



Pre-Feasibility Study Wastewater Management in Greater Colombo

November 2014
Executive Summary

A. Background

1. The Colombo Municipal Council (CMC) is being supported by the Asian Development Bank (ADB) in the rehabilitation and upgrading of the Colombo Sewerage System (CSS) through the Greater Colombo Wastewater Management Program (GCWMP). Additional assistance is programmed under Tranches 3 and 4 of the ADB funded Multi-tranche Financing Facility (MFF) of the Greater Colombo Water and Wastewater Improvement Investment Program (GCWWMIIP).
2. In order to prioritise the needed wastewater management investments, the Cities Development Initiative for Asia (CDIA) is supporting a Pre-Feasibility Study (PFS) to provide an overall framework for Tranches 3 and 4 by analysing the wastewater collection and treatment facilities, as well as the management services, in Greater Colombo and providing recommendations for their improvement. This will include the problem contributed by storm water drainage and solid waste management in the overall wastewater context in Greater Colombo/Colombo City.
3. This Final Report describes the outcomes of the PFS and outlines recommendations for activities that may be subjected to further feasibility to be included in Tranches 3 and 4 of the GCWWMIIP.

B. Situation Analysis

4. Much of the Colombo Sewerage System (CSS) was constructed between 1902 and 1925 and now covers nearly 80% of the Colombo Municipal Council (CMC) area. 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 which is managed by the CMC Drainage Division. Rehabilitation and extension of the sewerage system has occurred progressively following Master Plans prepared in 1972 and in 1993 including through the on-going GCWMP. Nevertheless, the system still suffers from many technical deficiencies including the following:

- 4.1. Some sewers are in poor condition or are under-capacity and experience collapses, serious blockages and overflows.
- 4.2. Recent rapid development of the City, in particular from commercial developments in the CBD as well as a proposed Port City and the on-going program of resettlement of poor communities into high-rise developments requires upgrading of a number of sewers.
- 4.3. 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.
- 4.4. There are 11 significant areas within the CMC boundaries that are not covered by the sewerage system, representing more than 40% of the city population, many of which are poor communities.
- 4.5. There are numerous cross-connections between the sewerage system and the storm water drainage system resulting in pollution of the city's waterways and overloading of the sewerage system.
- 4.6. There is considerable ingress of solid waste into the sewerage system contributing to system blockages and damage to the infrastructure.
- 4.7. The system relies almost entirely on a series of pumping stations which results in high operational costs. Power costs are estimated to represent up to 20% of the total operational costs of the CMC Drainage Division.
- 4.8. Due to the failure of equipment at the Madampitiya and Wellawatta Pumping Stations, untreated and unscreened sewage is discharged to the ocean through the long sea outfalls.

5. The outcomes of these deficiencies are the relatively high incidence of waterborne disease and the poor environmental condition of the canals and lakes within the city. It is the low income communities that bear the greatest burden resulting from the inadequate sewerage services provided. CMC also suffers from a number of constraints institutionally in managing the wastewater services. These include:

- 5.1. A lack of independence in decision-making with some functions having been appropriated by the National and Provincial Governments.
- 5.2. Lack of resources to manage both the wastewater and storm water systems for which the Drainage Division is responsible.
- 5.3. Staff shortages at the professional, sub-professional and skilled/unskilled labour levels. In particular, replacement of deep sewer workers is proving difficult.
- 5.4. CMC has been ineffective in penalising those who violate municipal standards, by-laws, rules and regulations, such as addressing illegal connections or enforcing mandatory sewer connections.
- 5.5. Procurement arrangements currently suffer from many delays primarily because some of the equipment required by the Drainage Division is specialized, vendors are few and at times there are no local agents in the country. CMC needs to transition to a system whereby suppliers and the Division act as partners rather than continue to act on an adversarial basis
- 5.6. The shortage of a trained and experienced second line of leadership is a critical concern. To ensure sustainability, municipal level structural systems need an effective second line of leadership that can offer the required professional skills and adequate institutional memory to carry on the work and pursue a vision. This should be an integral part of the CMC's human resources development plan, a plan that indicates tentatively where each of the middle and senior managers could aspire to be in the hierarchical ladder at short, medium and long term projections, depending on proven commitment, excellent performance and good behaviour.

C. Proposed Interventions

Sewer Rehabilitation, Upgrading and Re-alignment

6. The requirements for sewer rehabilitation and upgrading to satisfy the projected 2040 wastewater flows will only be able to be finalised once CCTV surveys have been conducted on the existing sewers to determine the condition and when a sewer model is in place to determine under-capacity sewers. This is unlikely to occur until early 2015. In the meantime the PFS team, based on information provided by CMC and the GCWMP Design and Supervision Consultants (DSC), has identified possible interventions that will need to be validated by further Feasibility Study. These are as follows.

- 6.1. Approximately 5.7 km of sewers identified by the GCWMP PPTA needing rehabilitation or upgrading which has not yet been addressed.
- 6.2. Approximately 20 km of sewers identified by CMC District Engineers including the Malalasekara Mawatha sewer in District 4 and the Walls Lane/Bloemendhal sewer in District 1 and other locations to be selected after the forthcoming CCTV surveys.
- 6.3. Sewer upgrading resulting from new UDA high-rise housing developments.
- 6.4. Approximately 8.3 km of sewer upgrading required from new CBD developments
- 6.5. System re-alignment proposed by the GCWMP DSC comprising a total of about 12 km of new trunk sewers along Marine Drive, and Baseline Road to replace pumping mains and save on operational costs. Economic analysis conducted during the PFS shows that neither of these trunk sewers can be justified

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- 6.6. Upgrading of the sewerage network to accommodate wastewater from the proposed Port City Development that will generate about 20 MLD of sewage by 2033.

Provision of Services to Unserved Areas

7. There are 11 principal areas not currently covered by the sewerage system, with an estimated population of almost 250,000 people representing over 40% of the population of the City of Colombo. Many of these areas house low-income communities, are low-lying and therefore difficult to serve with gravity sewers. Provision of additional pump stations or the use of pressure or vacuum sewers will need to be considered in seweraging these areas. Appropriate solutions will need to be developed for poor communities where affordability to connect into the sewerage system and pay tariffs may be problematic. Designs are currently ongoing to connect two of these areas, North Mattukkulia and Kirulapone.

Pumping Stations

8. Pumping Station rehabilitation is being undertaken during the current phase of GCWMP and the stations have been sized to receive sewage from the projected 2040 flows including all proposed new developments including the Port City. However, Madampitiya and Wellawatta Pumping Stations which were re-constructed several years ago are not included in this program despite intake penstocks, screens and grit removal facilities being out of order. It is critical that these are addressed in the next stage of the Project as unscreened raw sewage is now being discharged through the ocean outfalls. In addition a further six minor pumping stations handed over to CMC by NWSDB require upgrading.

Wastewater Treatment

9. Three potential sites for wastewater treatment facilities (WWTP) have been identified – adjacent to Madampitiya PS, adjacent to Wellawatta PS and the Fishery Harbour adjacent to the Mutwal outfall. The Fishery Harbour site is problematic due to potential significant safeguard issues. Analysis was conducted comparing the cost of providing two or three treatment facilities whereby flows from the Fort, S-3, Harbour and Vystwyke catchments and Port City would either be conveyed to a new treatment plant at Fishery Harbour or diverted to a treatment plant at Madampitiya. The analysis showed that considering capital and operating costs, there was no significant cost advantage in adopting either alternative. As such, given the safeguard issues at Fishery Harbour and the additional operational complexities of managing three, rather than two treatment facilities, it was recommended that only two treatment facilities be installed; at Madampitiya and Wellawatta.

10. Assuming Port City flows will be accepted into the CMC system, primary treatment facilities with capacities of 150 MLD and 55 MLD respectively will be required at Madampitiya and Wellawatta. Since both facilities are in residential areas, each WWTP will have a serious odour control system. The primary sewage treatment plants will screen the sewage down to 3 mm, degrit, settle out 60% of the total solids and remove 30-40% of the BOD before being discharged into the North and South ocean outfalls. It is proposed that all the currently faulty equipment at Madampitiya and Wellawatta PS be replaced, including the penstocks, screening and degritting facilities.

11. The 2040 projections estimate that the Madampitiya and Wellawatta WWTPs would produce up to 134 tonnes/day and 59 tonnes/day of 30% dewatered primary solids respectively. It is proposed to add lime to these sludges, bringing up the quantities to 160 tonnes/day and 70 tonnes/day. Addition of lime will bring the primary USEPA Class C biosolids up to Class A to Class B which greatly reduce the malodour and render the biosolids suitable for use as a soil conditioner.

12. In the future, these primary treatment plants can be upgraded to advanced primary plants that can remove up to 70% of the BOD, 90% of the total solids and 90% of the phosphorus. This upgrade is a matter of adding a coagulant such as iron salts or alum. The CAPEX and OPEX for these two treatment plants is summarised below:

Treatment Plant	CAPEX (USD)	OPEX (USD/Year)
Madampitiya WWTP (150 MLD)	43,500,000	2,700,000
Wellawatta WWTP (55 MLD)	23,000,000	1,300,000

Biosolids Management

13. While biosolids management from the proposed wastewater treatment plants has been included in the plant design, there are also biosolids from other sources that need to be considered. These are (i) biosolids from septic tank desludging operations; (ii) biosolids from sewer cleaning operations; and (iii) biosolids from tanker discharges from industries.

14. Sludge management facilities at Madampitiya and Thimbirigasaya (Kirulapone) Pumping Stations incorporating vehicle circulation, buffer zone and odour control and silt separation are recommended for further consideration the feasibility study. The Madampitiya facility may be incorporated into the proposed WWTP

Storm water Cross Connections

15. Discussions were carried out with Sri Lanka Land Reclamation and Development Corporation and the District Engineers of the CMC Drainage Division which confirmed the extensive interconnections causing mutual damage to both systems. A total of 18 locations were identified as critical cross-connections, including a major canal water inflow into the main sewer to Madampitiya at the San Sebastian Canal inverted Siphon. Further, household interconnections between the wastewater and storm water systems are considered numerous and extremely difficult to trace. The critical cross-connections (not including household inter-connections) are expected to be corrected under the World Bank assisted Metro Colombo Urban Development Project. In order to eliminate the household interconnection problem the following recommendations are made;

- 15.1. Enhancement of the Municipal inspectorate to carry out preventive household inspections.
- 15.2. Amendments to Legal enactments to obtain increased Police assistance when required and also in accordance with national policy.
- 15.3. Enhancement of Municipal by-laws to acquire capability to intervene with existing installations and future installations.

Solid Waste Management

16. The following interventions are proposed to limit the extent of solid waste ingress into the sewerage system.

- 16.1. Establishment of a reliable and sustainable disposal facility for Western Province.
- 16.2. Replacement of the old fleet of vehicles, machinery and equipment used for solid waste management.
- 16.3. Installation of a computer based monitoring system of the movement of vehicles and machinery.
- 16.4. Make necessary legal amendments to Laws, by-laws, Rules and Regulations related to Solid Waste Management and Wastewater Management.
- 16.5. Continuation of the approach to construct access roads adjacent to canals and railway reservations to restrict dumping of solid waste in these locations.

- 16.6. Regularising the solid waste management in existing and upcoming apartments managed by State Authorities.
- 16.7. Consideration of installing bio-gas plants in large housing apartments to provide energy needs and reduce the volume of solid waste.
- 16.8. More adequate monitoring and enforcement of CMC by-laws relating to solid waste discharge and management at public meeting places and working places including construction sites.
- 16.9. Installation of bar screens at junctions of open drains and inlets and installation of silt and sand traps to prevent ingress of solid waste into the drainage system.
- 16.10. Installation of a trapping system of oil, fat and other solid waste at mass collection points of wastewater before entering into the public sewer system.
- 16.11. Conducting a pilot project in the catchment area of a small pumping station to monitor solid waste ingress and test the proposed interventions.

Intervention Costs and Priorities

17. The estimated costs of the interventions described above are shown in the following table. The potential Tranche 3 interventions were prioritized by the CMC Drainage Division and these priorities are also shown in the table below.

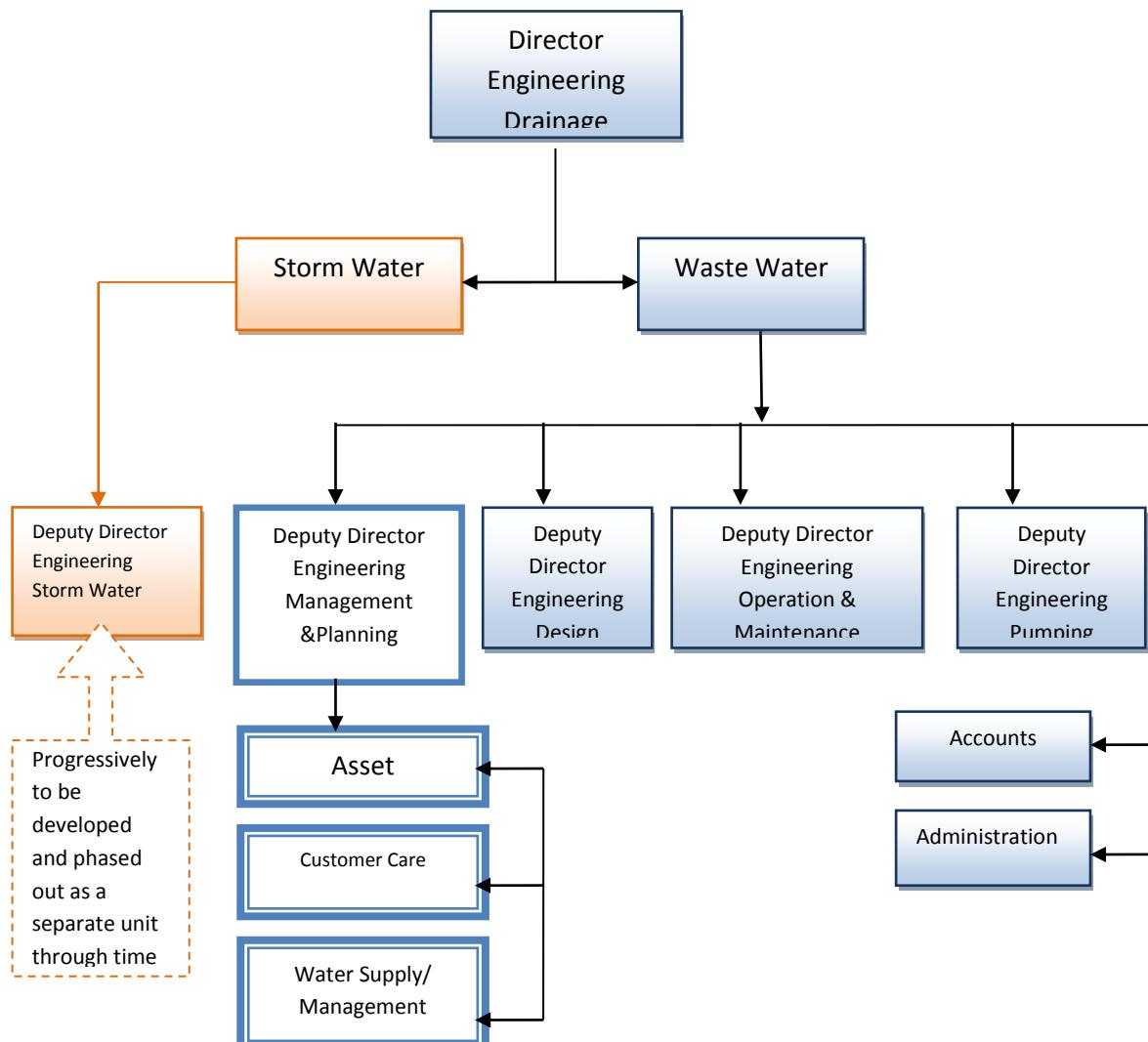
Item	Estimated Cost (USD mill)	Tranche	CMC Priority
Sewer Rehabilitation/Upgrading proposed by PPTA	8.0	3	8
Sewer rehabilitation needs reported by District Engineers	30.0	3	2
Sewer Upgrading for new UDA developments	9.6	3	3
Sewer Upgrading for new CBD developments	17.1	3	7
Proposed System re-alignments (Trunk sewers along Marine Drive and Mainline Road)	65.7	3	9 (Marine Dve) 10 (Baseline Rd)
Provision of sewerage to unserved areas	77	3	4 (Kirulapone) 5 (Mattakkuliya) 6 (Other Pockets)
Madampitiya and Wellawatta Pump Station Rehabilitation	5.0	3	1
Rehabilitation of Minor Pump Stations	3.0	3	Not Ranked
Sub-Total for Tranche 3	215.4		
Madampitiya Wastewater Treatment Plant (150 MLD)	43.5	4	
Wellawatta Wastewater Treatment Plant (55 MLD)	23	4	
Fort, CS-3, Harbour, Vystwyke and Port City sewage conveyed to Madampitiya WWTP	20.6	4	
Treated Effluent from Madampitiya WWTP to Mutwal Outfall	8.7	4	
Sub-Total for Tranche 4	95.8		
Total for Tranches 3 and 4	311.2		

18. The above costs include the cost of collecting and treating sewage from the proposed Port City development. The estimated average dry weather sewage flow generated by the Port City by the time of its ultimate development in 2033 in 18.7 MLD. The estimated cost of collecting and treating this wastewater is a capital cost of USD 20.5 million and operating cost of USD 493,000 per annum. The estimate of USD 77 million for provision of sewerage to unserved areas includes the cost of trunk sewers and laterals. In providing a high ranking for this intervention, CMC suggested that trunk sewers only be funded through Tranche 3.

Institutional Strengthening

19. It is proposed that the Drainage Division to be separated under the Director Drainage into Wastewater and Storm Water sections during the project (GCWWP) implementation period. Subsequently Storm Water will be progressively separated into a totally different division from Wastewater subject to resource availability and trained staff. The new structure is suggested below.

20. For the proposed new **Storm Water Division**, a “holistic” approach to storm water management that integrates planning, implementation and assessment of flood control and water quality protection programs into a single cohesive storm water management structure needs to be adopted. This will require identification of owned and managed assets, defining current and proposed levels of service, forecasting future financial needs, analyzing business risk exposure, linking of service levels and business objectives, developing monitoring and evaluation metrics and assessing the required staff structure.



21. The **Wastewater Division** will remain primarily the same except that the Water Supply Section will be converted into a Management and Planning section with a new Terms of Reference which will include customer service and asset management. The Design section will handle internally and externally funded projects, outsourced contracts as well as house connections.

22. Strengthening of the **Solid Waste Management Division** will focus on improved monitoring and law enforcement. This will be achieved by the inclusion of two technical officers in the permanent cadre empowered with the authority of law enforcement and 12 Nos. monitoring and reporting staff (two officers for each district) employed on a contract basis.

Capacity Building

23. Within the CMC the need for capacity upgrading is a major issue impeding good local governance with a lack of institutional, human resource and managerial capacities to perform in an efficient and effective manner. A multi-dimensional approach to capacity building is proposed which will consider the individual capacity, the institutional capacity and the environmental capacity. The following factors need to be considered in developing the capacity building programs.

- 23.1. The need for specific skilled training for new developments such as asset management and SCADA using annual contracts with relevant providers.
- 23.2. The capability of current employees to receive training in new systems.
- 23.3. Training to be demand driven, rather than supply oriented.
- 23.4. The development of a second tier of leadership.
- 23.5. The need to create institutional credibility to gain public confidence.
- 23.6. The need to retain key trained staff in the Division without prejudice to their promotion.

24. Additional emphasis on career development for Drainage Division employees is critical to improving performance of the organisation. This will require the preparation of structured career development plans for individual employees combined with appropriate mentoring from supervisors. Technical training programs need to be provided focusing on operation of equipment at sewage pumping stations, potentially at treatment plants and for sewer network cleaning and inspection. Training is also required in the design of sewerage systems, especially network modelling as well as in administrative procedures.

Social and Poverty Impacts and Mitigatory Measures

25. The existing Colombo wastewater management system continues to create adverse impacts, especially for poor communities living in underserved settlements. As a result of deficiencies in the sewerage system, storm water and sewer cross connections and solid waste dumping in canals, poor communities living in vulnerable low lying areas frequently face negative impacts. At the same time, the urban poor residing in un-served areas are living in a very pathetic and unhealthy environment with a series of problems associated with existing unsafe and inadequate sanitation status within their settlements. All stakeholders consulted were of the opinion that this project would provide socio-economic benefits for most people living in Greater Colombo as well as the floating population. The most direct beneficiaries of this project would be the poor communities living in Greater Colombo.

26. Furthermore, observation tours and focus group discussions with the unskilled workers of the pumping stations revealed a very unhealthy working environment prevailing in the pumping stations. There is an urgent need to improve the working environment for CMC employees in the pumping station and sewer line maintenance sections.

27. Based on available plans and designs of the GCWMP interventions, no serious direct involuntary displacement, land acquisition, dislocation or resettlement of poor communities are found in relation to the key components of the project, except in few main interventions. Most of the proposed interventions are located in low lying areas and generally on government owned land. Generally, these land areas have been encroached and utilized by slum and shanty dwellers as a result of unplanned urban development. The only key potential interventions with direct social and poverty impact would be (i) a Wastewater Treatment Plant located at the Fishery Harbour near the Mutwal outfall and (ii) involuntary relocation of 37 families resulting from implementation of the Kirulapone sewerage system.

28. Fishing communities in the Fishery Harbour area continue to live under the threat of re-location which would have an adverse impact on their livelihood. Lack of awareness and insufficient information provided to this local community on the proposed program activities has been identified during the social assessment. The potential impact of all other key interventions are indirect and medium level. There is no religious or cultural impact identified as a result of the proposed GCWMP activities. No specific historical or archaeological protected resources are identified with the proposed intervention areas.

29. Most of the communities living in underserved settlements may be affected, and therefore more comprehensive investigations and social surveys are needed to identify program affected persons. This social safeguard assessment has to be conducted using the Social Safeguard Policy and Legal Framework of Sri Lanka as well as ADB social safeguards guidelines.

Environmental Conditions

30. Colombo's underserved settlements are a major contributor to water pollution by untreated sewage. In addition, many highly populated coastal low-lying areas with shallow water table, vulnerable to frequent flooding contribute to severe faecal pollution in internal and near shore waters. People without facilities dispose of their wastewater on the seashore, in canals, and waterways, and on available open ground. Water quality surveys of sea water around the two sea outfalls at Mutwal and Wellawatta has indicated that the wastewater discharges are high in total and faecal coliform loadings, although the BOD and suspended solids are low. In addition, serious threats to ground water quality have been observed due to seepage of faecal matter and pollution with heavy metals in industrial zones. Thus, the present sewerage system in the CMC area has been contributing to environmental pollution and degradation.

31. Statistics from the Department of Health indicate high levels of waterborne and water associated diseases in Colombo. Hence, rehabilitating and improving the sewerage system in Colombo City is an essential step towards addressing underlying causes of environmental degradation and public health and reducing contamination of surface and groundwater resources.

Expected Environmental Impacts

32. The adverse impact of implementing the proposed interventions were identified as (a) impacts on the community; (b) impacts on the physical environment and ecosystems; and (c) potential health and risk issues. Most of the significant impacts can be avoided and minimized during the feasibility study stage by integrating environmental considerations into the project designs. The environmental assessment team shall work closely with the technical planning and design group and the representatives of the executing agency should also participate in the environmental assessment process. Most of the anticipated environmental impacts are limited to the construction stage of the project. The suggested measures and strategies to mitigate these adverse impacts are; (i) preparation and implementation of the contractor's environmental management plan; (ii) adopting

internationally accepted best practices in managing environmental impacts of construction; (iii) using appropriate technology alternatives to avoid/minimize adverse impacts of construction activities; (iv) providing grievance redress mechanisms; and, (v) resettlement planning as per National Involuntary Resettlement Policy, when required.

33. The environmental benefits of the sewerage system improvement are many and significant. Rehabilitation and upgrading of the sewer network will address problems associated with leakages, cross connections and overflows thereby minimising the release of untreated sewage into the environment. Contamination of inland water bodies will be arrested and pollution of groundwater will also be avoided. Provision of sewerage services to unsewered areas will prevent impacts on public health and environmental contamination while provision of wastewater treatment would avoid the transfer of untreated pollution load to the ocean from the terrestrial environment.

34. The adverse environmental impacts are low and limited mainly to the construction stage and therefore interventions would primarily be environmental category B requiring only an Initial Environmental Examination Report. However, in the case of a wastewater treatment plant at Mutwal (Fishery Harbour), a significant number of households will have to be displaced requiring a Resettlement Plan. This intervention could, therefore, be categorised as environmental category A. Under the Sri Lankan law none of the project activities require EIA / IEE approval except the Mutwal wastewater treatment plant as it may most likely come under the prescribed list requiring EIA approval.

Financing for Sewerage and Sanitation

35. The budgeting process followed by CMC has emphasis on expenditure, although there has been an increasing focus on revenue augmentation and identifying new sources of income. During the period 2009-12, the amount attributable to drainage programmes has averaged 9% of total recurrent expenses borne by the Council. The total amount of capital expenditure in drainage/sewerage programmes has averaged 23% of total capital expenditure. The main sources of revenue realised by CMC include own-source income primarily from rates, taxes, fees and other charges which represented 64% of total revenue during the period 2009-12. The other principal source of financing for the CMC is by way of government grants and reimbursements.

36. Currently, CMC does not separately charge users for the provision of sewerage services and receives internal fund transfers from property rate income generated by the CMC. In addition, the Drainage Division received a small amount of income from registration fees of contractors and suppliers along with charges for new connections. While CMC has made initial draft proposals to introduce a sewerage tariff scheme, agreement on the most suitable basis for its implementation is still pending. It has been suggested however that a sewerage tariff scheme within the CMC area may be introduced by 2016. Amongst the principal obstacles for the introduction of a wastewater/sewerage tariff is the separation of water supply and wastewater/sewerage management between two separate authorities (NWSDB and CMC respectively) as well as perceptions of municipal services expected by municipal rate payers.

37. In the absence of a separate sewerage tariff within the CMC area, the recurrent income generated by the drainage division has only covered around 2.5% of the recurrent expenditure within the division. Staff related expenses have on average accounted for approximately 65% of recurrent expenses incurred by the drainage division during recent years. Other significant recurrent expenses have been on account of supplies and capital asset maintenance which have averaged at around 23% and 11% respectively of total recurrent expenses. Capital asset maintenance expenses have more recently represented a higher proportion of recurrent expenses vis-à-vis the earlier part of the observed period

indicating the ad-hoc nature of maintenance spending in the absence of a proper asset management system and proactive preventive maintenance programme.

Between 2009-12, the drainage division has on average spent LKR 17.2 million / year on capital expenditure relating to acquisition of lands, buildings, machinery and tools, vehicles, furniture and fittings and related moveable capital assets and a cumulative total of LKR 345 million on infrastructure expenditure in relation to construction such as sewers and drains. Given the continuing shortage of capital funds, the drainage division has continuously depended on CMC's overall accumulated surplus from prior years.

Affordability and Willingness to Pay

38. Whilst no separate willingness to pay (WTP) survey had been carried out under the PFS study, findings from the survey carried out during the 2007 PPTA were reviewed and updated as per most recent household income surveys that had been carried out during 2012. As per the analysis carried out, based on the 2012 estimate of national mean household income per month of LKR 46,200, it has been deduced that households within the CMC area (currently covered by sewerage network) may be willing to pay an amount in the order of LKR 355 per month for the provision of wastewater / sewerage services whilst those living in presently unsewered areas within the CMC area may be willing to pay almost three-times as much for the same service.

39. Based on the average household consumption of water in Greater Colombo of 18 m³ per month and assuming the adoption of tariff structure similar to that implemented by NWSDB, the sewerage tariff for domestic users would be LKR 236 per month. This amount is within the estimated amount households are willing to pay. Considering an affordability threshold of 5% of average household income and the national poverty line, this level of average monthly sewerage tariff is within the affordability limit of households.

40. Whilst presently the CMC imposes connection charges from consumers in order to recover the investment cost of such new connections, this may act as a deterrent for consumers to obtain a connection (and may result in unauthorized connections or un-safe discharge practices). When exploring alternative sources of finance, it may also be pertinent for CMC to consider the prospect of discontinuing such high levels of connection charges currently being levied on consumers and which might also facilitate to overcome some of the perception obstacles for the introduction of a sewerage tariff amongst rate payers.

Financial and economic assessment of proposed interventions

41. The financial and economic viability assessment of the proposed interventions has assumed the likely introduction of a sewerage tariff similar to the present NWSDB sewerage tariff scheme from 2016 onwards. The incremental cost and benefits following the proposed interventions have been compared with the likely outcome without such interventions in order to comment on the viability of respective investment programmes.

42. The analysis of the proposed interventions reveal that majority of the investments will not directly contribute to significant amount of incremental tariff income from increased sewerage connections. The main financial benefit expected from the proposed investments is the reduction of certain operating expenses related to energy consumption and to some extent reduction in current level of asset maintenance spending, albeit the latter may be offset by the new spending required to maintain additional sewer lines and other infrastructure. Given the limited incremental financial benefits envisaged along with the significant capital investment costs estimated, the financial viability of the proposed interventions are highly debatable.

43. It is proposed that an extensive tariff modelling exercise be carried out during the detailed feasibility study to ascertain viable sewerage tariff levels to be introduced within the CMC area in order to at least cover the O&M costs. Whilst certain interventions proposed are not likely to have significant economic impact (eg. Proposed system realignments along Marine Drive and Baseline Road), further detailed economic assessments are required to assess the economic viability of other proposed interventions.

Financing sources and PPP options

44. The timely introduction of a suitable sewerage tariff within the CMC area is critical to support the on-going operational expenses of the drainage division. Despite such tariff scheme, it is unlikely that the drainage division can on its own support the significant capital investment costs required to support the proposed interventions and may need to rely on capital allocations made by the CMC. In order to reduce the overall burden on CMC finances, following financing options have been considered:

- 44.1. Long-term lease or concession agreement for the build, operation and maintenance of the wastewater treatment plants.
- 44.2. Long-term lease or concession agreement for the build / upgrade, operation and maintenance of pumping stations.

45. However, CMC has to date not implemented any significant PPP initiatives other than for a limited number of smaller initiatives associated with maintaining certain urban landscape and solid waste collection. As such, CMC will also require capacity building associated with contracting and managing public-private ventures.