Integrated Storm Water Drainage Project for the Expanded Areas of Chennai Corporation

Draft
Environmental Assessment Report

December 2014

Storm Water Drains Department,
Corporation of Chennai

Executive Summary

INTRODUCTION

1. Government of Tamil Nadu is proposed to implement the World Bank supported Tamil Nadu Sustainable Urban Development program (TNSUDP) to improve the delivery of urban services. The provision of Integrated to Storm Water Drains to extended areas of Corporation of Chennai is one of the sub-project proposed to be implemented by the Corporation of Chennai. This component is coordinated by, Government of Tamil Nadu.Tamil Nadu Financial Services Ltd. (TNUIFSL) Chennai are the fund Managers. This sub project proposed to implement in the roadsides and canals and doesn't involve any Land Acquisition and required land is owned by the Corporation of Chennai.

2. The Integrated Storm Water Drainage project for the expanded areas of Corporation of Chennai proposed to be taken up under proposed Tamil Nadu Sustainable Urban Development Project (TNSUDP). This project involves construction of storm water drains and canals. This sub project proposed to be implemented in the 4 Zones of the CoC. The total length of the drains to be constructed is about 329.18 kilometres including the 11.05 km length in the canals.

3. Projects proposed under TNSUDP shall be implemented safeguarding the environmental and social concerns of the development activity. The requirements for ensuring environmental and social safeguards have been stipulated in the TNUIFSL's Environmental and Social Management Framework exclusively prepared for TNSUDP.

4. The project as per the ESMF, is categorized as E2 category with lesser impacts than E1 projects and require Environmental assessment to be carried out and management measures be prepared.

PROJECT DESCRIPTION

5. The sub project will be implemented in the expanded areas of the Corporation of Chennai comprising of the following Administrative Zones and Divisions/Wards covering about 53.76 sq.kms. The Administrative zones covered under this sub-project are Part of Zone VII Ambattur area, Part of Zone XI Valasaravakkam Area, Part of Zone XI Part of Valasaravakkam area and Part of Zone XII Alandur area.
6. The total length of the storm water drain network is about 329.18 km, of which 94.86 km is Adyar basin and 234.32km is Cooum basin. Most of the newly proposed drains are along the roads. Reconstruction/Augmentation of existing drains, which were found inadequate, has been proposed. RCC rectangular drains have been proposed for construction. Wherever necessary, RCC Pre-cast Drains have been proposed in place of cast in situ if the drain width is up to 2m. Total length of proposed new and existing drains to be used as such & to be reconstructed, the drains of all categories viz. Arterial, Feeder and Collector drains, comes to about 100.28 Km.

3.0 ENVIRONMENTAL ASSESSMENT

7. The EA was carried out with an objective to identify and assess the environmental impacts arising out of implementation of the Storm Water Drain Construction and develop and Environmental Management Plan (EMP) to mitigate the identified impacts. The EA involved screening of the project, quantitative and qualitative surveys to collect the relevant

information, field visits to the project area, catchment areas, canals, etc. and consultations with the community.

`ENVIRONMENTAL REGULATIORY REQUIREMENTS

8. A review of national, state, regional and World Bank environmental laws, rules and regulations relevant to the proposed ISWM project indicates that in addition to the safeguard policies of the Bank and construction safety requirements, the project would require permission to cut the trees (41 nos) that will be cut during the construction phase of the project.

BASELINE ENVIRONMENTAL PROFILE

9. Chennai city is underlain by various geological formations from ancient Archaeans to recent Alluviums and the climate is generally hot and humid. The ambient air quality ranges between a hight 175μg/m^3 at Thiruvottiyur to a low of 8 μg/m^3 at NEERI CSIR campus. The noise levels are generally high in commercial areas and the soil/sediment quality in the city reflects that there is no toxic element present beyond to the safe limits. Ground water with a pH of 7.4-7.9, electrical conductivity 780-1288 μmho/cm, Total Dissolved Solids of 580-910 mg/l, total and calcium hardness of 260-482 mg/l and 168-340 mg/l, the ground water quality is within the prescribed standards.

ASSESSMENT OF IMPACTS

10. The major impacts of the project are expected to be during the construction phase leading air and noise quality deterioration, Health and Safety impacts to the works and local communities, traffic diversion and utility shifting, access to private properties, back flow of water from the canals, solid waste dumping and disposal of excavated silt from the drains.
11. The project is expected to lead to cutting of about 41 trees. In addition, another 242 trees located in the construction area of the proposed drains. The project proposes to carry out compensatory plantation of 10 times the trees that may be lost due to the project.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

12. To mitigate the identified impacts an Environmental Management Plan and Environmental Management Cost has been prepared. The likely adverse impacts on various environmental components, viz., Land, Air, Water, Biodiversity and Social & Aesthetic have been assessed. Based on the identified impacts' potential, the management practice to be followed for minimizing and mitigating the impacts on the surround environment, the activity wise Environment Management Plan is drawn. In summary, the expected impacts are of small scale, temporary and site specific depending on the implementation of the project and will not exceed the construction and major environmental norms. The EMP will be form part of the contract document.

13. In addition the project proposes (i) groundwater Recharge through construction of catchpits and recharging structures in the proposed storm water drainage network at every 90 m interval (ii) construction of sediment trap at the confluence point of drain with the water body, so that the sediments are deposited in the silt trap (iii) design of box type drains in RCC with cover on top, MS frame with wire mesh for major drains, flow of storm water through FRP gratings and public awareness programs to minimize the solid waste deposits in the drains.
14. To avoid back flow from the rivers in to the drains, flap gates are proposed in the drains. Further, Anna University is carrying out an overall storm water drainage modelling, based on which suitable mitigation measures will be implemented to manage flooding and other impacts (if any).

15. A detailed environmental management plan has been developed integrating these aspects and also the measures monitoring the implementation of EMP. A budget of about Rs. 4.2 million for drains flowing into Cooum river and Rs. 3.8 million for drains flowing into Adyar river have been provided various EMP measures of the project.

16. The EMP shall be implemented by the Corporation of through its dedicated environmental and social safeguards specialists and will submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

SOCIAL IMPACT ASSESSMENT

17. The sub project involves improvements to the canal and construction of storm water drains. As the construction of storm water drains in the road sides and the roads are owned and maintained by the corporation there is no social impacts. However, the social impacts are visible in the canals and hence covered in the socio economic survey. The canals covered are Nandampakkam canal, Padikuppam Canal, Nolambur Canal and Ambattur SIDCO canal. The total length of these canals is about 11.05 kilometres.
18. It has been identified that the project involves resettlement of about 467 Project Affected Families and hence is classified as **S1** Category. The project requires Social Impact Assessment and Resettlement Action Plan which has been carried out.

Draft Environmental Assessment for ISWD for expanded areas of Chennai Corporation

Contents

List of Tables

List of Annexures

1 INTRODUCTION

1.1 Government of Tamil Nadu has proposed to implement the World Bank supported Tamil Nadu Sustainable Urban Development program (TNSUDP) to improve the delivery of urban services. The provision of Integrated to Storm Water Drains to expanded areas of Corporation of Chennai is one of the sub-project proposed to be implemented by the Corporation of Chennai. This component is coordinated by, Government of Tamil Nadu. Tamil Nadu Financial Services Ltd. (TNUIFSL) Chennai is the fund Manager. To implement this sub project proposed to implement in the roadsides and canals and doesn't involve any Land Acqusition and required land is owned by the Corporation of Chennai.

1.2 The Corporation of Chennai (CoC) has expanded its area during 2011 by adding adjacent local bodies. Chennai city is divided in to 200 divisions/wards that are grouped in 15 zones. In order to provide storm water drains to the expanded areas, a Detailed Project Report for the Integrated Storm Water Drainage System (ISWD) to the expanded area of Chennai Corporation has been prepared. This project proposed to be taken up under proposed Tamil Nadu Sustainable Urban Development Project (TNSUDP) and intends to cover the expanded areas of Corporation of Chennai with an estimated cost of about Rs.1104.43 crores.

Environmental and Social Management Framework (ESMF):

1.3 Projects proposed under TNSUDP shall be implemented safeguarding the environmental and social concerns of the development activity. The requirements for ensuring environmental and social safeguards have been stipulated in the TNUIFSL's Environmental and Social Management Framework exclusively prepared for TNSUDP.

1.4 According to the guidelines in ESMF, the proposed ISWM to expanded areas of COC falls under E2 category which has much lesser impacts than E1 projects and require Environmental assessment to be carried out and management measures be prepared.

Environmental Assessment for ISWM to expanded areas of COC:

Objective and Scope:

1.5 **Objective:** The objective of this EA for ISWM in expanded areas of Chennai Corporation is to identify and assess the environmental impacts arising out of implementation of the Storm Water Drain Construction and to prepare necessary Environment Assessment Reports and mitigate the impacts through Environmental Management Plan (EMP).

1.6 **Scope:** The scope of this Environmental Assessment (EA) is to study the baseline of Environmental status of the project area, assess the impacts from the project implementation, identify issues through FGDs, consultations, prepare management plan, and making necessary provision in cost estimates and bid documents.

1.7 This EA is prepared in line with the Draft Environmental and Social Management Framework (ESMF) of TNUIFSL specifically evolved for the proposed Tamil Nadu Sustainable Urban Development Project (TNSUDP).

Methodology

1.8 In the screening stage, it is decided whether particular project is required to

decide whether an EA is required and focus on projects most likely to have significant impacts, those where impacts are uncertain and those where environmental management input is likely to be required. In the present scenario, the storm water drainage system projects are excluded from the Environmental Clearance (As per Ministry of Environment and Forests (MoEF) Notification issued on 14th September 2006). However, there is a need of environmental assessment prior to undertake any developmental activity to predict the environmental impacts, if any, due to implementation of the proposed activity and for eliminating or lessening the impact.

1.9 Quantitative and Qualitative surveys were conducted and relevant information was collected, analyzed and compiled to prepare Environmental and Resettlement Action Plans, wherein the issues before, during and post project implementation will be addressed in view of environmental and social impacts owing to the proposed implementation of the project.

1.10 The baseline information was collected during the field trips from local offices and from community. During Field Visits, Transect Walks were conducted through project area, catchment areas, canals, etc. and data was collected through observation and FGDs with the community.

1.11 As far as Scoping of the EIA is concerned, five environmental components viz. land, air, water, biodiversity and social & aesthetic and the proposed project activities under ISWM to extended areas of COC have been taken into consideration for impacts assessment.

Structure of the EA Report:
This EA for ISWD in extended areas of Chennai, covers the following:

1.12 First section provides an introduction to the project and report.

1.13 Second section briefly explains the project setting.

1.14 The third section provides the project description for the ISWD expanded areas of the Chennai Corporation.

1.15 The fourth section provides a review of the regulatory requirements

1.16 The fifth section covers baseline environmental status

1.17 The impacts from the proposed project activities on the environmental baseline is discussed in the sixth section.

1.18 Environmental Management Plan (EMP) with necessary costs and budget provisions are provided in section seven.

1.19 Section eight provides a brief on the consultation and public participation

1.20 Section 9 provides a summary on the Social impact assessment.

1.21 Section 10 covers the institutional arrangements and implementation proposal of COC for ISWD.

2 BACKGROUND

2.1 Chennai otherwise called as Madras city is the Capital city for the State of Tamil Nadu. Chennai is the fourth largest metropolitan city in India with an area of 174 sq.km and a population of 4.68 million (as per census 2011). Corporation of Chennai is responsible for provision of civic amenities with in Chennai including provision of Storm Water Drains (SWD). At present Chennai Corporation maintains 303 kms of Bus route Roads and 2475 kms of interior roads including cement concrete roads.

2.2 The Project area comprises of the expanded area of Chennai Corporation covering an area of 255.79 Sq. km. As many as nine municipalities, eight town panchayats and twenty five village panchayats have been brought under the Chennai Corporation limits, raising the city population from 46.81 lac to 62.2 lac (as per 2011 census). Merger of the expanded area has resulted in an increase in the area of corporation from 174 Sq. Km. to 429.79 Sq. Km. According to the present status, Corporation of Chennai is divided into fifteen (15) administrative zones out of which eight (8) zones namely Thiruvottiyur, Manali, Madhavaram, Ambattur, Valasaravakkam, Alandur, Perungudi and Shozinganallur fall in the extended area and remaining seven zones are in old city area.

2.3 **Geography:** Chennai is a seaside city where the sea is an ecstasy in blue, hugging the second largest beach in the world. From the sky, it looks neat with majestic long straight roads and the silvery streams meandering through the city. Dotted with clumps of trees and a low skyline, it is a sprawling city.

2.4 Chennai, sometimes referred to as the "Gateway to South India", is located on the south–eastern coast of India in the north–eastern part of Tamil Nadu on a flat coastal plain known as the Eastern Coastal Plains. Its average elevation is around 6.7 metres (22 ft), and its highest point is 60 m (200 ft). Two rivers meander through Chennai, the Cooum River through the centre and the Adyar River to the south. A part of the Adyar river forms a tidal creek before joining the sea.

2.5 A third river, the Kosasthalaiyar, flows through the northern fringes of the city before draining into the sea at Ennore. Adyar and Cooum rivers are heavily polluted with effluents and wastes from domestic, commercial and industrial sources. The state government periodically removes silt and pollution from the Adyar river, which is less polluted than the Cooum. A protected estuary on the Adyar forms a natural habitat for several species of birds and animal. The Buckingham Canal runs parallel to the coast, linking the two rivers. The Otteri Nullah, an east–west stream, runs through north Chennai and meets the Buckingham Canal at Basin Bridge. Several lakes of varying size are located on the western fringes of the city.

2.6 Chennai is divided into four broad regions: North, Central, South and West. North Chennai is primarily an industrial area. Central Chennai is the commercial heart of the city and includes an important business district, Parry's Corner. South Chennai and West Chennai, previously mostly residential, are fast becoming commercial, home to a growing number of information technology firms, financial companies and call centres. The city is expanding quickly along the Old Mahabalipuram Road and the Grand Southern Trunk Road (GST Road) in the south and towards Ambattur, Koyambedu and Sriperumbudur in the west.

2.7 **Topography:** Chennai is a low-lying area and the land surface is almost flat. The even topography of the land throughout the area makes it difficult to render the sub-divisions into natural regions. It rises slightly as the distance from the seahore increases average elevation of the town is not more than 7 m above mean sea level and the average slope varies at less than 0.7 m per Km, while some localities are just at sea level and drainage in such area remains a serious problem.

2.8 **Soil Condition:** Chennai's soil is mostly clay, shale and sandstone. The city is classified in into three regions based on geology and as sandy areas, clayey areas and hard rock areas. Sandy areas are found along the river banks and coasts such as Thiruvanmiyur, Adyar, Kottivakkam, Santhome, George Town, Tondiarpet and the rest of coastal Chennai. Here rainwater runoff percolates quickly through the soil. Clay underlies most of the city including T. Nagar, West Mambalam, Anna Nagar, Perumbur and Virugambakkam. Areas of hard rock include Guindy, Perungudi, Velachery, Adambakkam and a part of Saidapet. In clayey and hard rock areas, rainwater percolates slowly, but it is held by the soil for a longer time.

2.9 **Climate:** Chennai has a tropical climate, specifically a tropical wet and dry climate. The city lies on the thermal equator and is also on the coast, which prevents extreme variation in seasonal temperature. The weather is hot and humid for most of the year. The hottest part of the year is late May to early June, known locally as Agni Nakshatram ("fire star") or as Kathiri Veyyil, with maximum temperatures around 35–400C. The coolest part of the year is January, with minimum temperatures around 15–220C. The lowest temperature recorded is 13.80C and the highest recorded temperature is 45 0 C. The average annual rainfall is about 140 cm. The city gets most of its seasonal rainfall from the north–east monsoon winds, from mid–October to mid–December. Cyclones in the Bay of Bengal sometimes hit the city. The highest annual rainfall recorded is 257 cm in 2005. Prevailing winds in Chennai are usually south westerly between April and October and north easterly during the rest of the year.

2.10 **Corporation of Chennai:** The Corporation of Chennai (previously Madras) is the Oldest Municipal Institution in India established on the 29th September 1688. A charter was issued on the 30th December, 1607 by East Indian Company constituting the "Town of Fort St. George" and all the territories thereunto belonging, not exceeding the distance of ten miles from the Fort, into a Corporation. The Parliamentary Act of 1792 gave the Corporation power to levy Municipal Taxes in the City. The Municipal administration properly commenced from the Parliamentary Act, 1792 making provision for the good order and administration of the city. The Municipal Act has been amended introducing from time to time major changes in the constitution and powers of the Corporation. The Madras Municipal Corporation Act, 1919 (as amended) provides the basic statutory authority for the administration now. The Council of 200 councilors is headed by the Worshipful Mayor and Council meets ordinarily once in a month. The executive wing is headed by the Commissioner. There are Deputy Commissioners and various Heads of Departments and 15 Zonal Officers at present. The estimated present population of Chennai is 6.5 Million.

2.11 **Chennai Corporation** is maintaining 1160 roads to a length of 370 Km and storm water drain to a length of 962 Km. Total numbers of street lights in Chennai city under the maintenance of Chennai Corporation is 2, 13, 045 and

using 19 megawatts per day, and spending 2 lakhs for electric consumption per day. Chennai Corporation having 260 parks and constructed 113 community halls for public purpose. Chennai Corporation is removing 5000-5200 MT of solid waste per day through 966 conservancy vehicles and maintaining Kodungaiyur and Perungudi dumping grounds for dumping the solid waste. The total birth reported in Chennai city is 400 per day and death is 180 per day. Currently 23,538 staffs are working in it. The Annual Budgetary estimate of Chennai Corporation in 2012-13 revenue is 1326.11 crores and expenditure is 1232.97 crores. Surplus income is 93.14 crores.

2.12 As per survey conducted of the project area, there are about 205 Km of drains of width 0.60 m or more. Storm water drainage system in the project area is not sufficient and adequate. The drains do not have proper connectivity and ultimate linkage to natural waterways/ water bodies for efficient disposal of storm water runoff. Because of the flat terrain and partial & insufficient coverage of the project area with storm water drains, flooding and water stagnation is the recurrent feature in many areas during the monsoon period.

2.13 Storm Water Drains are maintained by the Department of Storm Water Drains. At present it maintains about 1660.31 km of Storm Water Drains.

Need for the ISWM:

2.14 The extended areas of Chennai corporation are developing rapidly. And presently they do not have any comprehensive drainage network (existing network length is only 224 km, built by the erstwhile ULBs about 5 to 10 years ago); and are facing frequent flooding/inundation, during monsoon season/heavy rains. The Chennai core city (area: 174 sq km) has already been covered with a drainage network, implemented in the year 2014

2.15 Water logging and flooding occurs regularly in low-lying areas of the Chennai city and its suburbs because of inadequacy or non-functioning of the local drainage infrastructure. The storm water drainage system in the extended city area including the project area is not adequate. The drains are not properly linked to natural waterways/ water bodies for efficient disposal of storm water runoff. To resolve these issues, the Corporation of Chennai has prepared a detailed project report (DPR) for implementing the storm water drainage system for Chennai extended area. In order to overcome the flooding and inundation and resultant impacts the implementation of an Integrated Storm Water Drainage Project is one of the necessary required infrastructures.

3 PROJECT DESCRIPTION

3.1 Storm Water Drains are maintained by the Department of Storm Water Drains. At present it maintains about 1660.31 km of Storm Water Drains.

3.2 The sub project will be implemented in the expanded areas of the Corporation of Chennai comprising of the following Administrative Zones and Divisions/Wards covering about 53.76 sq.kms.

3.3 The Administrative zones covered under this sub-project are Part of Zone VII Ambattur area, Part of Zone XI Valasaravakkam Area, Part of Zone XI Part of Valasaravakkam area and Part of Zone XII Alandur area.

3.4 Each of these zones are further divided into divisions or Wards

Table-3.1 ISWD Expanded Areas of Chennai Corporation

	Administrative Zone	Location
I	part area of zone VII	Ambattur
II	part area of zone XI	Valasaravakkam
III	part area of zone XI	Valasaravakkam
IV	part area of zone XII	Alandur

Project components

3.5 **Classification of Storm Water Drains:** The Storm Water Drains are broadly divided into two groups as per drain classification in Chennai. 1. Macro Drains and 2.Micro Drains. The Macro drains are natural drains that are maintained by PWD and 2. Micro Drains are the drains maintained by Corporation of Chennai. The Micro drains are further divided into storm water drains and canals.

3.6 This project involves construction of new storm water drains, rehabilitation of existing/unsized/dilapidated storm water drains and improvements to the existing canals. Further, the storm water drains are classified as follows:

(i) Collector Drains i.e. Street Drains end in feeder drains.

(ii) Feeder drains join the arterial drains,

(iii) Arterial drains will join in the canals and

(iv) Canals will join the river.

3.7 Other components are construction of culverts and cross drainage works, Rain Water Harvesting structures, Silt catch traps, fencing to the canals to prevent dumping of solid wastes, gratings in the canals to prevent entry of solid wastes into the system, etc.,

3.8 The total length of the storm water drain network is about 329.18 km, of which 94.86 km is Adyar basin and 234.32km is Cooum basin.

3.9 Most of the newly proposed drains are along the roads. Reconstruction/Augmentation of existing drains, which were found inadequate, has been proposed. RCC rectangular drains have been proposed for construction. Wherever necessary, RCC Pre-cast Drains have been proposed in place of cast in situ if the drain width is up to 2m. Total length of proposed new and existing drains to be used as such & to be reconstructed, the drains of all categories viz. Arterial, Feeder and Collector drains, comes to about 100.28 Km.

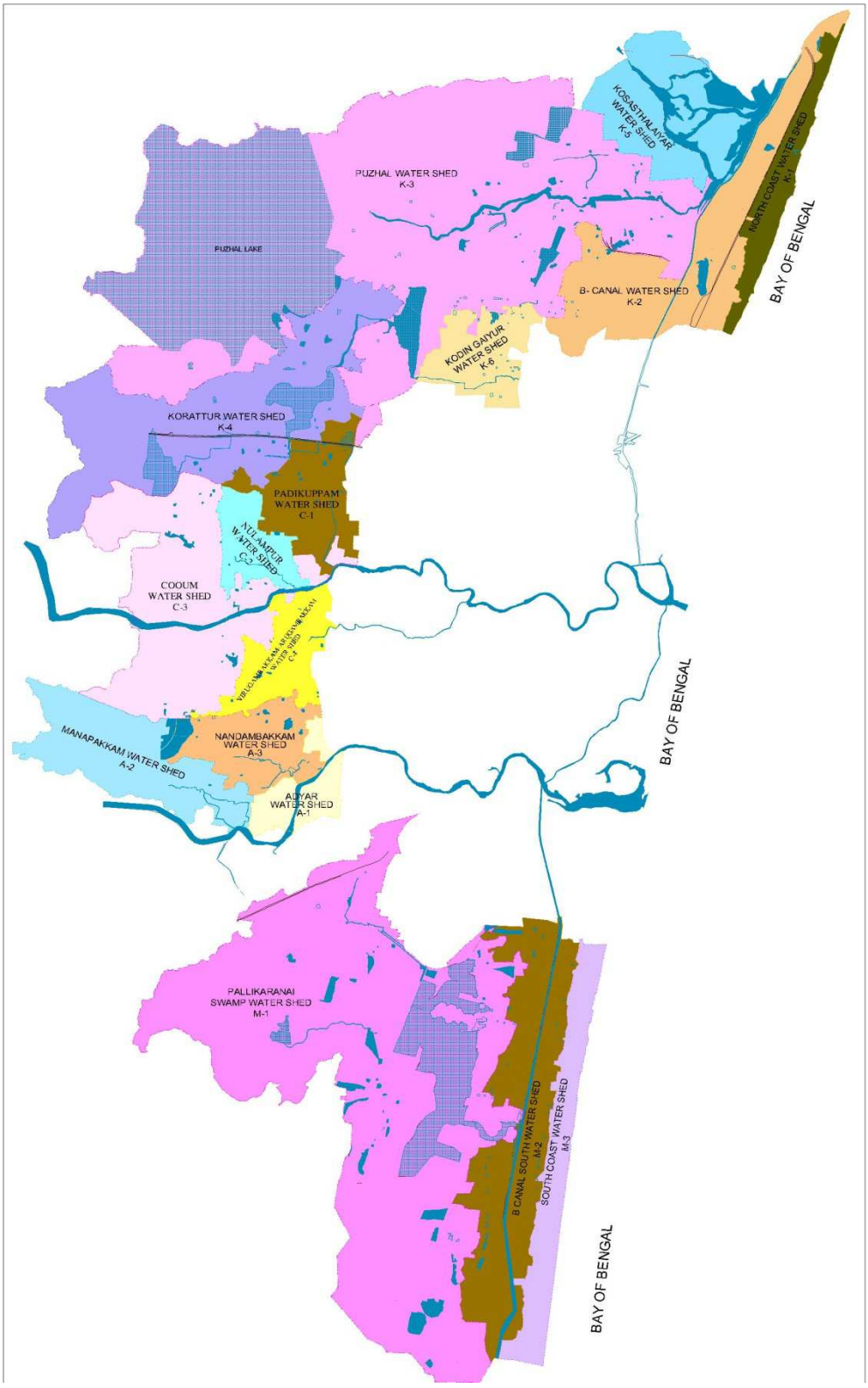


Figure 3.1 Watersheds of the expanded area of Chennai Corporation

4 REVIEW OF ENVIRONMENTAL REGULATIORY REQUIREMENTS, POLICIES & GUIDELINES

The national, state, regional and World Bank environmental laws, rules and regulations relevant to the proposed ISWM to extended areas of Chennai Corporation are provided below:

National Regulations:

- Water (Prevention And Control of Pollution) Act, 1974 and Tamil Nadu Water
- (Prevention And Control of Pollution) Rules, 1974
- The Water (Prevention And Control of Pollution) Cess Act, 1977
- Forest (Conservation) Act, 1980
- Air (Prevention and Control of Pollution) Act 1981 and Tamil Nadu Air (Prevention of Control of Pollution) Rules 1983
- Environment (Protection) Act, 1986
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008
- Public Liability Insurance Act, 1991
- Bio Medical Waste (Management & Handling) Rules 1998
- Municipal Solid waste (Management & Handling) Rules 2000
- The Noise Pollution (Regulation and Control) Rules, 2000
- EIA Notification, 2006 (S.O.1533(E), dt.14/09/2006)
- The National Green Tribunal Act, 2010
- E-Waste (Management and Handling) Rules, 2010
- Coastal Regulation Zone (CRZ) Notification, 2011 (S.O.19(E), dt. 06/01/2011)
- Plastic waste (Management & handling)Rules 2011
- Prohibition of Employment as Manual Scavengers' and their Rehabilitation Bill 2012

State Regulations:

- The Tamil Nadu Hill Areas (Preservation of Trees) Act, 1955
- Chennai Metropolitan Area Ground water (Regulation) Amendment Act, 2002

World Bank Operational Policies

- OP 4.01 Environmental Assessment
- OP 4.04 Natural Habitats
- OP 4.11 Physical Cultural Resources
- OP 4.36 Forests

The above relevant environmental legislations have been reviewed for activties proposed under the ISWM to expanded areas of COC and the environmental permission identified to be obtained is as below.

Table 4.1 Permissions required

S.No	Activity	Authority
1.	Cutting of trees	Permission is to be obtained from the Deputy Commissioner/ COC for cutting of trees.

Applicability of CRZ notification, 2011: CRZ limits (i.e., Adayar and Cooum Rivers) are confined within the core city limits and hence the ISWM activities in the expanded areas do not attract the provisions.

5 BASELINE ENVIRONMENTAL STATUS

5.1 Geology: Chennai is underlain by various geological formations from ancient Archaeans to recent Alluviums. It can be grouped into three viz. (i) Archaean Crystalline Metamorphic rocks (ii) Upper Gondwanas comprised of sandstones, siltstones and shoals, tertiary (Eocene to Pliocene) sandstones and (iii) coastal and river Alluvium. (Source: Chennai Master Plan II; Vol. i)

5.2 Meteorology of the region: The meteorological data of the Chennai region includes temperature, relative humidity, wind speed, wind direction and rainfall which has been referred from a report submitted to Chennai Corporation

5.3 Temperature: The region is within tropical semi-arid region. The climate is generally hot and dry. It is characterized with seasonal variations of cool season (winter) from November to February, hot season (summer) from March to mid-June and rainy season from mid-June to October. The mean monthly temperature is in the range 33.1 – 37.6°C, while in winter temperatures fluctuates between 28.1 – 30.6°C.

5.4 Relative Humidity: The mean annual humidity is 75.2% and highest percentage of humidity are observed during October to January and moderate in winter.

5.5 Winds: The predominant wind direction observed is from West-Northwest to East-Southeast. Whereas monsoon winds (west-south west) prevail during June-September with a mean wind speed of 11.8 kmph.

5.6 Rainfall: It has been recorded that Chennai receives 715mm of average rainfall mainly during north east monsoon during October to December. The mean annual rainfall is 1216 mm.

5.7 Landuse: The existing landuse pattern in the project area is provided in Table below.

Table 5.1: Landuse pattern of the Project Area

S.NO	LAND USE TYPE	TOTAL AREA IN SQMT
1	Agriculture Land	1717716.234
2	Built up	915576.239
3	Canal	89712.11
4	Drain	155664.75
5	Industry	4665847.128
6	Island	682.45
7	Lake	358.431
8	Lake	633553.548
9	Open space	5808306.18
10	Open Space with Grass	11961.133
11	Open Space with Tree	1033189.986
12	Play Ground	4060500.295
13	Public and Semi Public	825355.627

14	Railway Line	53659.623
15	RIVER	1074832.089
16	Road	8794916.559
17	Settlement	25397749.02
18	Tank	653318.724
19	Tree	1998813.128
20	**Total Area of Basin**	**57891713.26**

5.8 Air Environment: The ambient air quality monitoring data has been collected from Central Pollution Control Board (CPCB) website for Chennai Corporation area for the year 2008. The average values obtained are presented in Table 4.2

Table 5.2: Ambient air quality status of Chennai Corporation area

Parameter	**Type of Area**	**Yearly Average Value (µg/m3)**	**No of Observations**	**CPCB Standard (µg/m3),**	**Air Quality**
Suspended Particulate Matter (SPM)					
Thiruvottiyur	Industrial	173	114	60	Low
Kathivakkam,	Industrial	175	91	60	Low
Manali, Chennai.	Industrial	174	91	60	Low
Madras Medical College, Chennai	Residential	108	81	60	Low
NEERI CSIR Campus, Chennai.	Residential	94	93	60	Low
Respirable Suspended Particulate Matter (RSPM)					
Thiruvottiyur	Industrial	77	114	40	Medium
Kathivakkam, Chennai	Industrial	68	91	40	Medium
Manali, Chennai.	Industrial	78	91	40	Medium
Madras Medical College, Chennai	Residential	48	81	40	Medium
NEERI CSIR Campus, Chennai.	Residential	48	93	40	Medium
Sulphur Di-oxide (SO2)					
Thiruvottiyur	Industrial	13	113	50	Low
Kathivakkam,	Industrial	13	90	50	Low
Manali, Chennai.	Industrial	14	91	50	Low
Madras Medical College, Chennai	Residential	6	80	50	Low
NEERI CSIR Campus, Chennai.	Residential	6	93	50	Low
Nitrogen Di-Oxide (NO2)x					
Thiruvottiyur	Industrial	19	113	40	Low
Kathivakkam, Chennai	Industrial	20	90	40	Low
Manali, Chennai.	Industrial	21	91	40	Low
Madras Medical College, Chennai	Residential	9	80	40	Low
NEERI CSIR Campus, Chennai.	Residential	8	93	40	Low

5.9 The Air Quality sampling locations of Chennai area comprise of Residential and Industrial Category. The residential category includes Madras Medical College and NEERI CSIR Campus and Industrial Category includes, Thiruvottiyur, Kathivakkam and Manali area. The air quality monitoring results are interpreted as below:

5.10 The annual average concentration of Suspended Particular Matter levels in industrial area of Chennai Corporation was measured 174 µg/m3 which is well under the CPCB standard of 500 µg/m3 and the annual average concentration of Respirable Suspended Particular Matter was found as 74 µg/m3 against the standards of 150 µg/ m3.

5.11 **Noise Pollution:** The noise level survey conducted by the TNPCB reveals that noise level exceeded the limits mostly in commercial areas, mainly due to vehicular movement. During festive seasons in Chennai, the noise levels were noted high and particularly during Deepavali it exceeded 120 dB. (Source: Chennai Master Plan II; Vol. i)

5.12 **Soil:** Soil pH was recorded in the range of 8.1-8.5. As far as Total Organic carbon is concerned it was recorded in the range of 1486-3200 mg/kg while Total nitrogen was recorded in the range of 320- 912 mg/kg. Another nutrient, total phosphorous was recorded in the range of 129-352 mg/kg. Sodium and potassium was also recorded in the range of 90-312 mg/kg and 56-160 mg/kg respectively. Three heavy metals were also analysed and concentration of these metals was found well below to the standards. Above soil/sediment quality reflects that there is no toxic element present beyond to the safe limits prescribed by national/international agency thus excavated soil and sediment can be safely disposed of at suitable location.

Table 5.3: Soil quality status in the Existing Drains in Adyar Basin

S. No	Parameters	Results	
		Drain 1 (Girugampakkam Canal outside the COC limits.)	Drain 2 (Adayar river in zone X)
Physico-chemical			
1	pH	8.3	8.4
2	Total Organic Carbon (mg/kg)	1682	3200
3	Total Nitrogen (mg/kg)	610	912
4	Total Phosphorous (mg/kg)	241	352
5	Sodium mg/kg)	280	312
6	Potassium (mg/kg)	110	160
Heavy Metals			
1	Iron	2.8	3.4
2	Lead	0.30	0.97
3	Chromium (mg/kg)	BDL	0.01

Table 5.4: Soil quality status in the Existing Drains in Cooum Basin

S. No	Parameters	Results	
		Drain 1 (Virgambakkam Arumbakkam Canal in zone VII)	Drain 2 (TVS Canal in zone VI)
Physico-chemical			
1	pH	8.2	8.4
2	Total Organic Carbon (mg/kg)	1486	1552
3	Total Nitrogen (mg/kg)	355	320
4	Total Phosphorous (mg/kg)	142	145
5	Sodium mg/kg)	220	138
6	Potassium (mg/kg)	56	58
Heavy Metals			
1	Iron	3.4	2.1
2	Lead	0.26	0.61
3	Chromium (mg/kg)	BDL	BDL

5.13 Ground Water Quality: As reflected from the above results, pH of the collected ground water samples was recorded in the range of 7.4-7.9 shows slightly alkaline nature. As far as electrical conductivity is concerned, it was recorded in between 780-1288 µmho/cm while Total Dissolved Solids were recorded in the range of 580-910 mg/l. Total and calcium hardness of ground water was also recorded in the range of 260-482 mg/l and 168-340 mg/l respectively. Fluoride and nitrate which are the two important parameters as far as ground water quality is concerned were also recorded within the permissible limit of BIS 10500.

Table 5.5: Groundwater Quality in Adyar Basin

S. No	Parameters	Results	
		Sample 1	Sample 2
1	pH	7.4	7.8
2	Electrical Conductivity (µmho/cm)	1288	1242
3	TDS (mg/l)	910	890
4	Total Hardness (mg/l)	480	482
5	Calcium Hardness (mg/l)	340	322
6	Fluoride (mg/l)	0.29	0.36
7	Nitrate (mg/l)	2.4	1.2

Table 5.6: Assessment of Groundwater Quality in Cooum Basin

S. No	Parameters	Results	
		Sample 1	Sample 2
1	pH	7.6	7.5
2	Electrical Conductivity (µmho/cm)	820	900
3	TDS (mg/l)	590	680
4	Total Hardness (mg/l)	264	304
5	Calcium Hardness (mg/l)	182	222
6	Fluoride (mg/l)	0.21	0.18
7	Nitrate (mg/l)	0.9	1.4

5.14 **Flooding in Chennai**: Chennai a coastal city is marked mostly with flat terrain, and has increased run-off due to increased built-up area & urbanisation. Several low-lying areas of Chennai get flooded during rains.

6 ASSESSMENT OF IMPACTS

The proposed project is intended for better management of the hydrological situation and management of storm water, improvement of drainage and to prevent flooding in the low lying areas of the project area. However, the developmental activities which may be considered under the project both during under construction and operational phases may have some temporary or negligible impacts on various components of the environment. The baseline situation and the proposed activities have been analyzed for identifying the impacts from the ISWM implementation.

Table 6.1 Possible Impacts on Environment

Project Activities	Components of Environment										
		Air				Biodiversity		Social & Aesthetic			
	Land	Air Quality	Noise	Surface Water	Ground Water	Flora	Fauna	Resettlement & Land acquisition	Road and Traffic issues	Health and safety	Any damage to Public & sensitive property
Clearing and Cutting	□	□	□	X	X	□	X	□	□	□	X
Excavation & Filling Operations	□	□	□	□	X	X	X	X	□	□	X
Disposal of Excavated silt	□	X	X	□	X	□	X	X	X	X	X
Construction Camps	□	X	X	□	X	X	X	X	X	X	X
Disposal of Storm water	□	X	X	□	X	X	X	X	□	□	X

Table 6.2 Potential Adverse/Negative Impacts

Phase wise project activities	Potential Negative Impacts
During Construction	
Clearing and Cutting	▪ Loss of top soil ▪ Vegetation loss due to cutting of small shrubs and trees ▪ Increase of respirable suspended particulate matters & dust in surrounding ambient air ▪ Noise & vibration disturbances of fauna and local population during ▪ cutting of tress ▪ During clearing and cutting, there may be some hindrance in traffic due temporary increased machinery traffic ▪ There may be little impacts on health's due to Increase of respirable suspended particulate matters and noise level
Excavation & Filling Operations	▪ Loss of top soil ▪ Increase of respirable suspended particulate matters & dust in surrounding ambient air ▪ Noise & vibration disturbances of fauna and local population during ▪ cutting of tress ▪ Spillage of oil and other substances during the civil works ▪ During excavation, there may be some hindrance in traffic due temporary increased machinery traffic ▪ There may be little impacts on health's due to Increase of respirable ▪ suspended particulate matters
Disposal of Excavated silt	▪ Soil and water contamination due to improper disposal of excavated material, construction and demolition wastes ▪ Clogging of drains due to improper disposal of excavated material, construction and demolition wastes ▪ Loss of vegetation at dumping yard
Construction of labor Camps	▪ Impacts on surrounding due to improper drainage, sanitation facilities, solid waste management facilities during the use of temporary ▪ construction sites (camps, machinery sites, storage facilities etc.)
Operational Phase	
Disposal of Storm water	▪ Contamination of storm water due to mixing of sewage or industrial wastewater ▪ Clogging of drains due to deposition of eroded soil, improper cleaning ▪ Formation of misquotes breeding grounds ▪ Foul smell

6.1 Potential Negative Impact due to clear & cutting trees: Trees can be harmed by construction work in several ways. Any break or tear in a tree's bark disrupts the flow of vital fluids and exposes wood to invasion by disease and decay microorganisms, which the tree must then expend energy to deal with. A trunk wound does not always cause corresponding loss of branches or foliage, so the consequences may not be fully apparent. But a large wound in the trunk of a tree is serious-it cannot be repaired and will almost certainly result in future decay and loss of stem strength.

Table 6.3: Details of Trees to be affected

Description	**No of trees**	
No. of Trees may be affected		41
Highly vulnerable trees lying on the proposed drain corridor	31	31
Moderate vulnerable trees lying in between the vicinity and 0.5 m distance of the proposed storm water drain	67	10
Not vulnerable tree lying in between the vicinity and	144	-
Total Trees in the basin lying nearby the proposed drain	242	**41**

The other impacts that may arise from the implementation of ISWD are

i) Traffic issues due to excavation and construction activity
ii) Safety issues due to excavation
iii) Access difficulty to adjacent landuse
iv) Reverse flow into the drains from the canals
v) Solid waste dumping in the drains
vi) Disposal of excavated earth / silt
vii) Social impact due to activities in the canals.

7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 To mitigate the identified impacts an Environmental Management Plan and Environmental Management Cost has been prepared.

7.2 The likely adverse impacts on various environmental components, viz., Land, Air, Water, Biodiversity and Social & Aesthetic have been assessed. Based on the identified impacts' potential, the management practice to be followed for minimizing and mitigating the impacts on the surround environment, the activity wise Environment Management Plan is drawn. In summary, the expected impacts are of small scale, temporary and site specific depending on the implementation of the project and will not exceed the construction and major environmental norms. The EMP will be form part of the contract document.

7.3 Management measures proposed in ISWD to extended areas of COC:

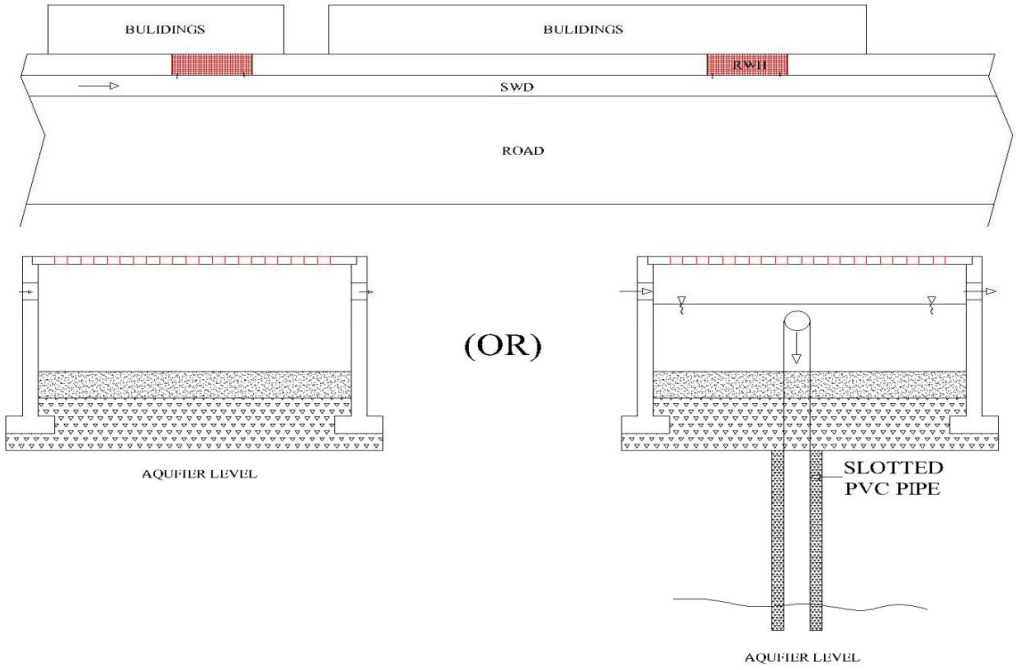
7.3.1 Groundwater Recharge through Rainwater Harvesting:

Corporation of Chennai has envisaged rainwater harvesting through constructing catchpits and recharging structures in the proposed storm water drainage network.
Rain water harvesting structure along with silt catching pit along at every 90 m interval cast -in- situ Silt Catch Pit With Rain Water Harvesting Structure of inner size 600 X 600 x 600 mm ie 1 no each between two catch pits as per the standards prescribed on the Chennai Corporation Storm Water Schedule of rates item no SCP-RWH-43A is provided in each cost estimate of drains separately.

It is also proposed to construct ground water recharging structures at an interval of 100 meters in drains The construction of structure is of cast -in- situ of inner size 2100mmx600mmx600mm including necessary earth work excavation including providing foundation in PCC 1:5:10 under walls 150mm thick and cutting the existing storm water drain of size 300 x 150mm for fixing 2 Nos of 160mm dia PVC pipe on the storm water drain mouth, with RCC cast in situ wall of size 120mm in RCC 1:1.5:3 with steel of 30.00 kg including fixing FRP Grating Cover with frame of size 700 x 700mm (clear opening 600mm x 600mm) - 10 MT - completing the finishing work etc., including drilling a hand bore of 200mm dia, fixing 160mm PVC slotted pipe to required depth(4 m) up to alluvial strata, filling in with20mm HBG metal and coarse sand for filter media inside recharging pit.

Provision of such recharging structures at an interval of 100 meters will suffice the purpose of ground water recharging and is also financially viable. Financial implication of construction of such ground water recharging structures in the drainage system for extended areas of Chennai Corporation is detailed in cost estimates and the cost for construction is provided as a separate item No 6 in cost abstract of each basin.

Ground water levels are likely to improve at least to an extent of 3m, through recharge measures taken up under the project.



7.3.2 **Considerations made in the project for Minimising Impacts**

The basic objective of the provision of storm water drains to the expanded areas of Chennai Corporation in order to avoid the flooding and inundation and for proper disposal of storm water. Hence it is proposed to provide storm water drains in the selected administrative zones with full coverage.

The narrow streets and lanes are provided with one side drains in order to minimise impacts.

7.3.3 **Sediment Control:**

For control of sediments it is proposed to construct sediment trap at the confluence point of drain with the water body so that the sediments are deposited in the silt trap and settle over there which can be removed periodically. It is also possible to provide additional silt traps at the point where the cross drainage confluence and the silt from these silt traps shall be periodically removed.

7.3.4 **Solidwaste Management:**

At present Corporation of Chennai is having an effective management system in solid waste management. However, the people living nearer to water bodies and the commercial pockets situating near Water bodies are having tendency to throw solid waste into water bodies. Therefore the following are proposed in the ISWD to extended areas of COC.

i) Micro drains are designed as box type drain in RCC with cover on top which will curtail dumping of solid waste in drains.
ii) Major micro drains belonging to Corporation of Chennai will be provided with top cover in MS frame with wire mesh to avoid dumping solid waste.
iii) Rain water will flow into drains through FRP gratings to screen the solid waste from entering into drains.

iv) Public awareness programs have been proposed through IEC activities to proper waste disposal to ensure public co-operation.

7.3.5 **Access Difficulty:**

It has been proposed to provide access ramp at critical locations to facilitate easy movement of vehicles and provision has been made in the estimates for providing temporary access to the adjacent landuses.

7.3.6 **Public Awareness**

Public play a major role in the successful functioning of proposed stormwater drain. Periodical awareness programs have been proposed to deal with the various aspects that are to be considered to improve the local public awareness by involving individually or with the voluntary organization groups.

7.3.7 **Flood Management:**

Several parts of Chennai gets flooded during rains owing to the terrain of the city and rapid developments. The ISWD is aimed to reduce the flooding to a greater extent.

The project area is at a higher elevation compared to the core city on an average of about 9.0m. Major Disposal Channels in the project area are Adayar River, Manapakkam and Nandampakkam canals (Adayar basin) and Cooum River, Padikuppam,Virugampakkam – Arumpakkam. And Nolambur canals (Cooum basin) and the final disposal point is the Bay of Bengal on the eastern side of Chennai city.

Design considerations:

The storm water drainage network was originally designed for 31.39mm/hr rainfall intensity, on an hourly average basis, for a two year Return Interval (as per Indian Design guidelines of CPHEEO manual, 1999 section 3.3). However after the review of the designs and historic trends of rainfall pattern, and the World Bank recommendation, it was decided to adopt higher Storm Return Intervals, higher rainfall intensity (68 mm/hr) based on sliding scale pattern and future land use pattern. Suggestion was also made to revise the boundary condition at disposal point, considering High Flood Level as MSL+5m.
The designed ISWD is envisaged to

a) reduce flooding/inundation hotspot areas, from 18.14 to 12.87 sq km (33% reduction in the flood/inundation prone area). This area of 12.87 sq.km will have only stagnation for a period of 1-3 hours during high intensity rainfall and there will be no prolonged flooding or inundation.

b) Overall 84% of the project area in Adayar, and 73% of the project area in Cooum is likely to be free of flooding/inundation, if the network is maintained properly.

With the revised designs,

- In the whole of project area, Ramapuram in Adayar basin, where GL is below MFL is likely to be inundated, but there is no habitation/development.

Out of 35 outfalls, 6 outfalls are below the MFL and there is a possibility of back flow in these drains however since the crests are higher than MFL, the backflow water will

remain in the drain itself. Further, flap gates are proposed to be provided in the drains to prevent reverse flow into the feeding drains.

Based on the historical trends it has been identified that the following are the critical locations that will still get flooded.

Adayar Basin

1. Adayar water shed – Ambetkar Nagar
2. Manapakkam water shed – VGN Lakshmi Nagar
3. Nandampakkam water shed – Parvathi Avenue

Out of the above, important areas are identified (from social/economic angle) as: Nil

Cooum Basin

1. Padikuppam water shed-Kamaraj Nagar
2. Padikuppam water shed-Kanthasamy nagar
3. Nolambur water shed-Ramalingam salai
4. Nolambur water shed- Near Ambattur Sidco
5. Virugampakkam Arumbakkam water shed -Sri Lakshmi Nagar

Out of the above, important areas are identified (from social/economic angle) as: Nil

To assess impacts due to flooding, currently Anna University is doing the overall storm water drainage modelling and if the study identifies any adverse impacts, then suitable mitigation measures will be proposed such as flood advance warning system to deal with any eventualities in the downstream areas.

Interventions supported by necessary equipment support, training and capacity building for Corporation to address any flooding/ inundation risks and a 3-year Operational support by Anna University etc are included under the project to develop a Flood risk model by Anna University during which time. Anna University will develop capabilities for real time modeling and handover the models to Chennai Corporation.

7.3.8 **Disposal of excavated earth/ silt:**

It is envisaged that large quantity of silt would have to be disposed from the drains and canals. The excess excavated earth will be conveyed to the existing dumping yards at Kodungaiyur and Perungudi. Necessary provision for conveyance of surplus earth has been made in the cost estimate. The vehicles conveying earth will be instructed to be covered with to avoid spreading of respirable suspended particulate matter & dust in the ambient air.

7.3.9 **Traffic Management Measures**

7.3.9.1 Traffic Diversion

During the construction stage of storm water drain, traffic diversion or management may be required in any of the following conditions.

1. If density of traffic is more in the construction road
2. Laying of storm water drain in major roads

3. If road width is lesser for traffic due to width of drains especially for arterial drains
4. Criticality of junction when drain crosses a junction
5. Local significance

7.3.9.2 Planning the works

The complexity of traffic diversion or management differs from scheme to scheme but the main objective is to maximise the safety of work force, publics living nearby and the travelling public and the second objective is to keep traffic flowing as freely as possible. So the traffic management should be a safe system of work for both operatives and road users.

During the planning stage of works the following points should be noted.

- Intimation to the public living or shops available adjoining the construction site.
- Attention must be paid to the needs of pedestrians. This applies especially in the vicinity of bus stops, shops, where larger numbers of people with physical/mental impairments may be expected.
- Construction works should be undertaken in the minimum time, taking up the minimum of road space, but without compromising safety. Where practicable, additional resources or time- reducing techniques should be considered.
- There must always be liaison with the Authority concerned to avoid concurrent works in close proximity.
- Period of execution based on the area specific. For example if an educational institution is present the works may be planned during holidays
- Transport authorities to be informed to plan their stops and routes if diverted
- There should be always liaison with traffic police and other emergency services

7.3.9.3 Designing Traffic management

1. Before execution minimum lateral (sideways) clearance should be given between moving traffic and work space
2. Outer boundary of work space should be provided with barricading as specified in the SOR of CoC
3. Barricading should be visible in day and night and also adjacent to running traffic lane should be lined with traffic cones.
4. Adequate working space should be provided around the work place to allow temporary works
5. If density of traffic is more in construction road and the road is two way at least 5.5 m width should be maintained. If not possible a single way traffic may be enrooted on other possible way by providing proper indication on the entrance of road or before the diversion way. For one way traffic at least 3.3 m clearance should be given for heavy vehicle or public transport, but. Car only traffic may be

maintained with 2.5 m width. Adequate warnings of narrow lanes must be given with proper sign board.

6. For construction of drains in the major roads the points discussed above is applicable along with the sign to vehicles to restrict the speed within 30 kmph while crossing construction site and sign indicating " no overtaking" may be erected during working hours.

7. If road width is less than required i.e., at least 2.5 m for one way traffic during the period of construction , the road can be closed and traffic diverted along a suitable diversion road after according concurrence with traffic police and road authorities.

8. For crossing of drains through culverts in major roads, push thro technology is suggested. But if the culvert crosses through open excavation proper closing of traffic is required for crossing road.

   Proper diversion board indicating the "Road ahead is closed" the nature of work going ahead with authority name should be placed before the entrance of road with advance warning of diversion should be placed before 100m of diversion with arrow sign for diversion before 3m from the diversion road.

A proper vehicle restraint and pedestrian barrier with proper signage board should be placed on either side of culvert crossing.

7.3.10 **Tree cutting and Compensatory plantation**:

The presence of trees adjacent to the drains/ canals and the vulnerable trees from the drain construction activity are estimated as 242 and 41. Adequate precaution shall be taken during implementation to keep the tree cutting at minimum. However, provision for plantation has been made at ten times the number of vulnerable trees.

Corporation has proposed to carryout compensatory plantation after completion of the drain construction. Around 410 trees shall be planted along the streets in the expanded areas, i.e., in Manapakkam, Mugalivakkam, Ramapuram, Padikuppam, Nolumbur and Ambattur, by the Parks Department of Chennai Corporation. List of suggested species of trees for the compensatory plantation is provided in the Annexure.

7.3.11 **Safety requirements for Maintenance of drains**

The inspection doors are provided at a distance of 10m to facilitate maintenance only through machineries and equipments avoiding manual entry.

However in case of any need for manual maintenance the following shall be ensured.

(a) A competent person should carry out a risk assessment and make recommendations on safety and health measures before undertaking work in confined space.

(b) Allow only certified workers to work in the confined space.

(c) Provide adequate ventilation.

(d) Isolate the confined space.

(e) Monitor the air quality throughout the entire working period by means of a gas detection device.

(f) A person should be stationed outside the confined space to monitor the weather condition and keep communication with the workers inside.

(g) if required ensure the use of approved breathing apparatus

(h) Appropriate emergency procedures shall be formulated to deal with serious or imminent danger.

(k) Instructions, training and advice shall be provided to all workers to be working within a confined space.

Benefits of the project

7.4 The population in the project area will be benefitted by the implementation of this project.

7.5 Economic Benefits: Direct economic benefits such as the costs for the restoration of damaged roads, engaging earth work excavators, cost of pumping and associated fuel costs, the cost of materials such as sand bags, restoring cross drainages, small bridges etc will be reduced. Further, the cost of cash and kind reliefs to flood affected population, loss of livestock, other structures will be reduced after implementation of ISWD Projects. Further, indirect benefits such as improved health status of population due to reduced risk of exposure to water borne diseases such as malaria, dengue and resultant health impacts.

TABLE 7.1 ENVIRONMENTAL MANAGEMENT PLAN FOR INTEGRATED STORM WATER DRAINAGE FOR EXPANDED AREAS OF CHENNAI

Sl.no	Potential Impact	Mitigation Measures	Responsible agencies
1.0	**PRE-CONSTRUCTION STAGE AND CONSTRUCTION PHASE**		
1.2	Clearances	All clearance required from other departments and Environmental aspects shall be ensured and made available before start of work. For trees identified for cutting, obtain prior permission from the Deputy Commissinoer, CoC prior to commencement of work.	COC
1.3	Tree Cutting	i) Provide adequate protection to the trees to be retained with tree guards (e.g. Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars) as required. ii) Take adequate care to determine to root protection zone and minimise root loss. iii) Trees shall be removed from the construction sites before commencement of construction iv) Undertake afforestation in nearby areas.	Contractor / COC
1.4	Utility Relocation	i) Identify the common utilities that would be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc. ii) Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts. iii) Where ever the entry and exit to houses/ establishments are affected due to construction activities, alternate temporary arrangement for crossing over shall be provided.	COC / Concerned departments/ Contractor
1.5	Baseline parameters	i) Base line parameters shall be recorded and ensured conformance till the completion of the project. ii) The contractor shall undertake periodical monitoring of air, water, noise and soil quality through an approved monitoring agency. The parameter to be monitored, frequency and duration of monitoring plan shall be prepared. iii) Adequate measures shall be taken and checked to control any pollution and report be sent to the Engineer.	Contractor / COC

1.6	Planning of temporary Traffic arrangements	i) Temporary diversion will be provided with the approval of the engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, one week prior to commencement of works. ii) The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of wok each day, SIGNAGES, safety measures for transport of hazardous materials and arrangement of flagmen. **The guidance for traffic management provided in Section 7.3.8 of the EA report shall be referred to for preparation of the traffic plan**.	Contractor / COC
1.7	Temporary flooding during construction activity.	i) Desilting activity shall be scheduled during non-flooding season. ii) Proper drainage arrangements to be made, to avoid the overflowing of existing drains due to construction activity.	Contractor/ COC
1.8	Prevention of accidents	i) Prevention of accidents involving human beings, animals or vehicles falling or accidents during construction period. This needs to be ensured with proper barricading, signage boards and lighting etc. ii) The project engineer of COC will plan and direct the contractor to execute the work progressively so that the length of the open excavated trench is minimised in order to reduce possible accidents	Contractor / COC
1.9	Barricading site	The construction area should be barricaded at all time in a day with adequate marking, flags, reflectors etc. for safety of general traffic movement and pedestrians.	Contractor
1.10	Drainage flow	i) Alternate arrangement like diversion of the drainage be ensured to allow the natural flow. ii) It shall be ensured that none of the construction activities affect the natural flow of the drainage.	Contractor / COC
1.11	Storage of materials	i) No construction materials should be stored on the road, on top of or beside drains and footpaths, or on any other public area as this may restrict public access to these utilities. ii) The contractor shall identify the site for temporary use of land for construction sites /storage of construction materials, etc. iii) Site for storage of construction materials to be identified without affecting the traffic and other common utilities, and the quality of the construction materials. iv) Construction materials should only be stored and prepared on the site if they do not obstruct	Contractor / COC

		the road or any surrounding public utility. Construction materials should only be transported to the worksite as and when required for construction	
1.12	Using of modern machineries	i) Using of modern machineries such as JCBs, backhoes etc, shall be used to minimize the construction period, it will reduce the construction period impacts to the near by residents.	Contractor
1.13	Dust Pollution near settlements	i) All earth work will be protected in manner acceptable to the engineer to minimize generation of dust. Area under construction shall be covered & equipped will dust collector. ii) Construction material shall be covered or stored in such a manner so as to avoid being affected by wind direction. iii) Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day. iv) Trucks carrying construction material to be adequately covered to avoid the dust pollution and to avoid the material spillage. v) Sprinkling of water to be done at regular intervals at places of work to protect the nearby inhabitants and road users.	Contractor
1.14	Protection of residential / sensitive receptors.	i) Noisy construction operations in residential and sensitive areas should be done only between 7.30 am and 6.00 pm. ii) Preventive maintenance of construction equipment and vehicles to meet emission standards and to keep them with low noise. iii) Provision of enclosing generators and concrete mixers at site. iv) Sound barriers shall be installed during the construction phase to protect the inhabited areas from the noise from construction activities. v) Adequate barricading and safety measures to protect dust pollution and noise impacts on sensitive receptors like schools and hospital etc due to vehicle movement to be ensured prior to the start of work and their effectiveness to be checked during construction and operation phase.	Contractor
1.15	Vehicular noise pollution at residential / sensitive receptors.	i) Idling of temporary trucks or other equipment should not be permitted during periods of loading / unloading or when they are not in active use. The practice must be ensured especially near residential / commercial / sensitive areas. ii) Stationary construction equipment will be kept at least 500m away from sensitive receptors. iii) All possible and practical measures to control noise emissions during drilling shall be employed. The COC may direct to take adequate controls measures depending on site	Contractor

		conditions.	
1.16	Noise from vehicles, plants and equipments	i) Use of less noise generating cutting equipment's, provide personal protective equipment's such as ear plugs/muffs and other safety measures to labourers. In addition the concrete mixture to be used for construction works will be prepared in a location away from the locality to minimize the noise generated from the machinery. ii) Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. iii) Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Engineer to keep noise levels at the minimum.	Contractor
1.17	Labour camp & facilities	Setting up of labour camps needs to be done as per the procedures. Adequate potable water facilities, sanitation and drainage etc., in conformity with the Indian labour laws shall be ensured. The contractor shall also guarantee the following: i) The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction. ii) The construction will commence only upon the written approval of the Engineer. iii) The Contractor shall construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. iv) Supply of sufficient quantity of potable water (as per IS) in every workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities. v) The sewage system for the camp shall be designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. Ensure adequate water supply is to be provided in all toilets and urinals. vi) The contractor shall provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Engineer. vii) Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Engineer will have to be provided by the contractor.	Contractor
1.18	Pollution from Construction	All waste arising from the project is to be disposed off in the manner that is acceptable by the Engineer.	Contractor

	Wastes	The engineer shall certify that all liquid wastes disposed off from the sites meet the discharge standard.	
1.19	Pollution from Fuel and Lubricants	i) The contractor shall ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500 m from sensitive receptors. ii) All location and lay-out plans of such sites shall be submitted by the Contractor prior to their establishment and will be approved by the Engineer. iii) Contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. iv) Contractor shall arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Engineer) and approved by the Engineer. All spills and collected petroleum products will be disposed off in accordance with MoEF and state PCB guidelines. v) Engineer will certify that all arrangements comply with the guidelines of PCB/ MoEF or any other relevant laws.	Contractor
1.20	Flora and Chance found Fauna	The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any wild animal is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Engineer and carry out the Engineer's instructions for dealing with the same. The Engineer will report to the near by forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials.	Contractor/ COC
1.21	Chance Found Archaeological Property	All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer of such discovery and	Contractor/ COC

		carry out the SC's instructions for dealing with the same, waiting which all work shall be stopped. The Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.	
1.22	Disposal of oil and grease	A suitable site should be identified for safe disposal / without contaminating the source, in relatively low lying areas, away from the water bodies etc., as approved by the Engineer & as per specific procedures.	Contractor/ COC
1.23	Safety Aspects	i) Adequate precautions shall be taken to prevent the accidents and from the machineries. All machines used shall confirm to the relevant Indian standards Code and shall be regularly inspected by the COC. ii) Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil. iii) Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc. iv) Welder's protective eye-shields shall be provided to workers who are engaged in welding works. v) Earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. vi) The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs. vii) The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract. viii) The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. ix) The contractor shall not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form.	Contractor
1.24	Risk from Electrical Equipment(s)	The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that - i) No material will be so stacked or placed as to cause danger or inconvenience to any person or the public.	Contractor

		ii) All necessary fencing and lights will be provided to protect the public in construction zones. iii) All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Engineer.	
1.25	First Aid	The contractor shall arrange for: i) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital	Contractor
1.26	Informatory Signs and Hoardings	The contractor shall provide, erect and maintain informatory/safety signs, hoardings written in English and local language, wherever required or as suggested by the Engineer.	Contractor/ COC
1.27	Disposal of desilted / excavated material, construction and other waste.	The excavated /desilted material shall be disposed off without any accumulation. The soil excavated from the canal and river shall be tested for quality, adequately treated with methods like bioremediation and proper reuse option explored. The rest may be safely disposed. The disposal shall be done in the existing dump yards of Chennai Corporation at Kodungaiyur and Perungudi or any other site identified by Chennai Corporation. The following shall be ensured during silt disposal (a) The dumping does not impact natural drainage courses (b) No endangered / rare flora is impacted by such dumping (c) Settlement area located at least 1.0 km away from the site. (d) Should be located in non residential areas located in the down wind side (e) located at least 100m from the designated forest land. (f) avoid disposal on productive land. (g) should be located with the consensus of the local community, in consultation with the engineer (h) All vehicles delivering material to the site shall be covered to avoid material spillage.	Contractor / COC
1.28	Clearing of construction	i) Contractor to prepare site restoration plans, the plan is to be implemented by the contractor prior to demobilization.	Prospective

	camps and restoration	ii) On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the contractor's expenses, to the entire satisfaction of the engineer.	contractor

2.0	**OPERATION PHASE**		
Sl.no	**Potential Impact**	**Mitigation Measures**	**Responsible agencies**
2.1	Maintenance	i) It shall be ensured by the COC that drains are not clogged. The following practices should be adopted in maintaining storm water drains: ii) Drains shall be regularly inspected and cleaned especially prior to monsoons. iii) All damaged or missing drain covers should be replaced immediately iv) Rubbish and silt that has been removed from the drainage system should not be left alongside the drain and shall be immediately disposed in pre-identified site with necessary precautions	COC
2.2	Impairment of receiving water quality due to mixing of waste water	i) Avoid mixing of wastewater from household, commercial, industrial and other establishments. ii) Provision for connecting domestic liquid waste to sewerage system is to be made during drain construction to avoid mixing of wastewater. iii) Periodical monitoring shall be carried out and sources of wastes/ effluent etc are to be identified by the COC. COC may initiate action to ensure proper linking of such connections to other waste disposal systems and it shall be ensured that the drains carry only the rainwater. iv) In case of any industrial effluent identified, necessary action be taken in co-ordination with the TNPCB.	COC
2.3	Nuisance due to clogging of drains, formation of mosquito	i) Ensure timely desilting of drains ii) Create awareness among the people not to throw garbage and other waste into the drains	COC

	breeding grounds etc.,		
2.4	Disposal of stormwater	i) Mixing of wastewater from households, commercial, industrial and other establishments will be avoided through improved sewerage system in the project area through periodical monitoring of water quality. ii) Possibility of reusing the stormwater for secondary uses with minimum treatment shall be explored and implemented.	COC
2.5	Tree Planting & Protection	i) Plantation of trees shall be carried out along the streets of Manapakkam, Mugalivakkam, Ramapuram, Padikuppam, Nolumbur and Ambattur etc or any other place possible like parks in the nearby areas. ii) Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars, use of plate compactors near trees may also be considered where necessary. iii) Growth and survival of trees planted shall be ensured and monitoring done at least for a period of 3 years. Survival status shall be monitored on monthly basis by Engineer in-charge.	COC
2.6	Flood management	Flood management system may be developed with forecasting and warning to protect areas prone to flooding and action be taken as necessary, like bailing out of water, relocation of residents to other locations etc.	COC
2.7	Solid waste Management	i) Provide additional bins in critical locations ii) Ensure frequent collection and disposal of waste iii) Carryout periodical awareness programmes to educate the public / stakeholders	COC

Environmental Monitoring Plan

To monitor the extent of environmental impact of the proposed /implemented project, the contractor has to periodically monitor the ambient environmental quality along the proposed project area. The monitoring requirement for the different environmental components is presented in table below

Environmental Monitoring Plan

Air Quality Monitoring	
Project stage	Construction
Parameter	SPM, RPM, SO_2, NO_x, CO and Pb
Sampling Method	Use method specified by CPCB for analysis
Standards	Ambient Air Quality Standards, CPCB, 1994, Air (Prevention and Control of Pollution) Act,1981
Frequency	Once every season except monsoon during construction period
Duration	As per CPCB guidelines for monitoring
Location	Sensitive locations, especially in the downwind direction along the alignment.
Measures	Wherever air pollution parameters increase above specified standards, additional measures as decided by the engineer shall be adopted
Implementation	Contractor through approved monitoring agencies
Supervision	COC
Water quality Monitoring	
Project stage	Construction & Operation period (as agreed)
Parameter	Parameters for Surface water quality standards (IS; 2296) Water pH, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater.
Sampling Method	Grab sample to be collected and analysis as per Standard Methods for Examination of water and Waste water.
Standards	Indian standards for Inland Surface Water (IS; 2296, 1982) and for Drinking water (IS; 10500,1991)
Frequency	Once every season during construction and during operation period.
Duration	Grab sampling
Location	Locations representing water quality in the drain and ground water quality
Measures	At locations of variation in water quality/increased pollution, remedial measures to be adopted /all inflow channels shall be checked for pollution loads
Implementation	Contractor through approved monitoring agencies
Supervision	COC
Noise Level Monitoring	
Project stage	Construction
Parameter	Noise levels on dB (A) scale.
Special guidance	• Free field at 1 m from the equipments whose noise level are being determined. • Equivalent noise levels using an integrated noise level meter kept at a distance of 15m from edge of pavement
Standards	National Ambient Air Quality Standards in respect of Noise, Noise

	Pollution (Regulation and Control) Rules, 2000
Frequency	Seasonal during construction period.
Duration	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged
Location	• Wherever the contractor decides to locate the equipment yard. • At sensitive locations such as school, hospitals etc along the alignment.
Measures	In case of noise levels causing disturbance to the sensitive receptors, management measures as suggested in the EMP shall be carried out.
Implementation	Contractor through approved monitoring agencies
Supervision	COC
Soil Quality Monitoring	
Project stage	Construction & Operation (as agreed)
Parameter	Soil quality parameters (Pb, SAR and Oil & Grease, monitoring silt for presence of toxic metals , etc)
Sampling Method	• Sample of soil collected to be acidified and analysed using absorption spectrophotometer
Standards	Threshold for each contaminated set by IRIS database of USEPA until national standards are promulgated
Frequency	• During the pre monsoon post monsoon seasons each year for the entire construction and operation phase
Duration	Grab sampling
Location	• At sample locations in the receiving waterbodies, at the places of dumping silt, excavated earth.
Measures	At location of increased in pollution levels, source shall be identified and measures adopted.
Implementation	Contractor through approved monitoring agencies
Supervision	COC

Apart form the above mentioned monitoring requirements, any major accidents /spillage during bulk transport of hazardous materials by the contractor, depending on the type of spillages / accidents, the parameters to be monitored will be decided by the engineer and should be carried out by the contractor through approved monitoring agencies and supervised by the Implementing agency at their own cost.

FORMATS FOR REPORTING:

Formats for reporting / monitoring the progress / parameters achieved will be finalized in consultation with the successful bidder.

Environmental Compliance Report

The contractor shall submit a monthly progress report as per the reporting format approved by the Engineer on the status of the implementation of the EMP and get it duly approved by the Engineer for its compliance and for proceeding with the work. The Engineer and the Environmental and Social Safeguard (ESS) Manager, who will have access and authority to monitor the status based on the same and for which necessary facilities shall be made by the contractor.

Cost estimates for Environmental Management Plan:

The budget proposed for implementation of environmental management measures proposed in the ISWD in extended areas of COC are given in Table below.

Table 7.2 Cost estimate for EMP for drains flowing into Cooum River

Sl.No	Management Activities	Unit	Rate	Amount, (Rs.)	Reference to BOQ/ Estimate
A-	**During Construction Phase**				
1.	Sprinkling of water on the exposed site and dust suppression barrios to minimize the generation of dust and respirable suspended particulate matters -	LS	-		It is included as a part of work to done in SI No 2 of BOQ
2.	Compensatory plantation after the completion of the activity (plantation of 190 trees and landscaping works) including maintenance during O&M	LS	-	1,90,000	Included in EMP No 12 of Abstract estimate of Adaya Responsible of Cc
3.	Provision of temporary barriers and proper signage for avoiding traffic congestion including traffic management measures	LS	-	19,20,000	Included as SI No 14 of Abstract Cost estimate of Adayar basin, Responsible of
4.	Lead and lift for excavated silts up to dumping area	considered in the main project cost			Included in SI No 13 of BOQ
5.	Provision of Proper drainage, sanitation along with water supply and temporary camps for habitation of labours	LS	-		Included in conditions of contract
6.	Provision for temporary arrangements to cross drains during execution	considered in the main project cost		89,00,000	Included in as SI No 15 of Abstract Cost estimate of Adayar basin, Responsible of
7.	Provision of Flap gates (where FSL of receiving body is higher)	To be fixed wherever necessary		23,00,000	Included in as SI No8 of Abstract Cost estimate of Adayar basin,
8.	Provision for rain water harvesting along the alignment of drains	considered in the main project cost			Included in SI No 10 of BOQ
9.	**Environmental Monitoring**				
(i).	8 hourly Air Quality Monitoring (2 Monitoring stations in project area) four times during construction period (Total No. of Samples at 8 Nos. Two stations =16)	Market Rate	Rs.15000/ sample	240000	Included in EMP No 12 of Abstract estimate of Adaya Responsible of CoC

(ii).	Noise level Monitoring twice in a day (at 5 locations including construction sites) six times during construction period	Market Rate	Rs.500 for each monitoring	300000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of
(iii).	Water Quality Monitoring (at 2 Monitoring station per water shed in the project area) twelve times during construction period (Total No. of Samples at 4 per watershed . TOTAL= 96	Market Rate	Rs.10000/ sample	960000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of CoC
(iv).	Soil Quality Monitoring (10 stations per watershed of the project area including the silt dumping area, three times during construction period (Total No. of Samples at 30 nos. per water shed = 120)	Market Rate	Rs. 8000/ sample	960000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of CoC
B	**During Operational Phase**				
10.	Lead for disposal of wastes / silt from the drains	considered in the Operation and maintenance cost			
11.	**Environmental Monitoring**				
(i).	Water Quality Monitoring (at 3 Monitoring stations in the project area) twice after construction period (Total No. of Samples at 6Nos. per zone=18)	Market Rate	Rs.10000/ sample	180000	
(ii).	Soil Quality Monitoring (4 stations of the project area including the silt dumping area, once after construction period (Total No. of Samples at 4Nos. per zone=12)	Market Rate	Rs. 8000/ sample	96000	
12.	Training programs for the labourers	LS		500000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of
13.	PPEs for the labourers	LS		100000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of
14.	Public Awareness and Capacity Building	LS	-	1000000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of CoC
	Total (A+B)			17646000	
	Sub-Total - EMP Cost			**42,50,000**	

Table 7.3 Cost estimate for EMP for drains flowing into Adayar River

Sl.No	Management Activities	Unit	Rate	Amount, (Rs.)	Reference to BOQ/ Estimate
A-	**During Construction Phase**				
1.	Sprinkling of water on the exposed site and dust suppression barrios to minimize the generation of dust and respirable suspended particulate matters -	LS	-		It is included as a part of work to done in SI No 2 of BOQ
2.	Compensatory plantation after the completion of the activity (plantation of 220 trees and landscaping works) including maintenance during O&M	LS	-	2,20,000	Included in EMP No 12 of Abstract estimate of Adaya Responsible of Cc
3.	Provision of temporary barriers and proper signage for avoiding traffic congestion including traffic management measures	LS	-	9,00,000	Included as SI No 14 of Abstract Cost estimate of Adayar basin, Responsible of
4.	Lead and lift for excavated silts up to dumping area	considered in the main project cost			Included in SI No 13 of BOQ
5.	Provision of Proper drainage, sanitation along with water supply and temporary camps for habitation of labours	LS	-		Included in conditions of contract
6.	Provision for temporary arrangements to cross drains during execution	considered in the main project cost		20,00,000	Included in as SI No 15 of Abstract Cost estimate of Adayar basin, Responsible of
7.	Provision of Flap gates (where FSL of receiving body is higher)	To be fixed wherever necessary		46,80,000	Included in as SI No8 of Abstract Cost estimate of Adayar basin,
8.	Provision for rain water harvesting along the alignment of drains	considered in the main project cost			Included in SI No 10 of BOQ
9.	**Environmental Monitoring**				
(v).	8 hourly Air Quality Monitoring (2 Monitoring stations in project area) four times during construction period (Total No. of Samples at 8 Nos. Two stations =16)	Market Rate	Rs.15000/ sample	240000	Included in EMP No 12 of Abstract estimate of Adaya Responsible of CoC
(vi).	Noise level Monitoring twice in a day (at 5 locations including construction sites) six times during construction period	Market Rate	Rs.500 for each monitoring	300000	Included in EMP No 12 of Abstract estimate of Adaya Responsible of

(vii).	Water Quality Monitoring (at 2 Monitoring station per water shed in the project area) twelve times during construction period (Total No. of Samples at 4 per watershed . TOTAL= 72	Market Rate	Rs.10000/ sample	720000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of CoC
(viii).	Soil Quality Monitoring (10 stations per watershed of the project area including the silt dumping area, three times during construction period (Total No. of Samples at 30 nos. per water shed = 90)	Market Rate	Rs. 8000/ sample	720000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of CoC
B	**During Operational Phase**				
10.	Lead for disposal of wastes / silt from the drains	considered in the Operation and maintenance cost			
11.	**Environmental Monitoring**				
(iii).	Water Quality Monitoring (at 3 Monitoring stations in the project area) twice after construction period (Total No. of Samples at 6Nos. per zone=18)	Market Rate	Rs.10000/ sample	180000	
(iv).	Soil Quality Monitoring (4 stations of the project area including the silt dumping area, once after construction period (Total No. of Samples at 4Nos. per zone=12)	Market Rate	Rs. 8000/ sample	96000	
12.	Training programs for the labourers	LS		500000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of
13.	PPEs for the labourers	LS		100000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of
14.	Public Awareness and Capacity Building	LS	-	1000000	Included in EMP (No 12 of Abstract estimate of Adaya Responsible of CoC
	Total (A+B)			11656000	
	Sub-Total - EMP Cost			38,00,000	

8 CONSULTATION AND COMMUNITY PARTICIPATION

Public Disclosure:

The first draft of the Environmental Impact Assessment Report (EIA) and the Executive Summary have been disclosed in the websites of the Corporation of Chennai (26.11.2014) and TNUIFSL (24.11.2014).

The links are as below:

Corporation of Chennai

http://www.chennaicorporation.gov.in/images/swd/CoC-ISWD-EIA-First%20Draft%20241114.pdf

TNUIFSL

http://www.tnuifsl.com/CoC-ISWD-SIA%20First%20Draft%20241114.pdf

Public Consultations:

During the initial surveys conducted during DPR preparation, brief discussions have been carried out in the project area. However currently, consultations are proposed to be conducted in the project area in the form of Focused Group Discussion (FGD). The methodology and number of FGDs are planned as below:

1. Consultation with People including PAFs in Part of Zone VII of Chennai Corporation
2. Consultation with People including PAFs in Part of Zone XI of Chennai Corporation
3. Consultation with People including PAFs in Part of Zone XI of Chennai Corporation
4. Consultation with People including PAFs in Part of Zone XII of Chennai Corporation
5. Consultation with Women and Women Headed PAFs in Zone VII & XI
6. Consultation with Women and Women Headed PAFs in Zone XI & XII

9 SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN

The sub project involves improvements to the canal and construction of storm water drains. As the construction of storm water drains in the road sides and the roads are owned and maintained by the corporation there is no social impacts. However, the social impacts are visible in the canals and hence covered in the socio economic survey. The canals covered are Nandampakkam canal, Padikuppam Canal, Nolambur Canal and Ambattur SIDCO canal. The total length of these canals is about 11.05 kilometres.

It has been identified that the project involves resettlement of about 467 Project Affected Families and hence is classified as **S1** Category. The project requires Social Impact Assessment and Resettlement Action Plan as per ESMF.

Social Impact Assessment has been carried out as required and the details are available in the Resettlement Action Plan (RAP) prepared for ISWD to COC.

10 IMPLEMENTATION PROPOSAL AND INSTITUTIONAL ARRANGEMENTS AT COC

10.1 Corporation of Chennai has proposed to take up the Integrated Storm Water Drainage (ISWD) project for the expanded areas of Chennai Corporation.

10.2 The sub project will be implemented by the Storm Water Drain Department of the Chennai Corporation.

10.3 Under TNSUDP, the storm water drainage network in the drains flowing into Adayar and Cooum Rivers are proposed to be taken up in a total of 39 packages. The ISWD works for drainage at an estimated cost of Rs.1104.43 crores.

10.4 The works for drainage network in Adayar basin are proposed under 9 packages for a total length of 82311m. This includes as a separate package the Nandambakkam canal for a length of 3669m.

10.5 The works for drainage network in Cooum basin are proposed under 30 packages for a total length of 188015 m. This includes the Padikuppam canal (2778m), Korattur TNHB canal (1927m), Ambattur SIDCO canal (1061m), and Nolumbur canal (2390m) as four separate packages.

10.6 Project Management Consultants (PMC) will be appointed by the CoC. At present it is proposed to engage two PMC agencies for managing ISWD Project.

10.7 The Chennai Corporation proposed to appoint Environmental and Social Safeguards specialists for ensuring adoption and compliance of ESMF.

10.8 The Environmental Management Plan identified for the construction will be included in the bid documents for ensuring implementation of the environmental safeguards. The management measures identified for the operation phase will be taken up by the CoC upon completion of construction activities.

Grievance Redressal Mechanism

10.9 The Corporation of Chennai will have the following mechanism to address the grievance of the project affected. The details of the Project Level Grievance Redressal Committee are as follows:

Grievance Redressal Committee:

- The Commissioner
- The Zonal Officer /Regional Deputy Commissioners of CoC
- A person of Local refute
- Elected representative of the Ward

10.10 All the grievances relating to the implementation of Integrated Storm Water Drain shall be handled by the Zonal Officers/ Regional Deputy Commissioners of the respective zones of the project area.

10.11 COC shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

Annexure I Suggested list of species for plantation

Gulmohar

Flame tree : Delonix regia is a species of flowering plant in the family Fabaceae, subfamily Caesalpinioideae. It is noted for its fern-like leaves and flamboyant display of flowers. In many tropical parts of the world it is grown as an ornamental tree and in English it is given the name Royal Poinciana or Flamboyant. It is also one of several trees known as Flame tree.

In Nepal,India and Pakistan it is known as Gulmohar.

It requires a tropical or near-tropical climate, but can tolerate drought and salty conditions. The tree is most commonly propagated by seeds.

The tree sheds large woody pods and brittle branches that get broken off in the wind due to weak stem

Flowering season

April–June

Royal poinciana gets 30-40 ft (9.1-12.2 m) tall, but its elegant wide-spreading umbrella-like canopy can be wider than its height.

Royal poinciana has shallow, wide-spreading roots that will not allow under planting and the roots can be a threat to building foundations and sidewalks.. Seedlings will come up all around the tree. the pods are used for fuel and called "woman's tongue" because of the rattling noise they make when the wind blows them

Yellow Gulmohar

PELTOPHORUM PTEROCRPUM(COPPER POD):

Golden Flamboyant, Yellow Flamboyant, Yellow Flame Tree, Yellow Poinciana, **Perunkonrai** *in Tamil*

a popularly ornamental tree grown around the world.

The trees have been planted alternately in India as a common scheme for avenue trees in India alternately with *Delonix regia* (Gulmohur) to give a striking yellow and red effect in summer, as has been done on on Hughes road in Mumbai.

Yellow Poinciana is a wonderful shade or specimen tree for a large landscape, especially when in full bloom, and it can make a street tree as long as it receives regular pruning to control its weedy,

Flowering season

May through September

Trees begin to flower after about four years

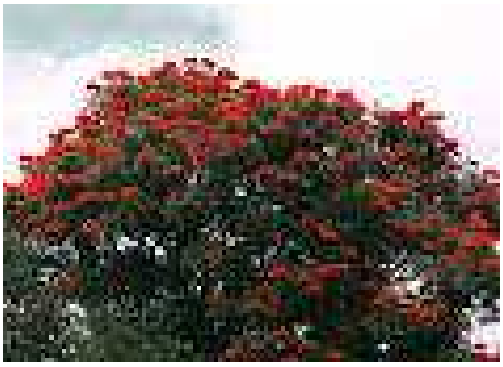
The dark green, delicate, feathery leaflets provide a softening effect for the tree's large size and create a welcoming, dappled shade.
The entire tree's canopy is smothered with a yellow blanket of flowers, appearing in showy, terminal panicles and exuding a delicious, grape-like perfume.
The wood has a wide variety of uses, including cabinet-making and the foliage is used as a fodder crop
Breakage: susceptible to breakage ;weak and tends to break

Plant only single-trunked trees along streets and other public areas to ensure a durable plant.

Spathodea campanulata, Bignoniaceae commonly known as
Fountain Tree,
African Tulip Tree,
Flame-of-the-forest,
Rudra Palash, **Pichkari** or **Nandi Flame**

It is a tree that grows between 7–25 m (23–82 ft) tall

This tree is planted extensively as an ornamental tree throughout the tropics and is much appreciated for

Honey suckle ***Spathodea campanulata***	its very showy reddish-orange or crimson (rarely yellow), campanulate flowers
	The tree blooms in the month of **August and September** and last for a couple of weeks 
)	• As Food: The seeds are edible and used in many parts of Africa. • As Timber: In its original habitat, the soft, light brownish-white wood is used for carving and making drums. • As Poison: The hard central portion of the fruit is used to kill animals. • As Medicine: The bark has laxative and antiseptic properties, and the seeds, flowers and roots are used as medicine.
• The bark is chewed and sprayed over swollen cheeks. The bark may also be boiled in water used for bathing newly born babies to heal body rashes. • *Spathodea campanulata* Beauv. is an important plant widely used in traditional medicine in Africa and the therapeutic uses include • aids, anti-inflammatory and hypoglycemic activities • The natural dye was obtained from different solvent extracts of Spathodea campanulata flowers.	

Sarakondrai

Cassia fistula, Fabaceae
known as the **golden shower tree**

State flower of Kerala in India ;

a popular ornamental plant and is an herbal medicine small tree with less branches

The flowers are of ritual importance in the Vishu festival of the Kerala state
the tree was depicted on a 20 Indian rupees stamp
Cassia acutifolia, the pudding-pipe tree, furnishes the cassia pods of commerce.

The streets of old Delhi and the other parts of India can be seen with full bloom of thousands of golden yellow Amaltas

MEDICAL USES:

In Ayurvedic medicine, golden shower tree is known as *aragvadha*, meaning "disease killer". The root is considered a very strong purgative, and self-medication or any use without medical supervision is strongly advised against in Ayurvedic texts.

flowering in **May**

Neem, ***Azadirachta indica***
Meliaceae

Indian Lilac

The tender shoots and flowers of the neem tree are eaten as a vegetable in India
Neem leaves are dried in India and placed in cupboards to prevent insects eating the clothes and also while storing rice in tins.
Neem leaves are dried and burnt in the tropical regions to keep away mosquitoes

fruits and seeds are the source of neem oil
Flowering **April- May**

Neem products are believed by Ayurvedic practitioners to be anthelmintic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative.[6] It is considered a major component in Ayurvedic and Unani medicine and is particularly prescribed for skin diseases

1.Arali, ***Nerium oleander;*** Apocynaceae

Nerium oleander is an evergreen shrub or small tree
Oleander grows to 2–6 m (6.6–20 ft) tall, with spreading to erect branches.
The leaves are in pairs or whorls of three, thick and leathery, dark green, narrow lanceolate, 5–21 cm (2.0–8.3 in) long and 1–3.5 cm (0.39–1.4 in) broad, and with an entire margin.
The flowers grow in clusters at the end of each branch; they are white, pink, red or yellow, 2.5–5 cm (0.98–2.0 in) diameter, with a deeply 5-lobed corolla with a fringe round the central corolla tube.

Oleander grows well in warm subtropical regions, where it is extensively used as an ornamental plant in landscapes, parks, and along roadsides.
It is drought tolerant
Mainly grown on road to avoid overview by drivers of vehicles and to reduce road hurdles as in tree branch breakings