to coastal waters, (iii) discharge of effluent to land for irrigation purposes, and (iv) hazardous waste management. There are no gazetted national standards for discharge to public sewers. CEA is currently working on revising the standards for discharges to marine coastal waters and to sewers with central treatment plants and expecting to gazette the revised standards within this year.[11] Table 3.1 provides the current and draft revised standards on discharge to marine waters which the WWTP effluent is required to comply. In the absence of official gazette, the existing standards have been considered in the design of the WWTP in Wellawatta.

Table 3.1: Comparison of discharge standard for marine water

No	Parameter	Unit Type of Limit	Existing Standards Tolerance Limit Values	Proposed Standards Tolerance Limit Values for Long Sea Outfall[12]	Remarks
1	Total suspended solids	mg/l, max	150	250	Relaxed standard
2	Particle size of – a) Floatable solids b) Settable solids	 mm, max µm, max	 3 850		No requirement with the proposed standard
3	pH at ambient temperature	-	5.5-9.0	5.5-9.0	No change
4	Biochemical Oxygen Demand, BOD (BOD_5 in five days at 20^0 C)0	mg/l, max	100	400	Relaxed standard
5	Temperature	^{0}C, max	45 at the point of discharge	40	Relaxed standard
6	Oils and greases	mg/l, max	20	20	No change
7	Phenolic compounds (as Phenolic OH)	mg/l, max	5	5	No change
8	Chemical Oxygen Demand, COD	mg/l, max	250	800	Relaxed standard
9	Total residual chlorine	mg/l, max	1.0	0.5	Relaxed standard
10	Ammoniacal Nitrogen (as N)	mg/l, max	50	80	Relaxed standard
11	Cyanide (as CN)	mg/l, max	0.2	0.4	Relaxed standard
12	Sulphides (as S)	mg/l, max	5.0	5	No change
13	Fluorides (as F)	mg/l, max	15	5	More stringent standard
14	Arsenic (as As)	mg/l, max	0.2	0.2	No change
15	Cadmium (as Cd)	mg/l, max	2.0	0.10	More stringent standard
16	Chromium, total (as Cr)	mg/l, max	2.0	0.10	More stringent standard
17	Chromium, Hexavalent (as Cr^{6+})	mg/l, max	1.0	0.05	More stringent standard
18	Copper (as Cu)	mg/l, max	3.0	1	More stringent

[11] Comment by Director, Environmental Pollution Control Division, CEA on March 2015.

[12] The proposed revised discharged standards classify sea outfalls into (i) near shore; (iii) short; and (iii) long outfall. The rehabilitated Wellawatta is considered as long outfall.

No	Parameter	Unit Type of Limit	Existing Standards Tolerance Limit Values	Proposed Standards Tolerance Limit Values for Long Sea Outfall[12]	Remarks
					standard
19	Lead (as Pb)	mg/l, max	1.0	0.10	More stringent standard
20	Mercury (as Hg)	mg/l, max	0.01	0.01	No change
21	Nickel (as Ni)	mg/l, max	5.0	1	More stringent standard
22	Selenium (as Se)	mg/l, max	0.1	0.10	No change
23	Zinc (as Zn)	mg/l, max	5.0	5	No change
24	Pesticides	mg/l, max	0.005	0.005	No change
25	Feacal coliform	MPN/100ml, max	60	10^{7}	Relaxed standard
26	Radio Active material: c) Alpha emitters d) Beta emitters	 micro curie/ml max micro curie/ml max	 10^{-8} 10^{-7}	 10^{-8} 10^{-7}	No change

5. Permit for Disposal under Marine Pollution Prevention Act

49. Under the Marine Environmental Protection Regulations No. 01/2013 (Government Gazette Notification No. 1816/37) disposal of substances into marine environment (dumping at sea) is controlled. Accordingly permit shall be obtained from the Marine Pollution Prevention Authority (MPPA).

50. **Status of Permit for Disposal.** CMC PMU will ensure permit is obtained to award of the DBO contract.

6. Permit from Geological Survey and Mines Bureau

51. Mining and exploitation for minerals, including sand, must be licensed under the Mines and Mineral Act No. 33 of 1992 by the Geological Survey and Mines Bureau. Permit is required for earth and quarry material for construction of buildings etc., either directly or through contractors. Alternatively, project contractors can procure the material from the open market, but they will have to make sure that such sources/traders are operating with valid licenses.

52. **Status of Mining Permit.** CMC PMU will require contractors to obtain permit from the Geological Survey and Mines Bureau and/or procure materials from licensed sources/traders.

7. Others

53. Table 3.2 provides applicable legislations pertaining to core labor standards and occupational health and safety. CMC PMU will ensure the following are included in the civil works and DBO contracts.

Table 3.2: Applicable Legislations on Labor and Occupational Health and Safety

Policy, Legal, and Administrative Framework	Description/ Salient Features	Permit/ Clearance Required	Required for the Project
Occupational Health and Safety – Sri Lankan Manual	This manual includes requirements for traffic control devices and signing of	No permit or clearance is	Required as part of the environmental

Policy, Legal, and Administrative Framework	Description/ Salient Features	Permit/ Clearance Required	Required for the Project
on Traffic Control Devices (Part II - Road Work Areas)	roadwork areas during trenching of roads. It also prescribes the essential safety measures to ensure the safety of road users and workmen during day and night.	required.	management plan
National Environmental (Noise Control) Regulations No.1 1996	These regulations provide maximum permissible noise levels for activities to be conducted during daytime and nighttime.	Written consent from the Central Environment Authority	All activities shall comply with noise standards prescribed in Schedules I, III, and V.
Manual on Traffic Control Devices, 2nd Edition, 2007 by the Ministry of Roads and Highways and the Road Development Authority	The regulations publish in the Government Gazette (Extraordinary) No. 444/19 dated 13 March 87under Section 237 along with Section 164 of the Motor Traffic Act is the basis for providing traffic control devices. These regulations were gazetted to amend the existing traffic signs and to incorporate international traffic signs agreed upon for adoption at the UN Conference on Road Traffic held in Vienna on 8 November 1968. Sri Lanka is a signatory to the convention for adoption of international traffic signs. The traffic control devices that are being adopted in Sri Lanka are those that were agreed upon at the convention for adoption in the Asian region.	No permit or clearance required	All traffic signs, barricades, and lighting devices to be used during excavation shall comply with the manual.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Methodology Used for the Baseline Study

54. **Data collection and stakeholder consultations.** Data for this study has been primarily collected through comprehensive literature survey, discussion with stakeholder agencies, and field visits to the proposed subproject sites.

55. The literature survey broadly covered the following:

(i) project details, reports, maps, and other documents available with the Design and Supervision Consultant team of the on-going ADB-funded GCWMP and PFS[13] teams
(ii) discussions with Feasibility Study team
(iii) secondary data from previous project reports and published articles, and
(iv) literature on land use, soil, geology, hydrology, climate, socioeconomic profiles, and environmental planning documents collected from Government of Sri Lanka agencies and websites.

[13] In order to prioritize the needed wastewater management investments, the Cities Development Initiative for Asia (CDIA) supported a Pre-Feasibility Study (PFS) to provide an overall framework for GCWWMIP Projects 3 and 4 by analyzing the wastewater collection and treatment facilities, as well as the management services, in Greater Colombo and providing recommendations for their improvement. This included the problem contributed by storm water drainage and solid waste management in the overall wastewater context in Greater Colombo/Colombo City.

56. **Effluent Dispersion Modeling by Lanka Hydraulic Institute.** CMC PMU engaged the services of Lanka Hydraulic Institute (LHI) to conduct a study on behavior of pollutants in the 2 sea outfalls (Mutwal and Wellawatte) and its surrounding areas, using a validated mathematical model to define the dispersive and assimilative capacities of the discharge locations and evaluate the changes produced in the environment due to the discharges. For the 2 outfalls, LHI has conducted (i) effluent plume dispersion modeling study to determine critical areas for coliform values of 150 MPN/100 mL and 300 MPN/100 mL as defined by World Health Organization (WHO) Guidelines for Safe Recreational Water Environments, 2003 and (ii) estimate pollutants concentration reaching the shore areas of Greater Colombo for 4 climatic seasons, determined by rainfall and reported by Survey Department as: (1) first inter-monsoonal season from March to April; (2) southwest monsoon from May to September; (3) second inter-monsonal season from October to November; and (4) northeast monsoon from December to February considering GCWMP technical parameters of the 2 outfalls, projected population and pollution loading for 2014.

57. **Ocular inspection.** Several visits to the project sites were made during PFS period in 2014 and 2015 to assess the existing environment (physical, biological, and socioeconomic) and gather information with regard to the proposed sites and scale of the proposed project. A separate socioeconomic study was conducted to determine the demographic information, archeological and religious places, densely populated pockets, and settlements.

58. **Data analysis and interpretation.** The data collected was analyzed and interpretations made to assess the physical, biological, and socioeconomic features of the project area. The relevant information is presented in the succeeding paragraphs.

B. Physical Characteristics

59. **Location.** The geographical location of Greater Colombo is 6º 55’ N latitude and 79º 52’ E longitude. The project area is located within CMC area (extent of 4,021.14 ha).

60. **Geology and geomorphology.** The project area falls in the pre-Cambrian South Western group (600 million years old) lowest peneplain of Sri Lanka. This coastal peneplain rises to a maximum elevation of less than 500 ft from the sea coast. The underlying geological formations of the present coastal plain consist of gneisses and granites, predominantly of the Vijayan complex of the pre-Cambrian era. As a consequence of the sea level rising during the Holocene period, this old basement is covered by more recent coastal deposits.

61. The major rock types in Greater Colombo consist of meta-sediments (quartzites and quartz schist, garnet sillimanite, gneisses, quartz feldspar, and granulites), charnockite gneisses and allied rocks, basic rocks, migmatitic and granitic gneisses, granite, and pegmatite. Overlying the pre-Cambrian basement are alluvial and littoral sedimentary deposits of Quaternary age, within the project area. The fluvial deposits here include a thick alluvium (20–30 m) in some areas of marshes, and water bodies. These alluvial deposits include lean/plastic clays, organic clays/peat, and sand with clay.

62. **Soil.** According to the Sri Lankan Survey Department soil maps, the main soil types in the project area are as follows: (i) red yellow podzolic soils with soft or hard laterite: undulating and rolling terrain; (ii) bog and half-bog soils: flat terrain; (iii) alluvial soils of variable texture and drainage: flat terrain; and (iv) regosols on recent beach and sand sands: flat terrain.

63. **Topography.** Greater Colombo's topography is a mix of flat and marshy land. The east and southeast areas are bordered by marshy land. The city has many canals, and Beira Lake is in the heart of the city. On the north and the northeast borders of the city flows the Kelani River. The river meets the sea in part of the city known as the "Modera" in Sinhala, which literally means "delta." The project area is more or less flat to gradual undulating.

64. **Hydrology and drainage.** The Greater Colombo drainage system consists of a network of canals and marshes functioning as retention basins. It has 6 outlets, 3 discharging to the sea (Wellawatta, Dehiwala, and Mutwal tunnel), 1 closed at present (Beira Lake), and the other 2 draining into the Kelani River. The Mutwal tunnel, Wellawatta canal, and Dehiwala canal have discharge capacities of 5, 60, and 30 m^3/s, respectively. A fourth outfall, St. Sebastian South Canal and Beira Lock, has no drain function under normal circumstances due to the high crest level of Beira Lake (+1.8 m mean sea level or msl).[14] There are four marshy lands identified as "flood retention areas" in Greater Colombo, namely (i) Bloemendhal Marsh, (ii) Kolonnawa Marsh, (iii) Heen Marshes, and (iv) low-lying lands known as the Green Belt surrounding the Parliament Lake. Figure 4.1 shows the major canals and waterways in the project area.

Figure 4.1: Major Canals and Waterways in Greater Colombo

Source: Compilation from Canal System of Colombo & Suburbs, Sri Lanka Land Reclamation & Development Corporation

[14] Beira Lake is artificially kept at +1.8 m mean sea level (msl) by means of pumps installed at Beira Lock. This is mainly done to prevent buildings constructed on wooden piles along the lake from collapsing. As a consequence, Beira Lake's flood discharge function is only operational at water levels exceeding +1.8 m msl.

65. **Climate.** The climate is classified as tropical monsoon, having a wet season and a short dry season. The project area is located in the southwestern quarter of the island, which is classified as a wet zone. The climate is characterized by the northeast monsoon from December to February, and the southwest monsoon from May to September. Heavy rainstorms occur mainly in the southwest monsoon period from May to September and occasionally in the two inter-monsoon periods (March-April and October-November), as well. The average annual rainfall is around 2,000–3,000 mm. There are two peaks of monthly rainfall in a year, May and October. The mean daily maximum temperature ranges from 31.1 ^{o}C in April to 29.3 ^{o}C in August, while the mean daily minimum temperature ranges from 25.3 ^{o}C in May to 22.2 ^{o}C in January.

66. **Surface Water quality.** Surface water pollution is the most serious issue among the environmental problems in the project area. Pollution of urban water bodies by domestic wastewater and industrial wastewater causes environmental problems as well as health hazards. The main causes of surface water pollution are: (i) discharge of urban drainage water mixed with waste of industrial and domestic origin into natural streams; (ii) runoff from open markets and garbage dumps; (iii) unauthorized connections of domestic wastewater pipes into drainage canals; (iv) direct discharge of industrial wastewater into rivers, lakes, canals, and lowlands; (v) uncontrolled and illegal dumping of waste of industrial and domestic origin in waterways, embankments, and lowlands; (vi) discharge of sewage into canal/surface water bodies mainly by shanty settlements along canals and around the lowlands such as marshes; and (vii) insufficient maintenance and cleaning of watercourses and embankments resulting in siltation, blockage, and aquatic plant growth. Table 4.1 shows the results of surface water monitoring in the project area conducted by CEA.

Table 4.1: Results of Water Quality Monitoring and Status of Pollution

Station No.	Description	pH	Conductivity	Turbidity	Temperature	DO	Ammonia	Nitrate	Phosphate	COD	BOD	Salinity
1	Baseline road crossing of Dematagoda Canal, Orugodawatta	N		S	N	T	H	N	T	T	T	N
2	End point of St. Sebastian Canal (Outlet to Beira Lake)	N		N	N	N	H	N	H	H	H	N
3	Bridge on Kotte North Canal	N		N	N	N	H	N	H	H	H	N
4	Railway bridge on Torrington Canal	N		S	N	T	H	N	T	T	T	N
5	Galle Road Bridge on Wellawatta Canal	N	S	N	N	N	H	N	T	T	T	S
6	Galle Road Bridge on Dehiwala Canal	N	S	S	N	N	H	N	T	T	T	S
10	Serpantine Road Canal	N		N	N	N	H	N	H	T	H	N
11	St. Sebastian Canal – bridge near Ingurukade Junction	N		S	N	T	H	N	T	T	H	N
12	Dematagoda Canal – Kolonnawa Bridge near Ceylon Petroleum Corporation	N		N	N	T	H	N	T	T	H	N
13	Mahawatta Canal – Cotta Road Bridge, Rajagiriya	N		N	N	T	H	N	T	T	H	N
14	Kirillapone Canal – Near Open University Bridge, Nawala	N		N	N	N	H	N	H	T	H	N
18	Station No. 1 – Diyawanna Oya – Kimbulawala Madiwela	N		N	N	N	H	N	H	N	T	N
19	Station No. 2 – Diyawanna Oya – Battaramulla South, Pelawatte	N		N	N	N	H	T	H	N	T	N

Station No.	Description	pH	Conductivity	Turbidity	Temperature	DO	Ammonia	Nitrate	Phosphate	COD	BOD	Salinity
20	Station No. 3 – Diyawanna Oya – Battaramulla North, Diyawanna Oya Outlet	N		N	N	N	H	N	H	N	T	N
21	Kelani River – Close to new bridge, upper stream to confluence of St. Sebastian Canal	N	S	N	N	N	H	N	H	N	NA	N
22	St. Sebastian Canal – North Lock Gate	N		S	N	T	H	N	T	T	NA	NA
23	Kelani River – Close to Victoria Bridge – downstream confluence of St. Sebastian Canal	N	S	N	N	N	H	N	H	H	NA	NA
24	Beira Lake – Just behind Pettah Private Bus Stand	N		S	N	T	H	N	T	T	NA	NA
25	St. Sebastian Canal – About 200 m downstream from location 2 (about 200 m upstream from outlet to Beira Lake)	N		S	N	T	H	N	T	T	NA	NA
26	St. Sebastian Canal (north) – Outfall to Kelani Ganga	N	S	N	N	T	H	N	T	T	NA	NA
27	Bloemendhal Canal – Branch earthen drain coming through garbage pile	N	S	S	N	T	**T**	N	T	T	NA	NA
28	Bloemendhal Canal – At the confluence of earthen drain of 27	N	S	S	N	T	**T**	N	T	T	NA	NA
29	Norris Canal – In front of Colombo General Hospital	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30	Colombo 10, D. R. Wijewardena Mawatha Canal along former UDA office	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: **N** – within the normal range according to CEA standards for aquatic life; **H** – above the standard values for aquatic life; **T** – above or below the threshold and significantly higher or lower than the standards and threat to aquatic life and human health; this indicates the health authorities have to take necessary actions immediately to improve the quality of water in these canals; **S** – no standards for the parameter but significantly high compared to other locations or significantly high according to available literature; **N. A.** – not available. The CEA standard values for aquatic life are the following (in milligrams per liter or mg/l) dissolved oxygen (DO) = 3, ammonia = 1, nitrate = 5; phosphate = 0.4, chemical oxygen demand (COD) = 15; biological oxygen demand (BOD) = 4; and turbidity = 20 NTU (as indicated by other countries).

67. The Beira Lake plays an important role in conveying surface drainage and flood waters in CMC. The lake is a stagnant water body which covers approximately 65.4 ha and has an average depth of 2 m at maximum elevation. It comprises of four main basins: East Lake, Galle Face Lake, West Lake, and South West Lake. Beira Lake's flood discharge function is only operational at water levels exceeding +1.8 m msl.[19] Although the local people do not derive other benefits than diverting their surface drainage into these canals, the intrinsic function is vital and most important in draining the flood waters of the area. There are numerous illegal discharge points of gray water from residences, commercial establishments, and warehouses adjoining the lake, and due to the high level of water pollution, no other local uses can be derived from the water body. At present, most of the lake bank is covered with commercial establishments, human settlements, institutions, religious places, etc. Therefore, it is hard to see vegetation or ground cover. Only in some part of the lake bank, which has been interrupted by human interventions, can vegetation and tree cover be found. *Mangifera indica* (*amba*), *Cocos nucifera* (*pol*), *Terminalia catappa* (*kottan*), *Gliricidia sepium* (*weta mara*), *Leucaena leucocephala* (*ipil-ipil*), *Azadirachta indica* (*kohomba*), *Filicium decipiens* (*pehimbiya*), *Plumeria obtuse* (*araliya*), *Musa x paradisiaca* (*kesel*), *Carica papaya* (*papol*), *Ficus religiosa* (*bo*),

Hibiscus rosasinensis (*wada*), *Delonix regia* (*mai mara*), *Calotropis gigantiea* (*wara*), *Lantana camara* (*gandapana*), etc. are the tree species which can be found on the bank. These provide an ecological niche to many bird species. However, these are common trees and do not have a special conservation status.

68. Baseline water quality surveys were conducted from 2013 to 2014 under the on-going GCWMP. The water quality parameters monitored are temperature, DO, conductivity, salinity, pH, turbidity, redox potential, BOD, total suspended solids (TSS), total nitrogen, total phosphorous, dissolved inorganic nitrogen, dissolved inorganic phosphorous, oil and grease, color, and E.coli.[15] The conclusions from the survey are: (i) most of the sampling locations resulted to an E.coli concentration of 10^2 MPN/100ml; (ii) BOD concentration is not detected for all sampling points indicating complete dilution; (iii) maximum concentration of TSS is at 19 mg/l.

69. **Groundwater quality.** Pollution of groundwater in the project area has arisen mainly as a result of nitrate and bacterial contamination from wastewater disposal systems (e.g. septic tanks and soakage pits), leachates from human and animal waste, and chemical pollution from industry and agriculture.

70. **Air quality**. The population growth and increase in commercial and social activities have led to an unprecedented increase in the demand for mobility, with a consequential increase in the number of motor vehicles entering CMC daily. The project area is generally along roadsides, which are experiencing heavy traffic. Vehicle emissions are considered the major contributor for air pollution in Colombo. Based on monitoring conducted by CEA, the ambient air quality in the project area is within the prescribed standards.

71. **Noise levels.** The project area is in the built-up part of Greater Colombo, with residential, commercial, and institutional establishments. A significant volume of traffic passes through these sections, causing frequent traffic jams. Heavy traffic movement is considered the major cause of noise pollution.

C. Ecological Characteristics

72. **Forests and ecological sensitive areas.** As Greater Colombo is considered a built-up area, there are no protected forests or ecologically sensitive areas in the project area.

73. **Flora and fauna.** The pre-existing natural environment of coastal wetlands and woodland has been modified by man over many years and is now highly urbanized with very limited natural habitats. Animals and plants in the project area are those commonly found in urban and built-up areas. There are no rare or endangered animal or plant species reported in the project area.

74. **Wetlands.** Approximately 20% of the Western Province (composed of districts of Colombo, Gampaha, and Kalutara) is composed of wetlands The definition given for wetlands

[15] Sampling locations are included in the Lanka Hydraulic Institute Draft Final Report on Computer Modeling of Wasterwater Dispersion: Rehabilitation of Sea Outfalls (June 2015). The study was conducted as part of the preliminary investigations for the design of GCWWMIIP Project 3 components.

in the Sri Lankan National Wetland Policy[16] is "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which at low tide does not exceed 6 m and may incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than 6 m at low tide within the wetlands." One of the most important functions of wetlands is their capacity to act as a drainage basin for temporary storage of storm water, acting as kidneys, purifying wastes entering into the wetland systems and safeguarding human health.

75. The wetlands located within the project area are mostly inland systems[17] and are not categorized as protected wetlands or wildlife sanctuaries. It has also been observed during the field visits conducted for this IEE that the wetlands in the project area were drained or used to dump refuse and urban waste.

76. **Coastal and Marine Environment.** Off Colombo the seabed shelves gradually to the west. Depths are shallow, being only 20 m to 30 m some 6 km offshore. The sea bed is interrupted by several reefs running parallel to the shore, including the sandstone Palagala reef which runs from Colombo to Mt. Lavinia about 500 to 800 m offshore and at a depth of 9 to 11 m, the shallower sandstone and limestone Kalapugala reef across the mouth of the Kelani River, about 1 km offshore, extending northwards, and the Onagala and Kelanigala reefs further offshore. Between the reefs the seabed is sandy, with a covering of finer material especially near the mouth of the Kelani River.

77. Tidal variation is small and current speeds are generally weak. Maximum tidal currents of 10-15 cm/s have been observed west of the existing harbor. These flow North on a rising tide and South on an ebb tide. Wind-driven currents dominate over the tidal currents and the maximum surface currents are of the order of 25-40 cm/s. Occasionally higher speeds occur both close to the surface and throughout the water column.

78. Annual average wave height is around 0.9 m and the annual maximum height is 2.7 m. A sea wave is created by local winds and is superimposed on the underlying swell wave which comes from the SW throughout the year. Occasional cyclones cause storm surges of several metres.

1. Baseline Information from ADB-funded Colombo Port Expansion Project[18]

[16] The National Policy and Strategies on Wetlands (2005) seeks to give effect to the National Environment Policy and other relevant national policies, while respecting national commitments towards relevant international conventions, protocols, treaties, and agreements on wetland protection to which Sri Lanka is a party. Among the international conventions, the Ramsar Convention on Wetlands of International Importance (1971), the Convention on Conservation of Migratory Species of Wild Animals (1979), and the Convention on Biological Diversity (1992) are significant.

[17] There are three major types of wetlands in Sri Lanka, namely: (i) offshore and marine systems; (ii) coastal systems; and (iii) inland systems.

[18] ADB Project Number 39431-013: Colombo Port Expansion Project (formerly Colombo Port South Harbor Development). The Colombo Port Expansion Project provides for dredging and breakwater construction sufficient to accommodate three terminals, which will be constructed sequentially. The Project includes the establishment of a new marine operations center, relocation of a submarine oil pipeline, provision of navigational aids, and construction of shore utilities. The EIA prepared in 2006 is available at http://www.adb.org/projects/documents/proposed-colombo-port-south-harbor-development-project.

79. Longshore sediment transport is predominantly towards the north as a result of the wave climate (SW monsoon sea waves and swell). However during the NE monsoon sediment transport (as a result of waves from the NW) is to the south for some of the time.

80. The rocky shore areas north of Galle Face and north of the Kelani River estuary provide protection against wave forces and erosion and are rich in marine flora and fauna. Much of these rocky shores is covered with marine macrophytes such as Ulva, Laminaria and Sagassum. Among these marine floras, several species of mollusks, polychaetes, echinoderms and fish are present. The brown mussel that grows on these rocky shores, especially in the areas north of the mouth of Kelani River, is harvested from time to time for food.

81. Sandy shores are present mainly in the Galle Face area and north of the Kelani River. These areas are poor in fauna and flora, but have some shore crabs and, in some places, the non-woody creeper Ipomoea pescapri is present. The sandy shores - beaches - are used by recreation. North of the Kelani River the beach is used for landing fish catches, hauling out fishing boats and mending nets. The beaches in the area are not used by turtles for egg laying.

82. The sandstone and limestone reefs support a limited range and number of corals. Hard corals are scarce on all reef habitats in the study area, with the majority found on Onagala reef. Soft corals of the Genus Dendronephthya are common on this reef. Favia spp. and Favites spp. sponges, sabellid polychaetes and echinoderms such as sea urchins are also common in some places on the reefs.

83. The sandy areas which comprise virtually the whole of the seabed except for the reefs are relatively low in marine life forms.

84. Overall, the marine environment in the area does not contain any unique habitats. Further, there are no protected habitats within or in close proximity to the project area. All habitats present in the area are common and widely distributed in the coastal marine environment of Sri Lanka.

85. Field surveys of plankton, nekton, benthos, and fisheries were carried out by the National Aquatic Resources Research and Development Agency (NARA) in February and April 2005 as part of the EIA study. Five dive surveys were carried out along transects in the project site. Of the principal habitats, only sandy seabed and open waters are affected by the project. The area has four reefs, whose species are generally of low diversity and abundance. All are significantly influenced by sediments from the Kelani River, with high turbidity as well as accumulated sediments on the reef surface. The density and diversity of colonization by corals is generally very low, typically 85% uncolonized. Only one species (damselfish) Pomacentrus proteus is endemic. However, no species were recorded to be confined to the proposed development area and no rare or endangered species were recorded. There are no protected habitats around the site. The nearest sensitive habitat is the Negombo Suda reef (25 km north and 15 km offshore), which supports 14% live coral cover and is permanently monitored by NARA.

2. Status of Marine Water Pollution in the Project Area per On-going GCWMP

86. In 2009, CMC PMU commissioned LHI thru the contractors to conduct sea water sampling and analysis to obtain an idea about water quality situation near the 2 outfalls. Coliform analysis of discharges to marine environment was also conducted by LHI. The results are presented in Tables 4.2 to 4.3. As per LHI investigation, BOD, total and faecal coliform

concentrations were highest at the location nearest to the outfall. Samples from locations about 500m away from the diffusers indicated quick dilution as the total coliform levels had decreased to the range of 500 to 800 MPN/100 mL and faecal coliforms 170 to 230 MPN/100 mL. It should be noted that that there are several large and numerous small pollution sources that contributes to the level of water pollutants and quality of marine water in the coastal belt between Wellawatta and Mutwal. All these other sources discharge wastewater in the near shore area compared to the two sea outfalls. A holistic approach is necessary to improve the water quality of coastal and marine waters.

Table 4.2: Sea Water Quality near Mutwal and Wellawatta Outfalls (LHI, 2009)

Mutwal Outfall	Wellawatta Outfall
BOD (mg/L): 0 to 1.7 COD (mg/L): 0 to 10 DO (mg/L): 5.2 to 8.9 TSS (mg/L): 0 to 12 TDS (mg/L): >35,000 Top (MPN/100mL): <2 E3 to 3 E5 Bottom (MPN/100mL): <9 E1 to <8 E4	BOD (mg/L): 3 to 8 COD (mg/L): 11 to 26 DO (mg/L): 5.5 to 6.8 TSS (mg/L): 38 to 62 TDS (mg/L): >35,000 Top (MPN/100mL): <3 E2 to 9 E6 Bottom (MPN/100mL): <5 E2 to <9 E6

Table 4.3: Sources of Coliforms Being Discharge to the Marine Environment

Location	Discharge (m^3/s)	Total Coliforms (MPN in 100ml)
Wellawatta Long Sea Outfall	2.2	6.0 E7
Mutwall Long Sea Outfall	2.9	1.6 E8
Kelani River	235	2.0 E4
Beira lake Outfall	0.23	2.6 E7
Wellawatta Canal	4.79	3.3 E4
Significant Outfalls within the Existing Port Area	0.47	1.8 E6

Note: Faecal Coliform count is about 1 to 2 orders less than the Total Coliform count

87. In June 2015, analysis of wastewater being discharged from the Wellawatta junction box to the outfall was analyzed. The results show the basic water quality parameters such as pH, BOD, COD, nitrogen and phosphates and total suspended solids are within the proposed standards. However, the concentrations of the heavy metals such as Pb, Hg, As and Ni are relatively higher compared to the standards. High concentration of total coliform is also observed in the Wellawatta junction box. The results are presented in Table 4.4. Near shore water quality monitoring will be conducted during commissioning of completed GCWMP components and during detailed design phase of the WWTP.

Table 4.4: Results of the Water Analysis from Wellawatta junction box

Parameter	Unit	Test Method	Test Results	Proposed standards tolerant limit values for long sea outfall
pH at 30^0C		APHA[a] 4500HB	6.38	5.5-9
BOD-5	mg/l	APHA 22nd Edition	127	400
COD	mg/l	APHA 22nd Edition	325	800
N and Nitrate	mg/l	APHA 22nd Edition	0.02	80
P and Phosphate	mg/l	APHA 22nd Edition	4.12	-
Total Suspended Solids	mg/l	APHA 22nd Edition	52	250
Settleable Solids	mg/l	APHA 22nd Edition	26	-
Total Dissolved Solids	mg/l	APHA 22nd Edition	296	-
Pb	mg/l	APHA 22nd Edition	0.11	0.10
Hg	mg/l	APHA 22nd Edition	0.53	0.01

Parameter	Unit	Test Method	Test Results	Proposed standards tolerant limit values for long sea outfall
As	mg/l	APHA 22nd Edition	3.19	0.20
Cd	mg/l	APHA 22nd Edition	Not detected	0.10
Cr	mg/l	APHA 22nd Edition	Not detected	0.05
Cu	mg/l	APHA 22nd Edition	Not detected	1.0
Ni	mg/l	APHA 22nd Edition	38.43	1.0
Zn	mg/l	APHA 22nd Edition	4.23	5
Total coliforms	MPN/100ml	SLS 146J: Part 2, 2013	>1200	10^7
E. coli	MPN/100ml	SLS 146J: Part 2, 2013	17	-

[a] Standard Methods for the Examination of Water and Wastewater published by American Public Health Association (APHA), American Waterworks Association (AWWA), and the Water Environment Federation (WEF).

3. Computer Modelling for the Wastewater Dispersion from the Mutwal and Wellawatta Sea Outfalls

88. The existing piped sewer network in Greater Colombo, built between 1906 and 1920, comprises about 320 km of sewers, 18 pumping stations in two catchments (*North* and *South*), and two long sea outfalls in Mutwal and Wellawatta. In order to identify the dynamic behavior of pollutants from these outfalls in the receiving body water, a computer modeling on wastewater dispersion was done by Lanka Hydraulic Institute Ltd in February-June 2015.

89. The main objective of the study is to design a tool to simulate the dynamic behavior of pollutants in the two sea outfalls and its surrounding areas, using a validated mathematical model to define the dispersive and assimilative capacities of the discharge locations and evaluate the changes produced in the environment due to the discharges. The mathematical models used in the simulation are CORMIX[19] and MIKE 21[20].

90. The simulations were based on the following parameters: (i) GCWMP outfall design parameters as rehabilitated and without treatment; (ii) projected pollution loading for the 2040 pollution;(iii) water quality parameters considered are biological oxygen demand (BOD), total suspended solids, (TSS) toxic substances and E. coli (fecal coliform concentration of 150, 300, and 1000 MPN/100mL were used as standards for primary contact, fish tolerance and secondary contact, respectively);[21] (iv) faecal coliform concentration of 10^9 MPN/100mL from both outfalls; (v) pollution sources in the area such as Kelani River, Colombo Port, Beira Lake and Wellawatta canal; (vi) four climatic seasons in Sri Lanka: inter-moonsonal season (IM1), southwest monsoon (SW), second inter-moonsonal season (IM2), and northeast monsoon (NE); and (vii) bathymetry, wind and tide data: High and Average.

91. The full report is attached in Appendix 3. The following are the observations from the mathematical simulations:

[19] CORMIX is a Mixing Zone Model and decision support system for environmental impact assessment of regulatory mixing zones resulting from continuous point source discharges.

[20] MIKE 21 is a professional engineering software package containing comprehensive modeling system for two-dimensional free-surface flows. MIKE 21 is applicable to the simulation of hydraulic and related phenomena in lakes, estuaries, bays, coastal areas, and seas where stratification can be neglected.

[21] Values are based on WHO Guidelines for safe recreational water environments - Volume 1: Coastal and Fresh Waters - http://www.who.int/water_sanitation_health/bathing/srwe1/en/.

(i) Initial dilution at mid-depth of the diffusers at Mutwal and Wellawatte outfalls reflect low dilution and high concentration during NE and SW monsoons;
(ii) Initial dilution shows that biochemical oxygen demand (BOD) has been completely diluted and concentrations range from 6.55mg/l to 7.76mg/l at five scenarios of climatic seasons and wind and tide data-SW High, SW Average, NE High, NE Average, and IM High;
(iii) Initial dilution shows total suspended solids (TSS) have been completely diluted and concentrations range from 7.09mg/l to 8.57 at five scenarios of climatic seasons and wind data-SW High, SW Average, NE High, NE Average, and IM High;
(iv) Thus pollutant of concern is faecal coliform with concentrations range of (a) 34, 483,000 MPN/100ml during SW high; (b) 40,816,566 MPN/100ml during SW Average; (c) 3,784,025 MPN/100ml during NE High; (d) 35,461,234 MPN/100ml during NE Average; and (e) 35,461,234 during IM High.
(v) The concentration of faecal coliform at the shoreline will not reach 150MPN/100mL at any time. The highest estimated concentration of faecal coliform is 77 MPN/100ml during the NE High season.
(vi) For Project 3 area (Wellawata outfall), the nearest distance to the shoreline with a faecal coliform concentration of 150MPN/100mL is 173m during high wave and wind conditions of southwest monsoon, i.e., SW high. All other climatic conditions will range from 479m to 662m from the shoreline.
(vii) While 300 MPN/100mL (fishing activities) is expected to happen at 299m from the shoreline during SW high. All other climatic conditions will range is from 483m to 714m from the shoreline.
(viii) 1,000MPN/100mL (boat riding) is expected to be reached at 603m from the shoreline during SW high. All other climatic conditions will range is from 502m to 801m from the shoreline.

92. The study concluded it should be noted that the study was carried out for the releasing concentration of faecal coliform concentration of 10^9 MPN/100mL (Metcalf and Eddy, 2004) and needs to be verified because if higher concentration are released from the outfall, additional treatment of effluent will be required before releasing the effluent to the sea.

D. Socioeconomic Profile

93. According to the Department of Census and Statistics, the estimated population in CMC in 2010 was 1,000,000. Table 4.5 summarizes the population density by planning units in Colombo City.

Table 4.5: Population Density of Each Planning Unit in Colombo City

Name of Planing Unit	Density (People per Hectare)		
	Year 1981	Year 1997	Year 2010
Fort	85	70	82
Kochchikade	486	506	536
Maradana	221	222	236
Kollupitiya	147	136	153
Mattakkuliya	159	191	216
Kotahena	188	180	180
Grandpass	218	244	272
Dematagoda	225	343	469
Borella	182	222	256

Name of Planing Unit	Density (People per Hectare)		
Cinnamon Garden	51	57	64
Bambalapitiya	99	92	104
Wellawatta	141	152	166
Narahenpita	78	86	97
Kirillapone	129	188	230
Total	**158**	**180**	**208**

94. The total occupied housing units in Colombo district was 473,045 in 2001. There was a sharp increase of occupied housing units in Colombo district by year 2011. Building survey conducted by the Department of Census in 2011 indicated that the number of housing units in Colombo district was 637,749. For the project area, it was indicated that the number of households was around 73,637, number of housing units was approximately 48,000, and number of families was 55,361. This comprises around 65% of the total occupied housing in Colombo City. The family size was 5.1, much higher than the national average family size of 4.3.

95. The population in the project area is ethnically diverse, with a preponderance of ethnic minorities particularly in tenement gardens. Nearly 50% of population in the project area is Sinhala, followed by Muslims (26%). The Tamil community has become smaller, and is 13% at present. Only 1% of the population represents the Burghers and Malay communities. However, in the Colombo Divisional Secretariat area (slightly bigger than the project area), according to the 2001 census, Tamil was the majority ethnic group at 33.2%, the Sinhala second highest at 30.8%, and Muslims third at 30.2%.

96. Distribution by religion showed that 30.2% of the population in the project area is Christian. This was because a substantial percentage of Sinhala and Tamil communities practiced the Christian religion. According to the primary survey[22], the percentage of the population practicing Islam and Buddhism in the project area was 27.2% and 26.9% respectively. The Hindus were the smallest religious group, at 15.5% of the population.

97. Data revealed that 15% of sample households lived in tenement gardens, while the balance (85%) was in areas where adequate space is available. Approximately 36% of the households had been living in their communities for more than 30 years. About 38% of the households had lived in their communities between 10 and 30 years, and the balance households had been was living in their communities for less than 10 years.

98. Primary data indicated that the percentage of women-headed households in the project area was somewhat high, around 23% of total households surveyed. The women-headed households in tenement gardens was 4%. Percentage of women-headed households in other areas was 19%.

99. Occupation data of the samples indicated that the majority of the active workforce (25.9%) in the project area was involved in the provision of unskilled labor. Employment in the government sector was approximately 7%, while 16% worked in the private sector. A substantial percentage (38%) of the active workforce in the project area was self-employed or engaged in

[22] Sample household survey has been conducted under ADB PPTA 7854 for the social analysis of the project area. The survey and focus group discussions were conducted for six sample communities (small administrative divisions called GNDs), namely Bluemandle, Grandpass, Lunupokuna, Maligawatta, Modara, and Sammanthranapura.

their own business. Percentage of overseas employment was around 2%, mostly as housemaids. Reported unemployment among the people in the area was 29%. Percentage of male employment in the project area was higher than the female employment. Unemployment among females was around 24%, which is substantially high.

100. The majority of people, 38%, in the service area, had studied up to General Certificate of Education (Ordinary Level or Advance Level). A substantial percentage (6%) of children dropped out after grade 5 due to various reasons. Information on higher education indicated that only 2% of people in the service area studied up to degree and post-graduate levels. Prevailing socioeconomic status, culture, poverty, and income-earning opportunities in informal and formal sectors influenced children and young people to start early employment.

101. The gender gap in literacy was insignificant in the project area. According to the available data, literacy among the male and female population over 10 years of age was 92.1% and 89% respectively. These figures were in agreement with the district literacy rate of 94.7%.

102. According to the Department of National Census, the average monthly income of households in Sri Lanka in 2009–2010 was Rs. 20,427. According to the declared income of the households surveyed, monthly income of 87% in the project area was Rs. 15,000 or more. Of that, 30% of the ehouseholds eardn Rs. 30,000 or more per month. Percentage of households below poverty line was only 0.3%, which is negligible. However, 5% of the households were low-income.

103. Primary data revealed that 14% of the total surveyed received Samurdhi benefits (assistance from the government to cover food expenses). The data indicated that the total numbers of families receiving Samadhi benefits in the project area was only 1,870, which was negligible (around 4% of total families). However, this data implies that a substantial level of poverty is concentrated in the proposed project area.

104. Disease incidence based on 180 days' recall method revealed that incidence of water-borne disease was two per population of 1,000, while incidences of vector-borne diseases, especially dengue, were reported moderate at six per 1,000. Vomiting, dengue, and diarrhea were the only reported diseases during the primary survey.

105. Overall average health expenditure in the project area was Rs. 1,110 per month. Health expenditure of households in the income category of more than 20,000 per month was substantial. The households in low-income groups did not have health expenditures, as all citizens of Sri Lanka have access to free medical facilities, including free medicine, lab tests, etc.

106. **Access to water.** Water sources were reported to be the same in dry and wet seasons by all households. Almost all households were enjoying the NWSDB's water supply. Eighty-two percent (82%) of the sample households reported access to individual water service connections. Around 6% of households used water from shared house connections, while 12% of households got water from public stand posts. None of the households used groundwater either from tube wells or hand-dug shallow wells. None of the sample households reported having installed pumps. However, in CMC area, there were several wells and hand pumps, and people used them as secondary water sources, and in asome instances as primary water sources, as well. Generally, such water sources were used by industries and laundries, which required large quantities of water.

107. According to the primary survey, per capita water consumption in the project area was low at 61 liters per day (lpd). For the households below poverty line (Rs. 3,551), it was 49 lpd. However, per capita consumption of water by income category of Rs. 3,551–Rs. 5,000 and Rs. 5,001–Rs. 10,000 was in line with the urban consumption level, which were 106 and 118 lpd respectively. Per capita consumption of water by all income categories over and above Rs 10,000 was between 46 and 67 lpd. During the focus group discussion (in a location where mixed services are provided), it was revealed that people monitored the quantity of water they used daily and took precautions to limit their monthly usage below 15 m^3. It was revealed that households who have individual connections use water from public stand posts once their households water meters indicate that they are close to high usage category (>15m^3). This was a common practice of all households in tenement gardens.

108. Following, quality issues were reported: bad taste (74%), contaminated with waste (13%), bad color (6%), high chlorine concentration (4%), and bad smell (1%). It was assumed that these quality issues were mainly associated with the conditions of the distribution network.

109. **Access to sanitation.** All households in the project area used latrines with septic tanks, as CMC by-laws do not provide any room to construct low-cost latrines within the municipal area. Hence, service level of sanitation infrastructure was somewhat acceptable with the majority of the surveyed households (83%) who had access to individual toilets in the project area. Only 15% of households used communal latrines, and the remaining 2% shared the neighbors' or relatives' latrines. Field observations revealed that some sanitary issues prevailed in some of the communal latrine blocks, such as outflowing of septic tanks, substructure damages, etc.

110. Observation confirmed that open-air defecation (OAD) was not a practice in the project area. Children's faecal matter was also disposed of in individual and public latrines. The major reason for the absence of OAD was the availability of public sanitation facilities in tenement gardens. Discussion revealed that the user groups attended to minor repairs such as water supply, lighting, etc. in latrine units, while the CMC attended to major repairs such as emptying of septic tanks, repair of substructures, etc.

111. **Access to solid waste disposal.** Lack of systematic disposal of solid waste was one of the main factors influencing environmental sanitation. Solid waste collection and safe disposal are the responsibility of local authorities, as people pay directly and indirectly for such services by way of property assessment taxes and stamp duty and other levies. Almost all households in the project area benefitted from the recently improved solid waste disposal collection in Colombo City. About 82% of surveyed households reported access to a household (door-to door) collection facility, while 4% of households had access to municipal vats and other means of waste disposal. A substantial percentage (15%) of people, including households that did not respond to this question, still dropped their waste by the wayside and or in CMC-built garbage bins. Irregular and ad hoc collection of waste was the main problem mentioned by the people in many places, especially in the households of tenement gardens.

112. **Availability of storm water drainage and wastewater disposal.** Surface drains and underground drainages were available in almost all areas of the project. About 86% households reported using underground drainages (UGD) and open drains for wastewater disposal. Only 1% of households diverted their wastewater into nearby open areas, while 3% diverted them into surface water bodies.

113. Generally, Colombo City's drainage system is not efficient enough to bear the runoff water during monsoon, resulting in the submerging of several low land areas. Thirty percent (30%) of surveyed households reported incidence of flooding in the vicinity of their house during monsoons (May-July and September-December). Of that, 26% lived in non-slum areas while only 4% lived in tenement gardens (slum households). However, due to lack of appropriate drainages, most tenement gardens were badly affected during monsoons. It is evident that 20% of households affected during floods are in high-income categories (monthly income > Rs 15,000). Only 2% of households in low-income categories were affected by seasonal floods.

E. Social and Cultural Characteristics

114. **Existing public parks and playgrounds in the CMC area.** Parks and playgrounds account for 95.4 ha or 2.5% of CMC total area. There are also 75.91 ha of other private and semi-public outdoor recreation spaces and 171.15 ha of outdoor recreation spaces (almost half of which belongs to private clubs and other organizations).

115. **Historical and archaeological sites.** Colombo has a number of historical places with the potential for expanding both local and foreign tourism. The list of archaeological sites found in CMC[23] is detailed in Table 4.6. Dutch Reform Church Bambalapitiya, Borah Mosque Wellawatta and Ramakrishna mission Wellawatta are located in the project area. However, excavation works will not be conducted in the vicinities of these archaeological sites.

Table 4.6: Historical and Archaeological Sites in Colombo Municipal Council Area

Colombo Port Ancient Security House near Ancient Parliament
Keragala Inscriptions, Tampita Vihara, Wall and Dagoba
Colombo Kuppiyawatta Ancient Image House, Awasageya, Dewalaya in Kuppiyawatta Jayasekera Vihara
Colombo Maligakanda Ancient Image House, Awasageya
Colombo Pettah Olcutt Building
Colombo Dematagoda Ancient Awasageya
Colombo Maligakanda Mahabodh Vihara at Maligakanda
Kotahena St. Lucia Church at Kotahena
Maradana Ancient Railway Station at Fort
Colombo Pettah Dutch Museum
Colombo Fort Dutch Warehouse at Sri Lanka Ports Authority
Kotahena Vihara and Awasageya at Deepaduththaramaya
Colombo Ancient Lighthouse (Northwestern) at Sri Lanka Ports Authority, Inner Breakwater
Colombo Ancient Lighthouse (North) at Sri Lanka Ports Authority, Inner Breakwater
Colombo Ancient Building (Ragu Mandiraya) at Sri Lanka Ports Authority
Colombo Ancient wall at Sri Lanka Ports Authority
Colombo Ancient Grand Oriental Hotel Buildings at York Street, Sri Lanka Ports Authority
Colombo Ancient Post Master General Office Building at Janadipathi Street, Sri Lanka Ports Authority
Colombo Ancient Clifan Burg House at Sri Lanka Navy Headquarters, Sri Lanka Ports Authority
Colombo Ancient Chartered Bank Building at Janadipathi Mawatha
Colombo Ancient Walkers Building at Sir Baron Jayatilake Mawatha
Colombo Ancient Lanka Maccanance Macancy Company Limited Building at Lady Bastian Mawatha
Colombo Portland Building at Sir Baron Jayatilake Mawatha
Colombo Pettah Dutch Bell Tower at Kaiman Gate, Pettah
Colombo Central Ancient Kovil, Rest Hall and Road
Colombo Ancient Chartered Bank Building at Janadipathi Mawatha

[23] Complete list for Colombo District can be found at http://www.archaeology.gov.lk/.

Colombo Central Ancient Kovil, Rest Hall and Road
Colombo Dematogoda Ancient Awasega
Dutch Reform Church Bambalapitiya
Borah Mosque Wellawatta
Ramakrishna mission Wellawatta

F. Site-Specific Description of Environmental Conditions

116. **Land for Proposed Pumping Station at Kalinga Mawatha.** Ownership of the Kalinga Mawatha pumping station site is with UDA. This land currently vacant land with open space located close vicinity to the new UDA Housing Scheme at Kalinga Mawatha. The land bordering boundary wall of the Open University of Sri Lanka, Kalinga Mawatha housing scheme and few scoters bounded the site. There are no trees in the site. Flora and fauna are those commonly found in urban and developed areas. There are no adjacent water bodies. The area is not flood-prone (Figure 4.2).

117. **Land for Proposed pumping station at Kirulapone, Thalakotuwawatta .** Thalakotuwawatta is CMC owned land situated at Kirula Narahenpita GN division of the Kirullapone. The land has been cleared by the CMC and few coconut trees can appears the site. Few houses still in the site and CMC already made arrangement to provide alternative houses for them. A resettlement plan has been prepared for the project. There are no trees in the site. Flora and fauna are those commonly found in urban and developed areas. There are no adjacent water bodies. The area is not flood-prone (Figure 4.3).

118. **Land for Proposed WWTP in Wellawatta.** The land belongs to CMC. This is the site of the old water treatment plant and Wellawatta pump station. Portion of the land is being utilized by CMC fire brigade. The remaining portion is vacant and being used as a playground by children from surrounding community. There are no trees in the site. Flora and fauna are those commonly found in urban and developed areas. There are no adjacent water bodies. The area is not flood-prone.

Figure 4.2: Location of Kalinga Mawatha pumping station

Figure 4.3: Location of the Thalakotuwawatta pumping stationsludge

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

119. This section of the IEE reviews possible subproject-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analysed during pre-construction, construction, and operational stages in the context of the subproject's area of influence. The primary impact areas are: (i) the existing network for the repair and rehabilitation; (ii) the sewerage collection network for Kirilapona unsewered area; (iii) the sewerage networks for Narahenpita and Kirula-Naranhepita unsewered area; (iv) the wastewater treatment plant in Welwattta; (v) the approach road, main routes/intersections which will be traversed by construction vehicles; and (vi) borrow pits as sources of construction materials.

120. The ADB Rapid Environmental Assessment Checklist for Sewage Treatment System in http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.asp was used to screen the subproject for environmental impacts and to determine the scope of the IEE investigation. The completed Checklist is given as Appendix 1. All the components of the project will interact physically with the environment.

121. The potential environmental impacts have been identified by the following means: (i) site visit and assessment in the project area; (ii) stakeholders' survey interviews; and (iii) desktop research of information relevant to the project.

122. In the case of this subproject (i) most of the individual elements are relatively small and involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements. The subproject will be in property held by the local government and access to the subproject location is through public rights-of-way and existing roads hence, land acquisition and encroachment on private property will not occur.

A. Pre-Construction: Location And Design

123. **Design of the proposed components.** The technical design of the (i) existing network improvement and rehabilitation; (ii) development of sewerage collection network for Kirulapone

unsewered area; (iii) rehabilitation of the pump stations; and (iv) construction of new sewerage networks in Narahenpita and Kirula-Narahenpita unsewered areas will ensure that appropriate routing and sizing of sewer pipelines will follow international and national guidelines. Also, the guidelines and techniques for sewer pipe replacement recommended from the ADB PPTA for Project 1 and 2 and on-going GCWMIP will also be implemented. Environmental considerations will be incorporated in the technical specifications, such as:

(i) Avoid sewer pipe alignments that will result in destruction/disturbance to historical and cultural places/values.
(ii) Ensure sewer pipes are laid keeping adequate vertical and horizontal clearance from water supply pipelines.
(iii) Use low-noise pumps and motors in the pump houses.
(iv) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replace if broken to minimize entry of garbage and silt into the system
(v) Equip pumping stations with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages.

124. The wastewater treatment plant will use Moving Bed Biological Reactor (MBBR) technology with a total capacity of 50MLD and design for 50 years. Other technologies studied by the design team include activated sludge process and membrane bioreactor. As per preliminary design, MBBR is the most suitable technology given the limitations on land availability and operations and maintenance (O&M) costs. Discussion for the detailed comparison on the operation/design parameters between the activated sludge process and MBBR is in Appendix 2. The treatment technology will be reassessed under the DBO contract.

125. **Activated Sludge Process.** This is the most common and oldest biotreatment process used to treat municipal and industrial wastewater. The activated sludge process uses microorganisms to feed on organic contaminants in wastewater, producing a high-quality effluent. The activated sludge process has three basic components: (i) a reactor in which the microorganisms are kept in suspension, aerated, and in contact with the waste they are treating; (ii) liquid-solid separation; and (iii) a sludge recycling system for returning activated sludge back to the beginning of the process (World Bank, 2015). Variations of the activated sludge technology are: (i) extended aeration; (ii) sequencing batch reactors or the fill-and-draw activated sludge system; and (iii) oxidation ditch which consists of a ring or oval shaped channel equipped with mechanical aeration devices for an extended aeration with long solids retention time.

126. **Membrane Bioreactor.** Membrane Bioreactor (MBR) is the latest technology for biological degradation of soluble organic impurities. MBR technology has been in extensive usage for treatment of domestic sewage. The MBR process is very similar to the conventional activated sludge process, in that both have mixed liquor solids in suspension in an aeration tank. The difference in the two processes lies in the method of separation of biosolids. In the MBR process, the biosolids are separated by means of a polymeric membrane based on microfiltration or ultrafiltration unit, as against the gravity settling process in the secondary clarifier in conventional activated sludge process. The advantages of MBR systems over conventional biological systems are better effluent quality, smaller space requirements, and ease of automation. The effluent from MBRs contains low concentrations of bacteria, TSS, BOD, and phosphorous. Effluents are readily discharged to surface streams or can be sold for reuse, such as irrigation. The primary disadvantage of MBR systems is the typically higher capital and operating costs than conventional systems for the same throughput. Operation and

maintenance costs include membrane cleaning and fouling control, and eventual membrane replacement. Energy costs are also higher because of the need for air scouring to control bacterial growth on the membranes. In addition, the waste sludge from such system might have a low settling rate, resulting the need for chemicals to produce biosolids acceptable for disposal (US EPA, 2007).

127. **Moving Bed Bioreactor.** MBBR uses thousands of biofilm carriers that operate in a mixed motion with a setup containing aerated wastewater. MBBR is a highly effective biological treatment process that was developed on the basis of conventional activated sludge process and bio-filter process. It is a completely mixed and continuously operated biofilm reactor, where the biomass is grown on small carrier elements that have a little lighter density than water and are kept in movement along with a water stream inside the reactor. The movement inside a reactor can be caused by aeration in an aerobic reactor and by a mechanical stirrer in an aerobic or anoxic reactor. Advantages of the MBBR process are: (i) compact units with small size; (ii) increased treatment capacity; (iii) complete solids removal; (iv) improved settling characteristics; (v) operation at higher suspended biomass; (vi) concentration resulting in long sludge retention times; (vii) enhanced process stability; (viii) low head loss; (ix) no filter channeling; (x) no need of periodic backwashing; (xi) reduced sludge production and no problems with; (xii) sludge bulking (Borkhar, Gulhane and Kotangale, IOSJ Journal of Environmental Science, Toxicology and Food Technology-2013).

128. Environmental considerations will be incorporated in the technical specifications, such as:

(i) Design parameters will be based on the effluent quality of the domestic wastewater (sewage) in the south catchment area of Colombo;
(ii) Use low-noise pumps and motors in the pump houses.
(iii) Equip the WWTP with a backup power supply to ensure uninterrupted operation during power outages.
(iv) Cover emission points (e.g., aeration basins, clarifiers, sludge thickeners, tanks, and channels), and vent emissions to control systems (e.g., compost beds, biofilters, chemical scrubbers, etc.) as needed to reduce odors and otherwise meet applicable national requirements and internationally accepted guidelines.
(v) Provide adequate buffer area, such as trees, or fences, between processing areas and potential receptors.
(vi) Treated sludge quality for land application should be consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater[24] and applicable national requirements.
(vii) Disposal sites for the sluge and solid waste generated from the operation of the WWTP should be identified prior to construction activities

129. **Location of the Proposed Components.** The location of the treatment plant is near the existing Wellawatta Pump Station and is within the coastal area defined by CCD act therefore CCD permit is required. The PMU will ensure that CCD permit will be obtained prior to the DBO contract. The proposed developments are located on existing properties of CMC and no land acquisition is required. However, the location of the development of sewerage collection network and the rehabilitation will involve the relocation of some families to UDA high-rise

[24] WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater available at http://www.who.int/water_sanitation_health/wastewater/gsuww/en/.

buildings. The mitigation measures and compensation associated to their relocation is discussed in details in the Resettlement Plan of the project. The identified sites are not located or adjacent to ecologically and culturally protected areas

130. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas.** Priority is to locate these near the subproject location. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near the forest, water bodies, swamps, or in areas which will inconvenience the community. All locations would be included in the design specifications and on plan drawings.

131. **Site selection of sources of materials.** Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution. To mitigate the potential environmental impacts, locations of quarry site/s and borrow pit/s (for loose material other than stones) would be included in the design specifications and on plan drawings. Priority would be given to sites already permitted by the Geological Survey and Mines Bureau. If other sites are necessary, these would to be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage systems; and in structurally stable areas even if some distance from construction activities. It will be the construction contractor‘s responsibility to verify the suitability of all material sources and to obtain the approval and/or permit from Geological Survey and Mines Bureau and/or procure materials from licensed sources/traders. If additional quarries will be required after construction is started, then the construction contractor shall use the mentioned criteria to select new quarry sites, with written approval from CMC PMU.

B. Construction

1. Screening of No Significant Impacts

132. The construction work is expected not to cause major negative impacts, mainly because:

(i) The treatment plant will be constructed away from urban areas thus will be constructed without causing impacts to community;
(ii) Overall construction program is expected to be completed in 24 months and most impacts will be localized; and
(iii) Most of the predicted impacts associated with the construction process are produced because the process is invasive, such as involving excavation.

133. Most of these impacts are short-term and site-specific. There are no impacts that are significant in nature. The impacts associated with the construction activities can be easily mitigated with the implementation of mitigation and management measures.

134. As a result, there are several aspects of the environment which are not expected to be affected by the construction process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in Table 5.1. These environmental factors are screened out presently but will be assessed again prior to the construction activities.

Table 5.1: Fields in which construction is not expected to have significant impacts

Field	Rationale
Geology, Geomorphology, Mineral Resources, and Soils	No mineral resources in the location of the project
Climate	Activities are not large enough to affect this feature
Air Quality	Anticipated to be short-term from the generation of dust during construction activities
Geohydrology and Groundwater	Activities will not affect the geohydrology or groundwater. Technical design will ensure that the groundwater table will not be impacted from the civil works
Protected Areas	No protected areas located or adjacent to the project area
Flora and Fauna	No endangered flora and fauna present in the project area
Population	Not anticipated for priority in employment will be given to members of the local community
Health and education facilities	Not anticipated to have significant impact

2. Construction Method

135. **Existing Network Improvement and Rehabilitation.** The civil work activities will include:

(i) Open cut pipe laying (trenching) in roads for sport repairs of pipes
(ii) Investigation work including bore hole construction along roads; utility identification using ground probing radar
(iii) Construction of shafts for micro tunnelling work
(iv) Road barricading for micro-tunnelling work/ travel and transport restrictions
(v) Muck collection and disposal
(vi) Trenchless rehabilitation and repair of pipes
(vii) Sewer pipe cleaning using jetting machines and other devices
(viii) Collection and disposal of grit from sewer system
(ix) Back filling
(x) Road reinstatement
(xi) Dewatering
(xii) Sheet pile driving

136. **Development of sewerage collection network for Kirilapona unsewered area.** The civil work activities will include:

(i) Trench excavation for open cut pipe laying
(ii) Spoil removal
(iii) Trench back filling
(iv) Road reinstatement
(v) Construction of shafts for micro tunnelling
(vi) Manhole construction (excavation and concrete work)
(vii) Shaft backfilling
(viii) Pile driving
(ix) Dewatering
(x) Micro-tunnelling
(xi) Muck separation and removal
(xii) Excavation work
(xiii) Concrete works
(xiv) Construction of a building for pump station and new generator units

137. For rehabilitation of the pump stations, the civil work activities will include:

(i) Wastewater bypassing to facilitate the work
(ii) Dismantling and removal of equipment: gates, screens, grit separation units and pumps and all other items identified for removal
(iii) Modifications to main inlet and approach channel as necessary to install the new main penstock or modified main penstock system as necessary to have effective flow control
(iv) Minor civil work related to the installation of new mechanical equipment
(v) Repair, replacement and rehabilitation of pump station roof, walls, floor, doors and windows and painting as necessary
(vi) Civil repair works around buildings, roads and boundary walls, gates as necessary including landscaping, site drainage
(vii) Supply and installation work involved with mechanical and electrical equipment

138. **Construction of new sewerage networks for Narahenpita and Kirula-Narahenpita unsewered areas and connecting them to the existing CSS.** The civil work activities will include:

(i) Trench excavation for open cut pipe laying
(ii) Spoil removal
(iii) Trench back filling
(iv) Road reinstatement
(v) Construction of shafts for micro tunnelling
(vi) Manhole construction (excavation and concrete work)
(vii) Shaft backfilling
(viii) Pile driving
(ix) Dewatering
(x) Micro-tunnelling
(xi) Muck separation and removal
(xii) Excavation work
(xiii) Concrete works
(xiv) Construction of a building for pump station and new generator units

139. **Construction of secondary wastewater treatment plant at Wellawatta.** The civil work activities per preliminary design will include the following:

(i) Excavation and earthwork
(ii) Ground clearing and leveling
(iii) Construction of water retaining structures such as the flow balancing tank, aeration tank, clarifier, and chlorine contact tank
(iv) Construction of reinforced concrete
(v) Construction of buildings and other required structures such as perimeter fence
(vi) Construction of drainage canal around the WWTP to collect incidental runoff
(vii) Pipe laying
(viii) Landscaping such as planting trees around the WWTP

140. The detailed construction method and implementation schedule will be provided in the final IEE.

3. Anticipated Impacts and Mitigation Measures

141. **Air Quality.** Construction activities may generate dust and gaseous pollutants. Dust generation is usually caused by a combination of on-site excavation and movement of earth materials, contact of construction equipment and machinery with bare soil, and exposure of bare soil and soil piles to wind. Excavation and backfilling works will also give rise to the increase in ground level concentration of total suspended particulate (TSP) matter. Secondary sources of emission may include exhaust from vehicles and equipment (such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides and hydrocarbon). To minimize the impacts on air quality, the following measures shall be implemented by the contractor:

(i) Consult with design consultants on the designated areas for stockpiling of soil, gravel, and other constructed materials;
(ii) Excavate foundations at the same time as the access roads are built so that dug material is used immediately, avoiding the need to stockpile on site;
(iii) Damp down exposed soil and any sand stockpiled on site by spraying with water when necessary during dry weather;
(iv) Truck carrying sands, soil, stone, and other loose materials should be covered with tarpaulin;
(v) Open burning of solid wastes will be prohibited on the construction sites; and
(vi) Vehicles and equipment used during construction must be properly maintained and in good condition to ensure optimal performance. Also, all vehicles and equipment used in the construction activities shall have valid certifications indicating compliance to vehicle emission standards.

142. **Water Quality.** Water sources are susceptible to pollution from run-off or soil erosion from stockpiled construction materials and spoils, domestic sewage from construction workers, accidental spillage of oil and other lubricants, wastewater from washing of construction equipment and vehicles and improper disposal of construction wastes. These wastewaters are likely to cause deterioration of surface water quality, flooding and flow obstruction of watercourses, including drainage and irrigation canals. To minimize the impacts on water quality, the following measures shall be implemented by the contractor:

(i) Minimize spoil by balancing cut and fill wherever possible. Spoil shall only be disposed to areas approved by local authority;
(ii) Impacts due to soil erosion will be mitigated by careful grading of the construction site such that water is not allowed to run off of the construction site into adjacent drainages. Where excavated soils are onsite, adequate measures will be implemented to control runoff, including covering exposed soils, construction of settling basins, or temporary silt traps along the drainage leading to water bodies;
(iii) All earthworks must be conducted during the dry season to prevent the problem of soil run-off during monsoon season;
(iv) Implementation of solid waste and construction waste collection and disposal system, with provision for waste segregation;
(v) Provision on adequate on-site sanitation facilities with septic tanks to prevent untreated sewage from being channeled into the drainage canals, irrigation canals, and river;
(vi) Place storage areas for fuels and lubricants away from any drainage leading to water bodies. Designate area for equipment and vehicle washing and maintenance. The area should be provided with oil and grease traps to prevent oil from being washed into drainage canals.

143. **Noise and Vibration**. The major sources of noise and vibration are from the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes; and transporting equipment, materials and people. Noise and vibration from the construction activities may cause disruption and nuisance to nearby community and other sensitive receptors (i.e. school, hospitals, place of worship). Also, noise and vibration due to the movement of vehicles along the access road may potentially result to nuisance. Vibration from the construction activities may also cause damage to other structures and buildings in the project area. To minimize noise and vibration impacts, the following measures shall be implemented by the contractor:

(i) Planning activities in consultation with the CMC PMU/DSIDC and with the community leaders so that activities with the greatest potential to generate noise and vibration are planned during periods of the day that will result in the least possible disturbance;
(ii) Noisy construction activities will be avoided during night time and religious or cultural events;
(iii) All construction equipment and vehicles shall be well maintained, regularly inspected for noise emissions, and shall be fitted with muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations;
(iv) Impose speed limits on construction vehicles to minimize emissions along areas where sensitive receptors are located (i.e. temples, hospitals, schools, houses)
(v) Truck driver and equipment operators shall avoid the use horns unless it is necessary to warn other road users or animals of the vehicle's approach;
(vi) Identify any buildings at risk from vibration damage and avoiding any pneumatic drills or heavy vehicles in the vicinity. Complete the civil works in these areas as quickly as possible.

144. **Quarry and Borrow Sites**. The following measures shall be implemented at quarry and borrow sites to minimize impacts on water quality, reduce dust emission during transport, minimize soil erosion and siltation of nearby water courses and avoid damage to productive land and ecologically sensitive areas:

(i) Utilize readily available sources of materials. If contractor procures materials from existing borrow pits and quarries, ensure that these conform to all relevant regulatory requirements;
(ii) Borrow areas and quarries (if these are being opened up exclusively for the project) must comply with environmental requirements, as applicable.
(iii) If additional quarries will be required after construction has started, obtain written approval from CMC PMU; and
(iv) Submit to DSIDC on a monthly basis the documentation of sources of materials

145. **Generation of Construction Wastes**. Solid wastes generated from the construction activities are excess excavated earth (spoils), discarded construction materials, cement bags, wood, steel, oils, fuels and other similar items. Domestic solid wastes may also be generated from the workers' camp. Improper waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape. The following mitigation measures to minimize impacts from waste generation shall be implemented by the contractor:

(i) Prepare and implement Waste Management Plan including a facility diagram

indicating the storage locations of stockpiles, equipment and other waste materials.

(ii) Construction materials and stockpiles of soils should be covered to reduce material loss;
(iii) Stockpiles, lubricants, fuels, and other materials should be located away from steep slopes and water bodies;
(iv) Avoid stockpiling any excess spoils. Excess excavated soils should be dispose to approved designated areas;
(v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site;
(vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed in disposal sites approved by local authorities;
(vii) Prohibit burning of construction and domestic waste;
(viii) Ensure that wastes are not haphazardly dumped within the project site and adjacent areas.
(ix) Request CMC PMU/DSIDC to report in writing that the necessary environmental restoration workshop has been adequately performed before acceptance of work

146. **Surface and Groundwater Quality.** Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids. To ensure that water will not pond in pits and voids near subproject location, the construction contractor will be required to conduct excavation works during non-monsoon season.

147. **Biological Environment.** The construction activities are located in the site of the old treatment plant and Wellawatta pump station. Portion of the land is being utilized by CMC fire brigade. The remaining portion is vacant and being used as a playground by children from surrounding community. There are no trees in the site. Flora and fauna are those commonly found in urban and developed areas. There are no adjacent water bodies.

148. If during project implementation, there will be cutting of trees or removal of vegetation, compensatory plantation for trees lost at a rate of two trees for every cut tree. Special attention shall be given to protecting giant old trees and locally important trees (with religious importance) during implementation.

149. **Historical, Archaeological, Paleontological, or Architectural sites**. No scheduled or unscheduled historical, archaeological, paleontological, or architectural sites near the project area. The area required for the proposed wastewater treatment plant in Wellawatta exceeds 0.25 ha therefore archaeological impact assessment (AIA) is required. PMU will ensure that archaeological impact assessment (AIA) is conducted and approved by the Archaeological Department prior to award of the civil works contract for the (i) existing network improvement and rehabilitation; (ii) development of sewerage collection network for Kirulapone unsewered area; (iii) rehabilitation of the pump stations; and (iv) construction of new sewerage networks in Narahenpita and Kirula-Narahenpita unsewered areas and prior to the mobilization of construction contractors for the WWTP DBO contract.

150. **Accessibility**. The repair, rehabilitation construction of sewer network and treatment plant will result to the access disturbance to mobile vendors, wheel parks, small shops, public and private institutions. Also, the vehicles carrying construction material to the site may result to an increase in movement of heavy vehicles in the affected area disrupting normal traffic patterns and exposing the local community to risk of injury or accidents. The following measures shall be

implemented by the contractor to minimize such impacts:

(i) Prepare and implement a Traffic Management Plan
(ii) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites;
(iii) Schedule transport and hauling activities during non-peak hours;
(iv) Locate entry and exit points in areas where there is low potential for traffic congestion;

(v) Keep the site free from all unnecessary obstructions;
(vi) Avoid full street closure as much as possible;
(vii) Laying of pipelines, backfilling and temporary reinstatement shall follow trench excavation as quickly as possible and trenches will not be left open for extended periods;
(viii) The contractor should require all drivers to lower speeds when passing through built-up and residential areas;

(ix) Coordinate with Traffic Police for temporary road diversions and for provision of traffic aids if transportation activities cannot be avoided during peak hours.
(x) Consultation with the affected business owners (mobile vendors, wheel parks, small shops, public and private institutions) on the schedule of civil works;

(xi) Provide sign boards, warning boards and diversion boards during construction time of the approach road.

151. **Damage to Infrastructure**. Transport of construction materials and other construction activities may cause damage to existing roads, irrigation and drainage canals adjacent to the construction sites. Also, temporary stalls located in sewerage network rehabilitation and improvement may be damaged during the relocation of mobile vendors and hawkers. The contractor shall implement the following measures to minimize the damage to existing infrastructure:

(i) The contractor shall not allow overloading of trucks used for the transport of materials; and
(ii) The contractor will be required to repair damaged infrastructure from the transport of materials and other construction activities. These infrastructures should be reinstated to their original condition upon completion of construction works;
(iii) Affected mobile hawkers and vendors will be assisted and/or compensated for any damaged infrastructure and/or loss of income as a result of the construction activities.

152. **Occupational Health and Safety**. Construction activities may cause harm and danger to the lives and welfare of workers. Potential impacts are negative and long-term but reversible with the implementation of mitigation measures. The construction contractor will be required to:

(i) Prepare occupational health and safety plan (OHSP) which will be part of the contractor's contract documents. The occupational safety plan should have provisions on (a) providing personnel protective equipment (PPE) like hard hats, safety gloves, ear mufflers to all workers; (b) providing occupational health and

safety (H&S) training[25] to all workers; (c) documenting safety procedures to be followed for all construction site activities including provisions on penalties and sanctions for non-compliance; (d) maintaining records of accident and the corrective actions implemented; and (e) emergency response plan during fire, earthquake and other incidents;

(ii) First-aid facilities should be present in the project area and at least one safety and health officer should be assigned in the construction area ;
(iii) Provide medical insurance coverage for workers;
(iv) Secure all installations from unauthorized intrusion and accident risks;
(v) Provide adequate, portable or permanent sanitation facilities serving all workers;
(vi) Provide supplies of potable drinking water;
(vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances;
(viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;
(ix) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazardous areas unescorted;
(x) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;
(xi) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and
(xii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than eight hours per day without hearing protection. The use of hearing protection shall be enforced actively

153. **Community, Health and Safety**. Construction activities may expose the communities to risks such as unintentional and intentional trespassing resulting to contact with hazardous materials, contaminated soils and other environmental media, or excavations and structures which may pose falling and entrapment hazards. Recommended measures to mitigate these risks, whenever applicable, include:

(i) The contractor should prepare a Community Health and Safety Plan (CHSP) which should be developed in consultation with the affected communities and local authorities. The CHSP should include specific emergency response procedures and preparedness, communication systems and protocols,

[25] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include(i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; (v) legislation and responsibilities; and (vi) prevention of malaria, diarrhea, HIV/AIDS). Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker

interaction with local emergency and health authorities and provision of emergency service vehicles.

(ii) Restrict access to the construction site, through a combination of institutional and administrative controls, including fencing and appropriate warning signage.

(iii) Providing security personnel in construction areas, if needed.

(iv) Posting information boards/signage about public safety hazards and emergency contact information;

(v) Members of the local community will be given priority for employment in the construction activities. This will have the added benefit of avoiding social problems usually encountered when workers are sourced from other provinces.

(vi) Workers need to be aware of the following general rules: (i) no alcohol/drugs on-site; (ii) prevent excessive noise; (iii) no illegal activities such as, but not limited to gambling, and hunting farm animals in the area; (iv) trespassing on private/commercial properties adjoining the site is forbidden; (v) workers are not allowed to be loitering in the project area.

154. **Work Camps**. Operation of work camps can cause temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Consult with DSIDC/CMC PMU before locating project offices, sheds, and construction plants;

(ii) Minimize removal of vegetation and disallow cutting of trees;

(iii) Provide water and sanitation facilities for employees;

(iv) Prohibit employees from poaching wildlife and cutting of trees for firewood;

(v) Train employees in the storage and handling of materials which can potentially cause soil contamination;

(vi) Recover used oil and lubricants and reuse or remove from the site;

(vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;

(viii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and

(ix) Request DSIDC/ CMC PMU to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

C. Operations and Maintenance

1. Screening areas of no significant impact

155. There are some aspects of the environment which are not expected to be affected by the operation and maintenance of the project process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in **Table 5.2**. These environmental factors are screened out presently but will be re-evaluated during the operation stage of the project.

Table 5.2: Fields in which the project does not have a significant environment impacts

Field	Rationale
Topography, Drainage, and Natural Hazards	There will be no activities affecting these features during the operation phase
Geology, Geomorphology, Mineral	There will be no activities affecting these features.

Resources, and Soils	
Climate	There will be no activities affecting the climate
Protected Areas	The project area is not located or adjacent to any protected areas
Flora and Fauna	There are no trees in the site. Flora and fauna are those commonly found in urban and developed areas
Health and Education facilities	Activities are not large enough to affect this feature. Also, health and sanitation will be improved because of the wastewater project.

2. Anticipated Environmental Impacts and Mitigation Measures

a. Sewer Network[26]

156. **Routine operations and maintenance.** The main operations and maintenance (O&M) activities of the rehabilitated pipes will be detection and repair of leaks and pipe bursts resulting to water and sewage overflow. In order to minimize and/or avoid the sewage overflow, routine operation and maintenance should be implemented by the CMC.

(i) Develop and implement operation and maintenance (O&M) plans for the sewer network and wastewater treatment plant
(ii) As a minimum, the O&M plan should specify (a) cleaning procedures and frequency; (b) responsible personnel; (c) maintenance and repairs schedule; (d) emergency contact details (i.e. address, telephone numbers); and

157. **Occupational Health and Safety.** Operation and maintenance of the sewer network may cause harm and danger to the lives and welfare of workers. CMC should implement the following measures:

(i) Comply with the applicable labor law and EHS guidelines in Sri Lanka;
(ii) Prepare occupational health and safety plan (OHSP) which should be based on the International Finance Corporation (IFC) Water and Sanitation Environment Health and Safety (EHS) Guidelines. The occupational safety plan should have provisions on (a) providing personnel protective equipment (PPE) like hard hats, safety gloves, ear mufflers to all workers; (b) providing occupational health and safety (H&S) training[27] to all workers; (c) documenting safety procedures to be followed for all construction site activities including provisions on penalties and sanctions for non-compliance; (d) maintaining records of accident and the corrective actions implemented; and (e) emergency response plan during fire, earthquake and other incidents;
(iii) First-aid facilities should be present in the project area and at least one safety

[26] Includes (i) existing network improvement and rehabilitation; (ii) development of sewerage collection network for Kirulapone unsewered area; (iii) rehabilitation of the pump stations; and (iv) construction of new sewerage networks in Narahenpita and Kirula-Narahenpita unsewered areas.

[27] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include(i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; (v) legislation and responsibilities; and (vi) prevention of malaria, diarrhea, HIV/AIDS). Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

and health officer should be assigned in the construction area ;
(iv) Provide medical insurance coverage for workers;
(v) Prove adequate, portable or permanent sanitation facilities serving all workers;
(vi) Provide supplies of potable drinking water;
(vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances;
(viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;
(ix) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;
(x) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and
(xi) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than eight hours per day without hearing protection. The use of hearing protection shall be enforced actively

158. **Community Health and Safety.** The operation of the sewer network may potentially subject the members of the community to risks and hazards such as accidental fall to open trench during repair and maintenance works and trespassing on the location of pumping station. CMC should ensure that the following mitigation measures are implemented:

(i) Restrict access to the construction site, through a combination of institutional and administrative controls, including fencing and appropriate warning signage;
(ii) Providing information boards, signage about public safety hazard and emergency contact information.

b. Wastewater Treatment Plant (WWTP)

159. **Routine operation and maintenance**. Based on the Greater Colombo Wastewater Management Feasibility Report (March 2015), wastewater of Colombo Sewer System (CSS) is considerably diluted. Also, the study concluded that even after improvement to the network, the characteristics of wastewater will only require primary and/or secondary treatment in order to dispose the treated effluent safely. However, the operations and maintenance activities are put into place to safeguards the operational activities of the WWTP.

160. The main operations and maintenance (O&M) activities of the water treatment plant are monitoring of the water volume and quality of influent and effluent water, screenings removal, sludge management and regular cleaning of the pumps and equalization tank. In order to avoid sewage outflow or overloading capacity of the WWTP, the following measures should be provided by the WWTP contractor before the final commissioning and transfer of operation control to CMC.

(i) Develop and implement operation and maintenance (O&M) plans for the wastewater treatment plant
(ii) As a minimum, the O&M plan should specify (a) cleaning procedures and frequency; (b) responsible personnel; (c) maintenance and repairs schedule; (d) sludge management; and

(iii) The water quality of the influent and effluent water should be regularly monitored;
(iv) Sludge management for the final treatment, transport and/or disposal of sludge.

161. **Air Quality**. The sources of air pollution from the operation and maintenance of the wastewater treatment plant are from the operation of diesel-powered generators and nuisance from odor that may result from the accumulation of scum in the wastewater treatment plant. To minimize the impacts on air quality, the following measures will be implemented:

(i) Monthly monitoring of air quality parameters for the operation of diesel-powered generators;
(ii) Ensure scum is appropriately removed, disposed or properly stabilized;
(iii) The perimeter of the wastewater treatment plant should be vegetated with trees and plants as a buffer from the odor; and
(iv) Regular monitoring of the water quality of the influent to avoid overloading the capacity of the treatment plant.

162. **Generation of Solid Waste**. Wastes generated from the operation of the wastewater treatment plant are screenings, grit, scum, sludge, biosolids and hazardous waste from the chemicals used in the chlorination process of the wastewater treatment plant. Based on the calculations done by the design consultants, the estimated amount of sludge that will be generated from the WWTP is 7.5 tons/day. Other sources of sludge are from (a) septic tank desludging operations; (b) sewer cleaning operations; and (c) tanker discharges from industries. Impacts from the inadequate sludge management may result to: (i) groundwater and/or water quality contamination especially on the occurrence of strong rains; (ii) odor or nuisance; (iii) vermin or the presence of insects, mosquitoes within the facility; and (iv) chemical spill. Recommended mitigation measures are the following:

(i) On-site pre-treatment (dewatering and drying) of sludge is required prior to disposal.
(ii) DBO contractors to assess possible reuse of dewatered and dried sludge (e.g., soil conditioning, organic fertilizer, etc.).
(iii) All disposal sites for screenings, sludge and hazardous waste should be identified prior to commissioning activities.
(iv) Screenings, grit and scum should be removed on a regular basis and properly stored in covered containers pending collection for final disposal.
(v) Sludge should be properly stored in a covered area before final disposal.
(vi) Hazardous waste such as the chemicals used in the chlorination process should be stored in cool, dry and dark conditions for no more than a month (or as stated in the Material Safety Data Sheet) and use containers with are corrosion-resistant. Hazardous wastes should also be collected, treated and disposed by an accredited waste facility.

163. Based on the meeting (June 2015) with the Director of CMC Solid Waste Management Department, CMC is currently collecting the accumulated solid waste in the Wellawatta pumping station and transported to the CMC municipal landfill in Meethotamulla for final disposal. The additional sludge generated from the WWTP can be accommodated by the Meethotamulla site.

164. **Occupational Health and Safety**. For the operation of the wastewater treatment plant, physical contact with the septage exposes the workers to the risk of bacteriological contamination. CMU should include the following measure for the operation of the wastewater treatment plant.

(i) Comply with the applicable labor law and EHS guidelines in Sri Lanka;
(ii) Prepare occupational health and safety plan (OHSP) which should be based on the International Finance Corporation (IFC) Water and Sanitation Environment Health and Safety (EHS) Guidelines. The occupational safety plan should have provisions on (a) providing personnel protective equipment (PPE) like hard hats, safety gloves, ear mufflers to all workers; (b) providing occupational health and safety (H&S) training[28] to all workers; (c) documenting safety procedures to be followed for all construction site activities including provisions on penalties and sanctions for non-compliance; (d) maintaining records of accident and the corrective actions implemented; and (e) emergency response plan during fire, earthquake, chemical spills and other incidents;
(iii) First-aid facilities should be present in the project area and at least one safety and health officer should be assigned in the construction area ;
(iv) Provide medical insurance coverage for workers;
(v) Prove adequate, portable or permanent sanitation facilities serving all workers;
(vi) Provide supplies of potable drinking water;
(vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances;
(viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;
(ix) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate;
(x) Ensure that workers are properly and adequately oriented on the proper handling of hazardous chemicals used in the chlorination process;
(xi) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than eight hours per day without hearing protection. The use of hearing protection shall be enforced actively.

165. **Community Health and Safety**. To ensure the safety of the communities near the wastewater treatment plant, the CMC should ensure the following measures:

(i) Restrict access to the construction site, through a combination of institutional and administrative controls, including fencing and appropriate warning signage;
(ii) Providing information boards, signage about public safety hazard and emergency contact information
(iii) Provide visitor orientation if visitors to the site can gain access to areas where

[28] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include(i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; (v) legislation and responsibilities; and (vi) prevention of malaria, diarrhea, HIV/AIDS). Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker

hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazardous areas unescorted.

166. **Economic Development**. Improvement in sanitation through the rehabilitation of the sewer network and construction of wastewater treatment plant may result to an improvement in public health such as the decrease in the number cases of diarrhea and other water-related diseases in the area. Also, the project will improve the quality of land and water resources in the project with the proper collection and treatment of sewerage in the area. The project is not expected to have direct economic benefits to the business industry, however business will almost certainly benefit from the expected improvement in the health and well-being of their workforce as this would result in fewer days lost through illness, and overall increase in productivity.

D. Cumulative Impact Assessment

167. The cumulative impact assessment examined the interaction between the project's residual effects (i.e., those effects that remain after mitigation measures have been applied) and those associated with other past, existing, and reasonably foreseeable future projects or activities. The interaction of residual effects associated with multiple projects and/or activities can result in cumulative impacts, both positive and negative. The project's potential cumulative effects were considered with respect to valued components in environmental and socioeconomic categories, in four areas:

(i) of any potential residual project effects that may occur incrementally over time;
(ii) consideration of other known relevant projects or activities within the specified study area boundaries, even if not directly related to the project;
(iii) potential overlapping impacts that may occur due to other developments, even if not directly related to the proposed project; and
(iv) future developments that are reasonably foreseeable and sufficiently certain to proceed.

168. The project has identified the valued components as water quality, air quality, acoustic environment/noise, socioeconomic and socio-community components, and human health and safety. There are no foreseeable projects that will overlap with the project. The spatial boundary of the project is the area along the sewer network, existing right of ways and building sites, and the area of the wastewater treatment plant. The temporal boundary can be considered as the towns in the South Catchment area of Colombo District.

169. **Water quality**. Locations and siting of the proposed infrastructures were considered to reduce impacts. Preliminary design integrates a number of measures, to ensure structural integrity, compliance to applicable building and design standards such as the provision of drainage canal to prevent groundwater and surface water pollution, and mainstream climate resilience in the project. Modeling study by LHI in June 2015 shows main pollutant of concern is faecal coliform, i.e., BOD and TSS will be negligible upon discharge from the rehabilitated outfalls. The introduction of WWTP will ensure faecal coliform concentration is decreased prior to discharge which will be further diluted by the outfall diffusers and climatic factors. Thus the project will result to a positive cumulative impact by ensuring that water discharge to the sea is treated and will not affect public health.

170. **Air Quality**. Air quality effects will occur during construction. Emissions of common air contaminants and fugitive dust may be elevated in proximity to active work sites, this impact will

be short-term and localized to the immediate vicinity of the sewer network rehabilitation and development and wastewater treatment plant . Greenhouse gas (GHG) emissions may increase as a result of project activities (i.e. vehicle equipment operation, concrete production, disposal of excavated material, landfilling of residual wastes). Given the project's relatively minor contribution to common air contaminants and GHG emissions during construction, the overall significance rating of both these potential residual effects is considered negligible.

171. **Acoustic environment**. Noise levels during construction and operation and maintenance activities in the immediate proximity of work sites are expected to increase. The duration of this exposure will be relatively brief and negligible. A buffer zone such as planting trees in the vicinity of wastewater treatment plant will be implemented to minimize the odor and noise generated form its operation. This exposure represents a temporary, localized, adverse residual effect of low to moderate significance for affected receptors. While building damage due to ground vibrations is unlikely, there may be annoyance to spatially located receptors during construction and operation and maintenance activities. The overall significance rating of potential residual effects is considered to be negligible.

172. **Socioeconomic and socio-community**. Land use/traffic management concerns will occur spatially during construction. Site-specific mitigation measures will be implemented to address temporary disruption to land use and access, traffic delays and detours, parking modifications, and increased volumes of construction-related traffic. Traffic movement along the alignment will be improved once construction is completed. Since the project will involves the rehabilitation of existing pipelines, it will not be in conflict with the existing or planned land use. However, following improvement in infrastructures and services added residential developments, commercial, and business facilities and increased in population densities are expected to develop and enhance the project area. This can be considered as a long-term cumulative benefit of the project.

173. Upon completion of the project, the socio-community will benefit from improved sewer network collection and wastewater treatment plant. Improvement in sanitation through the rehabilitation of the sewer network and construction of wastewater treatment plant may result to an improvement in public health such as the decrease in the number cases of diarrhea and other water-related diseases in the area. People would spend less on healthcare and lose fewer working days due to illness, so their economic status and overall health will be improved. This is considered a long-term cumulative benefit.

174. **Community and workers' health and safety**. No adverse residual effects to human health will occur as a result of the project construction or operation. Exposure to elevated noise levels and fugitive dust and common air pollutants will occur in proximity to project work sites during construction activities. However, these effects are expected to be short-term, minor and insignificant with no measurable effects on human health

175. Therefore, the project will improve will not result have any negative cumulative impact in the community. The positive cumulative impact of the project will be to alleviate the quality of life of the community by improving the sanitation through the rehabilitation of the sewer network. Also, the water quality and the concentration of pollutants, specifically faecal coliform in the sea outfall will be improved with the construction of the wastewater treatment plant.

VII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

176. Consultation, participation and disclosure will ensure information is provided and

feedback on proposed project design as early as during the project preparation phase, so that views, preferences of stakeholders including potential beneficiaries and affected people can be adequately considered in the project design, and continue at each stage of project preparation, processing, and implementation. It will also provide adequate opportunities for consultation/participation to all stakeholders in the project process. Relevant information about any major changes to project scope shall be shared with beneficiaries, affected persons, vulnerable groups, and other stakeholders.

177. The public participation process included (i) identifying interested and affected parties (stakeholders); (ii) informing and providing the stakeholders with sufficient background and technical information regarding the proposed development; (iii) creating opportunities and mechanisms whereby they can participate and raise their viewpoints (issues, comments, and concerns) with regard to the proposed development; (iv) giving the stakeholders feedback on process findings and recommendations; and (v) ensuring compliance to process requirements with regards to the environmental and related legislation.

A. Public Consultation Conducted

178. The IEE Report was prepared in consultation with stakeholders. Meetings and consultations with relevant Government Departments (are these the implementing and executing agency) were carried out to brief the project approach. Public consultations through Focus Group Discussions (FGDs) with project beneficiaries have been carried out. Issues discussed are:

(i) Awareness and extent of the project and development components;
(ii) Benefits of the subproject for the economic and social improvement of community;
(iii) Labour availability in the subproject locations or requirement of outside labour involvement;
(iv) Local disturbances due to civil works

179. Public consultations were conducted in Kirulapone and Wellawatta area during the site visits and assessment on January-March 2015. The methods for consultation were open meetings, interviews and focus group discussions. A total of 10 households were interviewed, 3 community leaders and 3 female, with a total of 10 participants, who may experience temporary access disruptions during construction activities, shopkeepers/businessmen from the project area. The list of participants in the public consultation are given in Appendix 4.

180. The consolidated response, comments and recommendations of the stakeholders on the project are the following:

(i) Project work should be completed with the shortest possible time as people experience a lot of problems due to the absence of proper septage disposal method such as overflowing of septic tanks during monsoon seasons.
(ii) Inconvenience and traffic disturbances due to construction work in the city should be minimized as much as possible.
(iii) They have a positive feedback concerning their relocation from their present residence near the rail track to UDA high-rise buildings
(iv) Request for the information on the timeline of project and the schedule of the construction activities
(v) Road disturbances should be minimized so as to minimize the loss of income

from mobile vendors
(vi) Most issues are related to the relocation of the families
(vii) Minimize water logging due to construction activities

181. The suggestions, comments, recommendations will be incorporated in the final technical design and environmental management plan of the project.

B. Future Consultation and Disclosure

182. The public consultation and disclosure program with the stakeholders will remain a continuous process throughout the project implementation and will include the following:

183. **IEE Disclosure**. The final IEE report will be disclosed on the ADB website. A Tamil/Sinhala version will be posted in CMC PMU. The IEE report (English and Tamil/Sinhala) and other relevant documents will also be made available at offices of implementing and executing agencies and contractor's office. It will be ensured that hard copies of IEE (Tamil/Sinhala) are kept at places which are conveniently accessible to all stakeholders.

184. For this project, the DSIDC will develop, in close coordination with CMC PMU, a public consultation and disclosure program which is likely to include the following:

(i) Consultation during detailed design:
  (a) Focus-group discussions with local public and other stakeholders (including women's groups, NGOs and community-based organizations) to hear their views and concerns, so that these can be addressed in subproject design when necessary; and
  (b) Structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project ;
(jj) Consultation during construction:
  (a) Public meetings to discuss and plan work programmes and allow issues to be raised and addressed once construction has started; and
  (b) Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;
(iii) Project disclosure:
  (a) Public information campaigns (via newspaper, TV and radio) to explain the project to the wider town population and prepare them for disruption they may experience once the construction programme is underway;
  (b) Public disclosure meetings at key project stages to inform the public of progress and future plans; and
  (c) Formal disclosure of completed project reports by making copies available at convenient locations in the city, informing the public of their availability, and providing a mechanism through which comments can be made.

185. Based on ADB requirements, the following will be posted on ADB website: (i) this IEE upon receipt; (ii) new or updated IEE; (iii) corrective action plan prepared during Project implementation to address unanticipated environmental impacts and to resolve non-compliance to EMP provisions; and (iv) environmental monitoring reports, upon receipt.

VIII. GRIEVANCE REDRESS MECHANISM

186. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate and facilitate the resolution of affected persons (APs) concerns, complaints and grievances about the social and environmental performance at the level of the project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. GRM was also implemented in Project 1 and 2 of the GCWP. Problems encountered from these projects are mostly from the construction activities such as the boat parking space of the fishermen which was amicably settled by the contractors.

187. **Common GRM.** A common GRM will be in place for social, environmental or any other grievances related to the project; the RP and IEE will follow the grievance redress mechanism described below, which is developed in consultation with key stakeholders. The GRM will provide an accessible and trusted platform for receiving and facilitating resolution of affected persons‟ grievances related to the project. The multi-tier GRM for the project is outlined below, each tier having time-bound schedules and with responsible persons identified to address grievances and seek appropriate persons‟ advice at each stage, as required.

188. A Public Awareness Campaign covering project 3 implementing area will ensure that awareness on grievance redress procedures is generated among relevant stakeholders. The responsibility on this task will be within the PMU of the project. The PMU will obtain active involvement of DSIDC consultants of the project. The implementing NGO of other similar party hired for the PMU will ensure that poor and vulnerable households are made aware of grievance redress procedures and entitlements, and will help ensure that their grievances are addressed.

189. APs will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes or through telephone hotlines at accessible locations, e-mail, post, or writing in a complaints register in the CMC district Engineer’s Office Appendix 5 has the Sample Grievance Registration Form). Careful documentation of the name of the complainant, date of receipt of the complaint, address/ contact details of the person, location of the problem area and how the problem was resolved, will be undertaken. The CMC - PMU Social Development/Safeguards Officer will be responsible for timely grievance redressal on environmental and social safeguards issues and responsible for registration of grievances, related disclosure and communication with the aggrieved party.

190. **Grievance Redress Process.** In case of grievances that are immediate and urgent in the perception of the complainant, the contractor and supervision personnel from the PMU/DSIDC on site will provide the most easily accessible contact for quick resolution of grievances. Contact phone numbers and names of the PMU Social Development/Safeguards Officer, DSIDC safeguards specialists, and contractor site engineer will be posted at all constructions sites in visible locations. In tenement gardens, the point of contact will be the contractor/supervision personnel or the project nongovernmental organization (NGO) personnel or other similar party hired for facilitation of social safeguard process that will be involved in community mobilization and awareness generation among such communities. The contractors and supervision personnel of PMU/DSIDC and/or the project NGO or other similar party can immediately resolve issues on site in consultation with each other and will be required to do so within 7 days of receipt of a complaint/grievance. If required, the advice of the District Engineer and/or the concerned Grama Niladhari (GN) officer as well as advice/assistance of PMU Social Development/Safeguards Officer and DSIDC safeguards specialists will be sought, for

resolution of the issue by any one or all of them jointly.

191. All grievances that cannot be redressed within seven days at field level will be jointly reviewed by PMU Social Development/Safeguards Officer and DSIDC safeguards specialists, who will attempt to resolve them within 15 days, enlisting the assistance of the local representative of CEA and other concerned stakeholders, as required. The CMC will have a PMU and PIU, DSIDC Environment Specialist and Resettlement Specialist to facilitate the grievance redress process at different stage.

192. The Project Director will refer major issues to the Grievance Redress Committee (GRC), which will resolve them within 30 days, and very major issues that are beyond the jurisdictional authority of the GRC or those that have the potential to cause/aggravate social divides/conflicts or cause environmental damage, directly to the Program Steering Committee (PSC). Grievances which the GRC is unable to resolve within 30 days will also be referred to the PSC. All paperwork (details of grievances) needs to be completed by the PMU Social Development/Safeguards Officer, facilitated by the social safeguard team of DSIDC, and circulated to the respective GRC and PSC members, at least a week in advance of the scheduled meetings. All decisions taken by the GRC and PSC will be communicated to the APs by the social safeguard officer of PMU.

193. For any issues that remain unresolved by the GRC or PSC, the AP can approach the Police and then the Court of Law, as per Sri Lankan procedure at any time (Figure 8.1).

194. **Composition of GRC and PSC**. The Grievance Redress Committee (GRC) for the project will have the following as members: Relevant Divisional secretary as Chairperson, Project Director, PMU Social Development/Safeguards Officer as the Convener, Social Safeguard Officer of DSIDC , Director of the project NGO or other similar party hired , The Deputy/Assistant Municipal commissioner , the relevant District Engineer of CMC , representatives of APs, Community Based Organizations (CBOs), and eminent citizens. The GRC must have at least two women members.

195. The local representative of CEA and representatives of Road Development Authority (RDA), Provincial Road Development Authority (PRDA), Colombo Municipal Council (CMC) and concerned GN Officers may be invited to GRC meetings as and when required. Presence of at least five members including one AP/civil society representative is necessary for resolutions to be passed.

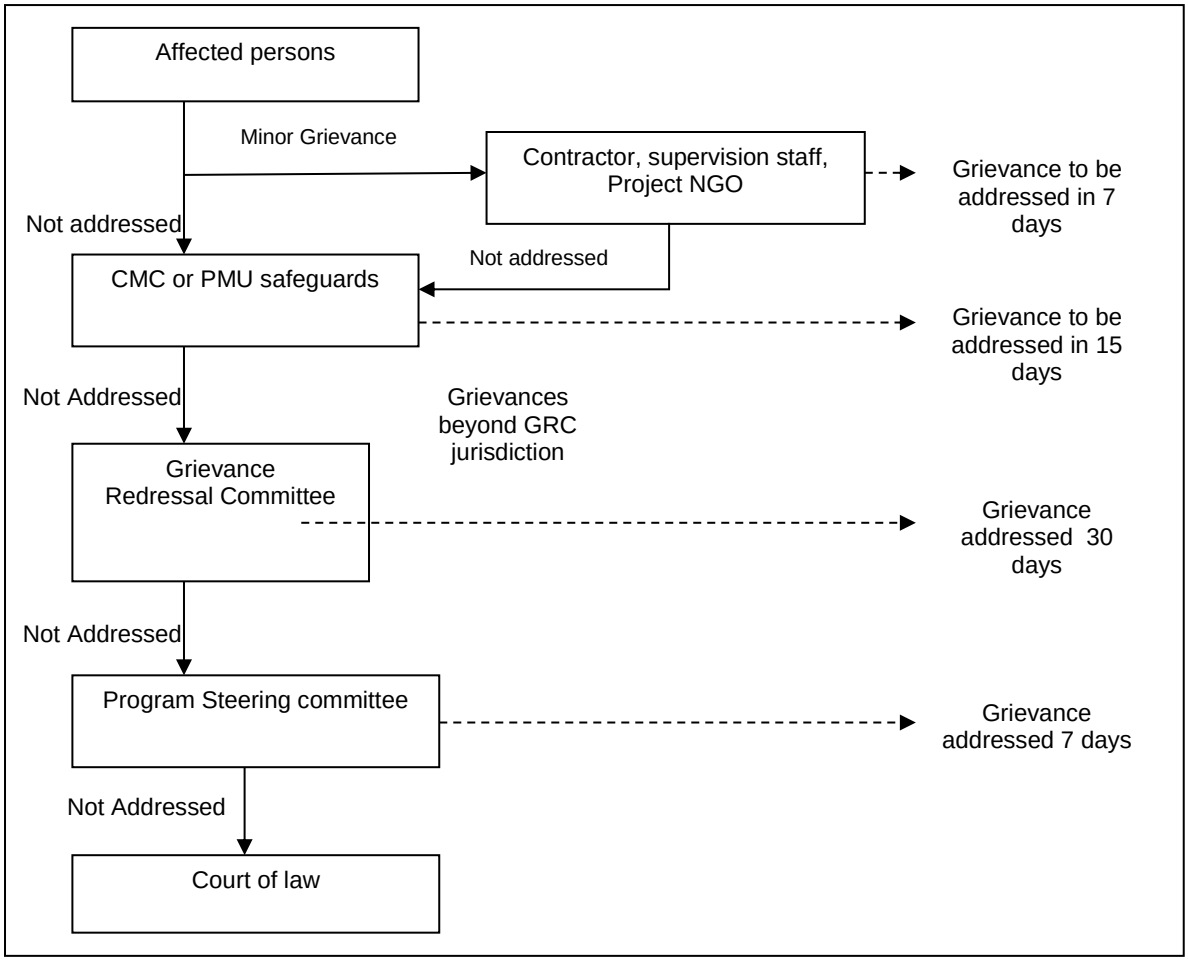
196. The Program Steering Committee for its responsibilities related to grievance redress will have the following as members: Ministry of Finance and Planning (MOFP), with the Secretary to Treasury (ST) as the Chairperson, the Secretary of MPALG&DG and senior officials from Department of External Resources (DER) and Department of National Planning (DNP), NWSDB and CMC. Representatives of concerned government ministries such as Ministry of Land and Land Development, Health etc. may be invited to participate as and when required.

197. **Record-keeping**. Records will be kept by the PMU of all grievances received including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were affected and final outcome. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the offices of the PMU, CMC, CMC District Engineer's Office and web, as well as reported in monitoring reports submitted to ADB on semi-annual basis.

198. **Periodic Review and Documentation of Lessons Learned**. The PMU Social Development / Safeguards Officer will periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the project's ability to prevent and address grievances. Lessons learnt shall be shared with the CEA and Ministry of Land Development as required under the National Involuntary Resettlement Policy (NIRP), 2001.

199. **Costs.** All costs involved resolving the complaints (meetings, consultations, communication and reporting/information dissemination) related to water supply projects will be borne by the CMC-PMU cost estimates. As a lesson learned from the implementation of Projects 1 and 2, it was suggested that remuneration should be given to the GRC during the implementation of GRM.

Figure 8.1: Grievance Redress Process



IX. ENVIRONMENTAL MANAGEMENT PLAN

200. This section presents the mitigation measures, environmental monitoring plant and institutional arrangements to address the environmental impacts of the project. The purpose of the environmental management plan (EMP) is to ensure all activities associated in the project will not result to significant adverse environmental and social impacts.

201. A copy of the EMP must be kept on work sites at all times. This EMP will be included in the bid documents and will be further reviewed and updated during implementation. The EMP will be made binding on all contractors operating on site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set-out in the document constitutes a failure in compliance.

A. Institutional arrangements

202. **Executing and Implementing Agencies**. The executing agency (EA) for Project 3 is the Ministry of Public Administration, Local Government and Democratic Governance (MPALG&DG). The implementing agency is CMC. Project Management Unit (PMU) will be established within the implementing agency, CMC.

203. **The Program Steering Committee (PSC)**. At the central level, a program steering committee (PSC) will be established at the Ministry of Finance and Planning (MOFP), with the Secretary to Treasury (ST) as the chairperson, the Secretary of MPALG&DG and senior officials from the Department of External Resources (DER) and Department of National Planning (DNP), and CMC, as members. The PSC will be the apex decision making body for the Investment Program. The PSC will meet quarterly, review progress, provide policy guidance, resolve inter-agency issues that impede Program progress and advice on necessary action, particularly with respect to scope and cost, and the reform agenda of the Investment Program, and facilitate inter-agency coordination. The PSC will be responsible for: (i) providing sanctions and approvals under the Investment Program; (ii) making all important decisions on the Investment Program implementation; and (iii) ensuring timely Investment Program implementation.

204. For wastewater management investments (sewerage), MPALG&DG will be the executing agency and CMC will be the implementing agency. The CMC- PMU has been established and headed by a full-time project director. The PMU will be responsible for: (i) preparation and implementation of the Investment Program; (ii) management of loan consultants; (iii) disbursement of funds and recover loan repayments; and (iv) conduct overall Investment Program monitoring and evaluation, including preparation of necessary Investment Program reports, with the help of loan consultants.

205. The PMU will also be responsible for implementing and monitoring safeguards compliance activities, public relations activities, gender mainstreaming activities, and community participation activities. The PMU will have a Social Development and Safeguards Officer (SDSO), who will be responsible for safeguards functions. The responsibilities of the SDSO is to: (i) review and approve the project's IEE and EMP; (ii) confirm existing IEE and EMP are updated based on detail designs; (iii) conform whether the EMP are included in bidding documents and civil work contracts; (iv) provide oversight on environmental management aspects of the project and ensure EMP is implemented by contractors; (v) establish a system to monitor environmental safeguards of the project, including monitoring the indicators set out in the environmental monitoring plan of the EMP; (vi) facilitate and confirm overall compliance with all government rules and regulations regarding sire and environmental clearances, as well as any other environmental requirements, as relevant; (vii) review, monitor and evaluate the effectiveness with which the EMP is implemented, and recommend necessary corrective actions to be taken as necessary; (viii) consolidate monthly reports DSIDC and submit semi-annual monitoring reports to ADB; and (ix) ensure timely disclosure of final IEE/EMP in locations and form accessible to the public; (x) address any grievances brought about through the GRM in a timely manner; and (xi) ensure that operation and maintenance (O&M) plans are prepared for the sewer network and wastewater treatment plant are prepared by the contractors prior to the final stage of the works. The monitoring reports will focus on the progress of implementation of the IEE and RP, issues encountered and measures implemented, follow-up actions required, if any, as well as status of compliance with relevant loan covenants.

206. **Design Supervision and Institutional Development Consultant (DSIDC)**. A Design Supervision and Institutional Development Consultant will be engaged to work closely with and advise the PMU, to build capacity on safeguards and to be involved in project supervision of social and environmental safeguards implementation. The DSIDC will have two safeguards - environment management and resettlement specialists. The environment management specilist will (i) ensure design and location of works are selected according to the environmental criteria for project selection; (ii) prepare the project's IEE and EMP; (iii) conduct environmental compliance audit of existing facilities as per item F, Appendix 4 of ADB SPS, 2009; (iv) update

the IEE/EMP during detailed design stage; (v) include EMP in bidding documents and civil work contracts; (vi) ensure all requisite government approvals are in place to allow implementation, and these are renewed in a timely fashion where required; (vii) oversee implementation of EMP during construction, including environmental monitoring of contractors; (viii) take corrective actions when necessary to ensure no environmental impacts; (ix) review monthly reports by contractors and submit monthly environmental monitoring reports to the PMU; and (x) address any grievances brought about through GRM in a timely manner as per IEE. The outline TOR for the DSIDC environment management specialist is attached in Appendix 6.

207. **Contractor:** The contractors for the civil works in the sewer network rehabilitation and WWTP DBO will have an environment supervisor to (i) coordinate with DSIDC on updating the IEE/EMP based on detailed designs, and (iii) and ensure implementation of EMP during civil works.

208. **NGO.** The project NGO, which will be responsible for formation of water user groups in the project area, will also help the CMC- PMU/DSIDC ensure that poor and vulnerable affected persons (APs) in tenement gardens are identified and receive benefits of the project and any entitlements. The NGO will collect and analyze data as required to help the PMU monitor impacts on the poor and vulnerable. The NGO will (i) put forth grievances of APs/vulnerable groups in the project area to the PMU/DSIDC and GRC; (ii) generate awareness about opportunities for employment in project related activities, rights and entitlements, grievance redress process among APs /vulnerable groups, and help them to make informed choices; (iii) assist the PMU in providing assistance to APs in tenement gardens, if required/applicable; (iv) participate in public meetings and consultations as and when required. In addition to the above tasks, the NGO shall: (v) document lessons learnt each year; (vi) identify follow-up actions and campaigns to ensure sustainability of Waste Water (sewerage) User Groups formed; (vii) follow-up on key messages of awareness campaign among tenement garden communities; and (viii) analyze and report on gender impacts of project interventions. The success of NGO inputs will largely depend on their liaison with APs and other concerned government agencies.

209. Organizational procedures/institutional roles and responsibilities for safeguards implementation and steps/activities involved in delivery of entitlements are described in Table 9.1 and Figure 9.1, respectively**.**

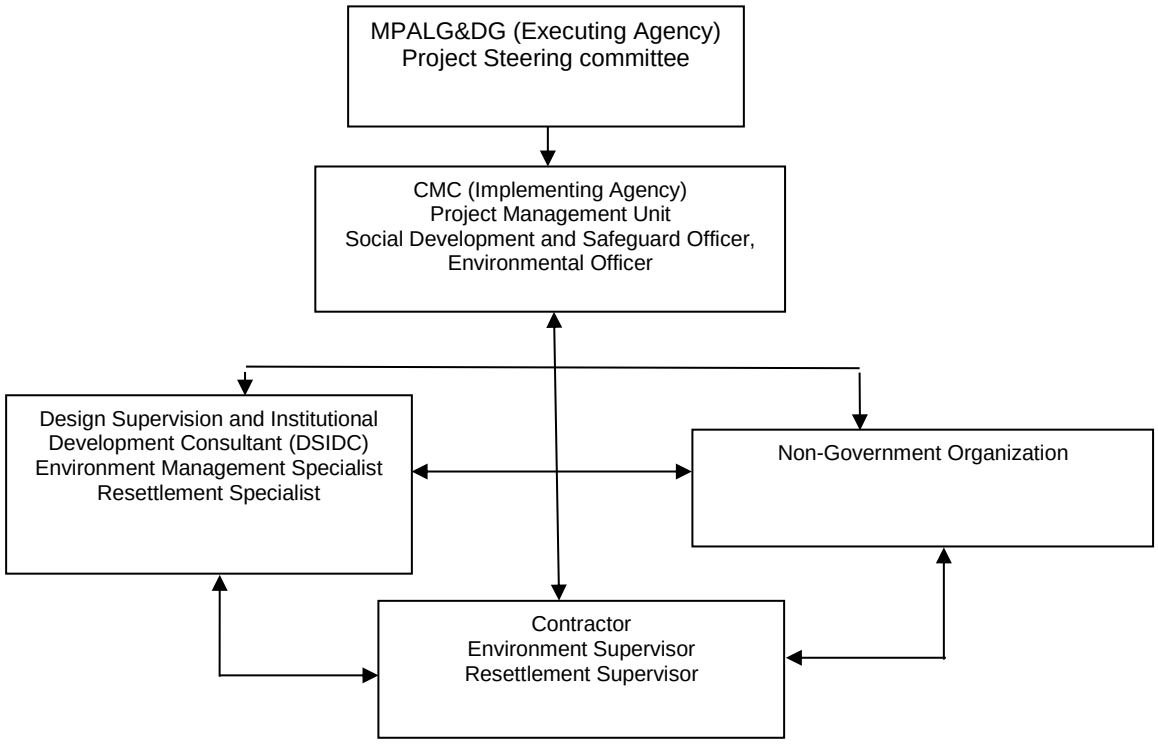
Table 9.1: Institutional Roles and Responsibilities for Safeguards Implementation

Activities	Agency Responsible
Disclosure of proposed project and anticipated social and environmental impacts on website	ADB CMC
Disclosure of proposed project, social/environmental impacts, proposed entitlements/mitigation measures in local languages	CMC
Disclosure of grievance redress mechanism/process	CMC PMU DSIDC NGO
Finalization of sites and alignments	CMC PMU DSIDC
Identification of roads for closure, existing utilities, road conditions	CMC PMU DSIDC
Updating of safeguard documents (IEE and RP) based on detailed design	DSIDC
Review of updated RP/IEE and send to ADB for approval prior to contract award	CMC PMU
Clearance and disclosure of updated safeguard	ADB

Activities	Agency Responsible
documents	CMC
Conducting transect walks through road stretches to identify extent of impacts	DSIDC Contractors[a] NGO
Conducting meetings at community/household level with affected persons (APs)	DSIDC Contractors NGO (in case of road in tenement gardens)
Design/implementation of Detailed Measurement Survey (DMS)[b] on roads for full / partial closure where potential impacts identified; Identification of poor and vulnerable APs	DSIDC NGO
Conducting focus group discussions/meeting/consultation/workshops during DMS and updating safeguard documents	DSIDC
Implementation of mitigation and rehabilitation measures	CMC PMU DSIDC Contractors
Grievance redressal	CMC PMU Grievance redressal committee DSIDC NGO Contractors
Internal monitoring	CMC PMU DSIDC

[a]Contractors for the civil works of the sewer network rehabilitation and for the WWTP DBO
[b]Detailed Measurement Survey to be carried out during detailed design, to record and quantify resettlement impacts and entit

Figure 9.1: Safeguards Implementation Arrangement



B. Capacity Building

210. A training program has been developed to build the capacity of PMU. This will be conducted by DSIDC.

211. PMU and DSIDC will organize an induction course for the training of contractors of the civil works in the sewer network rehabilitation and of the WWTP DBO preparing them on: (i) EMP implementation, including the monitoring of the implementation environmental mitigation measures; and (ii) taking immediate actions to remedy unexpected adverse impacts or ineffective mitigation measures found during project implementation. The contractor will be required to conduct environmental awareness and orientation of workers prior to deployment to work sites. The suggested outline of the training program is presented in Table 9.2

Table 9.2: Indicative Capacity Building and Training Program

Description	Contents	Schedule	Participants
Program 1 Orientation Workshop	**Module 1 – Orientation** **ADB Safeguard Policy Statement** **Sri Lankan policy** **Module 2 – Social/Environmental Assessment and Resettlement Planning/IEE Process** ADB policy and process, identification of impacts and mitigation measures, RP/IEE preparation, implementation, and monitoring requirements. Incorporation of safeguards into project design and contracts	1 day	MPALG&DG and CMC officials involved in project implementation PMU
Program 2 Workshop for Contractors and Supervisory staff	IR/environmental issues during construction Implementation of RP/IEE Monitoring of RP/IEE implementation Reporting Requirements	1 day	PMU Contractors
Program 3 Experiences and Best Practices Sharing	Experiences on RP/IEE implementation – Issues and Challenges - Best Practices followed	1 day on a regular period to be determined by PMU and	PMU Design Supervision and Institutional Development Consultant (DSIDC) Contractors Non-government Organization Central Environmental Authority and Ministry of Land Development representatives

MPALG&DG = Ministry of Public Administration, Local Government and Democratic Governance, CMC= Colombo Municipal Council, PMU= Project Management Unit.
Note: The above sessions will cover both environmental and social safeguards

C. Environmental Management Plan

212. The Environmental Management Plan (EMP) will guide the environmentally sound construction of the project and to ensure efficient lines of communication between PMU, DSIDC,

and contractors. The EMP identifies activities during : (i) site establishment and preliminary activities, including finalizing IEE/EMP; (ii) construction stage; and (iii) post-construction and operation stage of the project. Tables 9.3 to 9.5 outlines the mitigation measures, authority responsible for the implementation and parameters to be monitored. The EMP will be updated by the DSIDC during the detailed design stage. It should be noted that the final IEE/EMP should be reviewed and cleared by CMC and ADB at the time of detailed design and prior to commencement of construction work. Prior to commencement of any civil work, the contractors for both the civil works for the sewer rehabilitation and the construction of the WWTP will submit a compliance report[29] to the DSIDC ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP are implemented

D. Environmental Monitoring Plan

213. **Environmental monitoring program**. Table 9.6 shows the proposed environmental program for the project. It includes all relevant parameters, location, responsibility of mitigation and monitoring, method and frequency of monitoring.

214. **Reporting**. Regular reporting on the implementation of the mitigation and monitoring activities during construction phase of the project are required by ADB. The contractor for the civil works of the sewer network rehabilitation will submit monthly monitoring reports to CMC PMU. Also, the WWTP DBO contractor should submit progress report upon completion of the detailed design and monthly monitoring report during construction activities to CMC PMU. The CMC PMU, with the assistance of the DSIDC will submit semi-annual monitoring report to ADB.

215. During operation and maintenance phase: (i) CMC will prepare the monthly monitoring report on the operation and maintenance phase of the sewer network; and (ii) prior to the complete transfer of operation of the WWTP to CMC, the DBO contractors will prepare monthly monitoring reports to be submitted to CMC. CMC will then submit the annual monitoring report on the operation and maintenance of the sewer network and the wastewater treatment plant to ADB.

[29] The compliance report will include information on (i) barricades and warning signs; (ii) area for setting up of construction camps; (iii) methodology for surveys; (iv) area for establishing lay-down and storage; (v) sources of materials; (vi) records of environmental awareness, safety training, and orientation of workers prior to deployment of work sites; (vii) contact information of the environmental and resettlement supervisors; and (viii) construction method statement.

Table 9.3: Anticipated Impacts and Mitigation Measures: Pre-construction Phase

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
Legislation, permits, and agreements	Non-compliance to the necessary permits required such as the CCD, AIA, EPL, and permit for sea disposal of the effluent from MPPA.	The CMC PMU and DSIDC will ensure that all necessary permits required for the project are secured prior to the award of civil works and DBO contract	CMC PMU DSIDC prior to the award of construction and WWTP DBO contract	All applicable permits and approval
Technical design for the rehabilitation and construction of sewerage networks	Non-compliance to the technical design applicable international and national guidelines on routing and sizing of sewer pipelines	(i) Avoid sewer pipe alignments that will result in destruction/disturbance to historical and cultural places/values. (ii) Ensure sewer pipes are laid with adequate and vertical clearance from water supply pipelines. (iii) Use low-noise pumps and motors in the pump houses. (iv) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replace if broken to minimize entry of garbage and silt into the system (v) Equip pumping stations with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages.	CMC PMU and DSIDC will ensure that the measures are incorporated in the final design prior to the award of the civil works contract for the rehabilitation and construction of the sewerage networks	Design and routing for the rehabilitation and construction of sewerage networks
Construction work camps, stockpile areas, storage and disposal areas	Disruption to traffic flow and disturbances to access roads	(i) Prioritize areas within or nearest possible vacant spaces in the location of the project (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems; (iii) Do not consider residential areas; and (iv) Take extreme care in selecting sites to avoid direct disposal to water body which will directly affect nearby communities	CMC PMU DSIDC prior to the award of construction contract	List of selected sites for construction work camps, stockpile areas, storage and disposal areas
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution	(i) Priority would be given to sites already permitted by the Geological Survey and Mines Bureau. (ii) If other sites are necessary, these would to be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage systems; and in structurally stable areas even if some distance from construction activities. (iii) It will be the construction contractor‘s responsibility to verify the suitability of all material sources and to obtain the approval and/or permit from Geological Survey and Mines Bureau and/or procure materials from licensed	CMC PMU DSIDC Contractor Prior to the award of construction contract	List of approved quarry sites and sources of materials; Bid documents to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		sources/traders.		
Technical design of the WWTP	Non-compliance to the technical specifications and standards applicable for a WWTP.	Environmental considerations will be incorporated in the technical specifications, such as: (i) Design parameter will be based on the effluent quality of the domestic wastewater (sewage) in the south catchment area of Colombo. (ii) Use low-noise pumps and motors in the pump houses. (iii) Equip the WWTP with a backup power supply to ensure uninterrupted operation during power outages. (iv) Cover emission points (e.g., aeration basins, clarifiers, sludge thickeners, tanks, and channels), and vent emissions to control systems (e.g., compost beds, biofilters, chemical scrubbers, etc.) as needed to reduce odors and otherwise meet applicable national requirements and internationally accepted guidelines. (v) Provide adequate buffer area, such as trees, or fences, between processing areas and potential receptors. (vi) Treated sludge quality for land application should be consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater and applicable national requirements. (vii) Disposal sites for the sludge and solid waste generated from the operation of the WWTP should be identified prior to construction activities	CMC PMU and DSIDC prior to the award of the DBO contract	Technical design of the WWTP Accredited disposal sites for the waste generated from the operation of the WWTP (i.e. screenings, sludge, hazardous waste) should be identified.

Table 9.4: Anticipated Impacts and Mitigation Measures: Construction phase

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
Air Quality	(i) Dust generation is usually caused by a combination of on-site excavation and movement of earth materials, contact of construction equipment and machinery with bare soil, and exposure of bare soil and soil piles to wind. (ii) Excavation and backfilling works will also give rise to the increase in ground	(i) Consult with design consultants on the designated areas for stockpiling of soil, gravel, and other constructed materials; (ii) Excavate foundations at the same time as the access roads are built so that dug material is used immediately, avoiding the need to stockpile on site; (iii) Damp down exposed soil and any sand stockpiled on site by spraying with water when necessary during dry weather; (iv) Truck carrying sands, soil, stone, and other loose materials should be covered with tarpaulin; (v) Open burning of solid wastes will be prohibited on the	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Location of stockpiles; (ii) Complaints from public and affected persons; (iii) Heavy equipment and machinery with air pollution control devices; (iv) Details of water spraying for dust suppression; (v) Vehicles' certification on compliance to emission standards

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
	level concentration of total suspended particulate matter (TSP). (iii) Secondary sources of emission may include exhaust from vehicles and equipment (such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides and hydrocarbon)	construction sites; and (vi) Vehicles and equipment used during construction must be properly maintained and in good condition to ensure optimal performance. Also, all vehicles and equipment used in the construction activities shall have valid certifications indicating compliance to vehicle emission standards		
Water Quality	(i) Water sources are susceptible to pollution from run-off or soil erosion from stockpiled construction materials and spoils, domestic sewage from construction workers, accidental spillage of oil and other lubricants, wastewater from washing of construction equipment and vehicles and improper disposal of construction wastes. (ii) Wastewater are likely to cause deterioration of surface water quality, flooding and flow obstruction of watercourses, including drainage and irrigation canals	(i) Minimize spoil by balancing cut and fill wherever possible. Spoil shall only be disposed to areas approved by local authority; (ii) Impacts due to soil erosion will be mitigated by careful grading of the construction site such that water is not allowed to run off of the construction site into adjacent drainages. Where excavated soils are onsite, adequate measures will be implemented to control runoff, including covering exposed soils, construction of settling basins, or temporary silt traps along the drainage leading to water bodies; (iii) All earthworks must be conducted during the dry season to prevent the problem of soil run-off during monsoon season; (iv) Implementation of solid waste and construction waste collection and disposal system, with provision for waste segregation; (v) Provision on adequate on-site sanitation facilities with septic tanks to prevent untreated sewage from being channeled into the drainage canals, irrigation canals, and river; (vi) Place storage areas for fuels and lubricants away from any drainage leading to water bodies. Designate area for equipment and vehicle washing and maintenance. The area should be provided with oil and grease traps to prevent oil from being washed into drainage canals.	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Areas for stockpiles storage of fuels and lubricants and waste materials (ii) Number of silt traps installed along drainage leading to water bodies (iii) Surface water quality inspection and effectiveness of water quality management measures
Noise and vibration	(i) The major sources of noise and vibration are from the operation of pile drivers, earth moving and excavation equipment,	(i) Planning activities in consultation with the CMC PMU/DSIDC and with the community leaders so that activities with the greatest potential to generate noise and vibration are planned during periods of the day that will result in least disturbance;	Contractors (civil works for the sewer network rehabilitation and construction of	(i) Complaints from stakeholders; (ii) Use of silencers/mufflers on noise-producing equipment

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
	concrete mixers, cranes; and transporting equipment, materials and people. (ii) Noise and vibration from the construction activities may cause disruption and nuisance to nearby community and other sensitive receptors (i.e. school, hospitals, place of worship). (iii) Also, noise and vibration due to the movement of vehicles along the access road may potentially result to nuisance. (iv) Vibration from the construction activities may also cause damage to other structures and buildings in the project area	(ii) Noisy construction activities will be avoided during night time and religious or cultural events; (iii) All construction equipment and vehicles shall be well maintained, regularly inspected for noise emissions, and shall be fitted with muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations; (iv) Impose speed limits on construction vehicles to minimize emissions along areas where sensitive receptors are located (i.e. temples, hospitals, schools, houses) (v) Truck driver and equipment operators shall avoid the use horns unless it is necessary to warn other road users or animals of the vehicle's approach; (vi) Identify any buildings at risk from vibration damage and avoiding any pneumatic drills or heavy vehicles in the vicinity. Complete the civil works in these areas as quickly as possible	WWTP)	(iii) Noise generated should be within applicable national and international standards (iv) Speed limits of construction vehicles (v) List of building at risks from vibration in the project area (if applicable).
Quarry and Borrow Sites/Sources of Materials	Extraction of rocks and materials may cause ground instability	(i) Utilize readily available sources of materials. If contractor procures materials from existing borrow pits and quarries, ensure that these conform to all relevant regulatory requirements; (ii) Borrow areas and quarries (if these are being opened up exclusively for the project) must comply with environmental requirements, as applicable. (iii) If additional quarries will be required after construction has started, obtain written approval from CMC PMU; and (iv) Submit to DSIDC on a monthly basis the documentation of sources of materials	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	Contractor's documentation or report on the sources of materials
Generation of Construction Wastes	Improper waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape.	(i) Prepare and implement Waste Management Plan including a facility diagram showing the storage location of stockpiles, equipment and other waste materials (ii) Construction materials and stockpiles of soils should be covered to reduce material loss; (iii) Stockpiles, lubricants, fuels, and other materials should be located away from steep slopes and water bodies;	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Waste management plan (ii) Complaints from stakeholders (iii) CMC PMU/DSIDC to report in writing that the necessary environmental work has been adequately performed

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		(iv) Avoid stockpiling any excess spoils. Excess excavated soils should be dispose to approved designated areas; (v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; (vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed in disposal sites approved by local authorities; (vii) Prohibit burning of construction and domestic waste; (viii) Ensure that wastes are not haphazardly dumped within the project site and adjacent areas. (ix) Request CMC PMU/DSIDC to report in writing that the necessary environmental restoration workshop has been adequately performed before acceptance of work		before acceptance of work.
Surface and Groundwater	Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids	To ensure that water will not pond in pits and voids near subproject location, the construction contractor will be required to conduct excavation works during non-monsoon season.	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	Timeline/schedule of construction activities
Biological Environment	There are no trees in the site. Flora and fauna are those commonly found in urban and developed areas. There are no adjacent water bodies	If during project implementation, there will be cutting of trees or removal of vegetation, compensatory plantation for trees lost at a rate of two trees for every cut tree. Special attention shall be given to protecting giant old trees and locally important trees (with religious importance) during implementation	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	Number of trees to be cut/remove and removal of vegetation (if applicable).
Historical, Archaeological, Paleontological, or Architectural sites	Potential finds with historical, archaeological and paleontological importance in the project area.	A Chance Discovery Procedure will be implemented based on the AIA.	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	Implementation of the chance discovery procedure in the AIA
Accessibility	Traffic problems and conflicts near project locations and haul road. Also, exposing the local community to risk of injury or accidents	(i) Prepare and implement a Traffic Management Plan (ii) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; (iii) Schedule transport and hauling activities during non-peak hours; (iv) Locate entry and exit points in areas where there is low	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Traffic Management Plan (ii) Complaints from stakeholders (iii) Number of signages, warning boards and diversion boards posted in the location of the

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		potential for traffic congestion; (v) Keep the site free from all unnecessary obstructions; (vi) Avoid full street closure as much as possible; (vii) Laying of pipelines, backfilling and temporary reinstatement shall follow trench excavation as quickly as possible and trenches will not be left open for extended periods; (viii) The contractor should require all drivers to lower speeds when passing through built-up and residential areas; (ix) Coordinate with Traffic Police for temporary road diversions and for provision of traffic aids if transportation activities cannot be avoided during peak hours. (x) Consultation with the affected business owners (mobile vendors, wheel parks, small shops, public and private institutions) on the schedule of civil works; (xi) Provide sign boards, warning boards and diversion boards during construction time of the approach road		project
Damage to infrastructure	(i) Damage to existing roads, irrigation and drainage canals adjacent to the construction sites. (ii) Also, temporary stalls located in sewerage network rehabilitation and improvement may be damaged during the relocation of mobile vendors and hawkers.	(i) No overloading of trucks used for the transport of materials; and (ii) Repair damaged infrastructure from the transport of materials and other construction activities. These infrastructures should be reinstated to their original condition upon completion of construction works; (iii) Affected mobile hawkers and vendors will be assisted and/or compensated for any damaged infrastructure and/or loss of income as a result of the construction activities	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	Complaints from stakeholders
Occupational health and safety	Construction activities may cause harm and danger to the lives and welfare of workers	(i) Prepare occupational health and safety plan (OHSP) which will be part of the contractor's contract documents. The occupational safety plan should have provisions on (a) providing personnel protective equipment (PPE) like hard hats, safety gloves, ear mufflers to all workers; (b) providing occupational health and safety (H&S) training to all workers; (c) documenting safety procedures to be followed for all construction site activities ; including provisions on penalties and sanctions for non-compliance (d) maintaining records of accident and the corrective actions implemented; and (e) emergency response plan during fire, earthquake and other incidents; (ii) First-aid facilities should be present in the project area and at least one safety and health officer should be	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Site-specific occupational health and safety plan (OHSP); (ii) Equipped first-aid stations (iii) Medical insurance coverage of workers (iv) Number of accidents (v) Supplies of potable drinking water (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		assigned in the construction area ; (iii) Provide medical insurance coverage for workers; (iv) Secure all installations from unauthorized intrusion and accident risks; (v) Provide adequate, portable or permanent sanitation facilities serving all workers; (vi) Provide supplies of potable drinking water; (vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (ix) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazardous areas unescorted; (x) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (xi) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and (xii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than eight hours per day without hearing protection. The use of hearing protection shall be enforced actively		(vii) Record of H&S orientation and trainings (viii) Personal protective equipment (ix) % of moving equipment outfitted with audible back-up alarms (x) Sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal
Community, Health and Safety	Construction activities may expose the communities to risks such as unintentional and intentional trespassing resulting to contact with hazardous materials, contaminated soils and other environmental media, or excavations and structures which may pose falling and entrapment hazards	(i) The contractor should prepare a Community Health and Safety Plan (CHSP) which should be developed in consultation with the affected communities and local authorities. The CHSP should include specific emergency response procedures and preparedness, communication systems and protocols, interaction with local emergency and health authorities and provision of emergency service vehicles. (ii) Restrict access to the construction site, through a combination of institutional and administrative controls, including fencing and appropriate warning signage. (iii) Providing security personnel in construction areas, if	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Community Health and safety plan (ii) Complaints from stakeholders (iii) Enclosure/fencing in the project area and appropriate warning signage (iv) Employment record

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		needed. (iv) Posting information boards/signage about public safety hazards and emergency contact information; (v) Members of the local community will be given priority for employment in the construction activities. This will have the added benefit of avoiding social problems usually encountered when workers are sourced from other provinces. (vi) Workers need to be aware of the following general rules: (a) no alcohol/drugs on-site; (b) prevent excessive noise; (c) no illegal activities such as, but not limited to gambling, and hunting farm animals in the area; (d) trespassing on private/commercial properties adjoining the site is forbidden; (e) workers are not allowed to be loitering in the project area		
Work Camps	Operation of work camps can cause temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants	(i) Consult with DSIDC/CMC PMU before locating project offices, sheds, and construction plants; (ii) Minimize removal of vegetation and disallow cutting of trees; (iii) Provide water and sanitation facilities for employees; (iv) Prohibit employees from poaching wildlife and cutting of trees for firewood; (v) Train employees in the storage and handling of materials which can potentially cause soil contamination; (vi) Recover used oil and lubricants and reuse or remove from the site; (vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (viii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and (ix) Request DSIDC/ CMC PMU to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work	Contractors (civil works for the sewer network rehabilitation and construction of WWTP)	(i) Complaints from stakeholders (ii) Water and sanitation facilities for employees (iii) CMC PMU/DSIDC report in writing that the camp has been vacated and restored to pre-project conditions

Table 9.5: Anticipated Impacts and Mitigation Measures: Operation Phase

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
Sewer Networks				
Routine	The main operations and	(i) Develop and implement operation and maintenance	CMC and O&M	Operation and maintenance

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
operations and maintenance	maintenance (O&M) activities of the rehabilitated pipes will be detection and repair of leaks and pipe bursts resulting to water and sewage overflow	(O&M) plans for the sewer network and wastewater treatment plant (ii) As a minimum, the O&M plan should specify (a) cleaning procedures and frequency; (b) responsible personnel; (c) maintenance and repairs schedule; (d) emergency contact details (i.e. address, telephone numbers); and	Contractor	plan Complaints from stakeholders
Occupational Health and Safety	Operation and maintenance of the sewer network may cause harm and danger to the lives and welfare of workers	(i) Comply with the applicable labor law and EHS guidelines in Sri Lanka; (ii) Prepare occupational health and safety plan (OHSP) which should be based on the International Finance Corporation (IFC) Water and Sanitation Environment Health and Safety (EHS) Guidelines. The occupational safety plan should have provisions on (a) providing personnel protective equipment (PPE) like hard hats, safety gloves, ear mufflers to all workers; (b) providing occupational health and safety (H&S) training to all workers; (c) documenting safety procedures to be followed for all construction site activities including provisions on penalties and sanctions for non-compliance; (d) maintaining records of accident and the corrective actions implemented; and (e) emergency response plan during fire, earthquake and other incidents; (iii) First-aid facilities should be present in the project area and at least one safety and health officer should be assigned in the construction area ; (iv) Provide medical insurance coverage for workers; (v) Provide adequate, portable or permanent sanitation facilities serving all workers; (vi) Provide supplies of potable drinking water; (vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (ix) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (x) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with	CMC and O&M Contractor	Operation and maintenance plan Complaints from stakeholders

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and (xi) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than eight hours per day without hearing protection. The use of hearing protection shall be enforced actively		
Community Health and Safety	The operation of the sewer network may potentially subject the members of the community to risks and hazards such as accidental fall to open trench during repair and maintenance works and trespassing on the location of pumping station	(i) Restrict access to the construction site, through a combination of institutional and administrative controls, including fencing and appropriate warning signage; (ii) Providing information boards, signage about public safety hazard and emergency contact information	CMC and O&M Contractor	Operation and maintenance plan Complaints from stakeholders Signage and perimeter fence for the enclosure of pumping stations
Wastewater Treatment Plant				
Routine Operation and Maintenance	Sewage outflow and overloading capacity of the WWTP	(i) Develop and implement operation and maintenance (O&M) plans for the wastewater treatment plant (ii) As a minimum, the O&M plan should specify (a) cleaning procedures and frequency; (b) responsible personnel; (c) maintenance and repairs schedule; (d) sludge management; and (iii) The water quality of the influent and effluent water should be regularly monitored; (iv) Sludge management for the final treatment and/or disposal of sludge	WWTP Operations and Maintenance Contractor	Operation and maintenance plan Complaints from stakeholders Sludge Management Plan
Air Quality	The sources of air pollution from the operation and maintenance of the wastewater treatment plant are from the operation of diesel-powered generators and nuisance from odor that may result from the accumulation of scum in the wastewater treatment plant	(i) Monthly monitoring of air quality parameters for the operation of diesel-powered generators; (ii) Ensure scum is appropriately removed, disposed or properly stabilized; (iii) The perimeter of the wastewater treatment plant should be vegetated with trees and plants as a buffer from the odor; and (iv) Regular monitoring of the water quality of the influent to avoid overloading the capacity of the treatment plant	WWTP Operations and Maintenance Contractor	Monthly report for air and water quality
Generation of solid waste and sludge management	Wastes generated from the operation of the wastewater treatment plant are screenings, grit, scum, sludge, biosolids	(i) On-site pretreatment (dewatering and drying) of sludge is required prior to disposal (ii) DBO contractors to assess possible reuse of dewatered sludge and dried sludge (e.g. soil conditioning, organic	WWTP Operations and Maintenance Contractor	(i) Sludge and Waste Management Plan (ii) Complaint from stakeholders

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
	and hazardous waste from the chemicals used in the chlorination process of the wastewater treatment plant. Impacts from the inadequate sludge management may result to: (i) groundwater and/or water quality contamination especially on the occurrence of strong rains; (ii) odor or nuisance; (iii) vermin or the presence of insects, mosquitoes within the facility; and (iv) chemical spill.	fertilizer, etc.) (iii) All disposal sites for screenings, sludge and hazardous waste should be identified prior to commissioning activities (iv) Screenings, grit and scum should be removed on a regular basis and properly stored in covered containers pending collection for final disposal (v) Sludge should be properly stored in a covered area before being collected by an accredited sludge treatment facility for its final disposal (vi) Hazardous waste such as the chemicals used in the chlorination process should be stored in cool, dry and dark conditions for no more than a month (or as stated in the Material Safety Data Sheet) and use containers with are corrosion-resistant		
Occupational Health and Safety	For the operation of the wastewater treatment plant, physical contact with the septage exposes the workers to the risk of bacteriological contamination.	(i) Comply with the applicable labor law and EHS guidelines in Sri Lanka; (ii) Prepare occupational health and safety plan (OHSP) which should be based on the International Finance Corporation (IFC) Water and Sanitation Environment Health and Safety (EHS) Guidelines. The occupational safety plan should have provisions on (a) providing personnel protective equipment (PPE) like hard hats, safety gloves, ear mufflers to all workers; (b) providing occupational health and safety (H&S) training[32] to all workers; (c) documenting safety procedures to be followed for all construction site activities ; including provisions on penalties and sanctions for non-compliance (d) maintaining records of accident and the corrective actions implemented; and (e) emergency response plan during fire, earthquake, chemical spills and other incidents;	WWTP Operations and Maintenance Contractor	(i) Site-specific occupational health and safety plan (OHSP); (ii) Equipped first-aid stations (iii) Medical insurance coverage of workers (iv) Number of accidents (v) Supplies of potable drinking water (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances (vii) Record of H&S orientation and trainings (viii) Personal protective

[32] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include(i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; (v) legislation and responsibilities; and (vi) prevention of malaria, diarrhea, HIV/AIDS). Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Parameters to be monitored
		(iii) First-aid facilities should be present in the project area and at least one safety and health officer should be assigned in the construction area ; (iv) Provide medical insurance coverage for workers; (v) Provide adequate, portable or permanent sanitation facilities serving all workers; (vi) Provide supplies of potable drinking water; (vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (ix) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; (x) Ensure that workers are properly and adequately oriented on the proper handling of hazardous chemicals used in the chlorination process; (xi) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than eight hours per day without hearing protection. The use of hearing protection shall be enforced actively		equipment (ix) Sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal
Community Health and Safety	Trespassing in the WWTP.	(i) Restrict access to the construction site, through a combination of institutional and administrative controls, including fencing and appropriate warning signage; (ii) Providing information boards, signage about public safety hazard and emergency contact information (iii) Provide visitor information if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazardous areas unescorted	WWTP Operations and Maintenance Contractor	(i) Community Health and Safety Plan (ii) Complaints from stakeholders (iii) Signage and perimeter fence in the WWTP

Table 9.6: Environmental Monitoring Plan

Parameters to be Monitored	Location and method of monitoring	Schedule/Frequency	Responsibility
Pre-Construction			
Completion of the detailed design of the project in accordance to applicable national and international guidelines both for the sewer network rehabilitation and construction of WWTP	Review of detailed design documentation	Prior to the awarding of contract for the civil works of network rehabilitation and DBO contract of the WWTP	CMC PMU
Legislation permits and agreements	Checking for expiry of permits	Prior to the awarding of contract for the civil works of network rehabilitation and DBO contract of the WWTP	CMC PMU
Construction work camps, stockpile areas, storage and disposal areas	Checking of records	Prior to the awarding of contract for the civil works of network rehabilitation and DBO contract of the WWTP	CMC PMU
Sources of Materials	Checking of records	Prior to project implementation	CMC PMU
Updated IEE	Review of the disclosure of the updated IEE (if necessary) based on the final detailed design of the project	Upon completion of the detailed design	CMC PMU
Construction Phase			
Implementation of the construction phase environmental mitigation measures specified in Table 9.4.	Visual inspection Checking of records	Monthly and continuous throughout the project construction	DSIDC
Review of the contractor's occupational health and safety (OHS) plan	Review and approval of the OHS plan Monitor the implementation of OHS plan	Review the OHS plan before the start of the construction activities Quarterly	DSIDC
Review of the contractor's Community Health and Safety (CHS) Plan	Review and approval of the CHS plan Monitor the implementation of CHS plan	Review the OHS plan before the start of the construction activities Quarterly	DSIDC
Operation and Maintenance			
Routine operation and maintenance measures in the sewer network as specified in Table 9.5	Visual inspection Checking of records	Weekly	CMC

Parameters to be Monitored	Location and method of monitoring	Schedule/Frequency	Responsibility
Routine operation and maintenance and mitigation measures of wastewater treatment plant and in Table 9.5	Visual inspection Water quality testing of effluents	Weekly	Operation and maintenance contractor of the WWTP

E. Environmental Management Plan Costs

189. The contractor's cost for site establishment, preliminary activities, construction, defect liability activities, and environmental mitigation measures related to EMP implementation during planning, design, and construction will be incorporated into the contractual agreements and engineering costs, which will be binding on him for implementation. The survey will be conducted by the contractor.

190. The operation phase mitigation measures are again of good operating practices, which will be the responsibility of the implementing agency (CMC), PMU, DSIDC, and the WWTP operation and maintenance contractor. All monitoring during the operation and maintenance phase will be conducted by CMC and included in DBO contract for the WWTP; therefore, there are no additional costs.

191. The activities identified in the EMP mainly include site inspections and informal discussions with workers and local community, and this will be the responsibility of PMU with the assistance of DSIDC, costs of which are part of project management.

192. Table 9.7 presents the estimated cost to implement the EMP.

Table 9.7: Indicative Cost for EMP Implementation

Component	Description	Number	Cost per Unit (USD)	Cost (USD)	Source of Funds
Legislation, permits, and agreements both for the civil works of the sewer rehabilitation and the construction of the WWTP	**Sewer Network Repair and Rehabilitation**: Permit for excavation, permit from Coast Conservation Department, permit from Geological Survey and Mines Bureau, excavation permit from the Minister of Cultural and Religions Affairs, written consent from the Central Environment Authority, tree-cutting permits, permit for use of non-explosive/chemical blasting for rock breaking (excavation permit to be obtained from (i) Department of Archaeology for excavation works of more than 500 m in length; (ii) police office; (iii) Road Development Authority (RDA) for excavation of roads belonging to RDA; and (iv) CMC for excavation of roads belonging to CMC) Construction of WWTP. In addition to the required permits for the excavation works, the following permits are required for the project: EPL permit from CEA Permit for sea disposal from MPPA of the effluent of the WWTP	As required	Not Applicable	Not Applicable	These consents are to be obtained by contractor at his own expense.
Public consultations and information disclosure	Information disclosure and consultations during preconstruction and construction phase, including public awareness campaign through media	As per requirement	Lump sum	$150,000	Covered under DSIDC contract, NGO, and media packages
Capacity building	(i) Orientation workshop for the MUD&WSD and NWSDB officials involved in the project implementation on ADB Safeguards Policy Statement, Sri Lankan Environmental Laws and Regulations, and environmental assessment process; (ii) induction course for the training of contractors, preparing them on EMP implementation	Three modules, 1 day per module	$500 per module per tranche	$3,000	Covered under DSIDC contract

Component	Description	Number	Cost per Unit (USD)	Cost (USD)	Source of Funds
	and environmental monitoring requirements related to mitigation measures; and taking immediate actions to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation; and (iii) Lessons learned information sharing				
Providing access to commercial establishments and properties	Providing access, in case of access disruptions, to affected properties	As per requirement	Contractor's liability	Not applicable	Covered under engineering design and cost – contractor
Dust suppression at work sites	Application of dust suppression measures during construction phase	As required	Contractor's liability	$5,000	Covered under engineering design and cost – contractor
Traffic management	Safety signboards, delineators, traffic regulation equipment, flagmen, temporary diversions, etc.	Wherever required throughout the project corridor	Contractor's liability	Not applicable	Covered under engineering design and cost – contractor
Baseline monitoring for noise	Once before start of construction works at specified corridor per work day	Two samples (daytime and nighttime) per work day	$100 per sample	$200 for each work area per start of excavation	Covered under engineering design and cost – contractor
Construction monitoring for noise	Ongoing at two locations near pipe replacement corridors	Portable noise meters	Contractor's liability	Not applicable	Covered under engineering design and cost – contractor
Surveys and environmental parameters – linear works	Ongoing before start of construction work along pipe replacement corridors	Lump sum	Contractor's liability	$5,000	Covered under engineering design and cost – contractor
Surveys and environmental parameters analysis – DBO contract	Pre-construction (baseline conditions, water quality including near shore, air quality, noise level)	Lump sum	Cost per sample to be determined during detailed design	$10,000	Covered under DBO contractor
	Construction – noise level, ambient air quality, vehicle emissions, air pollutants at point sources (e.g., diesel generator sets)	Lump sum	Cost per sample to be determined during detailed design	$10,000	Covered under DBO contractor
	O&M – water quality near-shore, recreational areas, inlet and at junction box. Ambient air quality from diesel generator sets.	Annual	Cost per sample to be determined during detailed design	$10,000	Covered under DBO contractor
Any unanticipated impact due to project	Mitigation of any unanticipated impact arising during construction phase and	Lump sum	Contractor's liability	As per insurance requirement	Covered under engineering design

Component	Description	Number	Cost per Unit (USD)	Cost (USD)	Source of Funds
implementation	defect liability period				and cost – contractor's insurance

X. FINDINGS AND RECOMMENDATIONS

193. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Greater Colombo Water and Wastewater Management Improvement Program. Potential negative impacts were identified in relation to construction and operation of the proposed infrastructure. Mitigation measures have been developed in generic way to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

194. No impacts were identified due to location of project components. No land acquisition is required for the subproject. However, the location for the development of sewage network collection and rehabilitation will involve relocation of some families to the UDA high-rise buildings. The mitigation measures and compensation associated to their relocation is discussed in details in the resettlement plan (RP) of the project. During the construction phase, impacts mainly arise from the disturbance traffic and due to disposal of small quantity of debris and soil. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation.

195. During the construction phase, the anticipated impacts on the physical and biological environment are temporary, localized and can be easily avoided or minimized with the implementation of mitigation and monitoring measures which are detailed in the environmental mitigation plan (EMP) and environmental monitoring plan (EMoP), respectively.

196. In the operational phase, all facilities and infrastructure will operate with routine maintenance, which should not affect the environment. Facilities will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period. For the wastewater treatment plant, the contractor will be responsible a sludge management program will also be implemented to ensure that the final disposal of the sludge will be in compliance with applicable environmental standards. The contractor of the wastewater treatment plant will be responsible during the operation and maintenance for a period of 15 years and then it will be transferred to the supervision of the CMC.

197. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures in the EMP are implemented and to determine whether the environment is protected as intended. This will include observations on- and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the CMC PMU.

198. Therefore the subproject is unlikely to cause significant adverse impacts. The positive impacts are (i) improvement in sanitation from the rehabilitation of the sewer network may result to an improvement in public health such as the decrease in the number cases of diarrhea and other water-related diseases in the area; and (ii) water quality and the concentration of pollutants, specifically faecal coliform in the sea outfall will be improved with the construction of the wastewater treatment plant.

199. Finally, stakeholders were involved in developing the IEE through face-to-face discussions and on site meeting held in the city, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at

public locations in the city and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

XI. CONCLUSIONS

200. The subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the implementation of the recommended mitigation measures and procedures in the EMP. This IEE will be updated, if necessary upon completion and finalization of the technical design of the Project.

201. Based on the findings of the IEE, the classification of the Project as Category B is confirmed, and no further special study or detailed Environmental Impact Assessment (EIA) needs to be undertaken to comply with ADB's SPS (2009).

Appendix 1: Rapid Environmental Assessment Checklist for Sewage treatment

Country/Project Title:	SRI: Greater Colombo Water and Wastewater Management Improvement Program (Project 3)-Wastewater Improvement Project
Sector Division:	South Asia Urban Water (SAUW)

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area…			
▪ Densely populated?	✓		The location for the civil works on rehabilitation and development of sewerage collection in Kirulapone area is densely populated. The location for the construction of the wastewater treatment plant (WTP) is moderately populated.
▪ Heavy with development activities?		✓	
▪ Adjacent to or within any environmentally sensitive areas?		✓	
• Cultural heritage site		✓	The project components are not within locations in or near sensitive and valuable ecosystems, including protected areas and forests.
• Protected Area		✓	
• Wetland		✓	
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area		✓	
• Special area for protecting biodiversity		✓	
• Bay		✓	
B. Potential Environmental Impacts Will the Project cause…			
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		✓	
▪ interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	✓		Interference with other utilities and blocking of access to buildings potential during construction phase due to sewer network pipe-laying. Nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc. potential during operation of pumping stations and WTP. Mitigation measures are included in the Environmental Management Plan (EMP).
▪ dislocation or involuntary resettlement of people?		✓	Components will be located on government-owned properties thus no land acquisition is required. However, sewer network pipe-laying in dense and commercial areas may result to temporary disruption of livelihood. Mitigation measures are included in the Environmental Management Plan (EMP) to reduce the impacts. A resettlement plan (RP) has been developed to address involuntary resettlement impacts.
▪ disproportionate impacts on the poor, women and children, Indigenous		✓	Not applicable.

Screening Questions	Yes	No	Remarks
Peoples or other vulnerable groups?			
▪ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		✓	Not anticipated, Project will improve existing sewage collection and treatment. During the operation phase, discharge will be tested on a regular basis to ensure that effluent quality is within national and international standards.
▪ overflows and flooding of neighboring properties with raw sewage?		✓	Not anticipated. Project will develop O&M manual which includes routine maintenance procedures and schedules.
▪ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		✓	Not anticipated. Project will develop O&M manual which includes sludge management (collection, handling and disposal). DBO contractor will assess options of sludge reuse such as soil conditioner. Reuse of dewatered and dried sludge will follow internationally-accepted best practices.
▪ noise and vibration due to blasting and other civil works?		✓	Project will not involve blasting. Road and site excavation may increase local noise levels during construction phase, However not expected to be significant as project sites are within urban and developed areas. Mitigation measures are included in the EMP.
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?		✓	Not anticipated. Occupational health and safety measures are included in the EMP. Chemicals will not be used during construction and operation activities.
▪ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?		✓	Not anticipated.
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?		✓	Design of pumping stations and WTP includes buffer zone. Trees and vegetation will be provided in and around the pumping stations and WTP.
▪ road blocking and temporary flooding due to land excavation during the rainy season?		✓	DBO contractor is required to develop and implement a traffic management plan. Also, construction activities will be avoided during monsoon season.
▪ noise and dust from construction activities?	✓		Anticipated during construction activities. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Good construction practices will mitigate noise and dust, and will be specified in the EMP.
▪ traffic disturbances due to construction material transport and wastes?	✓		Anticipated during construction activities. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Contractors will be required to develop and implement a traffic management plan.
▪ Temporary silt runoff due to construction?		✓	Due to excavation and run-off from stockpiled materials. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Good construction practices will

Screening Questions	Yes	No	Remarks
			mitigate soil erosion and silt runoff and will be specified in the EMP.
▪ Hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		✓	Not anticipated.
▪ Deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		✓	Not anticipated. Collected septage will be treated at the WTP. Design of the WTP ensures sludge and effluent will comply with Indian standards. Reuse of dewatered and dried sludge will follow internationally-accepted best practices. WTP O&M manual will include environmental monitoring program.
▪ Contamination of surface and ground waters due to sludge disposal on land?		✓	Not anticipated. Reuse of dewatered and dried sludge will follow internationally-accepted best practices. WTP O&M manual will include environmental monitoring program.
▪ Health and safety hazards to workers from toxic gases and hazardous materials which may be contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge?		✓	Not anticipated. Workers health and safety, specifically the use of personal protective equipment and trainings, will be included in the WTP O&M manual.
▪ Large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		✓	Not anticipated. The contractor/s will be encouraged to hire local workers from the local labor force. Improved management systems through capacity building and institutional development will ensure reduced burden on services and infrastructure.
▪ Social conflicts between construction workers from other areas and community workers?		✓	Not anticipated. The contractor/s will be encouraged to hire local workers from the local labor force.
▪ Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		✓	Not applicable. Construction will not involve use of explosives and chemicals. Trenching will be done manually.
▪ Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		✓	Operational area will be clearly demarcated and access will be controlled. Only workers and project-concerned members will be allowed to visit the sites.

Appendix 2: Design Details of the Wastewater Treatment Plant

At present municipal sewage generated in Greater Colombo area is discharged through two sea outfalls operated at Mutuwal & Wellawatta pumping stations. Wellawatta outfall design flow is 2.4m^3/s through 1.5mø & 1243m long discharge pipe having 75mmø diffuser pipes of 122m long. It was estimated municipal sewage received for Wellawatta pumping station would be 50 million litres per day Approximate land availability to accommodate municipal wastewater treatment plant at Wellawatta is about 3Ac .

Moving Bed Biofilm Reactors (MBBR)

A moving-bed bio film reactor (MBBR) has been developed by a Norwegian company, Kaldnes Miljoteknologi. The process consists of adding small cylindrical shaped polyethylene carrier elements (specific density of 0.96 g/cm^3) in aerated or non-aerated basins to support biofilm growth. The small cylinders are about 10mm in diameter and 7mm in height with a cross inside the cylinder and longitudinal fins on the outside. The biofilm carriers are maintained in the reactor by the use of a perforated plate (5X25mm slots) at the tank outlet. Air agitation or mixers are applied in a manner to continuously circulate the packing. The packing may fill 25 to 50 percent of the tank volume. The specific surface area of the packing is about 500 m2/m3 of bulk packing volume. The MBBR does not require any return activated sludge flow or backwashing. A final clarifier is used to settle sloughed solids.

The MBBR process provides an advantage for plant upgrading by reducing the solids loading on existing clarifiers (Rusten et al., l998 and 2000). The presence of packing material discourages the use of more efficient fine bubble aeration equipment, which would require periodic drainage of the aeration and removal of the packing tor diffuser cleaning.
The Integrated Fixed-film Activated Sludge (IFAS) process combines the advantages of conventional activated sludge with those of biofilm systems by combining the two technologies in a single reactor. Typically, an IFAS configuration will be similar to an activated sludge plant, with biomass carriers introduced into carefully selected zones within the activated sludge process. This allows two distinct biological populations to act synergistically, with the MLSS degrading most of the organic load (BOD), and the biofilm creating a strongly nitrifying population for oxidation of the nitrogenous load (NH +).IFAS is typically used to upgrade existing plants in order to enable extensive Nitrogen removal, or in designing new plants with significantly smaller footprints for extensive BOD and Nitrogen removal.

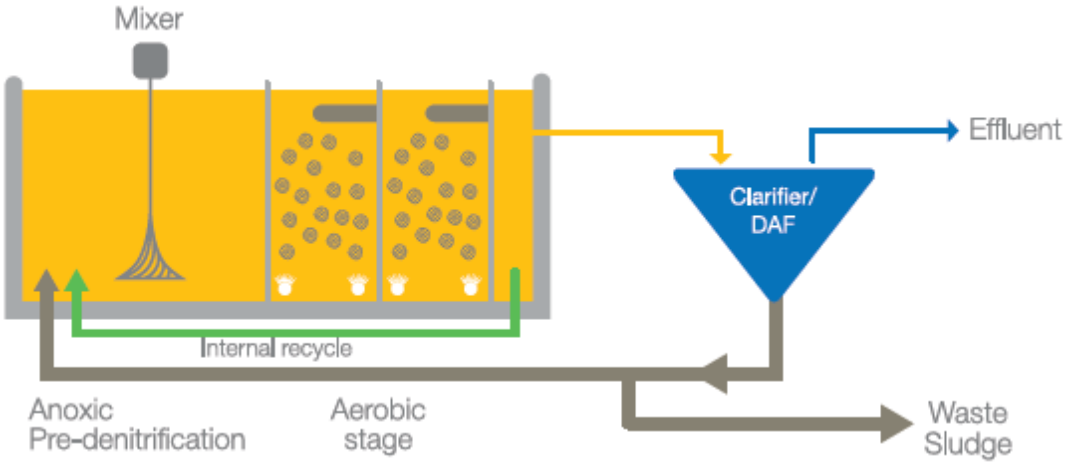
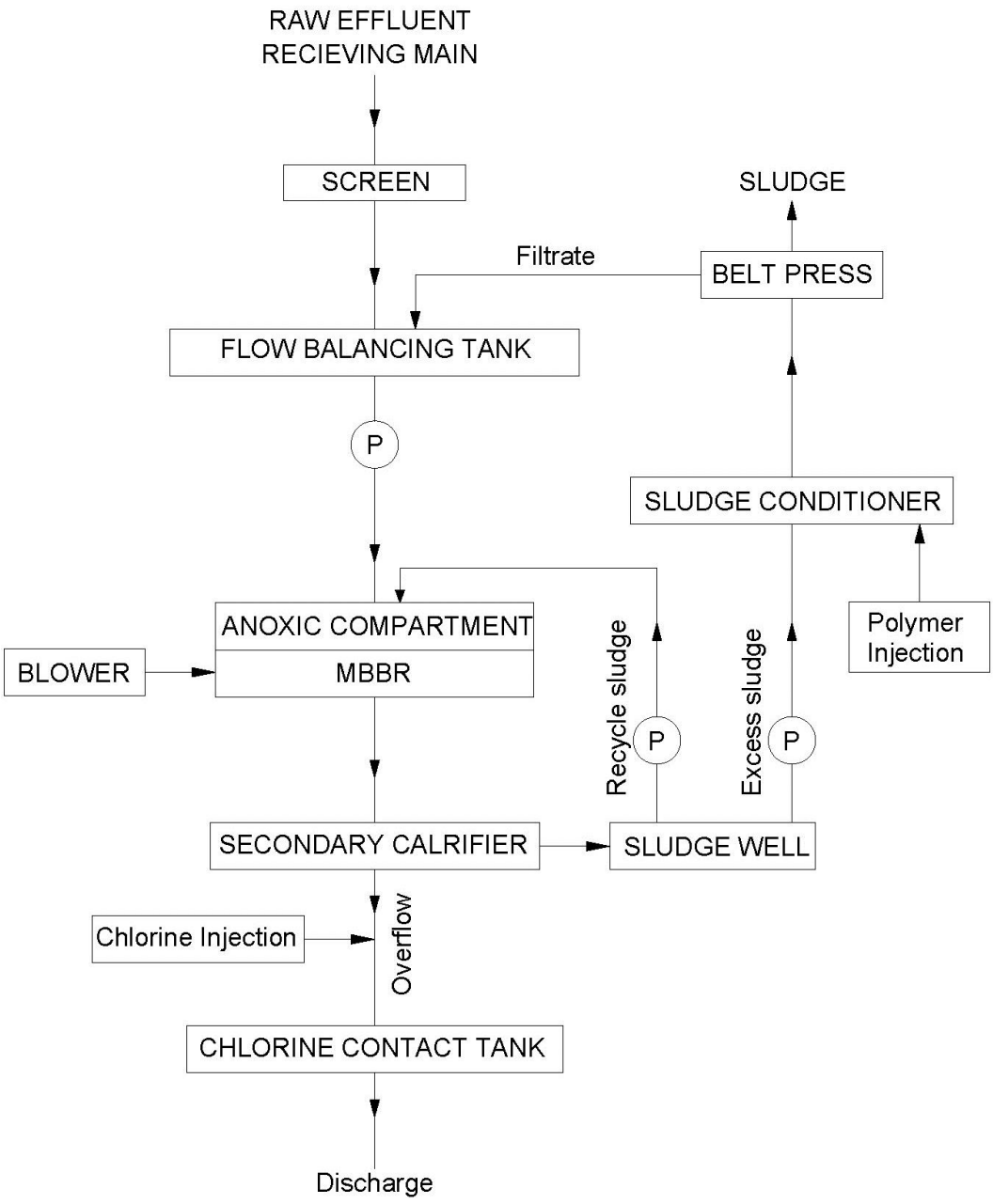


Figure 1: Membrane Bio Reactors (MBR)

Membrane biological reactors (MBR s).consisting of a biological reactor (bioreactor) with suspended biomass and solids separation by microfiltration membranes with nominal pore sizes ranging from 0.1 to 0.4 µm, are finding many applications in wastewater treatment. Membrane biological reactor systems may be used with aerobic or anaerobic suspended growth bioreactors to separate treated.

Figure 2: Moving Bed Bioreactor Process Flow Chart



Design Treatment Plants for Wellawatta:
Flow Balancing Tank

1. The balancing tank capacity required for 50,000m^3 of daily flow is 10,417m^3 (5*50,000/24). However, the proposed volume of balancing tank will be 13,000m^3 once 25% safety factor is applied to minimize the effect of daily flow fluctuation. The tank specification with required accessories proposed are as follows.

2. Tank: An underground tank is preferred to ensure gravity inlet flow. Area occupied could be minimized increasing tank depth. About 3,300m^2 land area is required for 4m water depth. Two removable bucket screens with aperture size not greater than 5mmø should install at tank inlet to avoid debris entering to the tank. The tank should have completely closed providing few manhole with covers to avoid spread of bad smelling. The tank top cover should strong enough to place few sludge drying beds for dewatering of slurry in case of emergency due to operation failure of the belt filter press.

3. Feed Pumps: Two submersible pump including standby unit of capacity 600 l/s at 6m head required to feed the aerobic treatment system. Another two submersible pumps including standby unit with 300 l/s capacity at 6m head are required for emergency operation when balancing tank level rises unexpectedly. Installation of electromagnetic flow meter and pressure gauge for the pump delivery pipe are optional instrument required for maintaining of constant flow.

Aeration Tank:

4. The aeration tank is major treatment unit in the aerobic biological treatment process that removes biodegradable pollutants presence in the wastewater by microbial digestion. Hence, aeration tank should be designed for the operation of wide range of substrate loading. The typical operation and design parameters for concerned treatment options given in the literature (Metcalf & Eddy & WEF[1]) tabulated below.

5. **Table Typical Design Parameters**

Operation/ Design Parameter	Unit	Extended Aeration	Oxidation Ditch	MBBR	MBR
Solid Retention Time (SRT)	d	20 - 40	15 - 30		12 - 20
Organic Loading (OL) (F/M)	kgBOD/kgMLVSS.d	0.04 – 0.10	0.04 – 0.10		0.05 – 0.20
Volumetric Loading (VL)	kgBOD/m^3.d	0.10 – 0.30	0.10 – 0.30	0.25 – 0.7#	0.5 – 1.0
MLSS	mg/l	2000 - 5000	3000 - 5000	6000 – 8500[1]	8000 - 15000
Hydraulic Retention Time (HRT)	h	20 - 30	15 - 30		6 - 15
RAS	%	50 - 150	75 - 150		

 # Calculated based on the 1.0 – 1.4 kgBOD/d per m^3 of packing volume with the media having specific surface of 200 - 250m^2/m^3 and tank filling volume of packing media is 25 – 50% (Metcalf & Eddy).

6. Volume of aeration tank can be computed to satisfy all important operation parameters as follows.

Table: Calculation of Aeration tank Volume

Design flow (Q) 50,000 m^3/d

Biodegradable COD load - C_i (Based on BOD=190mg/l, & bCOD = 1.6*BOD) 15,200 Kg bCOD/d

	Extended Aeration	Oxidation Ditch	MBBR	MBR
Tank Volume (m^3) based on HRT = (Q/24)*HRT	67,500 - 41,667	67,500 - 31,250		31,250 – 12,500
Tank Volume (m^3) based on VL = C_i/VL	152,000 – 50,667	152,000 – 50,667	21,714 - 60,800	30,400 – 15,200
Tank Volume (m^3) based on OL = (C_i/OL)*{10^3/(MLSS*0.85)}; (MLVSS=0.85MLSS)	223,529 – 35,765	149,019 – 35,765		44,705 – 5,961
Volume of tank (m^3) to satisfy all above operational condition	50,667 – 67,500	50,667 – 67,500	21,714 - 60,800	15,200 - 30,400
Tank volume (m^3) also calculated using kinetic theory applying 20d SRT (refer Appendix 1: Part I)	30,190 - 75,475	30,190 - 50,317	17,759 - 25,158*	10,063 – 18,869
Minimum volume of Aeration tank required (m^3)	50,667	50,667	25,158	18,869
Anoxic tank volume (m^3) for 2h HRT	Not required	Not required	4,167	4,167
Final Volume of Aeration tank(m^3)	50,700	50,700	29,500	23,100
Hydraulic retention time (h)	24.3	24.3	14.2	11.1

**Note: Even though the MBBR is combination of both attached and suspended growth system equivalent MLSS concentration given by WEF was used for capacity calculation*

7. For extended aeration & oxidation ditch process lowest tank volume of the acceptable range was considered. However MBR & MBBR processes highest volume of the acceptable range was taken to provide additional buffer in case of shock load is propagated to the aeration tank. According to above more than one day retention time is available for extended aeration & oxidation ditch option. Hence, balancing tank capacity could be reduced by half with providing additional pump for emergency operation in order to avoid tank overflow in case of sudden level rises.

8. Design of air supply system & secondary clarifier also based on the calculation given in Appendix I. The maximum air flow required for the biological oxidation is 381m^3/min, while maximum sludge production is 7,547.5 kg/d (Refer Item 3a of Appendix I – Part I)

Secondary Clarifier:

The secondary clarifier design is based on following parameters

- Surface overflow rate: 8 - 16m^3/m^2.d
- Solid loading: 1 – 5 kg/m^2.h
- Hydraulic retention time including 100% recycling of active biomass: 2.5 hrs
- Sludge space based on 120 L/kg SVI: 10%

Table : Calculation of Secondary Clarifier Capacity

** Typical MLSS concentration in MBBR tank is 2,500 – 4,500 mg/l (Metcalf & Eddy)

Clarifier dimensions are computed based on number of parallel treatment plant proposed under each treatment option.

9. Details of plant items required for each treatment option are tabulated as below.

:

Detail of Plant Item

	Extended Aeration	Oxidation Ditch	MBBR	MBR
Inlet Screen for balancing tank	Yes	Yes	Yes	Yes
Balancing tank (V= Volume in m^3, A= Area in m^2, D= depth in m)	V= 6,500 A= 1,625 D= 4	V= 6,500 A= 1,625 D= 4	V= 13,000 A= 3,250 D= 4	V= 13,000 A= 3,250 D= 4
Feed Pump - submersible (Q= Capacity l/s at 6m head; N1= No of duty pumps; N2= No of spare pumps}	Q= 150 N1= 04 N2= 02	Q= 150 N1= 04 N2= 02	Q= 200 N1= 03 N2= 02	Q= 150 N1= 04 N2= 02
Emergency Feed Pump - submersible (Q= Capacity l/s at 6m head; N1= No of duty pumps; N2= No of spare pumps}	Q= 75 N1= 04 N2= 02	Q= 75 N1= 04 N2= 02	Q= 100 N1= 03 N2= 02	Q= 150 N1= 02 N2= 01
Electromagnetic Flow meter (D= diameter in mm, N = No of units)	D= 250ø N= 4	D= 250ø N= 4	D= 250ø N= 3	D= 250ø N= 4
Inline micro filter of aperture less than 500µm with back facilities. (D= diameter in mm; N= No of units)				D = 250 N= 4
Aeration tank with anoxic compartments (Dimension in m, N= No of tanks)	72Lx36Wx5D N= 4	72Lx36Wx5D N= 4	60Lx30Wx5.6 D N= 3	72Lx36Wx4.5 D N= 2
Membrane Modules (A= area in m^2; N1= No of modules; M= Membrane air flow in m^3/min; N2= membrane sets; V= Membrane tank Volume in m^3)	-	-	-	A= 45,000 N1= 30; M=9.8x30 V= 6x24x4 N2= 02
Air Blower (Q= capacity in m^3/min at 65kPa, P= Power in kW; N1= No of duty units; N2= No of spare units,	Q=52.6 P= 90 N1= 08 N2= 04	Q=52.6 P= 90 N1= 08 N2= 04	Q=67.3 P= 110 N1= 06 N2= 03	Q=52.6 P= 90 N1= 08 N2= 04
Secondary Clarifier (D= diameter in m; H= depth in m; N= No of units)	D=36, H= 3 N= 4	D=36, H= 3 N= 4	D=48, H= 3 N= 3	-
Sludge Recycle Pump - submersible (Q= Capacity l/s at 6m head; N1= No of duty pumps; N2= No of spare pumps} (	Q= 150 N1= 04 N2= 02	Q= 150 N1= 04 N2= 02	Q= 200 N1= 03 N2= 02	Q= 150 N1= 04 N2= 02
Sludge Waste Pump - submersible (Q= Capacity l/s at 6m head; N1= No of duty pumps; N2= No of spare pumps)	Q= 4 N1= 04 N2= 02	Q= 4 N1= 04 N2= 02	Q= 5 N1= 03 N2= 02	Q= 4 N1= 02 N2= 01
Sludge Conditioner & Thickener (V = capacity in m3, N1= No of	V= 15 N1= 08	V= 15 N1= 08	V= 18 N1= 06	V= 15 N1= 04

	Extended Aeration	**Oxidation Ditch**	**MBBR**	**MBR**
thickeners, Q1= Polymer dosing pump capacity; N2= No of dosing pumps)	Q1= 700 l/h N2= 04	Q1= 700 l/h N2= 04	Q1= 900 l/h N2= 03	Q1= 700 l/h N2= 02
Belt Press (Q= Capacity m^3/h; L= Belt width in mm; N= No of units)	Q= 30 L= 1500 N= 02	Q= 30 L= 1500 N= 02	Q= 30 L= 1500 N= 02	Q= 30 L= 1500 N= 01
Chlorine Dosing Pump (Q Capacity in l/h; N1= No of duty Pumps; N2= No of spare pumps)	Q= 135 N1= 04 N2= 04	Q= 135 N1= 04 N2= 04	Q= 180 N1= 03 N2= 03	
Chlorine Contact Basin based on 01hr Contact time & 2m/min velocity (V= Volume of tank inm3; N= No of tanks)	V= 600, N= 04	V= 600, N= 04	V= 800, N= 03	
Approximate Floor area required in m^2	130x180=23,400	130x180=23,400	150x140=21,000	125x85=10,625

Appendix 3: LHI Study- Computer Modelling of Wastewater Dispersion: Rehabilitation of Sea Outfalls Greater Colombo Wastewater Management Project

LHI Coast and Water

Lanka Hydraulic Institute Ltd

Computer Modelling of Wastewater Dispersion:
Rehabilitation of Sea Outfalls
Greater Colombo Wastewater Management Project

Draft Final Report

June 2015

Leader Civil-Guangzhou Salvage JV

Appendix 4: Records of Public Consultation

No	Name of Community Member	Category	Male/Female	Address
01	Siril Perera	Community Leader	Male	Roxi Garden Wellawatta
02	Mohomad Hanifa		Male	Roxi Garden Wellawatta
03	H.M Siriyawathi	Housewife	Female	Kalinga Mawatha Kirullapone
04	Gunadasa Pathirana	Community member	Male	Kalinga Mawatha Kirullapone
05	A.W Antony	Community member	Male	Thlakotuwa watta Kirullpone
06	G.A Merynona	House wife	Female	Thalakotuwawa tta Kirullapone
07	Prassanna Gunarathna	Community Leader	Male	Elvitigala Mawatha Narahenpita
08	Madawa Karawita	Community member	Male	Elvitigala Mawatha Narahenpita
09	W.D Chandrawathi	Community Leader	Female	Vijaya kumaranatunga Mawatha Narahenpita
10	Sriyanai Subasingha		Female	

Appendix 5: Sample Grievance Registration Form

SAMPLE GRIEVANCE REGISTRATION FORM
(To be available in Sinhala, Tamil and English)

The Greater Colombo Wastewater Management Improvement Investment Program welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback. Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date		**Place of registration**			
Contact Information/Personal Details					
Name		**Gender**	*** Male** *** Female**	**Age**	
Home Address					
Place					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where and how) of your grievance below: **If included as attachment/note/letter, please tick here:**					
How do you want us to reach you for feedback or update on your comment/grievance?					

Appendix 6: TOR of the DSIDC

DESIGN, SUPERVISION AND INSTITUTIONAL DEVELOPMENT CONSULTANTS

I. Introduction

1. An international consulting firm with experience in designing and managing wastewater management improvement projects will be engaged for 5 years for a total of estimated input of 813 person-months (33 international and 780 national) in the first quarter of 2014 by CMC's PMU as the Design Supervision and Institutional Development Consultant (DSIDC). The DSIDC will (i) prepare detailed designs; (ii) provide construction supervision; (iii) provide project management support in order to effectively implement the wastewater management investments of the Investment Program; (iv) provide institutional development support to CMC and (iv) review and recommend tariff reforms and implementation support associated with media program. The expected design period is 24 months and supervision period is 36 months[33]. DSIDC will report to and be monitored by the CMC PMU, and will be engaged using the quality-and-cost-based selection (QCBS) method in accordance with *ADB's Guidelines on the Use of Consultants* (2010, as amended from time to time).

OUTLINE TERMS OF REFERENCE

2. The scope of work of DSIDC will include, but not be limited to, the following:

Pre-Designs Activities

(i) Review and analyze all information, reports, data, documents, maps, policies, plans and records pertaining to scope of the Project and develop conceptual plans to fulfill the objectives of the Project.
(ii) Examine the current status and propose for the project various important parameters such as planning standards; population projections; demand forecasting; design criteria; standard specifications and validate the flow model developed for the Investment Program.
(iii) Prepare concept reports for each subproject and disseminate all relevant information and data to all important stakeholders.
(iv) Prepare the work plan of consultants for the design phase and get approval from project authorities.
(v) Present to PMU on a regular basis the approach, study methodology, options considered and their pros and cons, key findings and recommendations.

Preparation of Manuals and Guidelines

(i) Prepare standard specifications for civil, mechanical and electrical works based on best international/national practices to ensure the highest standards of quality in design.
(ii) Prepare Quality Assurance and Quality Control (QA & QC) Manual delineating a consistent, comprehensive and uniform system of quality assurance and quality control of the subprojects including but not limited to system of checks and reviews of designs; description of type, frequency and procedures of on-site as well as laboratory tests and inspections etc to be followed for design so as to enforce the highest standards of quality.

[33] Design and supervision activities/periods may overlap depending on the needs of the contract packages.

(iii) Prepare Guidelines for planning standards; population projections; demand forecasting; design criteria; typical designs and drawings etc.
(iv) Formulate Guidelines for preparation of bid documents; procedure for invitation, receipt, evaluation, approval of bids and award of contracts; standard bidding documents; standards contract forms; and standard templates for bid evaluation reports, etc., as per ADB procedures.
(v) Circulate the manuals and guidelines to the relevant stakeholders and organize trainings and orientation workshops at appropriate times to ensure their proper and effective use for improving the quality of designs.

Surveys, Studies and Investigations

(i) Review available secondary data and reports and identify requirements of surveys, studies and investigations.
(ii) Schedule and prioritize the critical surveys in such a way that the detailed engineering designs can be carried out efficiently and expeditiously.
(iii) Conduct a sewer network asset condition survey to identify causes of recent sewer collapses; the extent of the problem; the location of cross connections between the sewerage and storm water networks and to ascertain the most suitable method for the rehabilitation and laying of new sewers proposed within the Project.
(iv) Carry out all required engineering surveys and investigations such as total station survey, geo-technical investigation, soil survey, construction material survey, ground water investigation, i.e., hydro-geological investigations, rainfall data collection, identification of underground utilities and their mapping, wastewater sampling and analysis.

Network Modeling, Sewerage GIS and Sewer Master Plan

(i) Undertake sewerage network modelling reflecting the results of surveys, investigations and the GIS data, and test and verify the model for the use of detailed design of the subprojects.
(ii) Undertake feasibility studies and detailed designs for the future wastewater treatment facilities.
(iii) Provide data and assist carrying out necessary analysis using sewerage GIS and Network model for preparing wastewater master plan to reflect recent urbanization trend and future urban development plan, along with the vision and strategy for the next 30 years i.e. up to 2040.
(iv) Work in coordination with the Master Plan preparation consultant under ADB TA.
(v) Train and assist capacity development of CMC sewerage engineers on network modelling and use of model for various simulations and analysis

Detailed Engineering Design

(i) Prepare the engineering designs in sufficient detail to ensure clarity and understanding by all relevant stakeholders. All the design should be in conformity with the best international/national engineering standards. All necessary calculations to be prepared to determine and justify the engineering solution proposed for each component, and to be incorporated into the design reports.
(ii) Based on the detailed engineering design, prepare all necessary tender drawings, technical specifications, bill of quantities (BOQ), detailed cost estimates, implementation schedule etc. The technical specifications should be in

accordance with the best international/national practices and should be prepared to achieve the highest standards of quality.

(iii) Prepare construction drawings with sufficient details to permit contractors to carry out construction work effectively, unambiguously and with highest standards of quality.

(iv) Carry out value engineering to generate number of technically feasible designs for each subproject, work out the least cost alternative in order to ensure the best techno-economic designs.

(v) Present to PMU on a regular basis the approach, study methodology, options considered and their pros and cons, key findings and recommendations thoroughly.

(vi) Prepare detailed designs, drawings, engineering estimates, BOQ, bid document on item-rate basis for disconnecting storm water interconnections identified during investigations;

(vii) Identify, based on network modeling, hydraulic analysis and sewer condition survey, the gravity sewers to be rehabilitated/re-laid and prepare detailed designs and drawings, engineering estimates, BOQ, bid document on item-rate basis for such a subproject.

(i) Establish proper systems and processes as per ADB Guidelines for effective execution of relatively more complex design-build-operate (DBO) subproject as a Public Private Partnership investment and operation.

(ii) Work with PMU to decide fair, reasonable, and judicious qualification criteria for bidders in accordance with ADB procedures so as to have sufficient competition without compromising the quality.

(iii) Prepare bid documents, along with detailed terms and conditions for the contract document clearly identifying the rights and obligations of each party.

(iv) Include proper safeguards for O&M part by incorporating appropriate conditions in the bid document such as minimum number of required personnel, minimum monthly cost for O&M etc, so that the tendency to front-load the bid by quoting high amounts for construction part and abnormally low amounts for O&M part is effectively controlled.

(v) Assist the PMU in facilitating and expediting the whole procurement process for the contract package by completing technical specifications and detailed terms of contracts.

Establishment of Sustainable Tariff System

(i) Review the O&M cost recovery mechanism for sewerage operations adopted by CMC and cost recovery policy developed by the Institutional Development Consultants of GCWMP and assist CMC in taking actions required to materialize the cost recovery as per the schedule agreed under the Project;

(ii) Analyze various tariff structures and mechanisms as long term measures for cost recovery, and create an enabling environment for introduction of sewerage tariff in appropriate form (surcharge, volumetric tariff, new tax, etc.) to ensure recovery in the long run.

(iii) Cary out willingness to pay surveys and public consultations including awareness and education when establishing the tariff structure.

(iv) Review existing legal framework in introducing an appropriate tariff mechanism and draft necessary legal amendments and assist CMC in institutionalising the cost recovery policy and tariff collection mechanism.

Contract Supervision and Management

(i) Supervise and monitor cleaning and condition survey of identified sewers, construction of all project components, prepare measurements for works completed and in progress and verify bills for payment to the contractors.

(ii) Check line level, layout of construction to ensure conformity with the contract, propose any change in the plans, if required.

(iii) Assess and enforce, as per standard Contraction Management System, the adequacy of contractors' inputs in terms of materials, equipment, machinery, workers, and cleaning and survey approach and methodologies.

(iv) Monitor and enforce, as detailed out in Safety Manual, the measures taken to ensure safety of the workers, other project personnel, general public and works.

(v) Furnish detailed drawings, with revisions as necessary, to the contractor, check contractors' design and drawings for Design-Build-Operate contracts.

(vi) Review and examine the process of passing of contractors' bills and payments to contractors with special emphasis on minimizing the time taken in submission of a bill by the contractor and payment received by the contractor against such a bill.

(vii) Attend third party inspections as necessary and provide certification on the quality of the supplies based on such inspections.

(i) Work as the engineer or employer's representative within the context of conditions of the contracts.

(ii) Regularly monitor physical and financial progress against the milestones as per the contract so as to ensure completion of contract in time.

(iii) Monitor and enforce, as detailed out in Quality Assurance and Quality Control (QA & QC) Manual, the quality of inputs, processes, and outputs during all activities of cleaning and condition survey to ensure the highest quality of works conforming to the specifications and drawings.

(iv) Examine contractors' claims for time extension, variations, additional compensation etc and recommend appropriate decisions.

(v) Assist PMU in resolution of various other contractual issues and overall contract management.

(vi) After physical completion of contract, prepare planned maintenance procedures; check installation and commissioning; monitor preparation of the "as built" drawings.

(vii) Monitor performance of the contractor during Defects Liability Period.

(viii) Supervise contractors for all tasks assigned to them and monitor their effective compliance as per their respective milestones and TORs. Carry out performance evaluation of contractors including their specific personnel and give regular feedback to PMU for timely corrective action.

Project Management

(i) Carry out all required activities for overall planning, implementation, management and monitoring of the Project; take a proactive role in advising the PMU on all project-related issues, including policy issues, loan covenants and special conditions.

(ii) Supervise contractors and NGOs for all tasks assigned to them and monitor their effective compliance as per their respective milestones and TORs. Carry out performance evaluation of contractors and NGOs including their specific personnel and give regular feedback to PMU for timely corrective action.

(iii) Review, give concrete suggestions for improvement and approve the feasibility reports, concept reports, preliminary and detailed engineering design reports and bid documents of all subprojects.
(iv) Review and comment on various reports submitted by contractors and NGOs. Based on such reports, support PMU to take timely corrective actions for effective implementation of the Project.
(v) Review and approve all designs and drawings prepared by contractors. Establish a system of proof-checking all structural designs and drawings at appropriate levels.
(vi) Regularly communicate and coordinate with other utilities and authorities before, during and after the works to ensure smooth implementation of the Project.
(vii) Anticipate in advance and obtain, in a timely manner, the required clearances, permits, approvals, sanctions or any other information from relevant competent authorities so that the Project activities are not unduly delayed.

Financial and Accounting Management

(i) Establish a proper financial accounting and control system for each subproject and for the entire project in PMU and administer the loan in accordance with ADB's disbursement guidelines.
(ii) Establish all necessary records and the procedures of maintaining/updating such records for each subproject and for the entire Project.
(iii) Ensure accurate and timely submissions of all required reports to CMC, Government and ADB.
(iv) Establish systems for smooth and timely funds flow from ADB/Government to CMC and contractors.
(v) Develop and implement procedure for timely payments to the contractors and monitor for compliance.
(i) Work with PMU and other consultants for ensuring sufficient financial allocation every year for implementation of all sub projects.
(ii) Work with PMU and other consultants for ensuring sufficient financial allocation every year for O&M of sewerage.
(iii) Work with PMU and other consultants to prepare medium term and long term capital investments in wastewater assets by assisting institutional, financial and management changes required.

Project Performance Management System (PPMS) and Benefit Monitoring

(i) Prepare PPMS as per Design and Monitoring Framework (DMF) for water components in accordance with relevant ADB guidelines.
(ii) Implement PPMS including a benchmark survey and subsequent monitoring and evaluation surveys.
(iii) Continuously monitor progress of the Project as per PPMS, prepare regular progress reports, and based on the progress reports take appropriate corrective action.
(iv) Develop suitable monitoring mechanisms to ensure timely completion of contracts with the highest standards of quality and the best construction management practices on site including compliance with all safety requirements.
(v) Develop computerized system (MIS) for monitoring progress of subprojects based on work plans for all stages (design and construction); regularly analyze the progress against the work plans including physical and financial progress of subprojects during construction; recommend ways to accelerate project

implementation; assess reasons for delays, if any and identify measures for improvement.

(vi) Regularly undertake visits of construction sites, supervise the activities of the contracts and provide concrete suggestions for improvement of quality and pace of execution on sites.

Social and Environmental Safeguards

(vii) Establish a system to monitor social and environmental safeguards of the Project; prepare indicators for monitoring important parameters of safeguards.

(viii) Take proactive action to anticipate the potential environmental impacts and resettlement requirements of the Project to avoid delays in implementation.

(ix) Conduct due diligence on all possible impacts on land acquisition and resettlement following the RF of prepared for the investment program. As required, prepare Resettlement Plan (RPs) for wastewater components and update them after the detailed design and obtain ADB's prior approval for public disclosure prior to contract award.

(x) Ensure that the resettlement activities will be carried out in accordance with the RP agreed between the Government and ADB and that any civil works will be commenced only after affected households have been compensated at full replacement cost.

(xi) Prepare and update the Initial Environmental Examination (IEE) and Environmental Management Plan (EMP)s for the wastewater subprojects and update them after the detailed design.

(xii) Ensure that the relevant environmental mitigation measures specified in the updated EMP will be incorporated in bidding documents and approved by ADB prior to issuance of invitation for bidding.

(xiii) Closely monitor and supervise that all mitigation measures and monitoring requirements set out in the RP and EMP are implemented and complied with throughout the Project implementation, and recommend necessary corrective actions to be taken.

(xiv) Prepare and submit the semiannual monitoring reports for social and environmental safeguards to the PMU so that the PMU will submit them to CMC, Government and ADB.

(xv) Provide training programs to PMU, other wings of CMC involved in the Project implementation for strengthening their capacity in managing and monitoring social and environmental safeguards.

Implementation of Gender Action Plan

(i) Prepare and integrate indicators related to gender, social inclusion and poverty in all project activities; ensure collection of disaggregated data and analysis of the results, especially benefits from the project corresponding to these indicators.

(ii) Implement in collaboration with NGOs the Gender Action Plan (GAP) for the projects under the Investment Program related to wastewater management part, and assist the PMUs in monitoring the same.

(iii) Train and sensitize stakeholders on project objectives related to poverty, gender and social inclusion ensuring inclusion of poor, women, indigenous people, and other marginalized and vulnerable groups in subprojects.

(iv) Work in collaboration with selected NGOs to prepare socio-economic profile of selected areas including social maps using appropriate techniques regarding social, economic, health and sanitation status of the community, especially focusing on the likely improvement in health status of the citizens; likely impact of

health and hygiene; community participation and public education program to be implemented during the Project; willingness to pay for wastewater management; ability to pay for wastewater management; current and likely change in consumption pattern of sanitation services etc.

(v) Work in collaboration with selected NGOs to develop specific criteria to identify the poor and generate suitable mechanisms to target the poor for inclusion in the services to be developed in the Project.