

Initial Environmental Examination

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**IND: Tamil Nadu Urban Flagship Investment Program
– Underground Sewerage System for Municipal Area
on the East of Tamirabarani River in Tirunelveli**

Prepared by Tirunelveli City Municipal Corporation of the Government of Tamil Nadu for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 11 May 2018)

Currency Unit	–	Indian rupee (₹)
₹1.00	–	\$0.015
\$1.00	=	₹67.09

ABBREVIATIONS

ADB	–	Asian Development Bank
ASI	–	Archaeological Survey of India
CMA	–	Commissionerate of Municipal Administration
CMSC	–	construction management and supervision consultant
CPCB	–	Central Pollution Control Board
CTE	–	consent to establishment
CTO	–	consent to operation
DPR	–	detailed project report
DWC	–	double wall corrugated
EAC	–	expert appraisal committee
EHS	–	environmental, health and safety
EIA	–	environmental impact assessment
EMP	–	environmental management plan
ESS	–	environmental and social safeguards
ESZ	–	eco-sensitive zone
GOTN	–	Government of Tamil Nadu
IEE	–	initial environmental examination
MOEFCC	–	Ministry of Environment, Forest and Climate Change
NOC	–	no objection certificate
PIU	–	program implementation unit
PMU	–	program management unit
REA	–	rapid environmental assessment
ROW	–	right-of-way
SEIAA	–	State Environmental Impact Assessment Authority
SIDCO	–	Small Industries Development Corporation
SPS	–	Safeguard Policy Statement
STP	–	sewage treatment plant
TCMC	–	Tirunelveli City Municipal Corporation
TNPCB	–	Tamil Nadu Pollution Control Board
TNUFIP	–	Tamil Nadu Urban Flagship Investment Program
TNUIFSL	–	Tamil Nadu Urban Infrastructure Financial Services Limited
TWADB	–	Tamil Nadu Water and Drainage Board
WHO	–	World Health Organization
WSP	–	waste stabilization pond
WTP	–	water treatment plant

WEIGHTS AND MEASURES

°C	degree Celsius
m ³	cubic meter
km	kilometer
lpcd	liter per capita per day
m	meter
mg/l	milligram per liter

MLD	million liters per day
mm	millimeter
km ²	square kilometer

NOTE

In this report, "\$" refers to United States dollars.

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EXECUTIVE SUMMARY

The Tamil Nadu Urban Flagship Investment Program (TNUFIP) will advance India's national urban flagship programs to develop priority urban and environmental infrastructure in ten cities located within strategic industrial corridors of Tamil Nadu (the State), including those within the East Coast Economic Corridor (ECEC), to enhance environmental sustainability, climate resilience, and livability. It will also strengthen the capacity of state and local institutions and improve urban governance. TNUFIP is aligned with the following impacts: (i) universal access to basic water and sanitation services achieved; (ii) "world-class" cities and industrial corridors across the state developed; and (iii) water security, reduced vulnerability to climate change in urban areas, and enhanced share of renewable energy achieved. TNUFIP will have the following outcome: livability and climate resilience in at least 10 cities in priority industrial corridors enhanced.

The TNUFIP is structured under three outputs: (i) climate-resilient sewage collection and treatment, and drainage systems developed in at least eight cities; (ii) water supply systems in at least five cities improved with smart features; and (iii) institutional capacity, public awareness, and urban governance strengthened. TNUFIP will be implemented over an 8-year period beginning in 2018, and will be funded by Asian Development Bank (ADB) via its multitranche financing facility.

The Subproject. Tirunelveli, located in the south eastern part of Tamil Nadu, is the sixth largest city in the state. City is spread over on the both sides of River Tamirabarani which flows south to north. In this subproject to be implemented under the ADB funded TNUFIP, it is proposed to provide underground sewerage system in the municipal area that is in the East of Tamirabarani river, which include the original municipal area (old town) area of Palayamkottai and Melapalayam. Subproject includes the following civil works components: (i) sewage collection system (417 kilometers [km] length of sewers and 15,413 manholes), (ii) 18 sewage lift stations, (iii) one new sewage pumping station and rehabilitation of one existing pumping stations (iv) sewage pumping mains (37 km length), (v) sewage treatment plant (STP) of 34 MLD capacity, and (v) 43,532 house service connections.

Project Implementation Arrangements. The Municipal Administration and Water Supply Department (MAWS) of GOTN acting through the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) is the state-level executing agency. A project management unit (PMU) will be established in TNUIFSL headed by a Project Director and Deputy Project Director (senior official from Commissionerate of Municipal Administration, CMA), and comprising dedicated full-time staff from TNUIFSL for overall project and financial management. The implementing agencies are project urban local bodies (ULBs). and Tirunelveli City Municipal Corporation (TCMC) is the implementing agency for this subproject. A program implementation unit (PIU) will be established in TCMC headed by a full-time Project Manager (Executive Engineer or above) and comprising dedicated full-time staff of the TCMC for day-to-day implementation of the sub-project. PIU is assisted by construction management and supervision consultant (CMSC) in implementation. Environmental Specialist of the CMSC will assist PIU in implementation of subproject in compliance with EMP and EARF, and will carry out all necessary tasks.

Screening and Assessment of Potential Impacts. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. As per the Government of India Environmental Impact Assessment (EIA) Notification, 2006, this subproject do not require EIA study or environmental clearance. The potential environmental impacts of the subproject have been assessed using ADB rapid environmental assessment (REA)

checklist for sewerage. The potential negative impacts were identified in relation to pre-construction, construction and operation.

Categorization. Based on results of the assessment and ADB SPS, 2009, the subproject is classified as environmental Category B, i.e., subproject potential adverse environmental impacts are less adverse than those of category A, and are site-specific, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.

Description of the Environment. Subproject components are located in Tirunelveli City, an urban area surrounded by land that was converted for agricultural use many years ago. Subproject components include sewer lines and sewage lifting and pumping stations. Sewer lines will be laid in the public roads, within the road carriage way, and pumping/lifting stations will be constructed on identified government owned vacant land parcels in or close to residential areas. Tirunelveli City is situated on both the bank of River Tamirabarani, and project area consists of Eastern part of the city, that include Tirunelveli old town. Most of the roads and streets are very narrow, congested, and areas are densely populated. There are vast land within the corporation area under water bodies (rivers, streams, canals and lakes) and agricultural use. Project area is a famous religious center in the State. With the project area there are no sensitive areas like forest or protected areas or nationally important/protected monuments. Agasthyamalai Biosphere Reserve is located at about 10-15 km west of the city. Biosphere reserve is mostly confined to Western Ghats, and it included several protected area, one of which is Kalakad-Mundanthurai Tiger Reserve (KMTR). None of these eco sensitive areas are located in or close to the subproject area. City is located on important national highway (NH) 7 that connects north and south of India. It is well connected with other parts of the state and country with roads and railway. Roads carry considerable traffic.

Potential Environmental Impacts and Mitigation Measures. The subproject is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented because: (i) the components will involve simple construction and operation, so impacts will be mainly localized; (ii) there are no significant sensitive environmental features in the project sites although careful attention needs to be paid to minimizing disruption to population of urban area, and (iii) predicted impacts are site-specific and likely to be associated with the construction process and are produced because the process is invasive, involving excavation and earth movements.

Sewerage system performs a crucial function of safely collecting, transporting, treating and disposing domestic wastewater, including, human excreta (designed as a separate system). Subproject is likely to have numerous positive impacts on the environment and public health. In this IEE, negative impacts were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant. Sewage pumping and lifting stations, which collect sewage to a pump to a higher elevation pump station or Sewage treatment plant (STP), are likely to generate odor. Subproject included construction of a new sewage pumping station and 18 sewage lifting stations. Proposed Sewage pumping station in Kumaresan nagar is located away from residential areas, and therefore no impact envisaged. Lifting stations are comparatively small, handle low volumes of sewage, and therefore odor nuisance is limited. Utmost care is taken to located these away from the houses, due to design considerations and land constraints, many sites are located close to the houses. Odor prevention and control measures are put in place – included in the design and operation.

A sewage treatment plant is included in the subproject as capacity of 34 MLD (waste stabilization pond or WSP Technology) and STP is proposed at Ramayanpatti with adequate buffer distance will be maintained to avoid any nuisance related issues.

Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result significant measures have already been included in the designs for the infrastructure. Various measures suggested for odor control including: appropriately locating sewage wells within site as far as away from the houses; developing tree cover; closed facilities; gas collection and treatment facilities, and design and operation measures to prevent odor build up; standard operating procedures for operation and maintenance; imparting necessary training; safety and personal protection equipment for workers, etc.

Potential impacts during construction are considered significant but temporary, and are common impacts of construction in urban areas, and there are well developed methods to mitigate the same. Except sewer works, all other construction activities (lifting and pumping stations) will be confined to the selected sites, and the interference with the general public and community around is minimal. In these works, the temporary negative impacts arise mainly from construction dust and noise, hauling of construction material, waste and equipment on local roads (traffic, dust, safety etc.), mining of construction material from the existing government licensed mining areas, occupation health and safety aspects. Sewer works will be conducted along public roads in an urban area congested with people, activities and traffic. Most of the Tirunelveli core city area has high density population, very narrow roads and congested with traffic, people and activities. Therefore sewer works will have significant impacts arising mainly: from the disturbance of residents, businesses and traffic due to construction work; safety risk to workers, public and nearby buildings due to deep trench excavations in the road; access impediment to houses and business, disposal of large quantities of construction waste, etc. These are all general impacts of construction in urban areas, and there are well developed methods of mitigation that are suggested in the EMP.

Environmental Management Plan. An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels, along with the delegation of responsibility to appropriate agency. As stated above, various design related measures are already included in the project design. During construction, the EMP includes mitigation measures such as (i) proper planning of sewer works to minimize the public inconvenience (ii) barricading, dust suppression and control measures (iii) traffic management measures for works along the roads and for hauling activities; (iv) provision of walkways and planks over trenches to ensure access will not be impeded; and (iv) finding beneficial use of excavated materials to extent possible to reduce the disposal quantity. EMP will guide the environmentally-sound construction of the subproject. EMP includes a monitoring program to measure the effectiveness of EMP implementation and include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

The EMP is included in the bid documents to ensure compliance with the conditions set out in this document. The contractor will be required to submit to PIU, for review and approval, a site environmental management plan (SEMP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; and (iii) monitoring program as per EMP. No works are allowed to commence prior to approval of SEMP. A copy of the EMP/approved SEMP will be kept on site during the construction period at all times.

Consultation, Disclosure and Grievance Redress Mechanism. The stakeholders were involved in developing the IEE through discussions on-site and a public consultation workshop at city level, after which views expressed were incorporated into the IEE and in the planning and development of the project. The IEE will be made available at public locations and will be disclosed to a wider audience via the ADB, TCMC and TNUIFSL websites. The consultation process will be continued during project implementation as required. A grievance redress mechanism (GRM) is described within the IEE to ensure any public grievances are addressed quickly.

Monitoring and Reporting. Contractor will submit a monthly EMP implementation report to PIU. PIU, with the assistance of CMC, will monitor the compliance of Contractor, prepare a Quarterly Environmental Monitoring Report and submit to PMU. The PMU will oversee the implementation and compliance, and will submit semi-annual monitoring reports to ADB. ADB will post the environmental monitoring reports on its website. Monitoring reports will also be posted on TCMC and TNUIFSL websites.

Conclusions and Recommendations. Therefore, as per EARF, the project is classified as environmental category B and does not require further environmental impact assessment.

This IEE shall be updated by TCMC during the implementation phase to reflect any changes, amendments and will be reviewed and approved by PMU.

I. INTRODUCTION

A. Background

1. The Tamil Nadu Urban Flagship Investment Program (TNUFIP) will advance India's national urban flagship programs to develop priority urban and environmental infrastructure in ten cities located within strategic industrial corridors of Tamil Nadu (the State), including those within the East Coast Economic Corridor (ECEC), to enhance environmental sustainability, climate resilience, and livability. It will also strengthen the capacity of state and local institutions and improve urban governance.

2. TNUFIP will be implemented over an 8-year period beginning in 2018, and will be funded by Asian Development Bank (ADB) via its multitranches financing facility. The executing agency is the Department of Municipal Administration and Water Supply (MAWS) of the State acting through the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) who will establish a program management unit (PMU). The urban local bodies (ULBs) will be the implementing agencies for projects and will establish program implementation unit (PIU).

3. TNUFIP is aligned with the following impacts: (i) universal access to basic water and sanitation services achieved; (ii) "world-class" cities and industrial corridors across the state developed; and (iii) water security, reduced vulnerability to climate change in urban areas, and enhanced share of renewable energy achieved. The investment program will have the following outcome: livability and climate resilience in at least 10 cities in priority industrial corridors enhanced. The TNUFIP is structured under following three outputs:

- (i) **Output 1: Climate-resilient sewage collection and treatment, and drainage systems developed in at least eight cities.** This includes (i) 187 million liters per day (MLD) of new and 155 MLD of rehabilitated sewage treatment capacity developed, with solar power systems installed for STP operations on a pilot basis; (ii) treated wastewater reused for industrial purposes in selected areas; (iii) 2,810 kilometers (km) of sewage collection pipelines constructed, with 426,600 households connected; (iv) 173 sewage pumping stations with a combined capacity of 6,390 kilowatts (kW) constructed; (v) 20 all-female community water and sanitation committees formed; and (vi) climate-resilient drainage and flood management systems (250 km of tertiary and 50 km of primary and secondary drains) established in selected cities.¹
- (ii) **Output 2: Water supply systems in at least five cities improved with smart features.** This includes (i) smart water supply distribution systems (1,520 km pipelines) established within 110 new district metered areas (DMAs) to reduce NRW and provide regular water supply, with 100% of households (total of 171,000) connected; (ii) 120 km of transmission mains built; (iii) 30 pump stations (1,530 kW capacity) constructed; and (iv) 40 water storage reservoirs (combined capacity of 70 million liters), covering Chennai, Coimbatore, Cuddalore, Tiruppur, and Thoothukudi.
- (iii) **Output 3: Institutional capacity, public awareness, and urban governance strengthened.** This includes (i) establishing within CMA (a) a new state-level urban data and governance improvement cell, and (b) a new project design and management center; and (ii) implementing (a) state-wide performance-based urban governance improvement program for Tamil Nadu's 135 cities to improve

¹ The eight cities are Ambur, Chennai, Coimbatore, Rajapalayam, Tiruchirappalli, Tirunelveli, Tirupur, and Vellore. Drainage systems are proposed in Chennai, Cuddalore, and Thoothukudi.

revenue, financial management, administration, service delivery, gender mainstreaming, wastewater reuse, and fecal sludge management; and (b) public awareness campaigns on water conservation, sanitation, and hygiene in project cities. The program will intensify the capacity building of key urban institutions and continue providing incentives for urban governance improvement. Project design consultants will be recruited by the PMU to prepare new projects in subsequent tranches that meet ADB requirements.

4. **Scope of Project 1.** Tranche 1 is representative of MFF investments and will support Chennai, Coimbatore, Rajapalayam, Tiruchirappalli, Tirunelveli, and Vellore. Outputs of Tranche 1 include:

- (i) **Output 1: Climate-resilient sewage collection and treatment, and drainage systems developed in six cities.** This includes (i) five new STPs with a combined treatment capacity of 165 MLD constructed, including one STP with a 2-megawatt solar photovoltaic system installed to power its operations; (ii) one STP (37 MLD capacity) rehabilitated; (iii) 8,000 cubic meters treated wastewater reused per day; (iv) 1,860 km of new sewage collection pipelines constructed, with 100% households connected (297,547 households); (v) 124 pump/lift stations (combined capacity of 4,473 kW) constructed; and (vi) 12 all-female community water and sanitation committees formed. The breakdown by city is: (i) new Tirunelveli—sewage collection system and 32 MLD STP (to supply treated wastewater for industrial reuse) constructed;² (ii) new Coimbatore sewage collection system and 30 MLD STP, with a 2-megawatt solar photovoltaic system, constructed;³ (iii) new Tiruchirappalli—sewage collection system with 30 MLD STP constructed and existing 37 MLD STP rehabilitated; (iv) new Vellore—sewage collection system and 50 MLD STP constructed; (v) new Chennai—sewage collection systems constructed in four areas in Chennai; and (vi) new Rajapalayam sewage collection system and 21 MLD STP constructed. In addition, in each city, two all-female community water and sanitation committees will be formed.
- (ii) **Output 2: Water supply systems in one city improved with smart features.** Four areas in Chennai will have (i) 275 km of distribution pipelines constructed, with 100% metered connections (30,800 households) in 20 newly established DMAs to manage and reduce NRW;⁴ (ii) 11 km of new transmission pipes constructed; (iii) nine new storage reservoirs (four underground and five overhead) of combined capacity of 11 million liters constructed; and (iv) five pump stations (combined capacity of 230 kW) constructed.
- (iii) **Output 3: Institutional capacity, public awareness, and urban governance strengthened.** This includes (i) establishing within CMA (a) a new state-level urban data and governance improvement cell, (b) a new project design and management center, and (c) a state-wide performance-based urban governance improvement program implemented for all 135 cities to improve financial management (audited accounts), municipal revenues (taxes and user fees), municipal administration (filling vacancies), and gender mainstreaming (gender

² Tirunelveli signed a purchase agreement for treated effluent from the proposed STP with an adjoining industrial park.

³ This pilot project will (i) produce 90% of the STP's energy requirement; (ii) reduce 72% of annual energy charges; and (iii) avoid 3,400 tons of carbon dioxide equivalent of emissions per year.

⁴ Smart water features in Tranche 1 include online automatic pressure sensors and flow meters, 100% household metered connections using DMA-based distribution management, and energy-efficient water pumps.

action plan);⁵ and (ii) public awareness campaigns on water conservation, sanitation, and hygiene implemented. Governance improvement and awareness consultants will support output 3.

5. Tirunelveli, located in the southwestern part of Tamil Nadu, and at the southernmost tip of Deccan Plateau, is sixth largest city in the state after the cities of Chennai, Coimbatore, Madurai, Trichy and Salem. It is an important city in the southern region of the state, and is a popular pilgrimage and education center. City is a major hub on the NH 7 that connects north and south India (Kashmir to Kanyakumari). First sewerage system in Tirunelveli was developed in 1989 covering about 55% of the city area, including the core town, including a sewage treatment plant. In addition, during the same time, Tamil Nadu Housing Board also developed sewerage in small colonies. A second sewerage system was developed in 2007 in the areas along the River Tamirabarani under the centrally funded National River Conservation Plan; this system covered about 35% of the total area. Presently, the sewerage schemes of 1989 are not functioning; sewer lines and manholes completely damaged and choked with grit and solid waste. It is therefore proposed to provide a new sewer scheme in these areas utilizing the existing infrastructure like sewage pumping station: (i) sewage collection system (417 km length of sewers and 15,413 manholes); (ii) 18 sewage lift stations; (iii) one new sewage pumping station; (iv) connection of sewer line to existing pumping stations in which rehabilitation of one existing pumping station will be done and full utilization of one existing pumping station; (v) pumping main sewers (37 km length), (vi) new single centralized STP for Phase III area at Ramaynpatti with capacity of 34 MLD; and (vii) 43,532 house service connections.

B. Purpose of this Initial Environmental Examination Report

6. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. The potential environmental impacts of the subproject have been assessed using ADB rapid environmental assessment checklist for water supply (Appendix 1). Then potential negative impacts were identified in relation to pre-construction, construction and operation of the improved infrastructure, and results of the assessment show that the subproject is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented. Thus, this initial environmental examination (IEE) has been prepared in accordance with ADB SPS requirements for environment category B projects.

7. This IEE is based on the detailed project report prepared by Tirunelveli City Municipal Corporation through a consultant. The IEE was based mainly on field reconnaissance surveys and secondary sources of information. No field monitoring (environmental) survey was conducted, however, the environmental monitoring program developed as part of the environmental management plan (EMP) will require the contractors to establish the baseline environmental conditions prior to commencement of civil works. The results will be reported as part of the environmental monitoring report and will be the basis to ensure no degradation will happen during subproject implementation. Stakeholder consultation was an integral part of the IEE.

C. Report Structure

8. This report contains the following ten (10) sections including the executive summary at the beginning of the report:

⁵ Details are in the Facility Administration Manual and Attached Technical Assistance Report (accessible from the list of linked documents in Appendix 2).

- (i) Executive summary;
- (ii) Introduction;
- (iii) Description of the project;
- (iv) Policy, legal and administrative framework;
- (v) Description of the environment;
- (vi) Anticipated environmental impacts and mitigation measures;
- (vii) Public consultation and information disclosure;
- (viii) Grievance redress mechanism;
- (ix) Environmental management plan; and,
- (x) Conclusion and recommendation.

II. DESCRIPTION OF THE PROJECT

A. Project Area

9. Project area is located in Tirunelveli, located in southwest part of Tamil Nadu at about 600 km southwest of State capital Chennai. The Tirunelveli city municipal corporation (TCMC) is spread over an area of 108.65 km², housing 473,637 population (2011 census). City is divided four administrative zones and 55 municipal wards: Tirunelveli Zone (18.641 km², wards 40 to 53); Melapalayam Zone (33.591 km², wards 19 and 26 to 38); Palayamkottai Zone (23.160 km², wards 11 to 18 and 20 to 25), and Thachanallur Zone (33.258 km², wards 1 to 10, 39, 54 and 55). For sewerage, based on the topography and physiographical features, city is divided into 2 sewerage systems: one on the west of Tamirabarani River, and another on the east of the river. Current subproject deals with the provision of sewerage system in the area East of the river, which include 3 Wards (Wards 8 to 10) of Thachanallur Zone, 14 wards (ward no 11 to 18, 20 to 25) of Palayamkottai Administrative Zone, 14 Wards (Wards 19, 26 to 37 and 38 Partial) of Melapalayam Zone. Of these 31 wards, ward nos. 9, 11 to 14, 16, 19 to 33, 35 and 36 are provided with sewerage facilities through the NRCP scheme implemented in 2007.

B. Existing Sewerage System

10. Until now, two sewerage schemes have been commissioned in TCMC area. First one was commissioned in 1989 in the then Tirunelveli municipality (prior to its formation as municipal corporation in 1994) and the second scheme funded under the National River Conservation Program of Government of India was commissioned in 2007. Both of these cover about 55% of the present municipal corporation area.

11. The 1989 sewerage scheme covers 12 wards (41 to 51) - 9 wards in full and 3 wards in part, of Tirunelveli and Palayamkottai Zones of the present TCMC area. Total length of sewers is about 40 km, and the sewage collected flows by gravity to a pumping station located at Nainarkulam, from where it is pumped through a pumping main of 5.5 km length to the waste stabilization pond (WSP) based sewage treatment plant (STP) (of 24 MLD capacity) at Ramayanpatti. At present this system laid is not in working condition; sewers and manholes choked with grit, sludge and solid waste, infrastructure damaged, and is not able to collect the sewage from house and convey to STP. A detailed survey of existing sewerage system conduct during detailed project report (DPR) preparation and found that it is beyond any repair or rehabilitation. At present, part of the sewerage scheme commissioned in 2007 drains into the collection well of Nainarkulam pumping station, and the same is pumped to the STP. The pumping station is currently in working condition, but requires rehabilitation. There is also a sewerage scheme implemented by Tamil Nadu Housing Board (THB) in 1989 THB colonies in Melapalayam Zones, but at present this scheme is also defunct.

12. The 2007 sewerage scheme covers 32 wards of TCMC (10 wards fully and 22 wards partially). Scheme comprises about 187 km sewer lines, 12.55 km of pumping main, 3 pumping stations located at Kuruchi, Vanarpettai and Balabhagyanagar. In addition, the old pumping station at Nainarkulam is also used. A STP on Waste Stabilization Pond Technology is constructed at Ramayanpatti with a capacity of 24.2 MLD, and the details of which are presented below. At present, this scheme is functioning well.

- (i) Tirunelveli City Municipal Corporation Total Area – 108.64 km²;
- (ii) Covered under existing UGD – 23 km²;
- (iii) Total Length of Road in Tirunelveli City Municipal Corporation – 1019 km;
- (iv) Covered Under existing UGD – 187 km;
- (v) Pumping/Main Pumping Station – 4;
- (vi) STP (WSP) – 1 No. – 24 MLD;
- (vii) This existing UGD commissioned in the year 2007.

13. **UGSS to Tirunelveli.** Though theoretically 55% of the municipal area is covered with sewerage system with the above two schemes, the functional sewerage system covers only about 30-35% area. Due to lack of proper sewerage system, wastewater normally flow in the open drains and flow into River Tamirabarani. River water is highly polluted, carries mostly wastewater. Hence, Tirunelveli City Municipal Corporation proposed to develop sewerage system to cover entire town. The city based on physiographic features is divided into two sewerage schemes, river being the main determining factor. Sewerage system Phase II is proposed for area west of Tamirabarani and Sewerage System Phase III is proposed for the area east of the river. Under this subproject it is proposed to develop sewerage system Phase III, which covers entire area of the municipal limits on the East of the river.

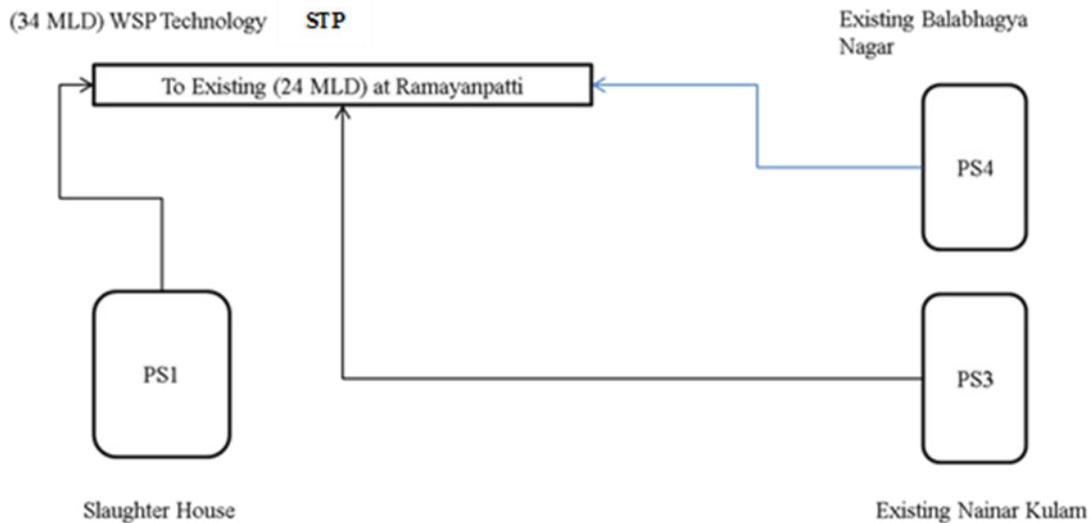
14. **UGSS System in West of Tamirabarani (Phase II).** Under this phase, it is proposed to develop sewerage system 1, which covers entire area of the municipal limits on the west of the river. West of River Tamirabarani covers Tirunelveli administrative zone (full), Melapalayam administrative zone (partial) and Thachanallur administrative zone (partial).

15. Topographically, major portion of the project area slopes into Thamirabarani River. System-I is further divided in to three sewerage zones with three pumping stations and 11 sewage lifting stations. Areas contributing sewage flow to existing pumping stations are considered as separate zones, namely Zone 2 (Nainarkulam Pumping Station) and Zone 2 (Balabhagya Nagar Pumping Station). Areas/sections of streets omitted in these zones are proposed with new sewer lines and connected to the existing sewage collection system of 2007. Sewage from Zone 1 areas will be collected at the proposed pumping station 1 to be located adjacent to the ULB Slaughterhouse. A separate pumping main from pumping station 1 is proposed to be laid to the existing STP at Ramayanpatti. Upgrades to the existing pumping station at Nainarkulam and Balabhagya Nagar are also proposed as part of this subproject to handle existing and added flows. Sewage generated in the entire System-I is proposed to be conveyed by two pumping mains from the Pumping stations and treated at the existing STP of WSP technology at Ramaiyanpatti.

16. This phase is currently under procurement stage and works are expected to be completed by end of 2020.

Table 1: Works to be Completed under Phase III

Sl. No.	Details	Information
1	Total Number of Sewerage Zones Zone 1, Zone 2 and Zone 3	3
2	Total Number of Pumping Stations	3
3	Total Number of Lifting Stations LS1 to LS 11	11
4	Total Sewer Length Proposed (km)	234.135
5	Total Number of Manholes	8,928
6	Gravity Sewers Size ranges from (mm)	200 to 700
7	Pumping Mains Size ranges from (mm)	150 to 700

Figure 1: Schematic Diagram of Sewage Pumping System

17. **Sewage Treatment Plant.** A WSP based STP with design capacity of 24 MLD was constructed under the National River Conservation Project (NRCP) and commissioned in 2007. STP consists of the following units: (i) manual screening; (ii) manual grit removal; (iii) flow division system to different treatment units; (iv) anaerobic ponds; (v) facultative ponds; and (vi) maturation ponds. At present, the existing STP received around 8 MLD of sewage. Details of STP units presented below:

Table 2: Components of Existing Sewage Treatment Plant

Component	Size (m)			Detention Period	No. of Units
	Length	Breadth	Depth		
Anaerobic Pond	108.50	38	3.0	1 day	2
Facultative Pond	315.00	110	1.5	4 days	2
Maturation Pond I	195.00	117	1.5	5 days	1
Maturation Pond II	156.00	125	1.5	5 days	1
Maturation Pond III	150.00	128	1.5	5 days	1
Maturation Pond IV	156.00	125	1.5	5 days	1
Laboratory	6.00	4			

18. Adequate capacity of sewage treatment plant is available for system to be provided in Phase II, but due to non-functional sewers, the sewage volume that reaches STP is very less. Of the total design capacity of 24 MLD, currently only 8-9 MLD reaches the STP. It is therefore not

proposed to augment the capacity of STP for the Phase II project. Though the total sewage generation from the Phase II project area will be higher than the available capacity of this STP, considering the connectivity achieved in the existing scheme the sewage flowing into the STP would be much lower and hence it can safely accommodate sewage from the project area fully for many more years if not till intermediate year (2035). Intermediate Stage (2035) estimated sewage generation is 27.5 MLD. Existing STP is capable of handling flows for period beyond 2020 and is compliant with the government mandated discharge standards. It is decided to utilize full-capacity of existing STP and subsequently upgrade process or add additional ponds. TCMC is also formulating a project to sell treated wastewater to nearby Special Economic Zone which may require process modification. Therefore, presently no modification proposed to existing STP. Further, new STP is also proposed for handling sewage received from areas east of river under a separate sub-project. Thus, the existing capacity is retained and no augmentation proposed as of now for meeting demand of areas west of the river, which is part of this this subproject.

19. **Proposed sewerage system.** Tirunelveli City Municipal Corporation proposed to develop sewerage system to cover entire town. The city based on physiographic features is divided into 3 sewerage schemes, river and railway line being the main determining factors. Sewerage system 1 is proposed for area west of Tamirabarani and Sewerage Systems 2 and 3 are proposed for the area east of the river (Figure 2). There will be separate STPs to cater to east and west areas. Under this subproject it is proposed to develop sewerage system 1, which covers entire area of the municipal limits on the west of the river.

20. Topographically, major portion of the project area slopes into Thamirabarani River. Phase III is further divided in to three sewerage zones with three pumping stations and 18 sewage lifting stations. Areas contributing sewage flow to each pumping stations are considered as separate zones, namely Zone 4 (Vannarapettai Pumping Station), Zone 5 (Kurichi Pumping Station) and Zone 6 (Kumaresan Nagar). Areas/sections of streets omitted in these zones are proposed with new sewer lines and connected to the existing sewage collection system of 2007. Sewage from Zone 4 areas will be collected at the existing Pumping Station 4 located at Vannarapettai Pumping Station. Sewage generated in the entire Phase III area is proposed to be conveyed by a single pumping main from the Vannarapettai Pumping station pumping station 4 is proposed to be laid to the proposed STP at Ramayanpatti. Upgrades to the existing pumping station 5 at Kurichi is also proposed as part of this subproject to handle existing and added flows. A separate pumping main from pumping station 5 is proposed to be laid to the existing Vannarapettai Pumping Station. Sewage from Zone 6 areas will be collected at the proposed pumping station 6 located at Kumaresan Nagar Pumping Station. A separate pumping main from pumping station 6 is proposed to be laid to the existing Kurichi Pumping Station. Also, new STP is proposed with 34 MLD capacity (2 modules of 17 MLD).

Figure 2: Proposed Subproject Location

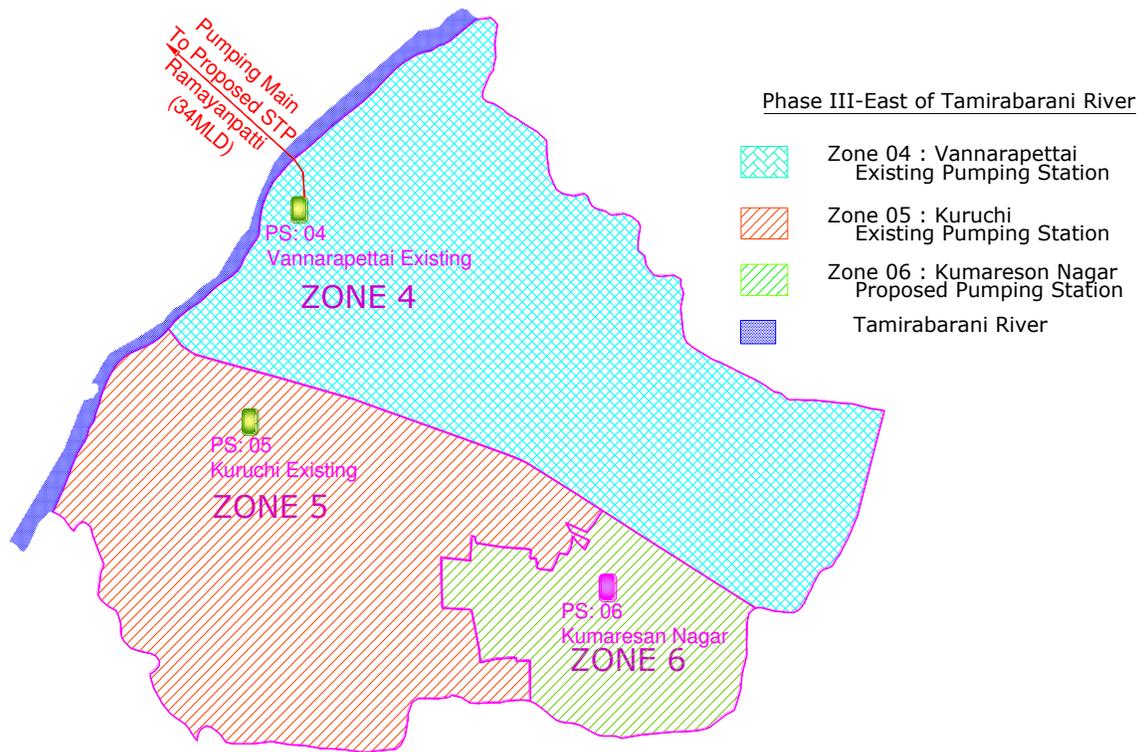
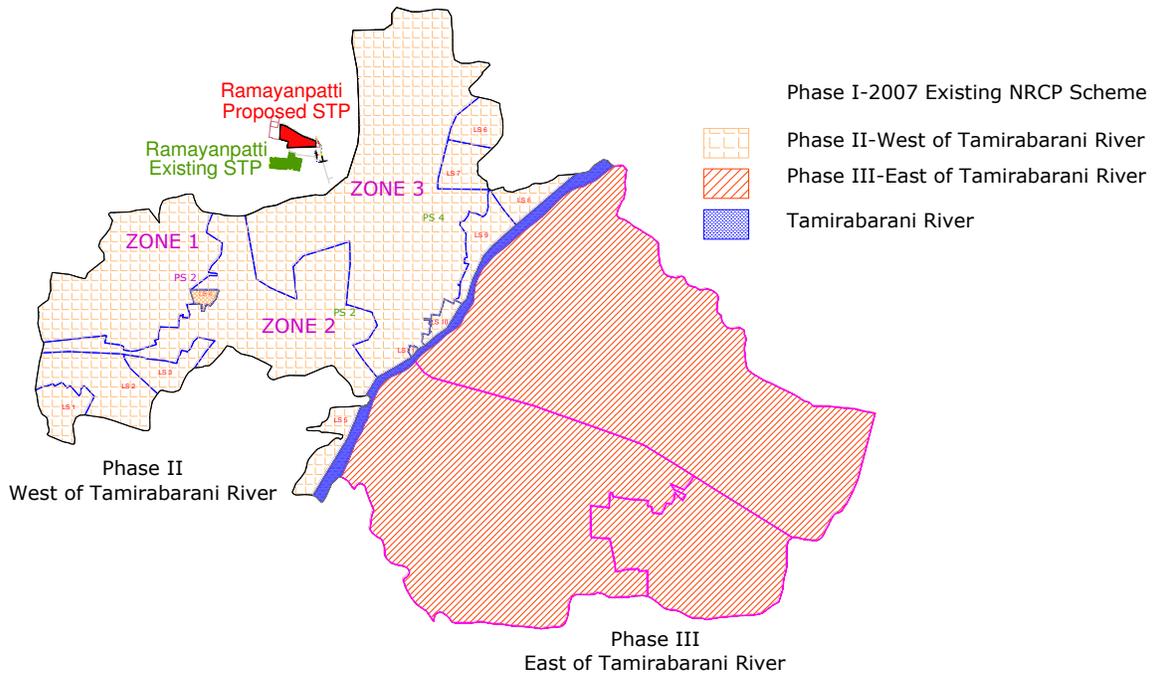
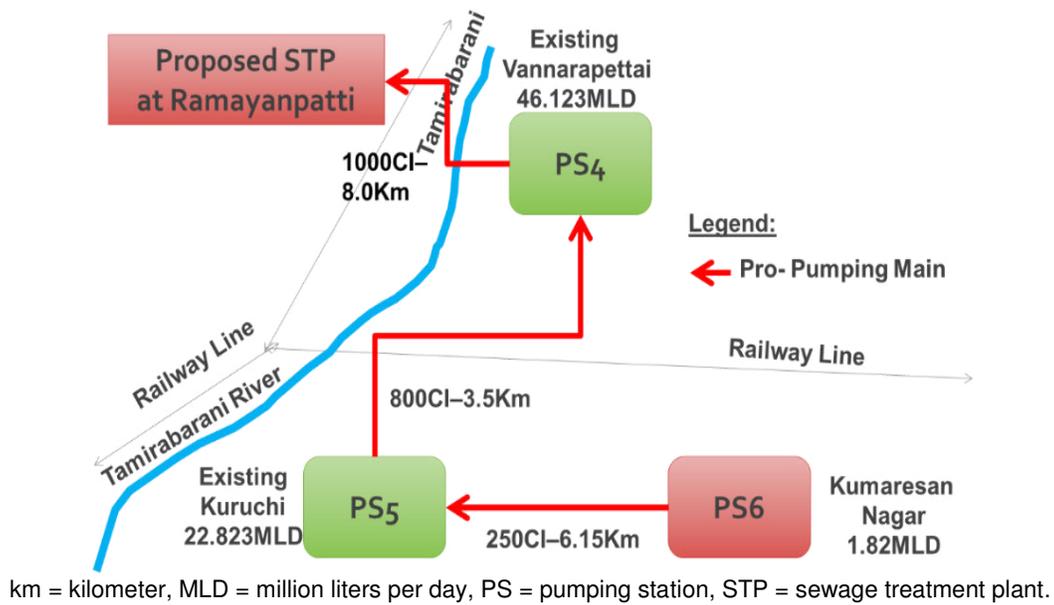


Figure 3: Proposed Sewerage System



21. TCMC is the responsible agency for providing basic urban services including sewerage in the city, and is the implementation agency for this subproject. Detailed project report for the proposed underground sewerage scheme is prepared by TCMC with the assistance of a Consultant.

C. Proposed Project

22. Following table shows the nature and size of the various components of the subproject. System is designed as a separate underground system catering only to domestic wastewater; storm runoff generated during rains will be carried by existing open drains and dispose into natural streams/ water bodies. Industrial wastewater will not be disposed into sewers. System is designed for 115 liters per capital per day, based on sewage generation rate of 80% of water supply. System is design with gravity flow as far as possible, however topography do not permit a complete gravity system from collection to inlet at the STP, and therefore wherever required sewage lifting and pumping stations introduced to optimize the system design. The sewage collected will of 34 MLD during the base year and will be treated in the proposed new STP at Ramaiyanpatti. The STP is proposed for the present flow with total capacity of 34 MLD (17 MLD - two set of modules). The process technology of the proposed STP is waste stabilization pond (WSP).

Table 3: Proposed Underground Sewerage System Subproject Components

Infrastructure	Function	Description	Location																																																
Sewer network	Collect wastewater from houses and convey to lifting / pumping stations by gravity	<p>417 kilometers (km); 200 to 300 millimeters (mm) dia: double walled corrugated (DWC) pipes (367 km) 200 to 750 mm dia: cast iron pipes (50 km)</p> <table border="1"> <thead> <tr> <th>Diameter (mm)</th> <th>Length (m)</th> <th>Percentage</th> <th>Material</th> </tr> </thead> <tbody> <tr> <td>200</td> <td>391621</td> <td>93.84%</td> <td>DWC/CI LA</td> </tr> <tr> <td>250</td> <td>7832</td> <td>1.88%</td> <td>DWC/CI LA</td> </tr> <tr> <td>300</td> <td>3132</td> <td>0.75%</td> <td>DWC/CI LA</td> </tr> <tr> <td>350</td> <td>1728</td> <td>0.41%</td> <td>CI LA</td> </tr> <tr> <td>400</td> <td>2500</td> <td>0.60%</td> <td>CI LA</td> </tr> <tr> <td>450</td> <td>1447</td> <td>0.35%</td> <td>CI LA</td> </tr> <tr> <td>500</td> <td>1607</td> <td>0.38%</td> <td>CI LA</td> </tr> <tr> <td>600</td> <td>4474</td> <td>1.07%</td> <td>CI LA</td> </tr> <tr> <td>700</td> <td>2834</td> <td>0.68%</td> <td>CI LA</td> </tr> <tr> <td>750</td> <td>165</td> <td>0.04%</td> <td>CI LA</td> </tr> <tr> <td></td> <td></td> <td>100%</td> <td></td> </tr> </tbody> </table> <p>Manholes 15413 no.s</p>	Diameter (mm)	Length (m)	Percentage	Material	200	391621	93.84%	DWC/CI LA	250	7832	1.88%	DWC/CI LA	300	3132	0.75%	DWC/CI LA	350	1728	0.41%	CI LA	400	2500	0.60%	CI LA	450	1447	0.35%	CI LA	500	1607	0.38%	CI LA	600	4474	1.07%	CI LA	700	2834	0.68%	CI LA	750	165	0.04%	CI LA			100%		Sewers will be laid underground in the roads and internal streets in the project area in Tirunelveli that covers entire area on the East of Tamirabarani River. This area included old city area, which is very congested and has very narrow roads. Sewers will be laid in almost all roads and internal streets in the project area
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Sewage pumping mains	Convey sewage from lifting stations to higher level manholes; and pumping stations to sewage treatment plant (STP), under pressure	<p>37 km; 150 – 1000 mm dia cast iron pipes</p> <table border="1"> <thead> <tr> <th>Diameter (mm)</th> <th>Length (m)</th> <th>Percentage</th> <th>Material</th> </tr> </thead> <tbody> <tr> <td>150</td> <td>7.99</td> <td>21%</td> <td>CI</td> </tr> <tr> <td>200</td> <td>8.15</td> <td>22%</td> <td>CI</td> </tr> <tr> <td>250</td> <td>8.87</td> <td>24%</td> <td>CI</td> </tr> <tr> <td>300</td> <td>1.6</td> <td>4%</td> <td>CI</td> </tr> <tr> <td>800</td> <td>3.5</td> <td>9%</td> <td>CI</td> </tr> <tr> <td>1000</td> <td>7.3</td> <td>20%</td> <td>CI</td> </tr> </tbody> </table>	Diameter (mm)	Length (m)	Percentage	Material	150	7.99	21%	CI	200	8.15	22%	CI	250	8.87	24%	CI	300	1.6	4%	CI	800	3.5	9%	CI	1000	7.3	20%	CI	Pumping mains will be laid from lifting stations to nearby higher level manhole, and from 3 pumping stations to STP. These will be laid mostly along wider main roads.																				
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Sewage lift stations (LS)	Collect sewage from low level sewer and pump to higher level manholes	<p>18 <i>Components of LS</i></p> <ul style="list-style-type: none"> Suction well of dia 1.0 meters (m) to 5.0 m and depth 4.5 – 8.5 m (closed) with a vent pipe Non-clog submersible pump sets Control panel box 	<p>Lift well will be constructed on the road shoulder (and in the road itself when there is no earthen shoulder). Lift stations are essentially proposed as enlarged manholes fitted with two small capacity sewage pumps and a curb or road-side wall mounted Pump Control Panel. Lift stations are proposed at following locations:</p> <table border="1"> <tbody> <tr> <td>LS12</td> <td>Tholkapiyar Street</td> </tr> <tr> <td>LS13</td> <td>Thirukurippu Thondar Street</td> </tr> <tr> <td>LS14</td> <td>Ulagaamman Kovil Street</td> </tr> <tr> <td>LS15</td> <td>Maruthi Nagar</td> </tr> <tr> <td>LS16</td> <td>Senthil Nagar</td> </tr> </tbody> </table>	LS12	Tholkapiyar Street	LS13	Thirukurippu Thondar Street	LS14	Ulagaamman Kovil Street	LS15	Maruthi Nagar	LS16	Senthil Nagar																																						
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Infrastructure	Function	Description	Location
			LS17 Kilanatham Melur Road LS18 Tiruvanathapuram LS19 Kakkan New Colony LS20 Andal Nagar LS21 Ragumath Nagar LS22 Police colony LS23 Saranya Park LS24 IOB Colony LS25 V.M.Chatram LS26 Achimadam LS27 Melanatham LS28 Karunkulam LS29 Anbu Nagar
Sewage pumping stations (SPS)	Collect sewage from lift stations and pumping stations and pump to sewage treatment plant	New: 1 <i>Components of SPS</i> <ul style="list-style-type: none"> • Screen well Dia 3.5 m and depth 4.39 m • Grit well Dia 2.50 m and depth 6.14 m • Suction well Dia 3 m and depth 8.30 m • Non-clog submersible pump sets Rehabilitation: 1 Augmentation of capacity with creation of new suction wells within the existing pumping station	New pumping station proposed near Kumaresan nagar, urban local body (ULB) owned land currently vacant. Existing pumping station is located at Kurichi
House service connections	Collect sewage from individual houses and convey into network	<ul style="list-style-type: none"> • 43532 (domestic) 	At each household, connected to wastewater outlet drain
STP	Treatment of collected sewage to comply with disposal standards prescribed by Tamil Nadu Pollution Control Board (TNPCB)	NEW STP Capacity 34 MLD (2 modules of 17 MLD each) Proposed process: Waste Stabilization Pond Components: <ul style="list-style-type: none"> • Anaerobic pond • Facultative ponds • Maturation ponds 	Proposed STP will be installed in Ramaynpatti for the sewage collected in Eastern side of Tamirabarani. STP will be located within a large campus that is holding the existing STP in the overall land extent of 180 Acres. Selected site is located ideally away from the residential areas.
Disposal	For the agriculture purpose	<ul style="list-style-type: none"> • The treated sewage will be disposed through the irrigation channel abutting the STP site. 	The treated sewage will be disposed through the irrigation channel which is presented in abutting the project site of proposed STP.

D. Implementation Schedule

23. Bids for civil works will be invited in March 2018, and the contract will be awarded by August 2018. Construction is likely to start in July 2018, and will take about 36 months to complete. Detailed implementation schedule (including design/pre-construction, construction, commissioning, and operation phases) will be provided in the updated IEE per detailed design.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

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

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

- (i) **Category A.** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.
- (ii) **Category B.** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.
- (iii) **Category C.** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
- (iv) **Category FI.** A proposed project is classified as category FI if it involves investment of ADB funds to or through a Financial Intermediary (FI).

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

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

- (i) Final or updated IEE upon receipt; and
- (ii) Environmental monitoring reports submitted by the implementing agency during project implementation upon receipt.

B. National Environmental Laws

28. **Environmental assessment.** The Government of India EIA Notification of 2006 (replacing the EIA Notification of 1994), sets out the requirement for Environmental Assessment in India. This states that Environmental Clearance is required for specified activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts.

29. Category A projects require Environmental Clearance from the central Ministry of Environment, Forests and Climate Change (MOEFCC). The proponent is required to provide preliminary details of the project in the prescribed manner with all requisite details, after which an Expert Appraisal Committee (EAC) of the MOEFCC prepares comprehensive terms of reference (TOR) for the EIA study. On completion of the study and review of the report by the EAC, MOEFCC considers the recommendation of the EAC and provides the Environmental Clearance if appropriate.

30. Category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The state level EAC categorizes the project as either B1 (requiring EIA study) or B2 (no EIA study), and prepares TOR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the Environmental Clearance based on the EAC recommendation. The Notification also provides that any project or activity classified as category B will be treated as category A if it is located in whole or in part within 10 km from the boundary of protected areas, notified areas or inter-state or international boundaries.

31. None of the components of this underground sewerage system subproject falls under the ambit of the EIA Notification 2006, and, therefore EIA Study or Environmental Clearance is not required for the subproject.

32. **Applicable environmental regulations.** Besides EIA Notification 2006, there are various other acts, rules, policies and regulations currently in force in India that deal with environmental issues that could apply to infrastructure development. The specific regulatory compliance requirements of the subproject are shown in Table 4.

Table 4: Applicable Environmental Regulations

Law	Description	Requirement
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	Act was enacted to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water. Control of water pollution is achieved through administering conditions imposed in consent issued under to this Act. All pollution potential activities will require consent to establish (CTE) from Tamil Nadu Pollution Control Board (TNPCB) before starting implementation and consent to operate (CTO) before commissioning.	A new STP of 34 MLD capacity (WSP Technology) proposed in the subproject. Consent is to be obtained from TNPCB for the proposed STP prior to start of subproject operation
Environment (Protection) Act, 1986 and CPCB Environmental Standards.	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards	To comply with applicable notified standards

Law	Description	Requirement
Noise Pollution (Regulation and Control) Rules, 2000 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	To comply with the noise standards.
Air (Prevention and Control of Pollution) Act, 1981, amended 1987 and its Rules, 1982.	- Applicable for equipment and machinery's potential to emit air pollution (including but not limited to diesel generators and vehicles); - CTE and CTO from TNPCB; - Compliance to conditions and emissions standards stipulated in the CTE and CTO.	Generators will require CTE and CTO from TNPCB Generators to comply with emission standards
Solid Wastes Management Rules, 2016	Rules to manage municipal solid waste generated; provides rules for segregation, storage, collection, processing and disposal.	Solid waste generated at proposed facilities shall be managed and disposed in accordance with the SWM Rules
Construction and Demolition Waste Management Rules, 2016	Rules to manage construction and to waste resulting from construction, remodeling, repair and demolition of any civil structure. Rules define C and D waste as waste comprising of building materials, debris resulting from construction, re-modeling, repair and demolition of any civil structure.	Construction and demolition waste generated from the project construction shall be managed and disposed as per the rules
Labor Laws	The contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline. The contractor shall provide equal wages and benefits to men and women for work of equal value or type.	Appendix 2 provides applicable labor laws including amendments issued from time to time applicable to establishments engaged in construction of civil works, which will need to be followed by the project

33. **Clearances/Permissions to be Obtained by Contractor.** Following table shows the list of clearances/permissions required for project construction. This list indicative and the contractor should ascertain the requirements prior to start of the construction, and obtain all necessary clearances/permission prior to start of construction.

Table 5: Clearances and Permissions Required for Construction

S. No	Construction Activity	Statutory Authority	Statute under which Clearance is Required	Implementation	Supervision
1	Tree Cutting	Department of Forest and District Collector	Clearances from the authorities as per the TamilNadu Timber Transit Rules, 1968 or latest.	Program implementation unit (PIU)	Implementing Agency and Program management unit (PMU)
2	Hot mix plants, Crushers and Batching plants	Tamil Nadu Pollution Control Board (TNPCB)	Consent to establish and consent to operate under Air Act, 1981	Contractor	PIU
3	Discharges from	TNPCB	Consent to establish and	Contractor	PIU

S. No	Construction Activity	Statutory Authority	Statute under which Clearance is Required	Implementation	Supervision
	construction activities		consent to operate under Water Act, 1974		
4	Storage, handling and transport of hazardous materials	TNPCB	Hazardous Wastes (Management and Handling) Rules. 1989 Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989	Contractor	PIU
5	Sand mining, quarries and borrow areas	Department of Geology and mining, Government of Tamil Nadu (GOTN)	Not applicable Contractor to obtain material from the existing government licensed mines / quarries; Contractor will require prior approval of PIU for obtaining material from a particular source. PIU to review and approve only existing licensed mines	Contractor	PIU
6	New quarries and borrow areas	Ministry of environment, Forest, and Climate Change (MOEFCC)	Not applicable No new quarries/borrow areas will be created for the subproject.	Contractor	PIU
7	Groundwater extraction	Public Works Department	(Groundwater) Tamilnadu Groundwater Development and Management Act 2000	Contractor	PIU
8	Disposal of bituminous wastes	Tamilnadu State Pollution Control Board	Hazardous Wastes (Management and Handling) Rules. 1989	Contractor	PIU
9	Temporary traffic diversion measures	-	MoRTH 112 SP 55of IRC codes	Contractor	PIU

34. **ADB SPS Requirements.** During the design, construction, and operation of the project the PMU and PIUs will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines (both General

Guidelines and sector specific guidelines of water and sanitation projects to be referred (http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines). These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Government of India regulations differ from these levels and measures, the PMU and PIUs will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the PMU and PIUs will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS, 2009.

Table 6: WHO Ambient Air Quality Guidelines

Table 1.1.1: WHO Ambient Air Quality Guidelines ^{7, 8}		
	Averaging Period	Guideline value in $\mu\text{g}/\text{m}^3$
Sulfur dioxide (SO ₂)	24-hour	125 (Interim target-1) 50 (Interim target-2)
	10 minute	20 (guideline) 500 (guideline)
Nitrogen dioxide (NO ₂)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM ₁₀	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter PM _{2.5}	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Table 7: World Bank Group's EHS Noise Level Guidelines

Table 1.7.1- Noise Level Guidelines ⁵⁴		
Receptor	One Hour L _{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational ⁵⁵	55	45
Industrial; commercial	70	70

IV. DESCRIPTION OF THE ENVIRONMENT

A. Methodology Used for Baseline Study

35. **Data Collection and Stakeholder Consultations.** Data for this study has been primarily collected through comprehensive literature survey, discussion with stakeholder agencies, and field visits to the proposed subproject sites.

36. The literature survey broadly covered the following:

- (i) Project details, reports, maps, and other documents prepared by technical consultants, TCMC, ADB project preparatory technical assistance (PPTA) team etc.;
- (ii) Discussions with technical experts of the PPTA team, TNUIFSL, implementing agency, DPR preparation agency, and other relevant government agencies;
- (iii) Secondary data from previous project reports and published articles; and
- (iv) Literature on land use, soil, geology, hydrology, climate, socioeconomic profiles, and other planning documents collected from Government agencies and websites.

37. **Ocular inspection.** Several visits to the project sites were made during IEE preparation period in 2017 to assess the existing environment (physical, biological, and socioeconomic) and gather information with regard to the proposed sites and scale of the proposed project. A separate socioeconomic study was conducted to determine the demographic information, existing service levels, stakeholder needs and priorities.

B. Physical Resources

1. Location, Area and Connectivity

38. Situated in the southernmost part of Tamil Nadu, and about 700 km southwest of capital city Chennai, Tirunelveli is the sixth largest city in Tamil Nadu after Chennai, Madurai, Coimbatore, Trichy and Salem. Geographically it is located at 8°44' N latitude and 77°44' E longitude. It is also known as Nellai and believed to be an ancient settlement. City is developed on the west of River Tamirabarani and its twin city, Palayamkottai, is developed on the east of the River. It is administrative headquarters of the district with same name. Tirunelveli city municipal corporation was constituted in 1994 by merging twin cities of Tirunelveli and Palayamkottai, and other surrounding towns and villages (Melapalayam municipality, Thatchanallur town panchayats and 11 village panchayats). For administrative purposes, municipal area has been divided in to four zones namely: Tirunelveli, Thachanallur, Palayamkottai, and Melapalayam. The subproject project area encompasses the two zones of Tirunelveli and Thachanallur. These two zones are located on the west bank of Tamirabarani River. The administrative area of Tirunelveli City Corporation is 108.65 km², population according to 2011 census was 473,637.

39. Tirunelveli City commands a pivotal position in the Southern Region of Tamilnadu. The city is a popular pilgrimage and educational center. It is well connected by roads and rail network with surrounding areas, Chennai and other parts of the country. It is an important center in south India along the National Highway No 44 that connects India from the North to South (Kashmir to Kanyakumari). It is also an important junction in southern railway. Nearest airport is at Tuticorin, a coastal town, 50 km east of Tirunelveli City.

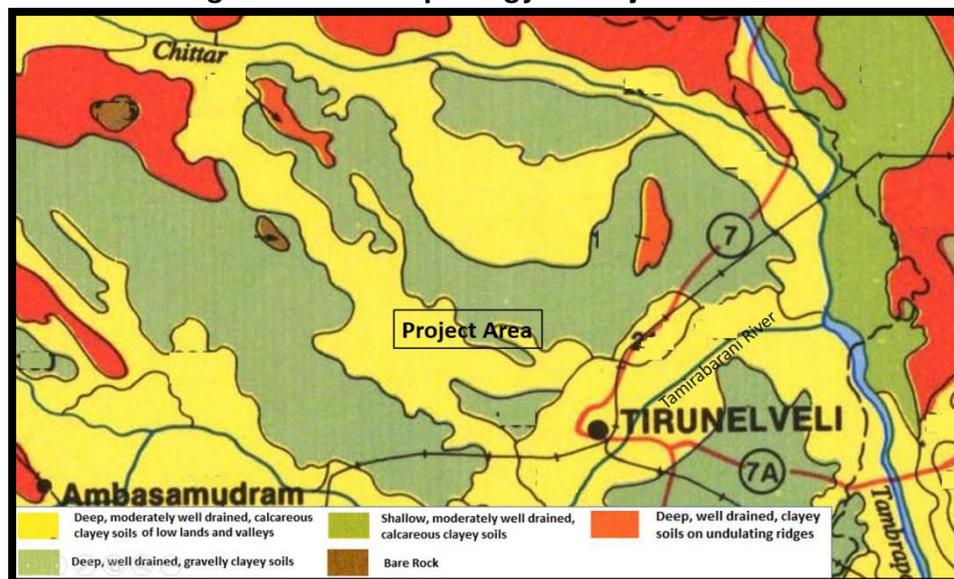
2. Topography, Soils and Geology

40. The project region has a predominantly flat terrain occasionally dotted with small hillocks. It is situated at about 36.39 m above the mean sea level. It has natural slope towards Tamirabarani river in the east. No incidences of land subsidence in the project area were identified in the past periods.

41. Diverse types of soils found in Tirunelveli region. Soils have been classified into (i) Deep Red soil, (ii) Red Sandy Soil, (iii) Black Cotton Soil, (iv) Saline Coastal Alluvium, and (v) River Alluvium. Major parts of the district are covered by Deep Red soil that it is suitable for cultivating coconut and palmyrah trees. The Black Cotton Soil is found in Tirunelveli, Palayamkottai and Sankarankoil blocks, and it is suitable for cultivating Paddy, Ragi, and Chulam etc. The River alluvial soils, occur along the river courses of Tamirabarani and Chittar river in Tirunelveli and Palayamkottai blocks, it is suitable for cultivating Groundnut, Chillies and Cumbu. Tamirabarani river valley is narrow but has got rich alluvial soil. The urban complex of Tirunelveli, Palayamkottai and Melapalayam is situated in this river valley. In the project area alluvial soil is widespread along the banks of the river and black cotton soils occurs towards the western boundary.

42. Tirunelveli district is on the southern part of the Indian Precambrian Shield comprising a wide variety of geological formations ranging from Precambrian to recent period. The rock types within the district can be broadly classified into (i) Charnokite group of rocks of Archean period with Hypersthene mainly in Sankarankovil, Sivagiri and Tenkasi taluks; (ii) Gneissic group of rocks of Archean period consisting of (a) Granitoid mica gneiss, (b) Granitic mica gneiss and Leptinites, and (c) Mixed and composite gneiss; (iii) Shell lime stone, tuffaceous kankar, tertiary kankar, coastal and their lands of quaternary period, recent to Holocene age. Project area has predominant zone of quartzite beds and associated crystalline limestone and calc gneisses with intercalated layers and bands of pyroxene granulites within the quartzite beds. There are no known or reported cases of land subsidence in or close to the subproject area. The dominant minerals found in the district are Limestone, Gypsum, Garnet sand, Ilmenite and Blue metal whereas Blue metal and Lime stone are available within the project area limit.

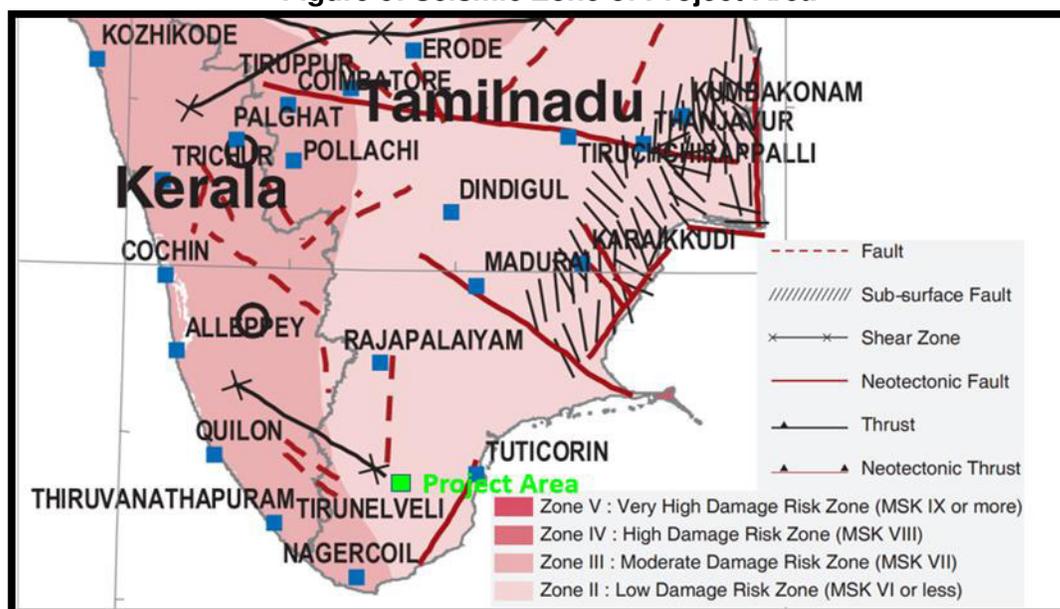
Figure 4: Geomorphology of Project Area



3. Seismology

43. Bureau of Indian Standards, based on the past seismic history, grouped the country into four seismic zones, viz. Zone-II, -III, -IV and -V. Of these, Zone V is the most seismically active region, while zone II is the least. The project area is in Low Damage Risk Zone II and as per the Modified Mercalli (MM) intensity scale, which measures the impact of the earthquakes on the surface of the earth, the project region is in MSK VI or less which indicates low intensity.

Figure 5: Seismic Zone of Project Area



Source: BMTPC.

4. Climatic Conditions

44. The climate of Tirunelveli is mild. The maximum temperature is 39.4°C in the month of May and minimum is 21.7°C in the month of January. From about the middle of February temperature increases steadily. The weather is quite hot in April, May and June. Sometimes reaches 42.5°C. With the onset of the southwest monsoon by beginning of June, there is some drop-in temperature. By about the middle of October, both day and night temperatures decrease appreciably. The period from November to January is the coolest part of the year.

45. Winds are generally light to moderate in strength. The wind direction is predominantly towards North and West in the mornings and South and East in the evenings. Between May and September winds are mainly north westerly or Westerly and from October to February winds are mainly North easterly or easterly. During the months of April and May, the sky become heavily clouded and threatening till the afternoons on many days when thunderstorms follow. In the southwest and northwest monsoon seasons, the sky is heavily clouded or over cast.

46. Humidity is maximum in the period of October-December and found to be high in the month of November as 98% and minimum is noticed in the month of May as 29%. The relative humidity in general, during the year, is between 56.6% and 72.9% in the district, except during the northeast monsoon season, when it is over 74.3%. District has a coastline and the coastal parts are comparatively more humid.

Table 8: Temperature and Humidity in Project Area

Month	Mean Maximum		Mean Minimum		Humidity 8.30 hours (%)
	Normal	Actual	Normal	Actual	
June 2015	31.0	35.4	22.5	27.6	56.6
July 2015	34.9	34.9	24.0	27.7	57.6
August 2015	33.3	33.9	24.5	26.9	60.4
September 2015	34.0	34.4	22.5	26.2	67.4
October 2015	33.9	33.3	23.3	25.4	74.3
November 2015	31.4	31.6	22.0	24.8	86.4
December 2015	30.5	29.7	21.6	24.5	89.9
January 2016	30.5	31.9	23.0	24.1	72.9
February 2016	32.3	34.1	21.0	24.2	68.0
March 2016	35.6	37.5	21.6	25.6	61.9
April 2016	36.2	39.5	23.0	27.5	58.7
May 2016	36.5	37.5	24.3	28.3	57.6

Source: District Statistical Handbook 2015-2016, Government of Tamil Nadu.

47. There are two principle monsoon seasons: (i) southwest (June to August/September); and (ii) northeast monsoons (October to January). Tirunelveli receives annual average rainfall of 845 mm, Main rainy season is from October to middle of January. The average rain fall in the district is 845.1 mm, most of which is received during the northeast monsoon. Much higher rainfall, above 1,000 mm per year, is received in the district in areas close to western ghats.

Table 9: Seasonal Rainfall during Last Five Years in Project Area

Year	South West Monsoon		North-East Monsoon		Winter Season		Hot Weather Season		Total		% Deviation from Normal
	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Actual	
2011-12	142.4	107.7	467.2	639.9	69.3	70.7	166.2	100.7	845.1	919.0	8.75
2012-13	142.2	36.9	467.2	515.8	69.3	98.9	166.2	169.7	844.9	821.3	-2.80
2013-14	142.4	237	467.2	412.8	69.3	70.4	166.2	314.1	845.1	1034.3	22.39
2014-15	142.4	118.8	467.2	847.5	69.3	19.5	166.2	317.9	845.1	1303.7	54.27
2015-16	142.4	158.8	467.2	1050.6	69.3	6.8	166.2	111.1	845.1	1332.6	58

Source: District Statistical Handbook 2015-2016, Government of Tamil Nadu.

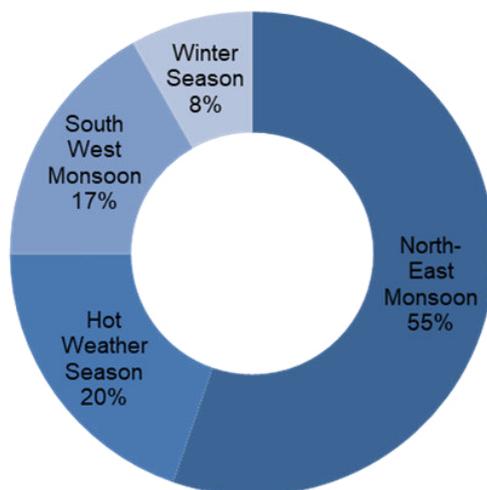
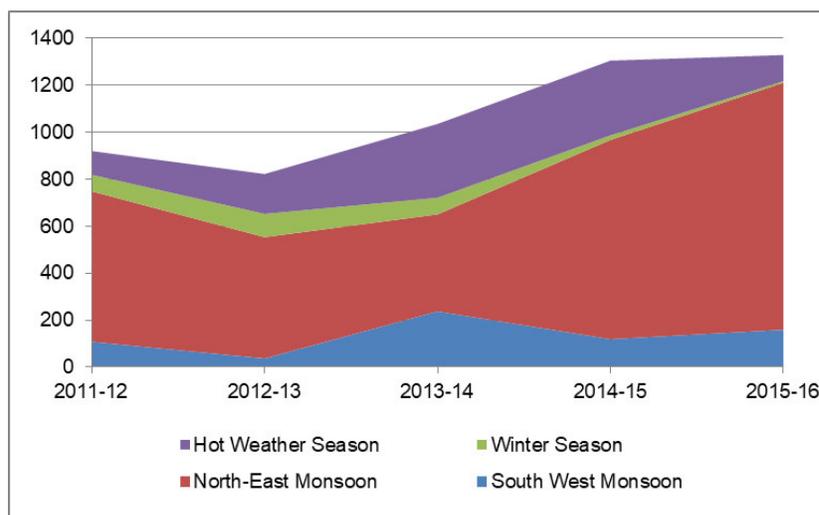
Figure 6: Seasonal Distribution of Normal Annual Rainfall

Figure 7: Actual Seasonal Rainfall 2011-2016



5. Surface Water

48. The project area lies within the watershed expanse of the Tamirabarani River Basin. River almost flows in the middle of the municipal area, with Tirunelveli old town located on west and Palayamkottai on the east. area. Tamirabarani is a perennial river; originating from Agastyarkoodam peak in the Western Ghats above Papanasam in Ambasamudram Taluk and flows through Tirunelveli and Tuticorin districts of Tamil Nadu and drains in Gulf of Mannar at Punnakyal in Srivaikuntam Taluk of Thoothukudi district. Total length of the river course is about 125 km. With origin in Western Ghats and receiving both monsoons in catchment area, river is flows perennially. There are several dams and anicuts across river Tamirabarani and its tributaries that provide water to irrigation, drinking and other needs to majority of population in Tirunelveli District. There are various channels branching off from both the banks of river for irrigation. The major lakes in the city are Nainar Lake and Udayarpetti Lake.

49. There are a number of small scale industrial units near the bank of Tamirabarani River, which include pulp and paper, textile, state transport corporation workshops, engineering units etc. River and canals flowing through the town are polluted due to entry of untreated and partially treated wastewater from industries and as well as domestic sewage due to lack of proper sewerage system.

50. Water quality of surface water bodies is classified by Central Pollution Control Board into five (A, B, C, D and E, see box) quality classes according to their quality suitability for designated best use. Water quality monitoring of Tamirabarani river is conducted regularly by TNPCB, and samples are collected regularly from 12 sampling points. According to the Water quality data of 2014-15, river water quality is classified as B. Annual average value of pH of water ranged between 6.2 and 7.7 and, Bio-chemical oxygen demand (BOD) ranged between 2.0 and 5.0 mg/l. None of these monitoring stations however are located within or near the town. These are located far up stream or far down stream of the city.

Table 10: Tamirabarani River Water Quality, 2014-2015

S. No.	Parameters	Units	Cheranmdevi	Kokirakulam	Murapanadu	Thiruvaidaimarudur	Ambasamudram	Authoor	Eral	Kallidai Kurichi
1	DO	mg/l	6.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00
2	BOD at 27°C	mg/l	3.00	3.00	2.00	3.00	5.00	3.00	2.00	3.00
3	COD	mg/l	33.33	38.67	28.67	33.33	29.33	41.33	29.33	32.67
4	pH	pH unit	6.40	6.50	6.80	7.70	7.70	7.20	7.00	6.20
5	EC	mhos/cm	110.00	144.00	220.00	80.00	65.00	1281.00	473.00	74.00
6	Ca ⁺⁺	mg/l	26.58	32.25	67.00	16.17	12.08	117.67	92.25	14.75
7	Mg ²⁺	mg/l	9.00	12.00	31.00	6.58	5.75	115.30	46.67	7.08
8	Na ⁺	mg/l	8.33	10.25	13.17	5.83	4.83	106.50	24.83	5.25
9	K ⁺	mg/l	1.50	2.10	2.60	1.30	1.30	10.80	4.70	1.30
10	PO ₄ ³⁻	mg/l	0.12	0.13	0.07	0.09	0.14	0.09	0.08	0.13
11	NO ₃ ⁻	mg/l	0.19	0.35	2.16	0.24	0.11	0.45	0.24	0.20
12	SO ₄ ²⁻	mg/l	11.69	14.67	14.43	9.23	6.97	52.00	18.70	9.06
13	Cl ⁻	mg/l	15.46	17.63	25.08	12.97	10.72	367.92	41.67	11.55
14	F ⁻	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
15	Total Alkalinity	mg/l	37.92	45.13	83.50	25.42	18.00	142.00	119.50	23.92
16	TDS	mg/l	80.50	105.50	158.17	59.17	49.50	878.00	347.17	55.50
17	Turbidity	NTU	6.75	6.00	4.75	5.00	4.50	5.83	6.00	5.00
18	Total coliform	MPN/100ml	56.00	82.00	45.00	45.00	46.00	62.00	60.00	52.00

BOD = biochemical oxygen demand, COD = chemical oxygen demand, DO = dissolved oxygen, mg/l = milligram per liter, ml = milliliter, MPN = most probable number, NTU = Nephelometric Turbidity Unit, pH = potential of hydrogen, TDS = total dissolved solids.

Source: [Tamil Nadu Pollution Control Board](#).

51. **General Health Profile.** Under Health wing two hospitals, seven dispensaries and eight health posts are functioning. Through hospital and dispensaries, out-patient services, inpatient services, deliveries are being carried out by qualified Medical Officers and para medical staff.

52. The general morbidity rate is 0.21 in the Corporation area. However, no persons are affected due to vector-borne or water-borne diseases. The proposed UGSS scheme will control the contamination of river Tamirabarani due to direct disposal of sewage.

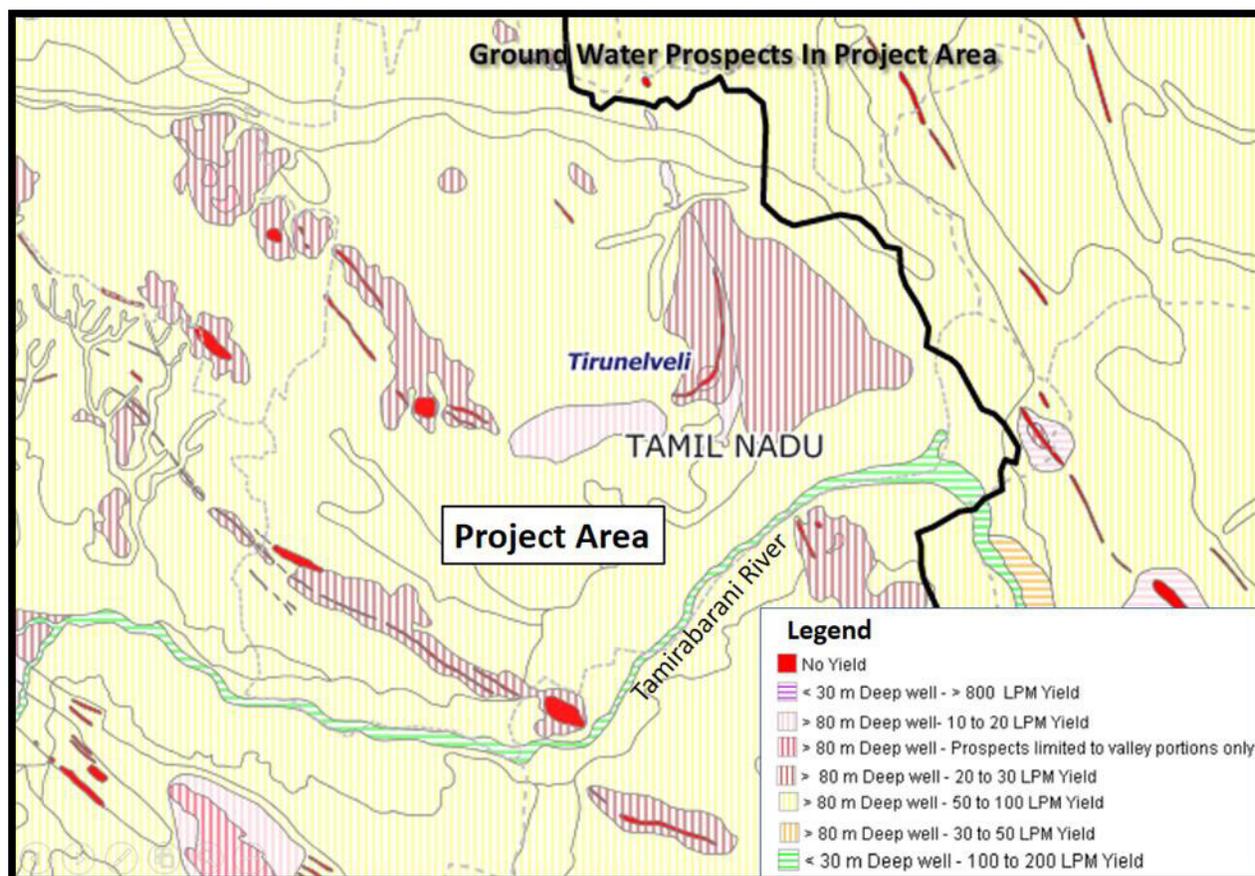
6. Groundwater

53. Ground water generally occurs under phreatic conditions in the weathered mantle and under semi-confined conditions in the fissured and fractured zones at deeper levels. The district is underlain by both porous and fissured formations. The important aquifer systems in the district are created by Weathered and fractured hard rock formations of Archaean age; and Porous sedimentary formations ranging in age from Tertiary and Recent. The porous formations are found as small patch in the southeastern part of the district. The porous sedimentary river alluvium is found along the river courses and the thickness of alluvium is restricted to 5m-6 m.

54. The thickness of weathered zone in the district is up to 30 meter below ground level (mbgl). The groundwater exploration in the district down to a depth of 200 mbgl by CGWB has revealed that in the western part of the district potential fractures are encountered beyond 100 mbgl while in the rest of the area, potential fractures are restricted to 100 mbgl. The well yield is in the range of 63 to 270 liters per minute. The depth to water level in the district varied between 1.19 to 13.35 mbgl during pre-monsoon (May 2006); depth to water level varied between 0.18 to 7.97 mbgl during post monsoon (January 2007). The seasonal fluctuation shows a fall in water level, which ranges from -0.12 to -2.14 mbgl, and rise in water level, which ranges from 0.33 to 11.24 mbgl (CGWB Report, 2009).

55. The estimation of groundwater resources for the district has shown that 1 block was "Semi Critical", four blocks were "Over-Exploited" and 14 blocks were under "Safe" category. The project area falls under the "safe" category.

Figure 8: Ground Water Prospects in Project Area



Source: Bhuvan.

56. **Groundwater Quality.** Ground water quality of phreatic aquifers in Tirunelveli district, in general is colorless, odorless and slightly alkaline in nature. Groundwater quality in Tirunelveli town is good. Following table presents the groundwater quality data from the wells located in four localities of the town. No data on coliform available. Water fit for drinking after proper disinfection. All the physico-chemical parameters are within the drinking water standards specified by Bureau of Indian Standards (BIS).

Table 11: Groundwater Quality in Tirunelveli, 2014

S. No.	Parameters	Units	BIS Standards	Sankar Nagar	Vannar pettai	Rajagopala-puram	IOB Colony
1	Total Hardness	Mg/l	300-600	220	52	310	328
2	pH	-	6.5-8.5	7.68	8.14	7.05	7.56
3	EC	Micro.mho/cm	-	789	135	1042	980
4	Ca ⁺⁺	Mg/l	75 – 200	50	12	88	85
5	Mg ²⁺	Mg/l	30 – 100	23	5	22	28
6	Na ⁺	Mg/l	200	75	7	88	75
7	K ⁺	Mg/l	-	15	2	19	13
8	PO ₄ ³⁻	Mg/l	-	0.21	0.02	0.27	0.16

S. No.	Parameters	Units	BIS Standards	Sankar Nagar	Vannar pettai	Rajagopala-puram	IOB Colony
9	NO ³⁻	Mg/l	45 – 100	3	0	6	6
10	SO ₄ ²⁻	Mg/l	200 – 400	41	4	44	26
11	Cl ⁻	Mg/l	250	90	14	140	146
12	F ⁻	Mg/l	1 – 1.5	0.8	0.1	0.1	0.0
13	Total Alkalinity	Mg/l		232	42	280	240
14	TDS	Mg/l	500 – 2000	536	95	708	667

Source: Vijila J. et al (2015).

7. Ambient Air and Noise Quality

57. No regular ambient air or noise quality monitoring is conducted by TNPCB in Tirunelveli. Following data shows the random monitoring conducted for 24 hours by TNCPB/CPCB to record air and noise quality in 2014 and 2015. The data shows the oxides of sulphur and nitrogen in ambient air is well below the ambient air quality standards, however, particular matter is about 10-20% above the standard. Dry weather conditions coupled with poor road surface and traffic contribute to the high particulate matter in ambient air. Ambient noise levels are much higher than the notified noise standards in residential and silence zones, and however are well within the limits in commercial areas.

Table 12: Ambient Air Quality

Sl. No	Monitoring day	Concentrations of Air Pollutants (24 hours) in µg/m ³		
		SO ₂	NO ₂	PM ₁₀
1	November, 2014	20	38	72
2	November, 2015	23	35	67
NAAQ standard (24 h)		50	40	60

Source: Central Pollution Control Board. Ministry of Environment, Forest & Climate Change. [Ambient Air Quality and Noise Levels: Deepawali Festival Monitoring Report 2015](#).

Table 13: Ambient Noise Quality

Monitoring Location	Land Use of Monitoring Location	Noise Level in 2014 (dBA)	Noise Level in 2015 (dBA)	Noise Standard (day-time) (dBA)
Tirunelveli Old town	Residential	82	61	55
Samathanapuram	Commercial	64	58	65
Pettai near to Nursing home	Silence	67	60	50

Source: Central Pollution Control Board. Ministry of Environment, Forest & Climate Change. [Ambient Air Quality and Noise Levels: Deepawali Festival Monitoring Report 2015](#).

C. Ecological Resources

58. Project area, Tirunelveli town, is an urban area surrounded by land that was converted for agricultural use many years ago. Tirunelveli city is surrounded by vast agricultural lands. There is no remaining natural habitat in the town, and the flora is limited to artificially planted trees and shrubs, and the fauna comprises domesticated animals (cows, goats, pigs and chickens), plus other species able to live close to man (urban birds, rodents and some insects). River Tamirabarani, which flow the town, is an important part of its ecosystem. River during its course through Tirunelveli town collects wastewater – both partially treated and untreated, from the

surrounding areas. River has high seasonal fluctuations in flows, with very high flow during monsoon to or no flow during summers.

59. There are no sensitive areas like forest or protected areas in the project area. Agasthyamalai Biosphere Reserve boundary is on the west, at about 15-20 km from Tirunelveli city, this includes several protected areas such as The Kalakad-Mundanthurai Tiger Reserve (KMTR). KMTR is part of Agasthyamalai Biosphere Reserve (ABR) is home to 2,254 species of higher plants including about 400 that are endemic. The fauna here includes the Asian elephant, tiger and Nilgiri Tahr. The biosphere reserve which is recently selected as world heritage site by UNESCO is a unique genetic reservoir of cultivated plants especially cardamom, jamun, nutmeg, pepper and plantain. The Tirunelveli district also harbors a unique forest type called Tirunelveli Semi Evergreen Forests. These forests are ecotones, as they are found between evergreen and dry deciduous forests. The forest type is found in KMTR and occurs relatively in a narrow strip on the Papanasam hills.

D. Economic Development

1. Land Use

60. Total geographical area under the Tirunelveli municipal corporation limit is 108.65 km² (108,65 ha). As per the Master Plan of the Tirunelveli Local Planning Area which include the TCMC area, majority of the area under the municipal limit is in undeveloped category, which include vast agricultural lands on the outskirts, and water bodies (river, streams, lakes etc.). Developed area is predominantly under residential use, followed public/semi-public use, industrial use and commercial uses. Residential developments are mostly concentrated in the heart of the Tirunelveli town, Pettai, Kokkirakulam, Vannarapettai, South bazaar area, Kottur Road area, Samathanapuram area and heart of the Melapalayam and Thatchanallur area. The scattered residential developments are along Sivanthipatti road, NH7 road beyond southern side of Government engineering college, Papanasam Road, Tuticorin Road, Tiruchendur Road, Mukkoodal road, and Madurai road etc.

Table 14: Existing and Proposed Land Use of Tirunelveli Municipal Area

Land Use	Existing (2005)		Proposed (2021)	
	Area (in ha)	%	Area (in ha)	%
Residential	1,202.18	11.1%	3,756	34.6%
Commercial	91.83	0.8%	265	2.4%
Industrial	216.02	2.0%	284	2.6%
Public and Semi public	529.72	4.9%	566	5.2%
Undeveloped area (agri, water bodies)	8,825.25	81.2%	5,994	55.2%
Total	10,865.00	100.0%	10,865	100.0%

Source: Master Plan for Tirunelveli LPA, Town and Country Planning, GOTN.

Figure 9: Land Use Pattern in Tirunelveli Municipal Area

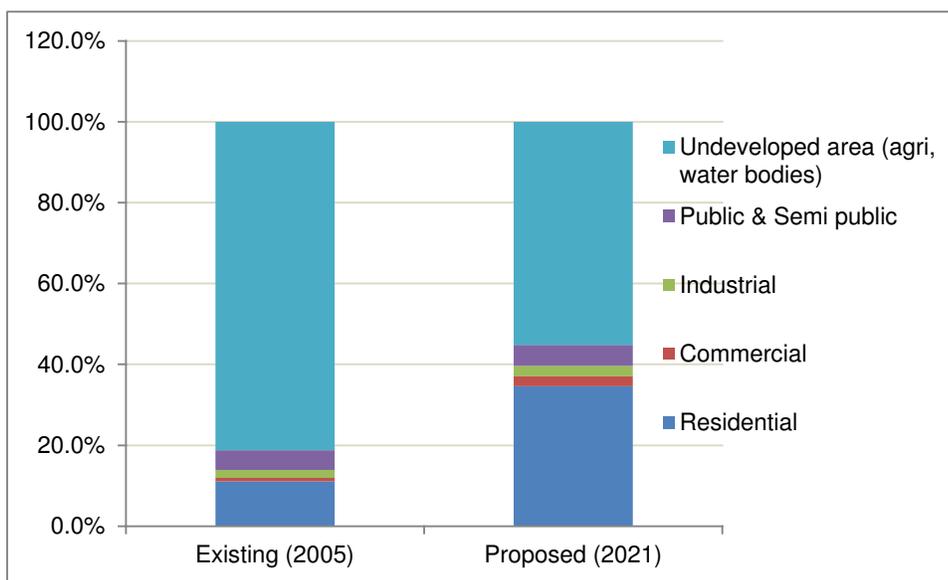
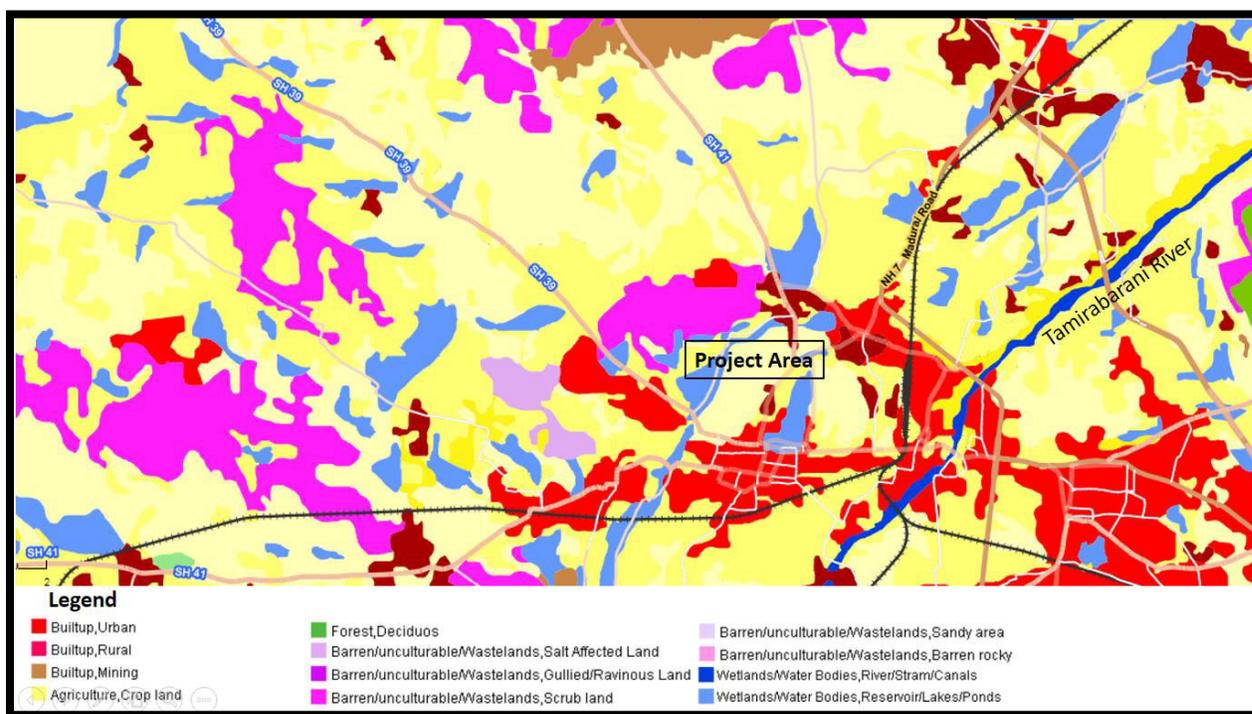


Figure 10: Map showing Land Use and Land Cover in the Project Area



Source: Bhuvan.

2. Industry and Agriculture

61. Tirunelveli is a fastly developing urban center and it extends its influence over the entire Tirunelveli district, and the surrounding districts such as Thoothukudi, Kanniyakumari and Viruthunagar districts. It is one of the religious important centers in the State. The economy of

Tirunelveli district is chiefly agro based, given its vast agricultural hinterland. It is also rich in mineral resources like limestone, garnet sand etc., that contribute to the region's economy. Small Industrial Development Corporation (SIDCO) has developed an Industrial estate in Pettai area on the northern part of the city. The city has the distinction of having the first spinning mill established under co-operative movement at Pettai in 1958. Tamilnadu Sugar Corporation limited has established a factory at Tirunelveli. Due to lime stone deposits, there are cement factories in the vicinity of the city.

62. There are 25 medium and major industries such as Cement, Cotton yarn, Sugar, Rice bran oil, Printing papers and flour Mill etc. Beedi rolling, safety matches making, mat weaving and processing and manufacturing of palm fibre and articles from Palm trees and hand loom weaving of textiles are the main household industries that are found in the city and its adjoining hinterland. Some of the famous products from Tirunelveli area include: Korai mats from Pathamadi, Kallidaikurichi Pappads, Karukurichi mud pots.

63. The river and the centuries old irrigation system associated with it, have made Tirunelveli district, a major 'rice bowl' of Tamil Nadu. The primary crops grown in the region are paddy and cotton; people are also engaged in the cultivation of spices and condiments (like cumbu, ragi) groundnut, pulses, gingelly, coconut, chillies, and indigo. The most common tree is the palmyra palm, a raw material in cottage industries.

Table 15: Zone-Wise Micro, Small and Medium Scale Establishments Industrial Units in Tirunelveli City

Zones	Number of Micro, Small and Medium Scale Establishment Units
Thatchanallur Zone	37
Palayamkottai Zone	66
Melapalayam Zone	31
Tirunelveli Zone	60
Total	194

64. The city is also an educational hub of southern Tamil Nadu, with institutions such as Tirunelveli Medical College, the Veterinary College and Research Institution, Tirunelveli Law College and the Government College of Engineering. There are 23 Elementary Schools, 5 Middle Schools and Higher Secondary Schools maintained by Tirunelveli City Municipal Corporation. There are several other educational institutions, especially in Palayamkottai zone, established by private agencies.

3. Infrastructure

65. **Water Supply.** At present, the main source of water supply for Tirunelveli Corporation is from River Tamirabarani. There are infiltration wells constructed near or along the river at several places in the upstream (1 - 2 km) of Tirunelveli town. Wastewater of the towns joins the river downstream of these infiltration wells. The water is treated at Kondanagaram, Manappadaiveedu, Tirumalaikolunthapuram, Krukkuthurai, Suthamalli and Tiruvannathapuram. There are 56 overhead tanks with capacity of water of 36.45millionlitres. About 55 MLD of water is supplied to the city with per capita supply of 116 lpcd from 11 head works, covering 55 wards. The treated water is distributed to the city through 40,153 domestic and 2,003 commercial connections, 1,264 public fountains. This is being supplemented by 2.88 MLD water extracted from underground sources through 1,436 bore wells. The distribution system consists of rising mains and distribution lines with a total length of 335.74 km of distribution lines and 17 km rising mains.

66. A new water supply scheme has been designed to meet the growing demand of the Corporation area that envisages supply of 135 lpcd with 5% treatment losses and 10% for transmission and distribution losses. Ariyanayagipuram Anicut across River Tamirabarani is proposed as source for the water supply improvement scheme to Tirunelveli Municipal Corporation. This Anicut is located at about 5 km upstream of Tirunelveli.

67. **Sewerage.** Tirunelveli town and junction of the Corporation area have underground drainage systems from 1989. The remaining areas manage sewage through septic tanks and public conveniences. The corporation is divided into 4 Administrative zones. The sewage generated from each zone is collected through a network of street sewers to a collection well. The sewage collected in each zone is pumped to the sewage treatment plant constructed at Ramaiyanpattai of capacity 24.20 MLD by adopting Waste Stabilization Pond system. The treated effluent is let into the open channel and utilized for Agriculture. The total length of sewer line is 187.272 km with 7924 manholes. The total number of house service connections is 22,226.

68. **Solid Waste Management.** Sanitation in the Tirunelveli Municipal Corporation is effectively operated by 17 sanitary units each one composting of two to four wards. Each unit is headed by a Sanitary Inspector assisted by Sanitary Supervisor and is allotted necessary equipment, manpower and vehicles for the SWM. About 100 metric tonnes of solid waste is collected from the city daily in door-to-door collection. The per capita waste generation was about 350 gram per day and total generation is around 180 tons per day.

69. **Transportation.** Tirunelveli city being the district headquarters of Tirunelveli, has an extensive transport network. It is well connected to other cities of Tamil Nadu by the National Highway (NH7). In terms of railways, Tirunelveli Junction is one of the oldest and most popular stations in Indian Railway. A large network of inter-state and intra-state buses ply to various destinations from Tirunelveli. There is a good co-existence of both private and public transport in the city round the clock. The closest airport to the city is the Tuticorin airport, located at Vaagaikulam in Thoothukkudi district, 28 km East of Tirunelveli. The Madurai Airport and Thiruvananthapuram International Airport are about 150 km away by road.

70. Total road length in Tirunelveli is about 600 km (maintained by TCMC), majority of which are bituminous roads (56%) followed by cement concrete roads (20%). The other 18% are earthen/unsurfaced roads while the remaining 6% are WBM roads. Most of the roads in the core city area are narrow and congested, with vehicles (two and four wheelers), cycles and pedestrians, comparatively, roads in the outer areas are wide. Sewer lines will be laid within the road carriage in most of the roads, this therefore requires cutting open of bituminous or cement concrete surface. This has high potential to disrupt the traffic flow in the city during construction.

E. Socio Cultural Resources

1. Demography

71. The Tirunelveli Municipal Corporation has a population of 473,637 (Census 2011). There are 55 wards in the city, among them Tirunelveli Ward No 26 is the most populous ward. Demographic details of Tirunelveli town are given in the following table. Notable is sex ratio, which is higher than natural 1:1 ratio (1,027 females for 1,000 males), much higher than state average of 996.

Table 16: Demographic Characteristics (2011 Census)

Demographic parameters	Tamil Nadu	Tirunelveli
Population (2011)	72,147,030	473,637
Geographical area (km ²)	130,060	108.65
Total households	18,462,231	120,466
Decadal Growth rate (2001-11)	15.61%	15%
Sex ratio	996	1,027
Population Density, (per km ²)	555	4,359
Household size	3.9	3.9
literacy rate	80.09%	90.39%
literacy rate (male)	86.77%	94.75%
literacy rate (female)	73.73%	86.18%
Scheduled Caste Population	20.01%	13.17%
Scheduled Tribe Population	1.1%	0.32%
Work participation ratio	45.58%	42.73%
Work participation ratio – male	59.31%	60.88%
Work participation ratio – female	31.8%	25.21%
Main workers	85%	93%
Marginal workers	15%	7%
Cultivators	12.9%	1.2%
Agricultural Labourers	29.2%	3.3%
Household industry workers	4.1%	11.2%
Other workers	53.7%	84.3%

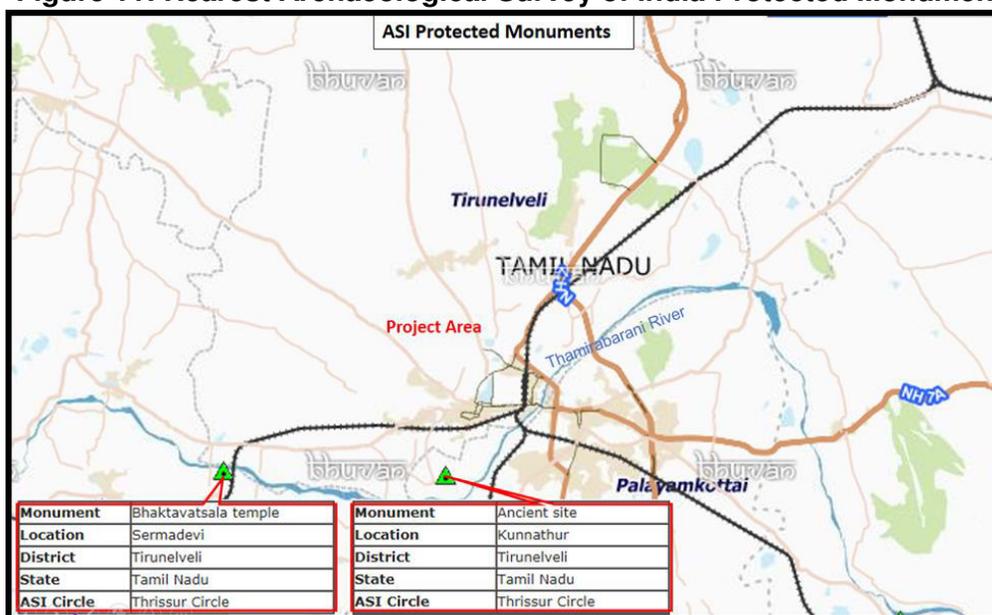
2. History, Culture and Tourism

72. Tirunelveli also known as “Nellai” is believed to be an ancient settlement. The two names of the city, Tirunelveli and Nellai have the term “nell” which means rice in Tamil, directly associates the city with rice fields.

73. Tirunelveli had been under the prominence of the Pandya kings, It was an important city of the Chola kingdom (c.900–1200) and of the Vijayanagar empire. The city was the chief commercial town in the period of Arcot Nawabs and Nayaks. They called the city "Nellai Cheemai", with cheemai meaning a developed foreign town. It was the Nayaks who, in 1781, granted its revenues and local administration to the British. In 1801, it was annexed by the British, who governed it until India achieved independence in 1947. On acquisition from the Nawab of Arcot in 1801, the British anglicized its name as Tinnevely and made it the headquarters of Tirunelveli district. This happened despite the fact that their administrative and military headquarters was located in Palayamkottai (which was also anglicized as Palankottah), during their operations against the Palayakars. Post-independence, both towns reverted from their anglicized names to their original names and grew together as twin cities.

74. Tirunelveli has many Temples, Nellaiappar Temple being the most prominent. This, however, is not a notified or protected monument. In all there 57 religious places (temples, churches, mosques etc.) in the city. The temple was greatly expanded during the 16th century Nayak period and has many architectural attractions, including musical pillars. The district has several monuments that are notified under the Ancient Monuments and Archaeological Sites and Remains Act, 1958 [protected by Archaeological survey of India (ASI)] and those that are under state protection. Bhaktavatsala Temple at Seramadevi and Ancient Site at Kunnathur are two ASI protected monuments that are present in the proximity to the project area (10-20 km). There are several other temples around the famous temples near the town, frequented by pilgrims, important of which include: Arulmigu Venkadachalapathy Tirukkovil at Melathiruvankadanatha puram and Arulmigu Etteluthu Perumal Kovilat Alaganeri Village.

Figure 11: Nearest Archaeological Survey of India Protected Monument



Source: Bhuvan.

F. Subproject Site Environmental Features

75. Features of the selected subproject sites are presented in the following table.

Table 17: Site Environmental Features

Infrastructure	Location and Environmental Features	Site Photograph
Sewage pumping stations	<p>1. New sewage pumping station at Kumaresan Nagar</p> <p>The Land belongs to the Corporation. It is proposed to construct Compound wall for the entire site. Green buffer is proposed to mitigate the odor problems and cost is included in the DPR</p>	
	<p>2. Existing sewage pumping station at Vannarapettai and Kuruchi</p> <p>The existing pumping station at Vannarpettai is fully utilized. The sewage generated from the contributing area of the pumping station is proposed to be collected in the existing collection cum screen well. The existing pumping station at the Kuruchi is also fully utilized, in addition to the existing grit well and suction well a new suction well is proposed with 5.5 m dia which is connected from the grit well directly.</p> <p>The existing trees in the area will mitigate the odor problem. Hence, there is no additional of</p>	

Infrastructure	Location and Environmental Features	Site Photograph
Sewage lift stations (LS)	<p>any odor control measures.</p> <p>LS:12, Thokapiyar Street, Kokirakulam road The Land belongs to the Corporation. As the land is an Pound site it is proposed to construct Compound wall for the entire site. Plantation of trees are proposed to mitigate the odor problems. North, South and East sides- The houses are adjoining to the site and the West side 6m wide road.</p>	
	<p>LS:13, Thirukurippu Thondar Street The land identified is adjoining the Public toilet building. The ownership of the land is Revenue department. TMC had taken measures to obtain the NoC from the Revenue. In East side, the Public Toilet is adjoining to the site, West sides the houses are adjoining to the site, the North side is Vacant Land and the South side 4m wide road.</p>	
	<p>LS:14, Ulgaamman kovil street Since the Alternate land is not available it is proposed to provide a Road side lift Manhole arrangement instead of Lifting station</p>	
	<p>LS:15, Maruthi nagar The land identified is adjoining the Public toilet building. The Land belongs to the Corporation. As the land is an Poonthotam site it is proposed to construct Compound wall for the entire site. In North & East side the houses are 20m away from the site. South side is 3.5m wide road. East side has the public toilet adjoining to the site.</p>	

Infrastructure	Location and Environmental Features	Site Photograph
	<p>LS:16, Senthil nagar</p> <p>Since the Alternate land is not available it is proposed to provide a Road side lift Manhole arrangement instead of Lifting station.</p> <p>The all-around houses are adjoining to the site.</p> <p><i>Road side Lift stations are essentially proposed as enlarged manholes (either road-side on available land or on road center by enlarging a collection system manhole) fitted with two sewage pumps (small capacity) and a curb or road-side wall mounted Pump Control Panel.</i></p>	
	<p>LS17: Kilanatham melur road</p> <p>Since the Alternate land is not available it is proposed to provide a Road side lift Manhole arrangement instead of Lifting station.</p> <p>In North side has the river 100m away from the site. South side is 5m wide road. West side has the temple 8m away from the site and East side the Pump room adjoining to the site.</p>	
	<p>LS18: Thiruvannanathapuram, Near Public Toilet</p> <p>The land identified is adjoining the Public toilet building.</p> <p>The Land belongs to the Corporation.</p> <p>As the land is an Panchayat Oorakuli site.</p> <p>North side has the Public Toilet, South side : 3.5m wide road, East side: Public Toilet, West side : 3.5m wide road</p>	
	<p>LS 19: New Colony</p> <p>Since the Alternate land is not available it is proposed to provide a Road side lift Manhole arrangement instead of Lifting station</p>	

Infrastructure	Location and Environmental Features	Site Photograph
	<p>LS20: Andal Nagar</p> <p>The land identified is adjoining the Public toilet building. The Land belongs to the Corporation. North side has the Public Toilet, South side : 4m wide road, East side: Public Toilet, West side : Vacant Land.</p>	
	<p>LS21: Ragumath nagar</p> <p>Since the Alternate land is not available it is proposed to provide a Road side lift Manhole arrangement instead of Lifting station</p>	
	<p>LS22: Near OHT police colony</p> <p>The Land belongs to the Corporation. Green buffer of 3 m width is provided around the modules As the land is an OHT site it is proposed to construct Compound wall for the entire site. North side: 4m Wide road, South side : Vacant Land, East side: 4m Wide road, West side : 5m Wide road. Green buffer is 3m width proposed to mitigate the odor problems and cost is included in the DPR</p>	
	<p>LS23: Saranya Nagar</p> <p>The Land belongs to the Corporation. Green buffer of 3m width is provided around the modules As the land is an Park site it is proposed to construct Compound wall for the entire site. Green buffer is proposed to mitigate the Odor problems and cost is included in the DPR However, TCMC initiated to change the Ownership to the corporation</p>	

Infrastructure	Location and Environmental Features	Site Photograph
	<p>LS24: IOB Colony The Land belongs to the Corporation. Green buffer of 3m width is provided around the modules As the land is an Park site it is proposed to construct Compound wall for the entire site. Green buffer is proposed to mitigate the Odor problems and cost is included in the DPR However, TCMC initiated to change the Ownership to the corporation. North side: 4m Wide road, South side : 3 m Wide road, East side: 3m Wide road, West side : Vacant Land.</p>	
	<p>LS25: V.M Chatram The Land belongs to the Corporation. Green buffer of 1m width is provided around the modules As the land is an Ex. Sump site it is proposed to construct Compound wall for the entire site. North side: adjoining Ex. Pump Room, South side : adjoining residential building, East side: 5m Wide road, West side :adjoining residential building.</p>	
	<p>LS26: Achimadam The Land belongs to the Corporation. Green buffer of 1m width is provided around the modules As the land is an Ex. well site it is proposed to construct Compound wall for the entire site. North side: adjoining residential building, South side : Ex. well, East side: Vacant Land, West side :6m wide road.</p>	
	<p>LS27: Melanatham Since the Alternate land is not available it is proposed to provide a Road side lift Manhole arrangement instead of Lifting station. North side: 6m Wide road, South , East & West side : adjoining residential buildings.</p>	

Infrastructure	Location and Environmental Features	Site Photograph
	<p>LS28: Karunkulam -Agraharam</p> <p>The Land belongs to the Corporation. Green buffer of 3m width is provided around the modules As the land is an Ground site it is proposed to construct Compound wall for the entire site. Green buffer is proposed to mitigate the Odor problems and cost is included in the DPR. North & East side: Vacant Land, South and West side: 3.5m wide road.</p>	
	<p>LS29: Anbu Nagar</p> <p>The Land belongs to the Corporation. Green buffer of 3m width is provided around the modules As the land is an Ground site it is proposed to construct Compound wall for the entire site. Green buffer is proposed to mitigate the Odor problems and cost is included in the DPR. North side: Vacant Land, South side : 4m wide road, East Side: 3m wide road, West side: Ex. Pump House.</p>	
Sewer network	<p>Sewer lines will be laid in the center of road by cutting open the surface (BT/CC/others). In wider roads, like NH, divided 2-way roads etc., sewers will be laid along the edge of the road, but mostly within the carriageway. In the outskirts where adequate land in the road shoulder is available along the blacktop and is clear of any structures or activities, sewers will be laid in the earthen shoulder. Large diameter sewers will be laid on main roads (300 – 750 mm), while the tertiary sewers of small size (150 mm to 300 mm dia) that collect wastewater from each house will be laid in all streets in the subproject area. Trench size to bury the sewer will be of 0.8 m to 1.5 m wide and 1 m to 6 m deep. Most of the roads in central part of the town (old town area) are very narrow and congested with traffic, pedestrians and activities.</p>	
Sewage Treatment Plant (STP)	<p>Treatment of collected wastewater to comply with disposal standards . Proposed STP will be placed in the Ramayanpatti with the total capacity of 34 MLD (2 modules of 17 MLD) . The STP components consist of anaerobic pond, facultative pond and aerobic pond. The project site has the total land extent of 180 acres in which existing STP, solid waste dumping yard are in place. The site has totally 95 acres of vacant land in which 60 acres will be utilized for proposed STP. Site is presently vacant, and covered with shrubs and bushes of local species. Site is not a low lying area. Site is surrounded by Existing STP, vacant/agricultural lands. The Government Vetnary College and Hospital is 0.25Km away from STP. The Existing STP is 1km Away from</p>	

Infrastructure	Location and Environmental Features	Site Photograph
	<p>STP. The houses are in North East (Veppankulam Area) and South East side (Annai Velankanni Nagar) is >1 km away from STP. The Western side is Agricultural and vacant Land is >1m away from the STP.</p> <p>Treated wastewater from STP will be discharged into Kodagan irrigation Channel, located at about 1 km East of STP site. A pipe will be laid from STP to tank along an existing road. Tank is under the Public Works Department of Government of Tamil Nadu. Normally, the water is using for the agricultural purpose. These are maintained by PWD. Treated water from the STP will be disposed into Kodagan Irrigation Channel.</p>	
Disposal line	<p>The treated sewage will be let into the irrigation channel where the existing treated sewage is also disposed. The irrigation channel entitled Kodagan Channel is present abutting STP site which runs through the agricultural lands. The treated water will be utilized for agriculture lands which is available on the both sides of the irrigation channel. The Kodagan irrigation channel takes off from the right side of the anicut, and supplies water to 11 tanks located in Ariyanayakipuram and Melacheval villages . The channel which has the adequate width to carry the treated sewage and is facilitated for the irrigation of 3000 acres of land directly and 3000 acres of land indirectly in Ariyanayakipuram village and its surrounding areas.</p>	

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

76. Potential environmental impacts of the proposed infrastructure components are presented in this section. Mitigation measures to minimize/mitigate negative impacts, if any, are recommended along with the agency responsible for implementation. Monitoring actions to be conducted during the implementation phase is also recommended to reduce the impact.

77. Screening of potential environmental impacts are categorized into four categories considering subproject phases: location impacts and design impacts (pre-construction phase), construction phase impacts and operations and maintenance phase impacts.

- (i) **Location impacts** include impacts associated with site selection and include loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their livelihood or any other structures by the development of that site.
- (ii) **Design impacts** include impacts arising from Investment Program design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services.
- (iii) **Construction impacts** include impacts caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.

- (iv) **O&M impacts** include impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams, and occupational health and safety issues.

78. Screening of environmental impacts has been based on the impact magnitude (negligible/moderate/severe – in the order of increasing degree) and impact duration (temporary/permanent).

79. This section of the IEE reviews possible project-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the project's area of influence.

80. The ADB rapid environmental assessment checklist in http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.asphas been used to screen the project for environmental impacts and to determine the scope of the IEE.

81. In the case of this project (i) most of the individual elements involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; (ii) negative impacts associated with sewage facilities such as odor are already considered in the design and siting; (iii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements; and (iv) being mostly located in an urban area, will not cause direct impact on biodiversity values. The project will be in properties held by the local government and access to the project location is through public rights-of-way and existing roads hence, land acquisition and encroachment on private property will not occur.

A. Pre-Construction Impacts – Design and Location

82. **Design of the Proposed Components.** Technical design of the (i) sewage pumping and lifting stations; and (ii) sewer network including manholes and house connections, follows the relevant national planning and design guidelines, focusing on providing a robust system which is easy to operate, sustainable, efficient and economically viable.

83. **Sewage Treatment.** New sewage treatment plant is proposed in the subproject with waste stabilization pond (WSP) technology in Ramayanpatti, Tirunelveli.

84. **Design of the Proposed Components.** Technical design of the (i) sewage treatment plants; (ii) sewage pumping and lifting stations; and (iii) sewer network including manholes and house connections, follows the relevant national planning and design guidelines, focusing on providing a robust system which is easy to operate, sustainable, efficient and economically viable.

85. **Design of Sewage Treatment Plant.** A 34 MLD STP is proposed to be constructed at the identified site to treat the sewage generated from the subproject areas which lies on the Eastern side of Tamirabarani River. The selected site for STP is adjoining the dumping yard in the overall land extent of 180 Acres. On considering the land availability, reduction of operation and maintenance costs and performance in future, the proposed STP is based on Waste Stabilization Pond (WSP) technology treatment plant.

86. One of the critical aspects in STP operation is, change in raw sewage characteristics at inlet of STP may affect the process and output quality. The system is designed for municipal

wastewater, which does not include industrial effluent. Characteristics of industrial effluent widely vary depending on the type of industry, and therefore disposal of effluent into sewers may greatly vary the inlet quality at STP, and will upset process and affect the efficiency. Although legally the disposal of effluent meeting certain standards is allowed into municipal sewers the monitoring of the same is not-practical. Although there are no significant presence of industries with problematic water discharges in the subproject area of Eastern side of Tamirabarani River, following measures are suggested to safeguard sewerage system efficiency:

- (i) No industrial wastewater shall be allowed to dispose into municipal sewers;
- (ii) No domestic wastewater from industrial units shall be allowed into municipal sewers;
- (iii) Ensure that there is no illegal discharge through manholes or inspection chambers
- (iv) Conduct public awareness programs; in coordination with TNPCB; and
- (v) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with the standards.

87. **Process technology of Waste Stabilization Pond.** Waste stabilization ponds (WSP) are large man-made basins in which greywater, blackwater or faecal sludge can be treated to an effluent of relatively high quality and apt for the reuse in agriculture (e.g. irrigation) or aquaculture (e.g. macrophyte or fish ponds). They are semi-centralized treatment systems combined after wastewater has been collected from toilets(see also wastewater collection and user interface). For the most effective treatment, WSPs should be linked in a series of three or more with effluent being transferred from the anaerobic pond to the facultative pond and, finally, to the aerobic pond. Stabilization Ponds provide comparatively long detention periods extended from few to several days. Under many situations in warm climate countries Pond Systems are cheaper to construct and operate compared to conventional method. Hence, based on the availability of land, WSP is proposed. Also, the proposed STP will consist of anaerobic pond, facultative pond and aerobic pond which are connected sequentially

88. **Sewage sludge** generally consists of organic matter, pathogens, metals and micro pollutants. The concentration of parameters such as metals can be influenced by input to the sewers system from industry. Since no industrial wastewater is allowed into sewers, it is unlikely that sludge contains heavy metals. . A sludge management plan will be developed by the TCMC for proper disposal. Sludge shall be periodically tested for presence of heavy metals. Proper sludge handling methods should be employed. Personal Protection Equipment should be provided to the workers.

89. Dried and properly composted sludge can be used as soil conditioner. Periodic testing of dried sludge will be conducted to ensure that it does not contain heavy metals that make it unsuitable for food crops. As there are no specific standards notified for sludge reuse, the compost quality standards notified under the Solid Waste Management Rules, 2016 shall be adopted.

90. **Sewer system – collection and conveyance.** The sewerage system is designed as a separate system of sewage collection (i.e. caters only to wastewater). Existing surface road side drains in the project area cater to collection and conveyance of runoff during rains. The underground gravity sewers will carry sewage from households to the nearest lifting or pumping station, from where the sewage is pumped to the STP. Sewer system will cater to domestic wastewater - grey water (from kitchen and bath areas) plus black water (toilet waste/excreta), and every household outlet carrying the wastewater will be connected to the sewer network.

91. To maximize the benefits as intended, City Corporation will ensure that all existing septic

tanks are phased out by bypassing the inlet and connecting the toilet discharge from each house directly to sewerage system.

92. Accumulation of silt in sewers in areas of low over time, overflows, blockages, power outages, harmful working conditions for the workers cleaning sewers etc. are some of the issues that are taken into consideration during the sewer system design. Measures such as the following are included in sewer system design to ensure that the system provides the benefits as intended:

- (i) Limit the sewer depth where possible;
- (ii) Sewers shall be laid away from water supply lines and drains (at least 1 m), if not possible, sewer lines shall be laid down below the water lines;
- (iii) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm);
- (iv) In unavoidable cases, where sewers are to be laid close to storm water drains, appropriate pipe material (that has no or least infiltration risk) shall be selected (stoneware pipes shall be avoided);
- (v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes;
- (vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry; and
- (vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation.

93. **Sewage Pumping stations and lift stations.** It is proposed to construct 18 sewage lift stations, and one new sewage pumping stations, and rehabilitate an existing one pumping stations. The two existing pumping stations at Vannarapettai and Kuruchi will be fully utilized. However, Kuruchi pumping will be rehabilitated and new suction well with 5.5 m dia is proposed. These will which will receive sewage from the catchment area via the sewer network and pump to higher level manholes or pumping stations or to STP as per the design. Lift stations are necessitated where in the design the depth of sewer exceeds the downstream interlinking manhole invert levels. Attempts to eliminate lift stations by examining the feasibility of providing rider mains are assessed to be uneconomical. Therefore, in such situations, the feasible and practical solution was to opt for a low capacity lift station with submersible pumps to lift and convey the collected sewage from peripheral areas to the downstream system through a bell-mouth chamber.

94. Lift stations will cater to small area, and will be located at lowest point where the sewage from catchment area will be collected, and then pumped to a higher level manhole for further gravity flow or to a pumping station, from where it is ultimately pumped to the STP. Lift station will consists of a sewage sump or suction well of dia 2.5 m to 3.5 m and 4.2 m to 9.5 m deep, below the ground, to receive sewage, submersible pumps in the sump to pump out, and an electrical panel board for operation of pumps above the ground. A generator set will also be provided at each lift station of required size.

95. **Sewage pump station** will also perform same function as sewage lift stations but cater to much larger area or sewage flow, and will also have several components, and occupy comparatively larger area. Components of the proposed sewage pumping station near Kumaresan Nagar include:

- (i) Screen well - Dia 3.5 m and depth 4.39 m;

- (ii) Grit well - Dia 2.50 m and depth 6.14 m; and
- (iii) Suction well - Dia 3 m and depth 8.30 m.

96. At the these pumping or lifting stations, the operation involves accumulation of incoming sewage in the suction well, and then pumping out as the sewage level reaches the designed pumping depth. The water level in the well rises up before the pumping cycle starts, and as the pumping is performed the water level goes down, registering its lowest depth at the end of pumping of cycle. This cycle of rising and lowering will continue throughout the day and night, however, the duration between successive pumping cycles will significantly vary depending on the sewage generation. During morning and evening peak hours, sewage will accumulate quickly, and pumping frequency will be high. The sewage retention time in the suction well therefore varies throughout the day, with very high retention periods during the nights and mid-days.

97. **Odor from pump and lift stations.** In the suction wells, the sewage emits gases, which accumulated in the air above water surface. The gas may include odorous compounds like hydrogen sulphides (H₂S), amines, fatty acids, aldehydes, ketones and other volatile organic compounds (VOCs). As the water level rises before the pumping cycle, it physically displaces the air, along with the odorous gas compounds. H₂S is the most dominant odor causing compound, and therefore can cause nuisance to nearby households. When sewage becomes stagnant, H₂S is generated in the anaerobic conditions. The quantum of H₂S generation depend on quantity of accumulated sewage and sewage retention time that create anaerobic conditions. Both increase in quantity of sewage accumulation and retention time will increase the H₂S generation. Design considerations are included to minimize the both as much as possible. Pumping stations cater to large area and will have high capacity of suction wells and pump sets, while lift stations are small with lower capacity of suction wells and pumps sets. The retention time is kept to its lowest possible so that there is no stagnation of sewage for long time which could create anaerobic conditions.

98. **New and Rehabilitation of Pumping Stations.** Proposed site for new pumping station near Kumaresan Nagar is located outside the city, and surrounded mostly by vacant and agricultural lands. Nearest residential area is at about 50-100 m from the site. Adequate land available in the selected for locating pumping station away from residential areas. Existing pumping station at Vannarapettai and Kuruchi is located within town in a dense residential and commercial area. This pumping station is operational during the visit, and no odor nuisance noticed. Following design related measures are included in the pumping station designs to avoid any odor nuisance:

99. **Measures for New pumping station at Kumaresan Nagar**

- (i) Maintain a buffer distance from Kumaresan Nagar boundary to the pumping station wells;
- (ii) Locate pumping station as far as away from the road
- (iii) Develop green buffer zone around the facility with a combination of tall and densely growing trees in multi rows as per the land availability to control odor and also act as visual shield, and improve aesthetical appearance

100. **Measures for pumping station (Kumaresan Nagar) new and rehabilitation**

- (i) Proposed wells to be closed using RCC slabs. Design of RCC slab to consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells;
- (ii) RCC Slab to be designed and fixed in a modular manner such that access to pumps/appurtenances and other equipment can be provided for

- (iii) maintenance/replacement/renewal purposes;
- (iii) Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metalled grating/grill work shall be provided over the sections (or full cross section if required) where workers will stand/work for inspection and repair/O&M purposes;
- (iv) Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by positioning vent in such a way that cover slab fitment/movement/drawl if required for maintenance purposes is not compromised;
- (v) Height of vent to be provided appropriately and a minimum 2 m above the lintel level (top level) of window(s)/passageways/doors in the nearby adjoining buildings.
- (vi) Provision of odor control/mitigation system as per site conditions/requirements;
- (vii) Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength-corrosion resistant heavy duty construction shall be proposed;
- (viii) In locations/cases where sewage flow in the present to intermediate design stage is envisaged to be low, position of the submersible pumps and design of the collection well floor by providing necessary side benching / sloped flooring to allow for higher submergence during low flow shall be made to ensure regular pump operation and avoid sewage stagnation beyond the permissible limit;
- (ix) Diesel Generators shall be provided for all pump stations and in cases of lift stations with space for control room. In cases of lift manholes (road-side or road-center type structures with only provision of kerb-side kiosk), an electrical cut-out provision shall be made for connecting an Emergency Mobile/Skid Mounted Diesel Generator for pumping out during long period of electricity supply interruption;
- (x) Develop standard operating procedures/operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emerge situations;
- (xi) Provide training to the staff in SOPs and emergency procedures; and
- (xii) Periodic monitoring of H₂S levels at sewage pumping and lifting stations using handheld H₂S meters.⁶

101. **Provision of odor treatment system.** Besides the above measures, following odor control and mitigation measures, would be considered at sewage pumping and lifting stations, where required for facilities located very close to the houses/properties.

- (i) Provide closed wells fitted with necessary ventilation wherever required
- (ii) Provide greenbelt (tree cover) around the lift stations, wherever possible
- (iii) a suitable arrangement such to capture the gaseous emissions from the wells and treat via scrubber/activated carbon filter before letting out into the ambient air; such system should be designed appropriately to meet the likely emissions/flow rate of respective pumping/lifting stations

⁶ There are no any standards notified by Government of India or Government of Tamil Nadu. However, Central Pollution Control Board (CPCB) has stipulated Guidelines on Odor Pollution and its Control. These guidelines deal only with the basics of odor pollution, its sources and measurement, technologies for its control etc. but do not specify any threshold limits for odor-causing pollutants. Therefore, as part of mitigation, provision for odor control measures has been made in the sewage pumping stations for all UGSS subprojects. However, in case of STPs, the odor-causing processing units will be located far off to the extent possible within the premises so as to mitigate the odor nuisance. Further, the technology for treating sewage plays a vital role since release of gases like H₂S cannot be avoided in the process involving anaerobic decomposition whereas release of H₂S will almost be nil in case of aerobic treatment. PIU and design engineers have not specified any odor standards adopted elsewhere in the preliminary design as not to limit the technology that can be considered by the bidders in the treatment of domestic sewage. Sufficient mitigation measures have been taken for all sewage pumping stations and will be taken for all STPs when finalizing/revising the IEEs based on the detailed engineering design.

102. **Lifting stations** are also to be located at technically feasible locations (lowest point to where sewage can be conveyed from households by gravity) within or close to the residential areas which are being served by respective lifting station. Given very limited land availability in urban areas like the project area, that too of government owned lands, locating the lifting stations away from the houses is not practical. In Tirunelveli, sites for lifting stations were identified based on the technical suitability and availability of government owned land parcels to avoid land acquisition. Many of the sites are located along the river, which is the lowest point, and most of the area are highly dense. Odor nuisance from lifting stations is very limited compared to pumping stations. Lift stations are essentially proposed as enlarged manholes (either road-side on available land or on road center by enlarging a collection system manhole) fitted with two sewage pumps (small capacity) and a curb or road-side wall mounted Pump Control Panel. Following odor control and mitigation measures have been adopted in the DPR:

- (i) Provide closed wells fitted with necessary ventilation wherever required; and
- (ii) Provide greenbelt (tree cover) around the lift stations, wherever possible.

103. **Noise from pumping operations.** Operation of pumps and motors and diesel generators is a major source of noise. As the pumping and lifting stations are located in the residential areas, with few located very close to the houses, noise generated from lifting/pump stations can have continuous negative impacts on the surrounding population. High inside noise levels can affect the health of operators and staff at the facilities, and therefore, noise levels needs to be maintained within and outside the plant at acceptable levels.

- (i) Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80 dB(A) at a distance of 1 m.⁷ The noise level around the boundary will be around 45 dB(A) to 50 dB(A) and thus the noise level on the recipients will be around only 50 dB(A). Also, the pumps will be operated only during day time and there is no operation of pumps during night time.
- (ii) In order to control the noise levels twin lobe pumps is proposed in the lifting and pumping stations.
- (iii) Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise
- (iv) Use acoustic enclosures – manufacturer specified, for all pumps, motors
- (v) Procure only CPCB approved generators to meet air emission and noise level requirements
- (vi) Provide sound mufflers for ventilators in the plant rooms; and sound proof doors
- (vii) Provide ear plugs designated for noise reduction to workers

104. **Energy Efficiency.** Project area is mostly plain and gently sloping ground, it is therefore not technically feasible or economical to design a completely gravity system to collect sewage from individual houses and transfer the same the STP on the outskirts of the city. It necessitated provision of lifting and pumping stations, which are optimized to the extent possible to minimize the overall pumping. In the current design, sewage will be collected from the houses via sewer network and conveyed by gravity to the lifting station. Lifting stations are designed just to lift the sewage to higher level and deliver it to a nearby sewer manhole on the higher elevation, from

⁷ Indian Standards require to maintain the noise level of 70 dBA or less during night time. However, in case of STPs/water treatment plants/water supply head works, where heavy duty pump sets are to be installed and the noise levels may even exceed 80 decibels at 1 m distance, noise level will be measured at the time of commissioning the units and necessary mitigation measures such as noise barriers will be installed if required.

there it can flow by again by gravity, rather than pumping directly to a pumping station. This optimized the energy consumption.

105. To optimize the power consumption, the hydraulic design shall follow optimal approach, and the following also considered in design and selection of pumping systems. According to Manual for the Development of Municipal Energy Efficiency Projects in India (jointly developed by Bureau of Energy Efficiency (BEE) and International Finance Corporation in 2008), energy savings, at minimum, of 25% to 40% is possible with appropriate measures. The following measures have been considered and incorporated into the subproject designs wherever possible:

- (i) Using low-noise and energy efficient pumping systems;
- (ii) Efficient Pumping system operation; and
- (iii) Installation of Variable Frequency Drives (VFDs).

106. **Tree cutting at selected project sites.** As presented in the baseline profile of subproject sites, there are no notable tree cover in the project sites. Sewers are proposed within the roads, and therefore no tree cutting envisaged. Following measures need to be implemented to minimize and/or compensate for the loss of tree cover.

- (i) Minimize removal of trees by adopting to site condition and with appropriate layout design of pumping stations;
- (ii) Obtain prior permission for tree cutting; and
- (iii) Plant and maintain 10 trees for each tree that is removed.

107. **Utilities.** Telephone lines, electric poles and wires, water lines, drains, if exists within the proposed project locations may require to be shifted. All the selected project sites are vacant and unused government lands, there are no notable existing utilities. Sewer lines are proposed within the road way, where there are no utilities. In the outer areas where there is adequate earthen shoulder along the road carriage way, sewer lines can be accommodated in the shoulder. In such cases, the work may require shifting of utilities on the shoulder. To mitigate the adverse impacts due to relocation of the utilities, the contractor, in collaboration with the City Corporation will:

- (i) identify the locations and operators of these utilities to prevent unnecessary disruption of services during construction phase; and
- (ii) instruct construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.

108. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas.** Priority is to locate these near the project location, but at least 100 m away from residential areas, groundwater wells and surface water bodies. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up construction camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near forest areas, water bodies, or in areas.

109. **Site selection of sources of materials.** Significant quantities of coarse aggregate and fine aggregate will be required for construction works. Contractor should procure these materials only from the quarries permitted/licensed by Department of Geology and Mining. Contractor should, to the maximum extent possible, procure material from existing quarries, and creation of

new quarry areas should be avoided as far as possible. If new quarries are required then the contractor will be responsible for obtaining all permissions and clearances, including environmental clearance for mining. Contractor should factor in the time required for obtaining clearances including conduct of EIA if required under the law. It will be the construction contractor's responsibility to verify the suitability and legal status of all material sources and to obtain the approval of Department of Geology and Mining and local revenue administration, as required.

110. Social and Cultural Resources – Chance Finds. Any work involving ground disturbance can uncover and damage archaeological and historical remains. For this project, excavation will occur in project sites for foundations, laying pipelines, and for construction of underground structures at pumping/lifting stations. Although Tirunelveli is an historical city, there are no archeologically or historically recognized sites or places close to project sites or within the project area. There are no known sites or areas potential for containing archaeological or historical remains, and risk of uncovering them is low but cannot be ruled out, especially in the old town area and along Tamirabarani River. City Corporation will follow chance find protocol to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved:

- (i) Construction contractors to follow these measures in conducting any excavation work;
- (ii) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work;
- (iii) Stop work immediately to allow further investigation if any finds are suspected;
- (iv) Inform State Archaeological Department if a find is suspected, and taking any action they require to ensure its removal or protection in situ.

B. Construction Impacts

111. Main civil works in the subproject include laying of sewer lines and construction of sewage pumping and lifting stations at the identified sites.

112. Sewage pumping and lifting stations works will be confined to sites, and construction will include general activities like site clearance, excavation for foundations, and creation of concrete structures will be one of the major construction activities for this project, as many of the subproject components will be fixed to concrete plinths and most will be housed in buildings with at least some concrete structural elements. Most such structures will be constructed from reinforced concrete, where steel reinforcing rods and bars are placed and attached by hand to create an interior skeleton for the foundations, walls, columns, plinths, etc, and heavy-duty metal and timber/plywood formwork is bolted around the outside to build a mould into which pre-mixed concrete is poured. Once the concrete has set, the formwork is removed, and the concrete surface is finished by masons by hand if necessary. Some buildings, such as the pump station, facilities, etc., may be constructed from brick work, in which case this work will be done using standard house-building techniques. Since these works are confined to the boundary of identified sites, there is no direct or significant interference of construction work with the surrounding land use. However, construction dust, noise, use of local roads for transportation of construction material, waste, labour camps etc., will have negative impacts, which needs to be avoided or mitigated properly.

113. Subproject also include linear works (laying of 417 km of tertiary sewers, and 37 km of pumping mains along the roads). This covers entire Palayamkottai, Melapalayam, and Part of Thatchanallur area on the Eastern part of River Tamirabarani. Sewers will be laid along almost

all the roads. Small sewers (tertiary sewers) that collect sewage from households will be laid in all streets and roads, the larger sewers that collect sewage from tertiary sewers and convey to pumping stations will be laid mostly on wider main roads. Sewers will be laid by open cut method.

114. Open cut trenching method of sewer laying involves trench excavation in the road, placing sewers in the trench, jointing and testing, and refilling with the excavated soil. Proposed pipes for tertiary sewers are double wall corrugated (DWC) pipes and conveying mains (pumping mains) are of cast iron. The diameter of sewer ranges from 200 mm to 750 mm, of which nearly 95% of the sewers are of size between 150 mm and 250 mm. According to the design the sewers will be laid at a depth of 1 to 6.5 m. The width of the trench excavation along the roads will vary from 0.8 m to 1.3 m, and the depth varies from a minimum of 1 m to 6.5 m. Nearly 80% length of sewers will be laid in trench of depth 3 m or less, and only about 3.7% of sewers will be laid deeper between 5 and 6.5 m. The design is optimized to minimize the sewer depth to the extent possible with an optimal combination of sewer depth and pumping requirements. Details of sewer construction are provided in the following table.

Table 18: Sewer Construction

Proposed Depth of Sewer (m)	Total Length of Sewers to be Laid (m)	% of Length
0 - 2.0	21,615	66.17
2.0 - 2.5	45,580	10.92
2.5 - 3.0	31,450	7.54
3.0 - 3.5	21,157	5.07
3.5 - 4.0	13,801	3.31
4.0 - 4.5	10,611	2.54
4.5 - 5.0	8,695	2.08
5.0 - 5.5	5,243	1.26
5.5 - 6.0	4,499	1.08
6.0 - 6.5	160	0.04
Total	417,340	100.00

115. Earth work excavation will be undertaken by machine (backhoe excavator) and include danger lighting and using sight rails and barricades. The work will also be supplemented manually where there is no proper working area (e.g., very narrow streets) for the backhoe excavators. As trenches are deep (up to 6.5 m), there is risk of collapse of trenches and/or damage to surrounding buildings, safety risk to pedestrians and traffic. Necessary precautions such as bracing/shoring in the trench will be provided for trenches of more than 1.2 m deep. The normal working hours will be 8 hours daily, the total duration of each stage depends on the soil condition and other local features. Excavated soil will be used for refilling the trench after placing the sewer and therefore residual soil after pipe laying and refilling is not significant. Total earthwork excavation will be nearly 600,000 m³, of which nearly 95-96% will be reused, and the remaining 24,000-30,000 m³ of excess soil needs to be disposed safely.

116. Although sewer laying work involves quite simple techniques of civil work, the invasive nature of excavation in the urban area where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as residents, businesses, and the community in general. These anticipated impacts are temporary and for short duration, however, needs to be mitigated.

117. Comprising old town area of Tirunelveli, project area is mostly characterized by high density residential areas and very narrow streets and roads. Outer areas are comparatively less dense, however, erstwhile village areas which are added to corporation, and which are part of subproject area, are also have dense habitations in the core village areas. Outer areas are mainly

a mix of old village habitations with narrow streets, and few well planned newly developed / developing residential layouts in the lands previously under agricultural use. Old and new developments are intercepted with agricultural and vacant lands.

118. Sewers will extend to all residential and developed areas, while large diameter sewers will be laid mostly along the main roads. Main roads include: Bypass road, Trivandrum Road, Thiruchendur Road, Tuticorin road, etc., The next level roads are internal main roads providing connectivity within the city, which are mostly narrow. Most habitations in the core city, and along the Tamirabarani River are very congested.

119. Anticipated impacts during the construction phase are discussed below along with appropriate mitigation measures to avoid, minimize or mitigate those impacts to acceptable levels.

120. **Sources of Materials.** Significant amount of sand and coarse aggregate will be required for this project, which will be sourced from quarries. Quarries inevitably cause extensive physical changes; as construction materials are excavated from the ground, leaving large cavities, or levelling hillsides, etc. The physical damage caused by quarries is controlled by allowing them to operate within specific limited areas only, so the damage is restricted in extent and not allowed to spread indiscriminately. New quarries are subject to a rigorous process of environmental assessment to ensure appropriate siting and adequate environmental controls on the operation. It will therefore be important to ensure that construction materials for this project are obtained from government approved licensed quarries only, to ensure these controls are in place. In Tirunelveli, construction sand is normally obtained from Karur (about 140 km from the city), and gravel and aggregate is available locally in Tirunelveli district (about 10 km from the city). Contractor should not create/use new borrow pits/quarries. The contractor should also make a concerted effort to re-use as much excavated material from this project as possible. The construction contractor will be required to:

- (i) Obtain construction materials only from government approved quarries with prior approval of PIU;
- (ii) PIU to review, and ensure that proposed quarry sources have all necessary clearances/ permissions in place prior to approval;
- (iii) Contractor to submit to PIU on a monthly basis documentation on material obtained from each sources (quarry/borrow pit); and
- (iv) No new borrow areas, quarries etc., shall be developed for the project.

121. **Air Quality.** Construction work, especially from earthwork activities, coupled with dry and windy working conditions, material and debris transport, and works along the public roads carrying significant traffic, have high potential to generate dust in an airshed that appears to already be degraded for dust. Significant quantities of earthwork will be conducted in the subproject, spread all over the project area. Nearly 600,000 m³ of earthwork is anticipated from the subproject, and 97-98% of which will be reused for filling the trenches. Also emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality. Anticipated impacts include dust and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons. Dust generation from construction work in individual and confined work sites lifting and pumping stations etc., will be mainly during the initial construction phase of earth work, as the site is confined, dust can be effectively controlled with common measures. Dust generation will be significant during sewer laying along the roads. Increase in dust/ particulate matter in ambient air is detrimental, and may have adverse impacts on people and environment. To mitigate the impacts, construction contractors will be required to:

122. For all construction works

- (i) Provide a dust screen (6 m high) around the construction sites of pumping and lifting stations; provide 2 m high barricades for the sewer works;
- (ii) Damp down the soil and any stockpiled material on site by water sprinkling (water sprinkled 3-4 times a day – before the start of work, 1-2 times in between, and at the end of the day; when working in the roads there should permanently be one person responsible for directing when water sprinkling needs to take place to stop the dust moving);
- (iii) Reduce the need to spray water by stabilizing surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition;
- (iv) Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process;
- (v) Cover the soil stocked at the sites with tarpaulins and surround by dust screens
- (vi) Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work areas; limiting soil disturbance will minimize dust generation
- (vii) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by open trucks;
- (viii) Control dust generation while unloading the loose material (particularly aggregate, sand, soil) at the site by sprinkling water and unloading inside the barricaded area; minimize the drop height when moving the excavated soil;
- (ix) Clean wheels and undercarriage of haul trucks prior to leaving construction site
- (x) Ensure that all the construction equipment, machinery are fitted with pollution control devices, which are operating correctly, and have a valid pollution under control (PUC) certificate; and
- (xi) No vehicles or plant to be left idling at site generators to be at placed maximum distance from properties.

123. For sewer works.

- (i) Barricade the construction area using hard barricades (of 2 m height) on both sides;
- (ii) Initiate site clearance and excavation work only after barricading of the site is done;
- (iii) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.), to the barricaded area;
- (iv) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area;
- (v) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones;
- (vi) Conduct work sequentially - excavation, sewer laying, backfilling; testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done;
- (vii) Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated soil for back filling, this will avoid stocking of material, and minimize the dust;
- (viii) Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will

generate dust from backfilled section. Road restoration shall be undertaken immediately.

124. **Immediate road restoration after refilling the trench.** Excavation and refilling activities disturb the top soil, and under the influence of wind, traffic, pedestrians, and other activities etc., produces dust. There is large potential to generate significant quantities of dust after refilling the trench, and prior to road relaying. It is a common practice not to restore the road immediately after refilling the trench so as to allow sufficient time for the refilled material to stabilize naturally. Given the dry and windy conditions, and heavy traffic and other activities along the roads, the refilled trenches with loose top soil along the roads will generate maximum dust, and create very unhealthy conditions. Moreover, as the barricades/dust screens will be removed after the trench is refilled, there will be absolutely nothing to control the dust generation. Dust control activities like wetting of top soil will not be effective given the site conditions. It is therefore necessary to restore/relay the road surface immediately or take suitable steps to arrest the dust. Soil consolidation technique shall be used so that road can be restored immediately. Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. Backfilled trench without any road restoration is a major source of dust.

125. **Surface Water Quality.** Run-off from stockpiled materials and chemicals from fuels and lubricants during construction works can contaminate water quality of the receiving water bodies and streams/rivers. Project area receives rainfall in southwest and northeast monsoon seasons, between June/July to November/December. Nainarkulam, a big lake, is located within the project area, and Tamirabarani River flows in the east of the project area, forming the project area boundary. River flows only during monsoon, rest of the time it carries mostly wastewater. Besides, there are canals and other small water bodies in and around the project area. Project area mostly drains into Tamirabarani river and Nainarkulam Lake. It is important that runoff from the construction areas, which may contain silt and chemical traces do not enter these water bodies. Impact will be temporary, and but needs to be mitigated. Construction contractor will be required to:

- (i) All earthworks be conducted during the dry season to prevent the problem of soil/silt run-off during rains;
- (ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; do not stock earth/material close to water bodies (at least 100 m);
- (iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used;
- (iv) Install temporary silt traps, oil traps or sedimentation basins along the drainage leading to the water bodies;
- (v) Place storage areas (with impermeable surface) for fuels and lubricants away from any drainage leading to water bodies; these should be at least 100 m away from water bodies and groundwater wells;
- (vi) Store fuel, construction chemicals etc., on an impervious floor, also avoid spillage by careful handling; provide spill collection sets for effective spill management
- (vii) Dispose any wastes generated by construction activities in designated sites; and
- (viii) Conduct surface quality inspection according to the environmental management plan (EMP).

126. Construction of bridges across canals/streams to cross over sewers will have negative impact on water quality of canals/streams. Following measures to be implemented:

- (i) Conduct works in the water body (especially foundation work) only during no-flow season;
- (ii) Select a construction method which is less disruptive (e.g., precast type);
- (iii) Do no spill construction chemicals, fuels, lubricants in the water body; and
- (iv) Clean up the site immediately after construction is complete; construction debris, materials, etc., shall be cleared and pre project condition restored or improved.

127. **Surface and Groundwater Quality.** Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids. In the project area, groundwater table is much deeper than the anticipated excavation depth and therefore this impact is not envisaged. However during the rains, water will be collected in open pits and trenches. The water collected in excavated pits will contain silt and disposal of this in drainage channels lead to silting. To avoid this the contractor needs to be implement the following measures:

- (i) As far as possible control the entry of runoff from upper areas into the excavated pits, and work area by creation of temporary drains or bunds around the periphery of work area;
- (ii) Pump out the water collected in the pits/excavations to a temporary sedimentation pond; dispose off only clarified water into drainage channels/streams after sedimentation in the temporary ponds; and
- (iii) Consider safety aspects related to pit collapse due to accumulation of water.

128. **Generation of Construction Wastes.** Solid wastes generated from the construction activities are excess excavated earth (spoils), discarded construction materials, cement bags, wood, steel, oils, fuels and other similar items. Domestic solid wastes may also be generated from the workers' camp. Improper waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape. Total earthwork excavation will be nearly 600,000 m³, of which nearly 95-96% will be reused, and the remaining 24,000-30,000 m³ needs to be disposed safely. The following mitigation measures to minimize impacts from waste generation shall be implemented by the contractor:

- (i) Prepare and implement a Construction Waste (Spoils) Management Plan (format is given in Appendix 3);
- (ii) As far as possible utilize the debris and excess soil in construction purpose, for example for raising the ground level or construction of access roads etc.,
- (iii) Avoid stockpiling any excess spoils at the site for long time. Excess excavated soils should be disposed off to approved designated areas immediately;
- (iv) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should located away from residential areas, forests, water bodies and any other sensitive land uses;
- (v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; create a compost pit (with impermeable bottom and sides) at workers camp sites for disposal of biodegradable waste; non-biodegradable / recyclable material shall be collected separately and sold in the local recycling material market;
- (vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed off via licensed (by TNPCB) third parties;
- (vii) Prohibit burning of construction and/or domestic waste;

- (viii) Ensure that wastes are not haphazardly thrown in and around the project site; provide proper collection bins, and create awareness to use the dust bins; recycle waste materials where possible; and
- (ix) Conduct site clearance and restoration to original condition after the completion of construction work; PIU to ensure that site is properly restored prior to issuing of construction completion certificate.

129. **Noise and Vibration Levels.** Except new pumping station site near slaughterhouse, all the work sites pumping stations, lifting stations and sewers are located within the town area. Sewer lines are spread over entire project area. All these sites are located within habitations, where there are houses, schools and hospitals, religious places and businesses. The sensitive receptors are the general population in these areas. Increase in noise level may be caused by excavation, particularly breaking of cement concrete or bitumen roads for laying of sewers, operation of construction equipment, and the transportation of equipment, materials, and people. Vibration generated from construction activity, for instance from the use of pneumatic drills, will have impact on nearby buildings. Trenches deeper than 2-3 m require removal of rocks (soft to hard), will generate heavy noise and vibration. This impact is negative short-term, and reversible by mitigation measures. The construction contractor will be required to:

- (i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance, especially near schools and other sensitive receptors;
- (ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable acoustic street barriers to minimise sound impact to surrounding sensitive receptor;
- (iii) Maintain maximum sound levels not exceeding 70 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s;
- (iv) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; if any building at risk, structural survey be completed prior to work, to provide baseline in case any issues from vibration, and if building is structurally unsound that measures taken to avoid any further damage;
- (v) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach; and
- (vi) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as nights, religious and cultural festivals.

130. **Accessibility and Traffic Disruptions.** Excavation along the roads for laying of sewers, hauling of construction materials and operation of equipment on-site will cause traffic problems. Sewers are proposed along all the main roads and streets:

- (i) NH7
- (ii) Azad Road
- (iii) Kurichi Main Road
- (iv) Ambai Road
- (v) Kanyakumari bypass road
- (vi) Tiruchendur Road
- (vii) Market Road
- (viii) Sivalaperi Road
- (ix) Kilanatham Melur Road

- (x) Samathanapuram Road
- (xi) Melanatham Road
- (xii) Thoothukudi Road
- (xiii) Vanarapettai Road

131. Almost all of the above roads carry considerable traffic. These roads also centers of commercial activities. Internal roads in the project area are narrow, except in the newly developing residential layout which comparatively have wide roads. In Nellai nagaram (old city area), roads are very narrow and congested with activities, traffic and pedestrians.

132. As the sewer lines are proposed to be laid within the road carriage way, it will disrupt the traffic in one-traffic lane. In the narrower roads, sewers will be laid in the center of the road, and therefore during the work traffic movement will be mostly disrupted.

133. Works related to all the remaining components (lifting and pumping stations) will be confined to the selected sites, therefore there is no direct interference of these works with the traffic and accessibility.

134. Hauling of construction material, equipment, construction waste, etc., to and from the work site may increase the road traffic on local roads. This will further inconvenience the local community and road users. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

135. **Sewer works.**

- (i) Prepare a sewer work implementation plan in each zone separately and undertake the work accordingly; ensure that for each road where the work is being undertaken there is an alternative road for the traffic diversion; take up the work in sequential way so that public inconvenience is minimal;
- (ii) Plan the sewer work in coordination with the traffic police; provide temporary diversions, where necessary with clear signage and effectively communicate with general public;
- (iii) Avoiding conducting work in all roads in a colony at one go; it will render all roads unusable due to excavations at the same time, creating large scale inconvenience
- (iv) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones;
- (v) Confine work areas in the road carriageway to the minimum possible extent; all the activities, including material and waste/surplus soil stocking should be confined to this area. Proper barricading should be provided; avoid material/surplus soil stocking in congested areas – immediately removed from site/ or brought to the as and when required;
- (vi) Limit the width of trench excavation as much as possible by adopting best construction practices; adopt vertical cutting approach with proper shoring and bracing; this is especially to be practiced in narrow roads and deeper sewers; if they deep trenches are excavated with slopes, the roads may render completely unusable during the construction period;
- (vii) Leave spaces for access between mounds of soil to maintain access to the houses/properties; access to any house or property shall not be blocked completely; alternative arrangements, at least to maintain pedestrian access at all times to be provided;

- (viii) Provide pedestrian access in all the locations; provide wooden/metal planks with safety rails over the open trenches at each house to maintain the access.
- (ix) Inform the affected local population about the work schedule a week before, and a day before start of work;
- (x) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum;
- (xi) Keep the site free from all unnecessary obstructions;
- (xii) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. Provide information to the public through media – newspapers and local cable television (TV) services; and
- (xiii) At work site, public information/caution boards shall be provided including contact for public complaints.

136. Hauling (material, waste/debris and equipment) activities.

- (i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites;
- (ii) Schedule transport and hauling activities during non-peak hours (peak hours 7-10 am, and 4-7 pm);
- (iii) Locate entry and exit points in areas where there is low potential for traffic congestion;
- (iv) Drive vehicles in a considerate manner; and
- (v) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.

137. Socioeconomic – Income. Sites for all projects components are carefully selected in government owned vacant lands and therefore there is no requirement for land acquisition or any resettlement. Blocking of access to the business/livelihood activities, especially during pipeline laying along the roads, may impact the income of households. However, given the alignment of pipeline within the road carriage way, and also the measures suggested for ensuring accessibility during sewer works, notable, but temporary, impact is envisaged. Some shops and other premises along the roads may lose business income if the access will be impeded by excavation of trenches, the presence of heavy vehicles and machinery, etc. Access disruption to hospitals, socio cultural places etc., will inconvenience public. Implementation of the following best construction measures will avoid the disturbance reduce the inconvenience and disturbance to the public. Resettlement and social issues are being studied in a parallel resettlement planning study of this subproject.

- (i) Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations;
- (ii) Do not block any access; leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches;
- (iii) Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around;
- (iv) Control dust generation;

- (v) Immediately consolidate the backfilled soil and restore the road surface; this will also avoid any business loss due to dust and access inconvenience of construction work;
- (vi) Employee best construction practices, speed up construction work with better equipment, increase workforce, etc., in the areas with predominantly commercial, and with sensitive features like hospitals, and schools;
- (vii) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and
- (viii) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.

138. **Socioeconomic – Employment.** Manpower will be required during the 24-months construction stage. This can result in generation of temporary employment and increase in local revenue. Thus potential impact is positive and long-term. The construction contractor will be required to employ local labour force as far as possible.

139. **Occupational Health and Safety.** Workers need to be mindful of the occupational hazards which can arise from working in confined areas such as trenches, working at heights, near the heavy equipment operating areas etc. Potential impacts are negative and long-term but reversible by mitigation measures. The construction contractor will be required to:

- (i) Follow all national, state and local labour laws (indicative list is in Appendix 2);
- (ii) Develop and implement site-specific occupational health and safety (OHS) plan, informed by OHS risk assessment seeking to avoid, minimize and mitigate risk, which shall include measures such as: (a) safe and documented construction procedures to be followed for all site activities; (b) ensuring all workers are provided with and use personal protective equipment; (c) OHS Training⁸ for all site personnel, (d) excluding public from the work sites; and (e) documentation of work-related accidents; Follow International Standards such as the World Bank Group's Environment, Health and Safety Guidelines.⁹
- (iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the sites;
- (iv) Secure all installations from unauthorized intrusion and accident risks
- (v) Provide health and safety orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;
- (vi) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted;
- (vii) Ensure the visibility of workers through their use of high visibility vests and other PPE when working in or walking through heavy equipment operating areas;
- (viii) Ensure moving equipment is outfitted with audible back-up alarms;

⁸ Some of the key areas that may be covered during training as they relate to the primary causes of accidents include (i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; and (v) legislation and responsibilities. Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

⁹ International Finance Corporation. [World Bank Group Environmental, Health & Safety Guidelines 101](#).

- (ix) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate;
- (x) Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively;
- (xi) Provide supplies of potable drinking water; and
- (xii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances

140. **Community Health and Safety.** Sewers works and deep excavations along the roads and narrow streets, and hauling of equipment and vehicles have potential to create safety risks to the community. Deep excavations without any proper protection may endanger the close by buildings. Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. Potential impact is negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

- (i) Confine work areas; prevent public access to all areas where construction works are on-going through the use of barricading and security personnel;
- (ii) Attach warning signs, blinkers to the barricading to caution the public about the hazards associated with the works, and presence of deep excavation;
- (iii) Minimize the duration of time when the sewer trench is left open through careful planning; plan the work properly from excavation to refilling and road relaying;
- (iv) Control dust pollution – implement dust control measures as suggested under air quality section;
- (v) Ensure appropriate and safe passage for pedestrians along the work sites;
- (vi) Provide road signs and flag persons to warn of on-going trenching activities;
- (vii) Restrict construction vehicle movements to defined access roads and demarcated working areas (unless in the event of an emergency);
- (viii) Enforce strict speed limit (20-30 kmph) for plying on unpaved roads, construction tracks;
- (ix) Provide temporary traffic control (e.g. flagmen) and signs where necessary to improve safety and smooth traffic flow;
- (x) Where traffic is diverted around crossings, traffic control or careful selection of the exit from the working areas will be provided with the aim of ensuring that vehicles join the road in a safe manner;
- (xi) At sensitive locations particularly where there are schools and markets close to the road, awareness of safety issues will be raised through neighbourhood awareness meetings;
- (xii) All drivers and equipment operators will undergo safety training; and
- (xiii) Maintain regularly the construction equipment and vehicles; use manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

141. **Construction Camps.** Contractor may require to set up construction camps – for temporary storage of construction material (sewer, cement, steel, fixtures, fuel, lubricants, etc.), and stocking of surplus soil, and may also include separate living areas for migrant workers. The contractor will however be encouraged to engage local workers as much as possible. Operation of work camps can cause temporary air, noise and water pollution, and may become a source of

conflicts, and unhealthy environment if not operated properly. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

- (i) Consult PIU before locating project offices, sheds, and construction plants;
- (ii) Select a camp site away from residential areas (at least 100 m buffer shall be maintained) or locate the camp site within the existing facilities of City Corporation
- (iii) Avoid tree cutting for setting up camp facilities;
- (iv) Provide a proper fencing/compound wall for camp sites;
- (v) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas
- (vi) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit;
- (vii) Ensure conditions of liveability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like galvanized iron sheets, tarpaulins, etc., shall not be used as accommodation for workers;
- (viii) Camp shall be provided with proper drainage, there shall not be any water accumulation;
- (ix) Provide drinking water, water for other uses, and sanitation facilities for employees; drinking water should be regularly tested to confirm that drinking water standards are met;
- (x) Prohibit employees from cutting of trees for firewood; contractor should provide cooking fuel (cooking gas); fire wood not allowed;
- (xi) Train employees in the storage and handling of materials which can potentially cause soil contamination;
- (xii) Wastewater from the camps shall be disposed properly either into sewer system; if sewer system is not available, provide on-site sanitation with septic tank and soak pit arrangements (100 m away from surface water body or groundwater well)
- (xiii) Recover used oil and lubricants and reuse or remove from the site;
- (xiv) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; provide a compost pit for bio degradable waste, and non-biodegradable/recyclable waste shall be collected and sold in local market;
- (xv) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
- (xvi) At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU; PIU to review and approve camp clearance and closure of work site.

C. Operation and Maintenance Impacts

142. Operation and Maintenance of the sewerage system will be carried out by Tirunelveli City Municipal Corporation. Operation will involve collection and conveyance of wastewater from houses to nearest lifting/pumping stations; operation of lifting/pumping stations to pump accumulated sewage main pumping stations; operation of main pumping stations to pump accumulated sewage to STP. Also, new STP is proposed with 34 MLD capacity which will be operated on Waste Stabilization Pond (WSP) technology.

143. **Sewage sludge.** A sludge management plan will be prepared; this will be simple activity for the WSP based STP. The ponds will be allowed to dry naturally, and the sludge will be collected from the basins by mechanical means. If necessary, sludge will be further air dried in sludge drying beds. The treatment and drying processes kill enteric bacteria and pathogens, and because of its high content of nitrates, phosphates and other plant nutrients the sludge is an excellent organic fertilizer for application to the land. The reuse of sludge should be preceded by rigorous bacteriological tests to confirm that the treatment methods render all dried sludge and effluent free from enteric bacteria and pathogens, so that it is safe to humans, animals and crops. Sludge shall also need to be periodically tested for presence of heavy metals, to check if it meets the compost standards specified the Solid Waste Management and Handling Rules, 2016.

144. **Quality of Raw Sewage.** As discussed previously, one of the critical aspects in STP operation is, change in raw sewage characteristics at inlet of STP may affect the process and output quality. The system is designed for municipal wastewater, which does not include industrial effluent. Characteristics of industrial effluent widely vary depending on the type of industry, and therefore disposal of effluent into sewers may greatly vary the inlet quality at STP, and will upset process and affect the efficiency. Tirunelveli houses various small and medium scale units; food, cotton, textiles, wood, paper, plastic, chemical, engineering, electrical units are established. Pettai Industrial estate is located within the subproject area. Although proposed sewer network will not cater to industrial wastewater, It is important to ensure that no wastewater from industries enters the sewer network with strict monitoring and enforcement. Following measures are to be implemented:

- (i) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers; and
- (ii) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB.

125. Following measures are to be implemented during the operation phase:

- (i) Ensure proper knowledge transfer, hands-on training to municipal staff engaged in STP operation has been provided by contractor prior to handover of facility;
- (ii) Ensure continuous uninterrupted power supply;
- (iii) Operate and maintain the facility following standard operating procedures of operational manual;
- (iv) Undertake preventive and periodic maintenance activities as required;
- (v) Maintain the mechanical/electrical parts as per the maintenance plan to avoid any hazards;
- (vi) Conduct periodic training to workers;
- (vii) Ensure that all safety apparatus at STP including personal protection equipment are in good condition all times; and are at easily accessible and identifiable place; periodically check the equipment, and conduct mock drills to deal with emergency situations;
- (viii) Implement sludge management plan at the STP;
- (ix) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers;
- (x) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB;
- (xi) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to

- (xii) ensure that the treated effluent quality complies with design standards; and Conduct periodic testing of dried sludge/compost to check presence of heavy metals and confirming to the applicable standards to use as compost.

145. **Odor and Noise from Sewage lifting and pumping stations.** Various measures are included in the design of these facilities giving utmost importance to odor and noise. Therefore it is anticipated there will not be any significant generation of odor or noise that will impact the surrounding households. Following measures are to be implemented during the operation:

- (i) Strictly follow standard operating procedures/operational manual for operation and maintenance of lifting and pump stations
- (ii) Ensure that operating staff is properly trained, and have clear understanding of odor issues vis a vis its relation with operational practices
- (iii) Ensure that pumping cycles are properly followed; and there is no buildup of sewage beyond design volume in the wells
- (iv) Conduct periodic H₂S monitoring (periodically at pumping and lifting stations);

146. **Sewer network.** During the system design life (15/30 years for mechanical/civil components) it shall not require major repairs or refurbishments and should operate with little maintenance beyond routine actions required to keep the equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

147. There are also certain environmental risks from the operation of the sewer system, most notably from leaking sewer pipes as untreated faecal material can damage human health and contaminate both soil and groundwater. It will be imperative therefore that the operating agency establishes a procedure to routinely check the operation and integrity of the sewers, and to implement rapid and effective repairs where necessary. There is an occupation health risk to workers engaged in sewer maintenance activities. Following measures should be followed:

- (i) Establish regular maintenance program, including:
 - (a) Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas;
 - (b) Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration;
 - (c) Monitoring of sewer flow to identify potential inflows and outflows;
 - (d) Conduct repairs on priority based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages).
- (ii) Maintain records; review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed;

- (iii) When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system.
- (iv) Prohibit/prevent disposal of wastewater/effluent from industrial units in the sewers; ensure regular checking to ensure no illegal entry of industrial wastewater into sewers;
- (v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc.;
- (vi) Provide necessary health and safety training to the staff in sewer cleaning and maintenance;
- (vii) Provide all necessary personnel protection equipment;
- (viii) Do not conduct manual cleaning of sewers; for personnel engaged sewer maintenance work, there is a risk due to oxygen deficiency and harmful gaseous emissions (hydrogen sulphide, methane, etc.); provide for adequate equipment (including oxygen masks) for emergency use.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Overview

148. The active participation of stakeholders including local community, NGOs/CBOs, etc., in all stages of project preparation and implementation is essential for successful implementation of the project. It will ensure that the subprojects are designed, constructed, and operated with utmost consideration to local needs, ensures community acceptance, and will bring maximum benefits to the people. Public consultation and information disclosure is a must as per the ADB policy.

149. Most of the main stakeholders have already been identified and consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders of the subproject are: residents, shopkeepers and businesspeople who live and work near sites where facilities will be built (sewer network and pumping/lifting stations), government and utility agencies responsible for provision of various services in project area. Secondary stakeholder are: NGOs and CBOs working in the area, community representatives, beneficiary community in general, government agencies, TNUIFSL, Government of Tamil Nadu and the ADB.

B. Public Consultation

150. The public consultation and disclosure program is a continuous process throughout the project implementation, including project planning, design and construction.

1. Consultation during Project Preparation

151. The subproject proposal is formulated by Tirunelveli corporation in consultation with the public representatives bodies in the project area to suit their requirements.

152. Focus group discussions with affected persons and other stakeholders were conducted to learn their views and concerns. A socioeconomic household survey has been conducted in the project area, covering sample households, to understand the household characteristics, health status, and the infrastructure service levels, and also the demand for infrastructure services.

General public and the people residing along the project activity areas were consulted through a project area level consultation workshop, which was conducted in Tirunelveli on 03 November 2017 with the public representatives and prominent citizens, NGOs, etc.

153. It was observed that people are willing to extend their cooperation as the proposed project will provide sewerage system, enhance basic infrastructure service levels and overall living standard of the public. The public expressed their concern regarding the nuisance and disturbance (dust, road closure and traffic management activities) during the construction stage which can have impact on their day to day activities. Construction on narrow roads is seen as biggest hindrance. Public demanded for advance notice before construction and proper warning signs along the construction area to avoid accidents and inconvenience. Public opined that an appropriate operation and maintenance system should be in place for sewerage system for its best functioning and to have the maximum health and aesthetic benefits. Issue of bad odors from lifting and pumping stations located close to the houses is also raised. Project team explained proposed EMP to manage the negative impacts, including odor prevention and control measures included in the design and operation.

2. Consultation during Construction

154. Prior to start of construction, PIU will conduct information dissemination sessions at various places and solicit the help of the local community, leaders/prominent for the project work. Focus group meetings will be conducted to discuss and plan construction work (mainly pipeline work) with local communities to reduce disturbance and other impacts and also regarding the project grievance redress mechanism. Project information and construction schedule will be provided to the public via mass media (newspapers, television, ULB websites, etc.). A constant communication will be established with the affected communities to redress the environmental issues likely to surface during construction phase. Contractor will provide prior public information (in Tamil and English) about the construction work in the area, 7 days prior to the start of work and again a day before the start of work via pamphlets (a sample public information template is provided in Appendix 4). At the work sites, public information boards will also be provided to disseminate project related information.

C. Information Disclosure

155. Executive summary of the IEE will be translated in Tamil and made available at the offices of PMU, PIU, and Tirunelveli Corporation and also displayed on their notice boards. Hard copies of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE in English and Executive Summary in Tamil will be placed in the official website of the TNUIFSL and Tirunelveli Corporation after approval of the IEE by ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

156. Public information campaigns to explain the project details to a wider population will be conducted. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future plans. Prior to start of construction, the PIU will issue Notification on the start date of implementation in local newspapers. A board showing the details of the project will be displayed at the construction sites for the information of general public.

157. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road

closure together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signage, etc.

VII. GRIEVANCE REDRESS MECHANISM

158. A common GRM will be in place to redress social, environmental or any other project related grievances. The GRM described below has been developed in consultation with stakeholders. Public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated. The campaign will ensure that the poor, vulnerable and others are made aware of grievance redress procedures and entitlements per project entitlement matrix, and program management unit (PMU) and concerned program implementation unit (PIU) will ensure that their grievances are addressed.

159. Affected persons will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes or through telephone hotlines at accessible locations, by e-mail, by post, or by writing in a complaints register in ULB or PIU or implementing agency offices. PIU Safeguards officer will have the responsibility for timely grievance redress on safeguards and gender issues and for registration of grievances, related disclosure, and communication with the aggrieved party.

160. GRM provides an accessible, inclusive, gender-sensitive and culturally appropriate platform for receiving and facilitating resolution of affected persons' grievances related to the project. A two-tier grievance redress mechanism is conceived, one, at project level and another, beyond project level. For the project level GRM, a grievance redress committee (GRC) will be established in PIUs; Safeguards officer, supported by the social, gender and environmental safeguards specialist of construction, management and supervision consultant (CMSC) will be responsible for creating awareness among affected communities and help them through the process of grievance redress, recording and registering grievances of non-literate affected persons.

161. GRM aims to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. All grievances – major or minor, will be registered. Documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and how the problem was resolved will be undertaken. PIU will also be responsible for follow-through for each grievance, periodic information dissemination to complainants on the status of their grievance and recording their feedback (satisfaction/dissatisfaction and suggestions).

162. In case of grievances that are immediate and urgent in the perception of the complainant, the contractor, and supervision personnel of the CMSC and PIU will resolve the issue on site, and any issue that is not resolved at this level will be dealt at PIU head level for immediate resolution. Should the PIU fail to resolve any grievance within the stipulated time period, the unresolved grievances will be taken up at TCMC level. In the event that certain grievances cannot be resolved even at TCMC level, particularly in matters related to land purchase/acquisition, payment of compensation, environmental pollution etc., they will be referred to the district level GRC headed by the District Collector. Any issue which requires higher than district level inter-departmental coordination or grievance redress, will be referred to the state level steering committee.

163. GRC will meet every month (if there are pending, registered grievances), determine the merit of each grievance, and resolve grievances within specified time upon receiving the

complaint-filing which the grievance will be addressed by the state-level steering committee. The steering committee will resolve escalated/unresolved grievances received.

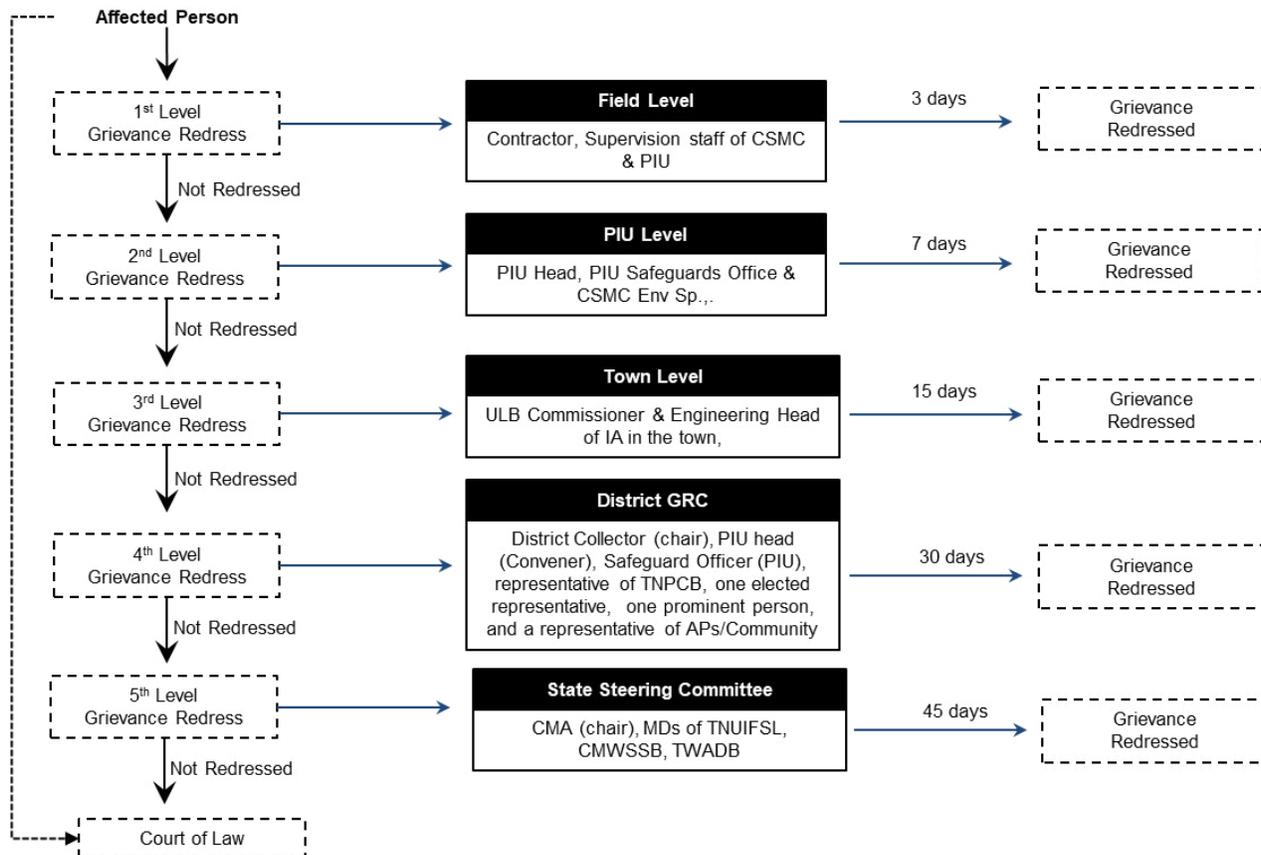
164. **Composition of Grievance Redress Committee.** GRC will be headed by the District Collector, and members include: PIU head, Safeguards Officer of PIU, representative of TNPCB, one elected representative/prominent citizen from the area, and a representative of affected community. GRC must have a women member.

165. **State level steering committee** will include Commissioner of Municipal Administration as chair, member include managing directors of TNUIFSL, CMWSSB, TWAD Board and others as necessary.

166. **Areas of Jurisdiction.** The areas of jurisdiction of the GRC, headed by the District Collector will be (i) all locations or sites within the district where subproject facilities are proposed, or (ii) their areas of influence within the District. The SC will have jurisdictional authority across the state (i.e., areas of influence of subproject facilities beyond district boundaries, if any).

167. The multi-tier GRM for the project is outlined below (Figure 12), each tier having time-bound schedules and with responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required. The GRC will continue to function throughout the project duration. PIU/TCMC shall issue notifications to establish the respective PIU level grievance redress cells, with details of composition, process of grievance redress to be followed, and time limit for grievance redress at each level.

Figure 12: Proposed TNUFIP Grievance Redress Mechanism



AP = affected person, CMWSSB = Chennai Water Supply and Sewerage Board, CMA = Commissionerate of Municipal Administration, CSMC = consultation supervision and management consultant, PIU = program implementation unit, TNPCB = Tamil Nadu Pollution Control Board, TNUIFSL = Tamil Nadu Urban Flagship Investment Financial Services Limited, TWADB = Tamil Nadu Water and Drainage Board, ULB = urban local body.

168. **Recordkeeping.** Records of all grievances received, including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were effected and final outcome will be kept by PIU (with the support of CMSC) and submitted to PMU.

169. **Information dissemination methods of the GRM.** The PIU, assisted by CMSC will be responsible for information dissemination to affected persons and general public in the project area on grievance redress mechanism. Public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated. The campaign will ensure that the poor, vulnerable and others are made aware of grievance redress procedures and entitlements per agreed entitlement matrix including. whom to contact and when, where/ how to register grievance, various stages of grievance redress process, time likely to be taken for redress of minor and major grievances, etc. Grievances received and responses provided will be documented and reported back to the affected persons. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the PIU, offices, ULB notice boards and on the web, as well as reported in the semi-annual environmental and social monitoring reports to be submitted to ADB. A sample grievance registration form has been attached in Appendix 5.

170. **Periodic review and documentation of lessons learned.** The PMU will periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the PIU's ability to prevent and address grievances.

171. **Costs.** All costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the respective PIU. Cost estimates for grievance redress are included in resettlement cost estimates.

172. **Country legal procedure.** An aggrieved person shall have access to the country's legal system at any stage, and accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

173. **ADB's Accountability Mechanism.** In the event that the established GRM is not in a position to resolve the issue, the affected person also can use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters or the ADB India Resident Mission. The complaint can be submitted in any of the official languages of ADB's developing member countries. Before submitting a complaint to the Accountability Mechanism, it is recommended that affected people make a good faith effort to resolve their problems by working with the concerned ADB operations department (in this case, the resident mission). Only after doing that, and if they are still dissatisfied, they could approach the Accountability Mechanism. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of the project GRM.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management Plan

174. An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels.

175. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between TNUIFSL, PMU, TCMC, PIU, consultants and contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with. The EMP includes a monitoring program to measure the environmental condition and effectiveness of implementation of the mitigation measures. It will include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

176. The contractor will be required to submit to PIU, for review and approval, a site environmental management plan (SEMP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; and (iii) monitoring program as per EMP. No works are allowed to commence prior to approval of SEMP.

177. A copy of the EMP/approved SEMP will be kept on site during the construction period at all times. The EMP included in the bid and contract documents. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

178. For civil works, the contractor will be required to (i) carry out all of the mitigation and monitoring measures set forth in the approved EMP; and (ii) implement any corrective or preventative actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of this IEE, EMP, and SEMP. The contractor shall allocate budget for compliance with these IEE, EMP, and SEMP measures, requirements and actions.

179. The following tables show the potential environmental impacts, proposed mitigation measures and responsible agencies for implementation and monitoring.

Table 19: Design Stage Environmental Impacts and Mitigation Measures
(included in Detailed Project Report)

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
Design of sewage treatment plant (STP)	Deficient treatment due to substandard operation/system malfunction	(i) Design process to meet the Central Pollution Control Board (CPCB) disposal standards of inland water disposal; (ii) Ensuring continuous uninterrupted power supply, including a back-up facility (such as generator); (iii) Providing operating manual with all standard operating procedures (SOPs) for operation and maintenance of the facility; (iv) Necessary training to urban local body (ULB) staff dealing with STP; (v) Extended contractor period for operation and maintenance (O&M), proper transfer of facility to ULB with adequate technical know-how on O&M and hands-on training to ULB staff; (vi) Provision for online monitoring of crucial wastewater quality parameters at the inlet and outlet of the plant (BOD, pH, ammonia etc.).	Program implementation unit (PIU)/TCMC	Project Costs
	Odor nuisance	Providing a green buffer zone of 5-10 meter (m) wide all around the STP with trees in multi-rows and land scaping. This will act as a visual screen around the facility and will improve the aesthetic appearance. Treated wastewater will be used for land scaping.	PIU/TCMC	Project Costs
	Sludge disposal	(i) Prepare sludge management plan to ensure safe collection, adequate treatment prior to reuse/disposal; (ii) Conduct periodic testing of sludge to check its quality according to set standards for reuse as manure/soil conditioner; and (iii) Provide training on safe handling of sludge, along with proper apparatus and personnel protection equipment (PPEs) to workers.	PIU/TCMC	Project Costs
Sewer network	Nuisance due to leaks, overflows, contamination of water supplies, occupation health and safety of workers, etc.	(i) Limit the sewer depth where possible; (ii) Sewers shall be laid away from water supply lines and drains (at least 1 m, wherever possible); (iii) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm); (iv) In unavoidable cases, where sewers are to be laid close to storm water drains, appropriate pipe material shall be selected (stoneware pipes shall be avoided); (v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes; (vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry; (vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation.	PIU/TCMC	Project Costs

Sewage pumping stations	Odour nuisance	<p>Measures specific (additional) to New Pumping Station near Kumaresan Nagar.</p> <p>(i) Locate pumping station as far as away from the road;</p> <p>(ii) Develop green buffer zone around the facility with a combination of tall and densely growing trees in multi rows as per the land availability to control odor and also act as visual shield, and improve aesthetical appearance.</p> <p>Design measures for all 3 pumping stations (1 new + 2 Existing)</p> <p>(i) Proposed wells to be closed using RCC slabs. Design of RCC slab to consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells.</p> <p>(ii) RCC Slab to be designed and fixed in a modular manner such that access to pumps/appurtenances and other equipment can be provided for maintenance / replacement/renewal purposes.</p> <p>(iii) Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metalled grating/grill work shall be provided over the sections (or full cross section if required) where workers will stand/work for inspection and repair/O&M purposes.</p> <p>(iv) Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by positioning vent in such a way that cover slab fitment / movement / drawl if required for maintenance purposes is not compromised.</p> <p>(v) Height of vent to be provided appropriately and a minimum 2 m above the lintel level (top level) of window(s)/passageways/doors in the nearby adjoining buildings.</p> <p>(vi) Provision of odor control/mitigation system by either or using both (listed below) as per site conditions/requirements:</p> <ul style="list-style-type: none"> • Suitable granular activated carbon filter with bird-screen fitted at the vent outlet to control odor. Size of GAC (including material size) should be selected based on the vent diameter and expelled air flow rate expected. <p>(vii) Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength-corrosion resistant heavy duty construction shall be proposed.</p> <p>(viii) In locations/cases where sewage flow in the present to intermediate design stage is envisaged to be low, position of the submersible pumps and design of the collection well floor by providing necessary side benching / sloped flooring to allow for higher submergence during low flow shall be made to ensure regular pump operation and avoid sewage stagnation beyond the permissible limit.</p> <p>(x) Develop standard operating procedures/operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emerge situations</p> <p>(xi) Provide training to the staff in SOPs and emergency procedures Periodically monitor odor generation at pumping stations</p>	PIU/TCMC	Project Costs
		(ix) Diesel Generators shall be provided for all pump stations and in cases of lift stations with space for control room. In cases of lift manholes (road-side		

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		or road-center type structures with only provision of kerb-side kiosk), an electrical cut-out provision shall be made for connecting an Emergency Mobile / Skid Mounted Diesel Generator for pumping out during long period of electricity supply interruption.		
Sewage lifting stations	Odor nuisance	(i) Provide closed wells fitted with necessary ventilation and odor abatement systems such as GAC air filters fitted to the ventilation shaft outlet(s); and (ii) Provide greenbelt (tree cover) around the lift stations, wherever possible	PIU/TCMC	Project costs
Sewage pumping and lifting stations	Noise	(i) Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80 dB(A) at a distance of 1 m; (ii) Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise; (iii) Use acoustic enclosures – manufacturer specified, for all pumps, motors; (iv) Procure only CPCB approved generators with low emission and low noise fitted with acoustic enclosures; (v) Provide sound mufflers for ventilators in the plant rooms; and sound proof doors; and (vi) Provide ear plugs to workers.	PIU/TCMC	Project costs
	Energy consumption	(i) Using low-noise and energy efficient pumping systems; (ii) Efficient Pumping system operation; (iii) Installation of Variable Frequency Drives (VFDs).	PIU/TCMC	Project Costs
	Tree cutting	(i) Minimize removal of trees by adopting to site condition and with appropriate layout design/alignment; (ii) Obtain prior permission for tree cutting; and (iii) Plant and maintain 10 trees for each tree that is removed.	PIU/TCMC	Project Costs

Table 20: Preconstruction Stage Environmental Impacts and Mitigation Measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
Submission of updated environmental management plan (EMP)/site environmental plan (SEP); EMP implementation and reporting	Unsatisfactory compliance to EMP	(i) Appoint environmental, health and safety (EHS) supervisor to ensure EMP implementation; (ii) Submission of updated EMP/SEP; and (iii) Timely submission monthly of monitoring reports including documentary evidence on EMP implementation such as photographs.	Construction Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
Utilities	Telephone lines, electric poles and wires, water lines within proposed project area	<ul style="list-style-type: none"> (i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) Require construction contractors to prepare a contingency plan to include actions to be taken in case of unintentional interruption of services. 	Construction Contractor in coordination with program implementation unit (PIU)	Project cost-
Construction work camps, stockpile areas, storage areas, and disposal areas.	Conflicts with local community; disruption to traffic flow and sensitive receptors	<ul style="list-style-type: none"> (i) Prioritize areas within or nearest possible vacant space in the project location; (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems; (iii) Do not consider residential areas; (iv) Take extreme care in selecting sites to avoid direct disposal to water body which will inconvenience the community. (v) For excess spoil disposal, ensure (a) site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, written consent from landowners (not lessees) will be obtained; (b) debris disposal site shall be at least 200 m away from surface water bodies; (c) no residential areas shall be located within 50 m downwind side of the site; and (d) site is minimum 250 m away from sensitive locations like settlements, ponds/lakes or other water bodies. 	Construction Contractor to finalize locations in consultation and approval of PIU	Project cost-
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	<ul style="list-style-type: none"> (i) Obtain construction materials only from government approved quarries with prior approval of PIU; (ii) PIU to review, and ensure that proposed quarry sources have all necessary clearances/ permissions in place prior to approval; (iii) Contractor to submit to PIU on a monthly basis documentation on material obtained from each sources (quarry/borrow pit); and (iv) Avoid creation of new borrow areas, quarries etc., for the project; if unavoidable, contractor to obtain all clearances and permissions as required under law, including Environmental Clearance prior to approval by PIU. 	Construction Contractor to prepare list of approved quarry sites and sources of materials with the approval of PIU	Project cost-
Consents, permits, clearances, no objection certificates (NOCs), etc.	Failure to obtain necessary consents, permits, NOCs, etc. can result to design revisions and/or stoppage of works	<ul style="list-style-type: none"> (i) Obtain all necessary consents, permits, clearance, NOCs, etc. prior to award of civil works. (ii) Ensure that all necessary approvals for construction to be obtained by contractor are in place before start of construction. (iii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc. 	Construction Contractor and PIU	Cost of obtaining all consents, permits, clearance, NOCs, etc. prior to start of civil works

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
				responsibility of PIU.
Chance finds	Damage/disturbance to artifacts	(i) Construction contractors to follow these measures in conducting any excavation work (ii) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work (iii) Stop work immediately to allow further investigation if any finds are suspected; (iv) Inform State Archaeological Department if a find is suspected, and taking any action they require to ensure its removal or protection in situ.	Construction Contractor and PIU	-
Temporary economic impacts	Disruption to vendors, hawkers on ROW during sewer laying works	(i) Contractor is required to provide notice to the shop owners of the need to shift kiosk/wares displayed on ROW as soon as the work plan is ready, with minimum 7 working days. (ii) No works can be commenced unless 100% shifted in sections ready for implementation.		

Table 21: Construction Stage Environmental Impacts and Mitigation Measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Environmental management plan (EMP) Implementation Training	Irreversible impact to the environment, workers, and community	(i) Project manager and all key workers will be required to undergo training on EMP implementation including spoils/waste management, Standard operating procedures (SOP) for construction works; occupational health and safety (OHS), core labor laws, applicable environmental laws, etc.	Construction Contractor	Project cost/PMU cost
Air Quality	Dust, emissions from construction vehicles, equipment, and machinery used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons.	For all construction works (i) Provide a dust screen (6 m high) around the construction sites of pumping and lifting stations; provide 2 m barricades for the sewer works (ii) Damp down the soil and any stockpiled material on site by water sprinkling (3-4 times a day – before the start of work, 1-2 times in between, and at the end of the day); when working in the roads, there should permanently be one person responsible for directing when water sprinkling needs to take place to stop the dust moving; (i) reduce the need to sprinkle water by stabilizing surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition (iv) Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process (v) Cover the soil stocked at the sites with tarpaulins, and surround with dust screens	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>(vi) Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work areas; limiting soil disturbance will minimize dust generation</p> <p>(vii) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by open trucks; minimize the drop height when moving the excavated soil</p> <p>(viii) Control dust generation while unloading the loose material (particularly aggregate, sand, soil) at the site by sprinkling water and unloading inside the barricaded area</p> <p>(ix) Clean wheels and undercarriage of haul trucks prior to leaving construction site</p> <p>(x) Ensure that all the construction equipment, machinery are fitted with pollution control devices, which are operating correctly, and have a valid pollution under control (PUC) certificate</p> <p>(xi) No vehicles or plant to be left idling at site generators to be at placed maximum distance from properties</p> <p>For sewer works</p> <p>(i) Barricade the construction area using hard barricades (of 2 m height) on both sides</p> <p>(ii) Initiate site clearance and excavation work only after barricading of the site is done</p> <p>(iii) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.), to the barricaded area</p> <p>(iv) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area</p> <p>(v) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones</p> <p>(vi) Conduct work sequentially - excavation, sewer laying, backfilling; testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done.</p> <p>(vii) Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated soil for back filling, this will avoid stocking of material, and minimize the dust.</p> <p>(viii) Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will generate dust from backfilled section. Road restoration shall be undertaken immediately.</p> <p>(ix) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement</p>		

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. Backfilled trench without any road restoration is a major source of dust.		
Surface water quality	Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during construction can contaminate nearby surface water quality. Ponding of water in the pits / foundation excavations	(i) All earthworks be conducted during the dry season to prevent the problem of soil/silt run-off during rains (ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; do not stock earth/material close to water bodies (at least 100m) (iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used; (iv) Install temporary silt traps, oil traps, or sedimentation basins along the drainage leading to the water bodies; (v) Place storage areas (with impermeable surface) for fuels and lubricants away from any drainage leading to water bodies; these should be at least 100 m away from water bodies and groundwater wells (vi) Store fuel, construction chemicals etc., on an impervious floor, also avoid spillage by careful handling; provide spill collection sets for effective spill management (vii) Dispose any wastes generated by construction activities in designated sites; (viii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).	Construction Contractor	Contractor costs
Pipe bridge construction across streams	Degradation of water quality / silting of water body	(i) Select a construction method which is less disruptive (e.g. precast type) (ii) use spill traps/metal basins to avoid accidental spillage of construction chemicals, fuels, lubricants in the water body (iii) Clean up the site immediately after construction is complete: construction debris, materials, etc. shall be cleared and pre project condition restored or improved.	Construction Contractor	Contractor costs
	Water accumulation in trenches/pits	(i) As far as possible control the entry of runoff from upper areas into the excavated pits, and work area by creation of temporary drains or bunds around the periphery of work area (ii) Pump out the water collected in the pits / excavations to a temporary sedimentation pond; dispose off only clarified water into drainage channels/streams after sedimentation in the temporary ponds Consider safety aspects related to pit collapse due to accumulation of water	Construction Contractor	Contractor costs
Noise Levels	Increase in noise level due to earth-moving and excavation equipment, and the	(i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; especially near schools and other sensitive receptors	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	transportation of equipment, materials, and people	<ul style="list-style-type: none"> (ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimize sound impact to surrounding sensitive receptor; and (iii) Maintain maximum sound levels not exceeding 80 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s. (iv) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; if any building at risk, structural survey be completed prior to work, to provide baseline in case any issues from vibration, and if building is structurally unsound, that measures are taken to avoid any further damage (v) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach; (vi) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as nights, religious and cultural festivals. 		
Landscape and aesthetics – waste generation	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers, spoils, oils, lubricants, and other similar items.	<ul style="list-style-type: none"> (i) Prepare and implement a Construction Waste Management Plan (refer Appendix 3) (ii) As far as possible utilize the debris and excess soil in construction purpose, for example for raising the ground level or construction of access roads etc., (iii) Avoid stockpiling any excess spoils at the site for long time. Excess excavated soils should be disposed off to approved designated areas immediately (iv) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should located away from residential areas, forests, water bodies and any other sensitive land uses (v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; create a compost pit at workers camp sites for disposal of biodegradable waste; non-biodegradable / recyclable material shall be collected separately and sold in the local recycling material market (vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed off in disposal sites approved by TNPCB; (vii) Prohibit burning of construction and/or domestic waste; (viii) Ensure that wastes are not haphazardly thrown in and around the project site; provide proper collection bins, and create awareness to use the dust bins. (ix) Conduct site clearance and restoration to original condition after the completion of construction work; PIU to ensure that site is properly restored prior to issuing of construction completion certificate 	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Accessibility and traffic disruptions	Traffic problems and conflicts near project locations and haul road	<p>Sewer works</p> <ul style="list-style-type: none"> (i) Prepare a sewer work implementation plan in each zone separately and undertake the work accordingly; ensure that for each road where the work is being undertaken there is an alternative road for the traffic diversion; take up the work in sequential way so that public inconvenience is minimal; prepare traffic management plans for each section (refer sample in Appendix 6) (ii) Plan the sewer work in coordination with the traffic police; provide temporary diversions, where necessary and effectively communicate with general public (iii) Avoiding conducting work in all roads in a colony at one go; it will render all roads unusable due to excavations at the same time, creating large scale inconvenience (iv) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones (v) Confine work areas in the road carriageway to the minimum possible extent; all the activities, including material and waste/surplus soil stocking should be confined to this area. Proper barricading should be provided; avoid material/surplus soil stocking in congested areas – immediately removed from site/ or brought to the as and when required (vi) Limit the width of trench excavation as much as possible by adopting best construction practices; adopt vertical cutting approach with proper shoring and bracing; this is especially to be practiced in narrow roads and deeper sewers; if they deep trenches are excavated with slopes, the roads may render completely unusable during the construction period (vii) Leave spaces for access between mounds of soil to maintain access to the houses/properties; access to any house or property shall not be blocked completely; alternative arrangements, at least to maintain pedestrian access at all times to be provided (viii) Provide pedestrian access in all the locations; provide wooden/metal planks over the open trenches at each house to maintain the access. (ix) Inform the affected local population 1-week in advance about the work schedule (x) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum. (xi) Keep the site free from all unnecessary obstructions; (xii) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. Provide information to the public through media – newspapers and local cable television (TV) services 	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>(xiii) At work site, public information/caution boards shall be provided including contact for public complaints</p> <p>Hauling (material, waste/debris and equipment) activities</p> <p>(i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites</p> <p>(ii) Schedule transport and hauling activities during non-peak hours (peak hours 7-10 a.m. and 4-7 p.m.);</p> <p>(iii) Locate entry and exit points in areas where there is low potential for traffic congestion;</p> <p>(iv) Drive vehicles in a considerate manner</p> <p>(v) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.</p>		
Socio-Economic Loss of access to houses and business	Loss of income	<p>(i) Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations;</p> <p>(ii) Do not block any access; leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches</p> <p>(iii) Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around</p> <p>(iv) Control dust generation</p> <p>(v) Immediately consolidate the backfilled soil and restore the road surface; this will also avoid any business loss due to dust and access inconvenience of construction work.</p> <p>(vi) Employee best construction practices, speed up construction work with better equipment, increase workforce, etc., in the areas with predominantly commercial, and with sensitive features like hospitals, and schools;</p> <p>(vii) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and</p> <p>(viii) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.</p>	Construction Contractor	Contractor costs
Socio-Economic – Employment	Generation of temporary employment and	<p>(i) Employ local labor force as far as possible</p> <p>(iii) Comply with labor laws</p>	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	increase in local revenue			
Occupational Health and Safety	Occupational hazards which can arise during work	<ul style="list-style-type: none"> (i) Follow all national, state and local labor laws (indicative list is in Appendix 2); (ii) Develop and implement site-specific occupational health and safety (OH and S) Plan, informed by OHS risk assessment seeking to avoid, minimize, and mitigate risk, which shall include measures such as: (a) safe and documented construction procedures to be followed for all site activities; (b) ensuring all workers are provided with and use personal protective equipment; (c) OHS Training^a for all site personnel, (d) excluding public from the work sites; and (e) documentation of work-related accidents; Follow International Standards such as the World Bank Group's Environment, Health and Safety Guidelines^b. (iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the sites; (iv) Secure all installations from unauthorized intrusion and accident risks (v) Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (vi) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (vii) Ensure the visibility of workers through their use of high visibility vests and other PPE when working in or walking through heavy equipment operating areas; (viii) Ensure moving equipment is outfitted with audible back-up alarms; (ix) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and (x) Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. (xi) Provide supplies of potable drinking water; (xii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances 	Construction Contractor	Contractor costs
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians	(i) Consult PIU before locating project offices, sheds, and construction plants;	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	during material and waste transportation	<ul style="list-style-type: none"> (ii) Select a camp site away from residential areas (at least 100 m buffer shall be maintained) or locate the camp site within the existing facilities of City Corporation (iii) Avoid tree cutting for setting up camp facilities (iv) Provide a proper fencing/compound wall for camp sites (v) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas (vi) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit (vii) Ensure conditions of livability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers (viii) Camp shall be provided with proper drainage, there shall not be any water accumulation (ix) Provide drinking water, water for other uses, and sanitation facilities for employees; drinking water should be regularly tested to confirm that drinking water standards are met (x) Prohibit employees from cutting of trees for firewood; contractor should provide cooking fuel (cooking gas); fire wood not allowed (xi) Train employees in the storage and handling of materials which can potentially cause soil contamination (xii) Wastewater from the camps shall be disposed properly either into sewer system; if sewer system is not available, provide on-site sanitation with septic tank and soak pit arrangements; (100 m away from surface water body or groundwater well) (xiii) Recover used oil and lubricants and reuse or remove from the site; (xiv) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; provide a compost pit for bio degradable waste, and non-biodegradable / recyclable waste shall be collected and sold in local market (xv) Remove all wreckage, rubbish, or temporary structures which are no longer required; and (xvi) At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU; PIU to review and approve camp clearance and closure of work site 		
Work Camps and worksites	Temporary air and noise pollution from machine operation,	(i) As far as possible located the camp site within the work sites (at STP or large pumping station sites); if any camp to be established outside these,	Construction Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	<p>water pollution from storage and use of fuels, oils, solvents, and lubricants</p> <p>Unsanitary and poor living conditions for workers</p>	<p>then select a camp site away from residential areas (at least 100 m buffer shall be maintained)</p> <p>(ii) Avoid tree cutting for setting up camp facilities</p> <p>(iii) Ensure that a proper compound wall is provided, and erect a wind/dust screen around</p> <p>(iv) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas</p> <p>(v) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit</p> <p>(vi) Provide proper temporary accommodation with proper materials, adequate lighting and ventilation, appropriate facilities for winters and summers; ensure conditions of livability at work camps are maintained at the highest standards possible at all times;</p> <p>(vii) Consult PIU before locating project offices, sheds, and construction plants;</p> <p>(viii) Minimize removal of vegetation and disallow cutting of trees</p> <p>(ix) Ensure conditions of livability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be allowed as accommodation for workers</p> <p>(x) Camp shall be provided with proper drainage, there shall not be any water accumulation</p> <p>(xi) Provide drinking water, water for other uses, and sanitation facilities for employees</p> <p>(xii) Prohibit employees from cutting of trees for firewood; contractor should be provide proper facilities including cooking fuel (oil or gas; fire wood not allowed)</p> <p>(xiii) Train employees in the storage and handling of materials which can potentially cause soil contamination</p> <p>(xiv) Recover used oil and lubricants and reuse or remove from the site</p> <p>(xv) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; provide a compost pit for biodegradable waste, and non-biodegradable / recyclable waste shall be collected and sold in local market</p> <p>(xvi) Remove all wreckage, rubbish, or temporary structures which are no longer required</p> <p>(xvii) At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU; PIU to review and approve camp clearance and closure of work site</p>		

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	<ul style="list-style-type: none"> (i) Remove all spoils wreckage, rubbish, or temporary structures (such as buildings, shelters, and latrines) which are no longer required; and (ii) All excavated roads shall be reinstated to original condition. (iii) All disrupted utilities restored (iv) All affected structures rehabilitated/compensated (v) The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up. (vi) All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and regrassed using the guidelines set out in the revegetation specification that forms part of this document. (vii) The contractor must arrange the cancellation of all temporary services. (viii) Request PIU to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work. 	Construction Contractor	Contractor costs

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

^b IFC. [World Bank Group Environmental, Health and Safety Guidelines 101](#).

Table 22: Operation Stage Environmental Impacts and Mitigation Measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
STP operation –	Public health, safety and environmental impacts	<ul style="list-style-type: none"> (i) Ensure proper knowledge transfer, hands-on training to municipal staff engaged in STP operation has been provided by contractor prior to handover of facility (ii) Ensure continuous uninterrupted power supply (iii) Operate and maintain the facility following standard operating procedures of operational manual (iv) Undertake preventive and periodic maintenance activities as required (v) Maintain the mechanical / electrical parts as per the maintenance plan to avoid any hazards (vi) Conduct periodic training to workers (vii) Ensure that all safety apparatus at STP including personal protection equipment are in good condition all times; and are at easily accessible and identifiable place; periodically check the equipment, and conduct mock drills to deal with emergency situations 	PIU and TCMC	Operating costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(viii) Implement sludge management plan at the STP (ix) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers (x) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB (vii) Conduct regular wastewater quality monitoring at inlet and at outlet of STP to ensure that the treated effluent quality complies with the standards (viii) Conduct periodic testing of dried sludge/compost to check presence of heavy metals and confirming stipulated concentrations to use as compost		
Operation of sewage lifting and pumping stations	Odor nuisance	(i) Strictly follow standard operating procedures / operational manual for operation and maintenance of lifting and pump stations (ii) Ensure that operating staff is properly trained, and have clear understanding of odor issues vis a vis its relation with operational practices (iii) Ensure that pumping cycles are properly followed; and there is no buildup of sewage beyond design volume in the wells (iv) Conduct H ₂ S monitoring (periodically at pumping stations and lifting stations);	PIU and TCMC	Operating costs
Operation and maintenance of sewerage system	Blocks, overflows, system malfunction, occupational health and safety	(i) Establish regular maintenance program, including: <ul style="list-style-type: none"> • Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas • Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration; and • Monitoring of sewer flow to identify potential inflows and outflows • Conduct repairs on priority based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages); (ii) Maintain records; review previous sewer maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed; (iii) When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage	PIU and TCMC	Operating costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>using vacuum equipment or use other measures to divert it back to the sanitary sewer system.</p> <p>(iv) Prohibit/prevent disposal of wastewater/effluent from industrial units in the sewers; ensure regular checking to ensure no illegal entry of industrial wastewater into sewers</p> <p>(v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc.</p> <p>(vi) Provide necessary health and safety training to the staff in sewer cleaning and maintenance</p> <p>(vii) Provide all necessary personnel protection equipment</p> <p>(viii) Do not conduct manual cleaning of sewers; for personnel engaged sewer maintenance work, there is a risk due to oxygen deficiency and harmful gaseous emissions (hydrogen sulphide, methane, etc.); provide for adequate equipment (including oxygen masks) for emergency use</p>		

Table 23: Construction Stage Environmental Monitoring Plan

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Construction disturbances, nuisances, public and worker safety,	All work sites	Implementation of construction stage EMP including dust control, noise control, traffic management, and safety measures. Site inspection checklist to review implementation is appended at Appendix 7	Weekly during construction	Supervising staff and safeguards specialists of CMSC	Staff and consultant costs are part of incremental administration costs
Ambient air quality	5 locations (locations 50 m downwind direction near sewer and pumping / lifting station work sites in the city);	<ul style="list-style-type: none"> PM10, PM2.5 NO2, SO2, CO 	Once before start of construction Quarterly (yearly 4-times) during construction (3 year period considered)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (65 samples x 5000 per sample = 325,000)
Ambient noise	5 locations (locations near sewer and pumping / lifting station work sites in the city);	<ul style="list-style-type: none"> Day time and night time noise levels 	Once before start of construction Quarterly (yearly 4-times) during construction (3 year period considered)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (65 samples x 1500 per sample = 97,500)

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Surface water quality	4 locations (2 points in River Tamirabarani u/s and d/s, near Tholkapiyar Street and irrigation channel near STP)	<ul style="list-style-type: none"> pH, chlorine, fluoride, nitrates, total carbon, e. coli, BOD, COD, turbidity, DO, total alkalinity, heavy metals and pesticides 	Once before start of construction Half yearly during construction (3 year construction period considered)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (28 samples x 4000 per sample = 112,000)

Table 24: Operation Stage Environmental Monitoring Plan (Sewage Treatment Plant)

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Monitoring of treated wastewater quality from sewage treatment plant (STP)	Inlet and outlet of STP	Parameters as specified by Tamil Nadu Pollution Control Board (TNPCB) in the consent	Monthly Once	TCMC	TCMC Operating Cost
Surface water quality	In the downstream of irrigation channel (disposal line) near STP	Potential of hydrogen (pH), chlorine, fluoride, nitrates, total carbon, e. coli, biochemical oxygen demand (BOD), chemical oxygen demand (COD), turbidity, DO, total alkalinity, heavy metals and pesticides	Monthly Once	TCMC	TCMC Operating Cost
Disposal of treated wastewater	At the outlet of STP: flow measurement	Flow records at STP inlet and outlet	Hourly/Daily	TCMC	TCMC Operating Cost
Sludge quality and suitability as manure	STP	Analysis for concentration of heavy metals and confirm that value are within the following limits (see table below)	Start of operation and Yearly once	TCMC	O&M costs (testing to be done at an accredited external laboratory)
Odor monitoring at STP	2 points (downwind direction) with in STP and at nearest house	Hydrogen sulphide (H ₂ S)	Half yearly (yearly twice) and as and when based on public complaints (throughout the operation phase)	VCMC	O&M Costs
	1 point (at the boundary wall of the STP)	Hydrogen sulphide (H ₂ S)	Periodically	VCMC	O&M Costs

**Table 25: Operation Stage Environmental Monitoring Plan
(Sewer Network including Sewage Pumping Station and Lift Station)**

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Odor monitoring at pumping stations	3 points (downwind direction) at all pumping stations: near inlet/suction well; outside the pumping station and at nearest house	Hydrogen sulphide (H ₂ S)	Half yearly (yearly twice) and as and when based on public complaints (throughout the operation phase)	VCMC	O&M Costs
	1 point (at each SPS (downwind direction) at the boundary wall of the pumping stations	Hydrogen sulphide (H ₂ S)	Periodically	VCMC	O&M Costs
Odor monitoring at lifting stations	3 points (downwind direction) at all lifting stations: near inlet/suction well; outside the pumping station and at nearest house	Hydrogen sulphide (H ₂ S) in ambient air	Half yearly (yearly twice) and as and when based on public complaints (throughout the operation phase)	VCMC	O&M Costs
	1 point at each LS (downwind direction) at the boundary wall of the pumping stations	Hydrogen sulphide (H ₂ S) in ambient air	Periodically.	VCMC	O&M Costs

B. Implementation Arrangements

180. The Municipal and Water Supply Department (MAWS) acting through TNUIFSL will be the executing agency. A program steering committee, headed by Principal Secretary, MAWS, GOTN, will provide overall guidance and strategic directions to the program. A program management unit (PMU) for TNUFIP, headed by the Managing Director, TNUIFSL acting as Program Director will be established within TNUIFSL for overall management, planning, implementing, monitoring, reporting, and coordinating TNUFIP. The CMA will act as the Deputy Program Director in the PMU. The project ULBs, represented by respective Municipal Commissioners, will be the implementing agencies for works in cities/towns and will establish program implementing units (PIUs) headed by a municipal engineer as full-time Project Manager. PIUs will comprise of dedicated staff responsible for overseeing implementation of projects on a day-to-day basis. The PIUs will be supported by a contract management and supervision consultant (CMSC) recruited by TNUIFSL. For the institutional capacity, public awareness, and urban governance component, CMA acting through its Commissioner, will establish a PIU and appoint a governance improvement and awareness consultant (GIAC) responsible for supporting these activities.

181. The implementing agency for this subproject is Tirunelveli City Municipal Corporation (TCMC). A program implementation unit (PIU) will be established in TCMC headed by full-time a Project Manager (a senior official of TCMC) and comprising dedicated full-time staff from engineering and other departments of TCMC. PIU under the TCMC will be responsible for planning, implementation, monitoring and supervision, and coordination of all activities of subproject. A Construction, Management and Supervision Consultant (CMSC) will be appointed to assist PIU in day-to-day implementation of the subproject.

182. **Safeguards Compliance Responsibilities.** Environmental and Social Safeguards (ESS) managers in the PMU, TNUIFSL will have overall responsibility of safeguard compliance with ADB SPS 2009. ESS Managers report to Vice President in the Projects Wing. At PIU level, a Safeguards Officer(SO) will be appointed, who will be an Assistant Engineer rank officer and will coordinate safeguard tasks at PIU. As expert support is available to PIU via CMSC, and the role of SO will be mainly to coordination, overseeing the implementation of safeguard tasks, grievance redress and reporting.

183. **PMU Safeguard Responsibilities.** Key tasks and responsibilities of the ESS Manager (Environment), for this subproject include the following:

184. **DPR finalization and Bidding stage.**

- (i) Ensure that all design related measures of the EMP are included designs;
- (ii) Ensure that EMP is included in bidding documents and civil works contracts including requirement for EHS supervisor with the contractor;
- (iii) Ensure that the bid/contract documents include specific provisions requiring contractors to comply with all applicable labor laws and core labor standards;
- (iv) Ensure that staff required for implementation of EMP (EHS officer) is included in the bid requirements;
- (v) Ensure that EMP cost is included in the project cost;
- (vi) Prior to invitation of bids and prior to award of contract ensure that all clearance/permissions as required for implementation of subproject are in place to the extent possible; and
- (vii) Ensure that consent to establish (CTE) is obtained from TNPCB for the proposed STP; ensure that proposed arrangement for reuse of the treated wastewater prior to operation of the sewerage project.

185. **Construction stage.**

- (i) Prior to start of construction:
 - (a) Ensure that all necessary clearances/permissions/licences, including that of contractor's are in place prior to start of construction;
 - (b) provide oversight on environmental management aspects of subprojects and ensure EMPs are implemented by PIUs and contractors.
- (ii) Oversee and provide guidance to the PIU to properly carry out the environmental monitoring as per the EMP;
- (iii) Oversee grievance redress mechanism to address any grievances brought about in a timely manner; ensure that records are properly maintained;
- (iv) Consolidate quarterly environmental monitoring reports from PIU and submit semi-annual monitoring reports to ADB;
- (v) Oversee site closures to ensure that all work/facility sites are restored properly prior to issuing work completion certificate to the contractor.

186. **Operation stage.** Ensure that all clearances as required for operation of project are in place prior to operation, such as consent to operate (CTO) for STP from TNPCB.

187. **PIU Safeguard Responsibilities.** Key tasks and responsibilities of the PIU assisted by CMSC for this subproject include the following:

188. **DPR finalization and Bidding stage:**

- (i) Include design related measures of the EMP in the project design and DPR;
- (ii) Include EMP in the bidding documents and civil works contracts, including requirement of staff (EHS supervisor) with contractor for EMP implementation;
- (iii) Provide necessary budget in the project as IEE for EMO Implementation;
- (iv) Ensure that the bid/contract documents include specific provisions requiring contractors to comply with all applicable labor laws and core labor standards including:
 - (a) Labour welfare measures and provision of amenities
 - (b) prohibition of child labor as defined in national legislation for construction and maintenance activities;
 - (c) equal pay for equal work of equal value regardless of gender, ethnicity, or caste;
 - (d) elimination of forced labor;
 - (e) the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites.
- (v) In the pre-bid meeting, provide insight into EMP measures, and overall compliance requirements to the bidders;
- (vi) Obtain all clearance/permissions as required for implementation of subproject, including consent to establish (CTE) from TNPCB for STP, prior to invitation of bids and/or prior to award of contract as appropriate.

189. **Construction stage.**

- (i) Identify regulatory clearance requirements and obtain all necessary clearances prior to start of construction; ensure construction work by contractor is conducted in compliance with all government rules and regulations including pollution control, labour welfare and safety etc.;

- (ii) Prior to start of construction organize an induction course for the training of contractors, preparing them on EMP implementation, environmental monitoring, and on taking immediate action to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation;
- (iii) Ensure contractor compliance with staff resources as per the IEE/EMP/Bid
- (iv) Guide contractor on updating EMP/preparing Site Environmental Plan at the start of the project;
- (v) Update IEE and EMP; ensure that IEE reflects the final design being implemented by contractor;
- (vi) Conduct public consultation and information disclosure as necessary;
- (vii) Take necessary action for obtaining rights of way;
- (viii) Supervise day-to-day EMP implementation on site by contractor, including the environmental monitoring plan;
- (ix) Supervise ambient environmental monitoring by contractors;
- (x) Take corrective actions when necessary to ensure no environmental impacts
- (xi) Submit quarterly environmental monitoring reports to PMU;
- (xii) Conduct continuous public consultation and awareness;
- (xiii) Address any grievances brought about through the grievance redress mechanism in a timely manner as per the EMP;
- (xiv) Monitor Contractor's compliance with the measures set forth in the EMP and any corrective or preventative actions set forth in a safeguards monitoring report that the PMU will prepare from time to time;
- (xv) Implement corrective or preventative actions in case of non-compliance or new/unanticipated impacts;
- (xvi) Inform PMU promptly in case if any significant impacts surfaces, which were not identified in the IEE and develop necessary corrective actions as necessary and ensure implementation by the contractors; include all such impacts and suggested actions in the Quarterly Environmental Monitoring Reports;
- (xvii) Implementation grievance redress system, and undertake appropriate actions to redress the complaints; ensure that complaints/grievances are addressed in a timely manner and resolutions are properly documented;
- (xviii) Review and approve monthly progress reports submitted by Contractor on EMP compliance;
- (xix) Prepare quarterly environmental monitoring reports and submit to PMU/TNUIFSL;
- (xx) Provide any assistance in environmental safeguard related tasks as required by PMU to ensure compliance and reporting to ADB.

190. **Operation stage:**

- (i) Obtain all clearances as required for operation of project prior to operation, such as consent to operate (CTO) for STP from TNPCB; and
- (ii) Conduct environmental management and monitoring activities as per the EMP.

191. **Contractor's Responsibilities.**

Bidding stage:

- (i) Understand the EMP requirements and allocate necessary resources (budget, staff, etc.,)
- (ii) Understand the regulatory compliance requirements related to labour welfare, safety, environment etc.,

Construction stage:

- (i) Mobilize EHS Supervisor prior to start of work;
- (ii) Prepare SEMP and submit to PIU;
- (iii) Ensure that all regulatory clearances (both project related and contractor related) are in place prior start of the construction work;
- (iv) Confirm with PIU availability of rights of way at all project sites prior to start of work.
- (v) Prepare and submit:
 - (a) Construction waste management (CWM) plan (sample is in Appendix 3);
 - (b) Traffic management (TM) plan (sample is Appendix 6);
 - (c) OHS Plan, pollution control plan, dust emergency response plan.
- (vi) Implement the mitigation measures as per the EMP including CWM and TM Plans
- (vii) Follow the EMP measures/guidelines for establishment of temporary construction camps, construction waste disposal sites, and material borrow areas, etc.,
- (viii) Implement EMP and ensure compliance with all the mitigation and enhancement measures;
- (ix) Conduct environmental monitoring (air, noise, water etc.,) as per the EMP;
- (x) Undertake immediate action as suggested by PIU to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation;
- (xi) Submit monthly progress reports on EMP implementation to PIU;
- (xii) Act promptly on public complaints and grievances related to construction work and redress in a timely manner in coordination with PIU and CMSC; and
- (xiii) Comply with applicable government rules and regulations.

C. Training Needs

192. The following Table 26 presents the outline of capacity building program to ensure EMP implementation. These capacity building and trainings will be conducted at the offices of PMU and PIU by the environmental safeguards specialist of PMU/PIU and their consultants, which are part of project implementation set-up, and therefore no separate or additional costs are envisaged. Adequate costs are already considered in project's capacity building program. The detailed program and specific modules will be customized for the available skill set after assessing the capabilities of the target participants and the requirements of the project by the PMU.

Table 26: Outline Capacity Building Program on Environmental Management Plan Implementation

Description	Target Participants and Venue	Schedule
1. Introduction and Sensitization to Environmental Issues (1 day) <ul style="list-style-type: none"> - ADB Safeguards Policy Statement - Government of India and Tamil Nadu applicable safeguard laws, regulations and policies including but not limited to core labor standards, occupational health and safety (OHS), etc. - Incorporation of environmental management plan (EMP) into the project design and contracts - Monitoring, reporting and corrective action planning 	All staff and consultants involved in the project At program management unit (PMU) (combined program for all program implementation unit or PIU)	yearly once for every tranche and as & when required

Description	Target Participants and Venue	Schedule
2. EMP implementation (1/2 day) - EMP mitigation and monitoring measures - Roles and responsibilities - Public relations, - Consultations - Grievance redress - Monitoring and corrective action planning - Reporting and disclosure - Construction site standard operating procedures (SOP) -- Chance find (archeological) protocol - AC pipe protocol - Traffic management plan - Waste management plan - Site clean-up and restoration	All PIU staff, contractor staff and consultants involved in the subproject At PIU	Yearly Once, To be conducted by CSMC at the PIU office; part of project implementation cost
3. Contractors Orientation to Workers (1/2 day) - Environment, health and safety in project construction	Once before start of work, and thereafter regular briefing every month once. Daily briefing on safety prior to start of work All workers (including unskilled laborers)	Contractors' EHS officer to conduct program, with guidance of CMSC

D. Monitoring and Reporting

193. Immediately after mobilization and prior to commencement of the works, the contractor will submit a compliance report to PIU that all identified pre-construction mitigation measures as detailed in the EMP are undertaken. Contractor should confirm that the staff for EMP implementation (EHS supervisor) is mobilized. PIU will review, and approve the report and permit commencement of works.

194. During construction, results from internal monitoring by the contractor will be reflected in their monthly EMP implementation reports to the PIU. CMSC will monitor, review and advise contractors for corrective actions if necessary. Quarterly report summarizing compliance and corrective measures, if any, taken will be prepared by CMSC team at PIU and submitted to PMU (Report format is at Appendix 8). During operation, PIU will conduct management and monitoring actions as per the operation stage EMP, and submit to PMU an annual report.

195. Based on PIU Quarterly monitoring reports and oversight visits to subproject work sites, PMU will submit semi-annual Environmental Monitoring Report (EMR). Once concurrence from the ADB is received the report will be disclosed on TNUIFSL, PMU and TCMC websites.

196. ADB will review project performance against the TNUFIP commitments as agreed in the legal documents (loan and project agreements etc.). The extent of ADB's monitoring and supervision activities will be commensurate with the project's risks and impacts. Monitoring and supervising of social and environmental safeguards will be integrated into the project performance management system.

E. Environmental Management Plan Implementation Cost

197. Most of the mitigation measures require the contractors to adopt good site practices, which should be part of their normal procedures already, so there are unlikely to be major costs

associated with compliance. The costs which are specific to EMP implementation and are not covered elsewhere in the projects are given below.

Table 27: Cost Estimates to Implement the Environmental Management Plan

	Particulars	Stages	Unit	Total Number	Rate (₹)	Cost (₹)	Costs Covered By
A.	Implementation staff						
1	EHS Supervisor	Construction	per month	72	35,000	2,520,000	Civil work contract
	Subtotal (A)					2,520,000	
B.	Mitigation Measures						
2	Providing gas capture and treatment system at selected lifting stations	Design	Lump sum provision	-	-	5,000,000	Provisional sums of contract (PIU)
3	Provision for tree cutting and compensatory plantation measures (1:10ratio replantation)	Construction	Per tree	100	1,000	100,000	Project costs (PIU)
4	Preparation of plans traffic management plan, waste (spoils) management plan etc.,), traffic management at work sites (Pavement Markings, Channelizing Devices, Arrow Panels and Warning Lights)	Construction	Lump sum	-	-	300,000	Civil works contract
5	Safety barricading	Construction	Lump sum	Lump sum	-	2,000,000	Civil works contract
	Subtotal (B)					7,400,000	
C.	Monitoring Measures						
1	Air quality monitoring	Construction	per sample	65	5,000	325,000	Civil works contract
2	Noise levels monitoring	Construction	Per sample	65	1,500	97,500	Civil work contract
3	Surface water monitoring	Construction	Per sample	28	4,000	112,000	Civil work contract
	Subtotal (C)					534,500	
D.	Capacity Building						
1.	Training on EMP implementation	Pre-construction				-	Part of PIU and PMU , consultant tasks
2.	Contractors Orientation to Workers on EMP implementation	Prior to dispatch to worksite				-	Civil works contractor cost
	Subtotal (D)						
	Total (A+B+C+D)					10,454,500	

Contractor Cost - 5,354,500
 PIU Cost - 5,100,000
Total - 10,454,500

IX. CONCLUSION AND RECOMMENDATIONS

198. The process described in this document has assessed the environmental impacts of all elements of the proposed underground sewerage subproject covering municipal area of Tirunelveli on the east of Tamirabarani River. All potential impacts were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result significant measures have already been included in the designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design. Various design related measures suggested for: odor control at pumping stations, uninterrupted power supply provision; standard operating procedures for operation and maintenance; and imparting necessary training for ULB staff; providing necessary safety, no manual cleaning of sewers, and personal protection equipment for workers (protection against oxygen deficiency, harmful gaseous emissions) and sludge handling, and development of green buffer zone around the sewage treatment plant.

199. A New sewage treatment plant is included in the subproject and it is proposed the 34 MLD capacity of waste stabilization pond (WSP).

200. All new lifting and pumping station sites (19 in all) are situated on government owned vacant land parcels, and sewers will be laid on the public roads. Therefore subproject do not involve any private land acquisition.

201. New sewage pumping station, which collect sewage from the sewer network and pump to higher level to convey to sewage to STP for safe treatment and disposal, is located outside the city. Existing two pumping stations, one proposed pumping station and all 18 new lifting stations are located within or close to residential areas. These facilities may generate odor and may cause nuisance to nearby households. Site selection is done with utmost care to located as far as away from the houses, however, given design considerations and land constraints, many sites identified are close to the houses. Various site planning, green buffer and design related measures are included in the project to prevent and control odor generation. These include: (i) appropriately locating sewage wells within site maintaining maximum distance from the nearby houses; (ii) developing tree cover; (iii) closed facilities; (iv) design and operation measures to prevent odor; and (v) providing gas collection and treatment facilities.

202. Except sewer works, all other construction activities will be confined to the selected sites, and the interference with the general public and community around is minimal. There will be temporary negative impacts, arising mainly from construction dust and noise, hauling of construction material, waste and equipment on local roads (traffic, dust, safety etc.), mining of construction material, occupation health and safety aspects. Sewer line works will be conducted along public roads in an urban area congested with people, activities and traffic, subproject is likely to significant impacts during construction. Impacts mainly arise from the construction dust and noise; from the disturbance of residents, businesses, traffic by the construction work, safety risk to workers, public and nearby buildings due to deep trench excavations, especially in narrow roads, dust, access impediment to houses and business, disposal of large quantities of construction waste, etc. These are all general impacts of construction in urban areas, and there are well developed methods of mitigation that are suggested in the EMP.

203. Once the new system is operating, the facilities will operate with routine maintenance, which should not affect the environment. Improved system operation will comply with the O&M manual and standard operating procedures to be developed for all the activities.

204. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the environment is protected as intended. This will include observations on- and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the PMU. There will also be longer-term surveys to monitor treatment efficiency of STP (raw and treated sewage quality), sludge and odor at pumping stations. Mitigation and monitoring measures, along with the project agency responsible for such actions, form part of the environmental management plan.

205. Stakeholders were involved in developing the IEE through a city level consultation workshop, which was conducted for larger public participation in the project. Views expressed by the stakeholders were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations and will be disclosed to a wider audience via the PMU, TCMC and ADB websites. The consultation process will be continued during project implementation as necessary to ensure that stakeholders are engaged in the project and have the opportunity to participate in its development and implementation.

206. The project's grievance redress mechanism will provide the citizens with a platform for redress their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance.

207. The EMP will assist the project agencies and contractor in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project. A copy of the updated EMP/ SEMP shall be kept on-site during the construction period at all times. The EMP shall be made binding on all contractors operating on the site, and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

208. The citizens of the Tirunelveli City will be the major beneficiaries of this subproject. The new sewerage system will remove the human waste from those areas served by the network rapidly and treated to an acceptable standard, and treated wastewater is utilized beneficial purposes. In addition to improved environmental conditions, the subproject will improve the overall public health in the project area. Diseases of poor sanitation, such as diarrhea and dysentery, should be reduced, so people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health.

209. Therefore, as per ADB SPS, the project is classified as environmental category B and does not require further environmental impact assessment.

210. This IEE shall be updated by PIU during the implementation phase to reflect any changes, amendments and will be reviewed and approved by PMU.

RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST

Sewerage

Instructions:

- This checklist is to be prepared to support the environmental classification of a project. It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Sustainable Development and Climate Change Department.
- This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.
- This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on (i) involuntary resettlement, (ii) indigenous peoples planning, (iii) poverty reduction, (iv) participation, and (v) gender and development.
- Answer the questions assuming the “without mitigation” case. The purpose is to identify potential impacts. Use the “remarks” section to discuss any anticipated mitigation measures.

Country/Project Title: India/Tamil Nadu Urban Flagship Investment Program – Underground Sewerage Subproject Eastern Areas of Tamarabarani River in Tirunelveli City Municipal Corporation

Sector Division: Urban Development and Water Division

Screening Questions	Yes/No	Remarks
A. Project Siting		
Is the project area...		
• Densely populated?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Subproject activities are located in Tirunelveli City, a fastly developing urban area in the state of Tamil Nadu. Subproject area includes old town area of Tirunelveli, which is very densely populated. Outer areas are comparatively less dense. Old villages areas in the outer city have dense residential pockets, with narrow roads. Newly developing residential areas have low density and well planned layouts. Agriculture is still practiced in the outer areas.
• Heavy with development activities?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	It is a developing area; urban expansion is considerable
• Adjacent to or within any environmentally sensitive areas?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Cultural heritage site	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Protected Area	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Wetland	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Mangrove	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Estuarine	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Buffer zone of protected area	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Special area for protecting biodiversity	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
• Bay	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
B. Potential Environmental Impacts		

Screening Questions	Yes/No	Remarks
Will the Project cause...		
Sewerage		
<ul style="list-style-type: none"> ▪ impairment of historical/cultural monuments/areas and loss/damage to these sites? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	No historical or cultural sites in the subproject area
<ul style="list-style-type: none"> ▪ interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.? 	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Few sewage lifting and pump stations are located close to the houses, and odor may create nuisance. Necessary measures are included to prevent and control odor; no net negative impacts envisaged
<ul style="list-style-type: none"> ▪ dislocation or involuntary resettlement of people? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Do not involve land acquisition or resettlement
<ul style="list-style-type: none"> ▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	No such possibilities; sewerage system will cover entire population including urban poor; In fact, it will have positive health impact due to improved sanitation condition.
<ul style="list-style-type: none"> ▪ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage? 	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The new STP is proposed for the treatment of waste water. The treated waste water will comply with the discharge standards prescribed by the TNPCB.
<ul style="list-style-type: none"> ▪ overflows and flooding of neighboring properties with raw sewage? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Sewerage system has been designed considering the population growth. It has been designed to accommodate sewage until design year. Design considers standard peak factors and therefore no such impact envisaged.
<ul style="list-style-type: none"> ▪ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
<ul style="list-style-type: none"> ▪ noise and vibration due to blasting and other civil works? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	No blasting activities envisaged. Temporary nuisance/disturbance due to construction activities will be minimized with appropriate mitigation measures.
<ul style="list-style-type: none"> ▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	In appropriate handling of sludge may have occupational health hazard. All necessary safety precautions will be taken to avoid any risk.
<ul style="list-style-type: none"> ▪ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	There are no sources of hazardous material that will find its way into the sewers. Wastewater other than domestic will not be discharged into the sewers.
<ul style="list-style-type: none"> ▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities? 	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Due to technical constraints and land availability, some lifting and pumping stations are located close to houses, however, necessary measures are included in site planning, design and operation. No net negative impacts envisaged
<ul style="list-style-type: none"> ▪ road blocking and temporary flooding due to land excavation during the rainy season? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Complete road block are not envisaged; in narrow roads, traffic may be diverted but access will be ensure for pedestrians. All necessary precautions will be taken to prevent flooding during construction; flooding is unlikely as work will be mostly be conducted during dry season.
<ul style="list-style-type: none"> ▪ noise and dust from construction activities? 	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	No major noise generating activities like rock blasting is envisaged. As the sewers will be lain on the road surface, cutting open of road surface using pneumatic drills will produce noise. Appropriate measures are suggested to minimize impact. Dust will be temporary and will be controlled with proper measures.
<ul style="list-style-type: none"> ▪ traffic disturbances due to construction material transport and wastes? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Proper planning, such as selection of routes and scheduling to avoid peak traffic hours, will be carried

Screening Questions	Yes/No	Remarks
		out in consultation with concerned authorities
<ul style="list-style-type: none"> ▪ temporary silt runoff due to construction? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Earthworks will not be conducted during rains; plain topography and moderate to low rains, so no such impact envisaged
<ul style="list-style-type: none"> ▪ hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	A chance of failure of sewerage system is very remote; proper design and standard operating procedures will be followed in O&M; necessary equipment and training to workers will be provided
<ul style="list-style-type: none"> ▪ deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	sludge management plan will be implemented
<ul style="list-style-type: none"> ▪ contamination of surface and ground waters due to sludge disposal on land? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Sludge will be dried in the ponds, no disposal of wet sludge on the land
<ul style="list-style-type: none"> ▪ Health and safety hazards to workers from toxic gases and hazardous materials which maybe contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Manual cleaning of sewers and facilities will be avoided. All necessary health and safety training and necessary personal protection equipment will be given to workers and staff during operation of sewerage system
<ul style="list-style-type: none"> ▪ Large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	No such impact anticipated; local communities in the vicinity of the project would be employed as much as possible.
<ul style="list-style-type: none"> ▪ Social conflicts between construction workers from other areas and community workers? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	No such impact anticipated; local communities in the vicinity of the project would be employed as much as possible.
<ul style="list-style-type: none"> ▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Not applicable. Construction/operation will not involve use of explosives and chemicals.
<ul style="list-style-type: none"> ▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning? 	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Operational area will be clearly demarcated and access will be controlled. Only worker and project concerned members will be allowed to visit the construction sites.

Climate Change and Disaster Risk Questions	Yes	No	Remarks
The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.			
Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunamis or volcanic eruptions and climate changes?	√		Prone for flooding along the river under heavy rains and due to release of water in River Tamirabarani from upstream dams.
Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?		√	No
Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		√	No

Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		√	No
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SALIENT FEATURES OF MAJOR LABOR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN CONSTRUCTION OF CIVIL WORKS

- (i) Workmen Compensation Act, 1923 - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.
- (ii) Payment of Gratuity Act, 1972 - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.
- (iii) Employees' PF and Miscellaneous Provisions Act, 1952 - The Act provides for monthly contributions by the employer plus workers @10 % or 8.33 %. The benefits payable under the Act are: (a) Pension or family pension on retirement or death as the case may be; (b) deposit linked insurance on the death in harness of the worker; (c) payment of PF accumulation on retirement/death etc.
- (iv) Maternity Benefit Act, 1951 - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- (v) Contract Labour (Regulation and Abolition) Act, 1970 - The Act provides for certain welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same are required to be provided by the Principal Employer by Law. The principal employer is required to take Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act is applicable to the establishments or Contractor of principal employer if they employ 20 or more contract labor.
- (vi) Minimum Wages Act, 1948 - The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employment.
- (vii) Payment of Wages Act, 1936 - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- (viii) Equal Remuneration Act, 1979 - The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees in the matters of transfers, training and promotions etc.
- (ix) Payment of Bonus Act, 1965 - The Act is applicable to all establishments employing 20 or more workmen. The Act provides for payments of annual bonus subject to a minimum of 8.33 % of wages and maximum of 20 % of wages to employees drawing Rs. 3,500/- per month or less. The bonus to be paid to employees getting Rs. 2,500/- per month or above up to Rs.3,500/- per month shall be worked out by taking wages as Rs.2,500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of the Act.
- (x) Industrial Disputes Act, 1947 - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(xi) Industrial Employment (Standing Orders) Act, 1946 - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.

(xii) Trade Unions Act, 1926 - The Act lays down the procedure for registration of trade unions of workmen and employees. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities.

(xiii) Child Labor (Prohibition and Regulation) Act, 1986 - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labor is prohibited in Building and Construction Industry.

(xiv) Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 - The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The inter-state migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc.

(xv) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996 - All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay Cess at rate not exceeding 2% of the cost of construction as may be notified by the Government. The employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for workers near the workplace etc. The employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the government.

SAMPLE OUTLINE SPOILS (CONSTRUCTION WASTE) MANAGEMENT PLAN

- The Spoil Management Plan should be site specific and be part of the monthly Construction Management Plan.
- The contractor, in consultation with the PIU, has to find out appropriate location/s for the disposal of the excess soil generated. The spoils should be deposited only at these sites.
- Further precautions need to be taken in case of the contaminated spoils
- The vehicle carrying the spoil should be covered properly.
- The spoils generating from each site should be removed on the same day or immediately after the work is complete. The site / road should be restored to the original condition.

I. Spoils information

The spoil information contains the details like a) The type / material, b) Potential contamination by that type, c) Expected volume (site / component specific), d) Spoil Classification etc.

II. Spoils management

The Spoil Management section gives the details of a) Transportation of spoil b) disposal site details c) Precautions taken d) Volume of contaminated spoil, if present, d) Suggested reuse of disposal of the spoil

III. Documentation

The volume of spoil generated (site specific, date wise), site disposed, reuse / disposal details should be documented properly.

PUBLIC INFORMATION NOTICE TEMPLATE

Public Announcement
Providing Underground Sewerage System Tirunelveli City
Tirunelveli City Municipal Corporation

Under this project, works are being conducted by xxxx Contractor to provide sewerage network in Tirunelveli

As part of this, works for laying pipeline / sewerage network will be taken up in ----- road---
-/ street/ lane From.....to (provide dates).

We request you to kindly co-operate for smooth implementation of the works.

We also request you to drive vehicles / pedestrians to walk carefully

Inconvenience caused is regretted.

PIU - Contact No.

Contractor – Contact no.

SAMPLE GRIEVANCE REGISTRATION FORM

(To be available in Tamil and English)

The _____ Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

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

FOR OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
Mode of communication: Note/letter E-mail Verbal/telephonic	
Reviewed by: (Names/positions of officials reviewing grievance)	
Action taken:	
Whether action taken disclosed:	Yes No
Means of disclosure:	

SAMPLE OUTLINE TRAFFIC MANAGEMENT PLAN

A. Principles for Traffic Management Plan around the Water Pipes Construction Sites

1. One of the prime objectives of this TMP is to ensure the safety of all the road users along the work zone, and to address the following issues:
 - (i) the safety of pedestrians, bicyclists, and motorists travelling through the construction zone;
 - (ii) protection of work crews from hazards associated with moving traffic;
 - (iii) mitigation of the adverse impact on road capacity and delays to the road users;
 - (iv) maintenance of access to adjoining properties; and
 - (v) addressing issues that may delay the project.

B. Operating Policies for TMP

2. The following principles will help promote safe and efficient movement for all road users (motorists, bicyclists, and pedestrians, including persons with disabilities) through and around work zones while reasonably protecting workers and equipment.
 - (i) Make traffic safety and temporary traffic control an integral and high-priority element of project from planning through design, construction, and maintenance.
 - (ii) Inhibit traffic movement as little as possible.
 - (iii) Provide clear and positive guidance to drivers, bicyclists, and pedestrians as they approach and travel through the temporary traffic control zone.
 - (iv) Inspect traffic control elements routinely, both day and night, and make modifications when necessary.
 - (v) Pay increased attention to roadside safety in the vicinity of temporary traffic control zones.
 - (vi) Train all persons that select, place, and maintain temporary traffic control devices.
 - (vii) Keep the public well informed.
 - (viii) Make appropriate accommodation for abutting property owners, residents, businesses, emergency services, railroads, commercial vehicles, and transit operations.
3. **Figure A2 to Figure A12** illustrates the operating policy for TMP for the construction of water pipes and the sewers along various types of roads.

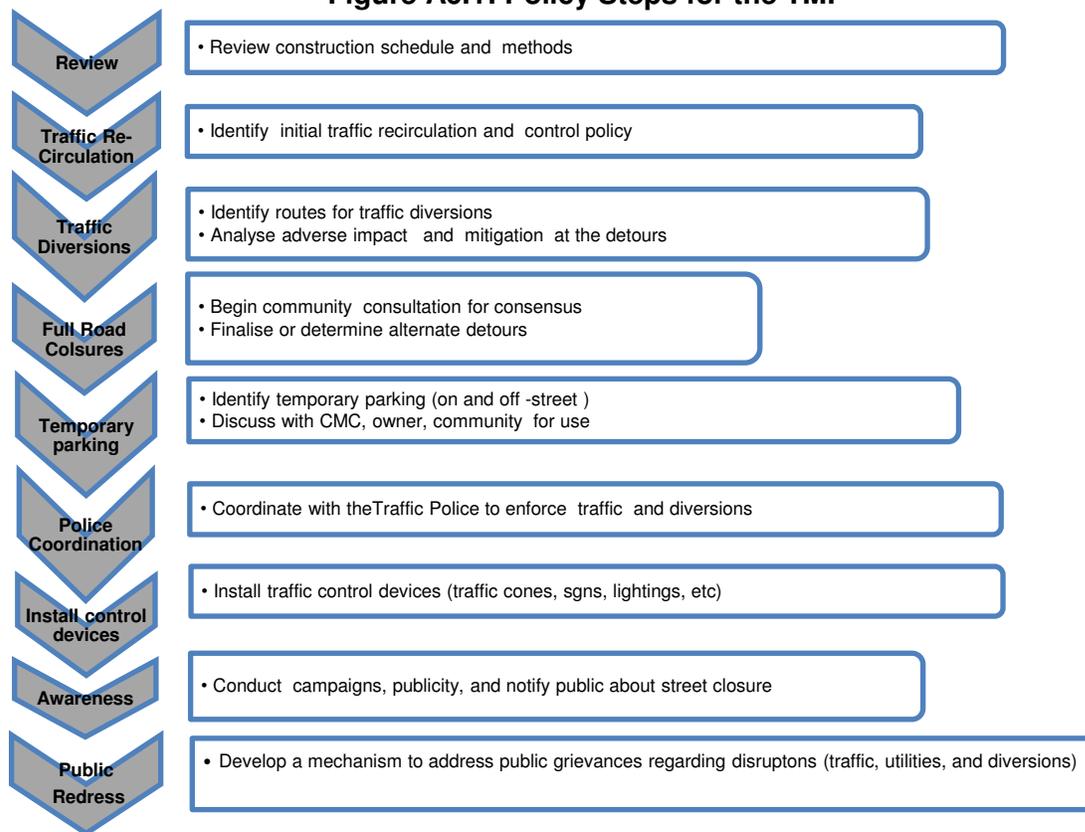
C. Analyze the impact due to street closure

4. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:
 - (i) approval from the ULB/Public Works Department (PWD) to use the local streets as detours;
 - (ii) consultation with businesses, community members, traffic police, PWD, etc, regarding the mitigation measures necessary at the detours where the road is diverted during the construction;
 - (iii) determining of the maximum number of days allowed for road closure, and incorporation of such provisions into the contract documents;
 - (iv) determining if additional traffic control or temporary improvements are needed along the detour route;
 - (v) considering how access will be provided to the worksite;

- (vi) contacting emergency service, school officials, and transit authorities to determine if there are impacts to their operations; and
- (vii) developing a notification program to the public so that the closure is not a surprise. As part of this program, the public should be advised of alternate routes that commuters can take or will have to take as result of the traffic diversion.

5. If full road-closure of certain streets within the area is not feasible due to inadequate capacity of the detour street or public opposition, the full closure can be restricted to weekends with the construction commencing on Saturday night and ending on Monday morning prior to the morning peak period.

Figure A6.1: Policy Steps for the TMP



D. Public awareness and notifications

6. As per discussions in the previous sections, there will be travel delays during the constructions, as is the case with most construction projects, albeit on a reduced scale if utilities and traffic management are properly coordinated. There are additional grounds for travel delays in the area, as most of the streets lack sufficient capacity to accommodate additional traffic from diverted traffic as a result of street closures to accommodate the works.

6. The awareness campaign and the prior notification for the public will be a continuous activity which the project will carry out to compensate for the above delays and minimize public claims as result of these problems. These activities will take place sufficiently in advance of the time when the roadblocks or traffic diversions take place at the particular streets. The reason for

this is to allow sufficient time for the public and residents to understand the changes to their travel plans. The project will notify the public about the roadblocks and traffic diversion through public notices, ward level meetings and city level meeting with the elected representatives.

7. The PIU will also conduct an awareness campaign to educate the public about the following issues:

- (i) traffic control devices in place at the work zones (signs, traffic cones, barriers, etc.);
- (ii) defensive driving behaviour along the work zones; and
- (iii) reduced speeds enforced at the work zones and traffic diversions.

8. It may be necessary to conduct the awareness programs/campaigns on road safety during construction.

9. The campaign will cater to all types of target groups i.e. children, adults, and drivers. Therefore, these campaigns will be conducted in schools and community centres. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the area and will also be available at the PIU, and the contractor's site office. The text of the brochure should be concise to be effective, with a lot of graphics. It will serve the following purpose:

- (i) explain why the brochure was prepared, along with a brief description of the project;
- (ii) advise the public to expect the unexpected;
- (iii) educate the public about the various traffic control devices and safety measures adopted at the work zones;
- (iv) educate the public about the safe road user behaviour to emulate at the work zones;
- (v) tell the public how to stay informed or where to inquire about road safety issues at the work zones (name, telephone, mobile number of the contact person; and
- (vi) indicate the office hours of relevant offices.

E. Install traffic control devices at the work zones and traffic diversion routes

10. The purpose of installing traffic control devices at the work zones is to delineate these areas to warn, inform, and direct the road users about a hazard ahead, and to protect them as well as the workers. As proper delineation is a key to achieve the above objective, it is important to install good traffic signs at the work zones. The following traffic control devices are used in work zones:

- Signs
- Pavement Markings
- Channelizing Devices
- Arrow Panels
- Warning Lights

11. Procedures for installing traffic control devices at any work zone vary, depending on road configuration, location of the work, construction activity, duration, traffic speed and volume, and pedestrian traffic. Work will take place along major roads, and the minor internal roads. As such, the traffic volume and road geometry vary. The main roads carry considerable traffic; internal

roads in the new city areas are wide but in old city roads very narrow and carry considerable traffic. However, regardless of where the construction takes place, all the work zones should be cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary “STOP” and “GO”).

12. **Figure A6.2 to Figure A6.6** illustrates a typical set-up for installing traffic control devices at the work zone of the area, depending on the location of work on the road way, and road geometrics:

- Work on shoulder or parking lane
- Shoulder or parking lane closed on divided road
- Work in Travel lane
- Lane closure on road with low volume
- Street closure with detour

13. The work zone should take into consideration the space required for a buffer zone between the workers and the traffic (lateral and longitudinal) and the transition space required for delineation, as applicable. For the works, a 30 cm clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 cm is necessary to install the temporary traffic signs and cones.

14. Traffic police should regulate traffic away from the work zone and enforce the traffic diversion result from full street closure in certain areas during construction. Flaggers/ personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type) for regulating the traffic during night time.

16. In addition to the delineation devices, all the construction workers should wear fluorescent safety vests and helmets in order to be visible to the motorists at all times. There should be provision for lighting beacons and illumination for night constructions.

Figure A6.2 and A6.3: Work on shoulder or parking lane and Shoulder or parking lane closed on divided road

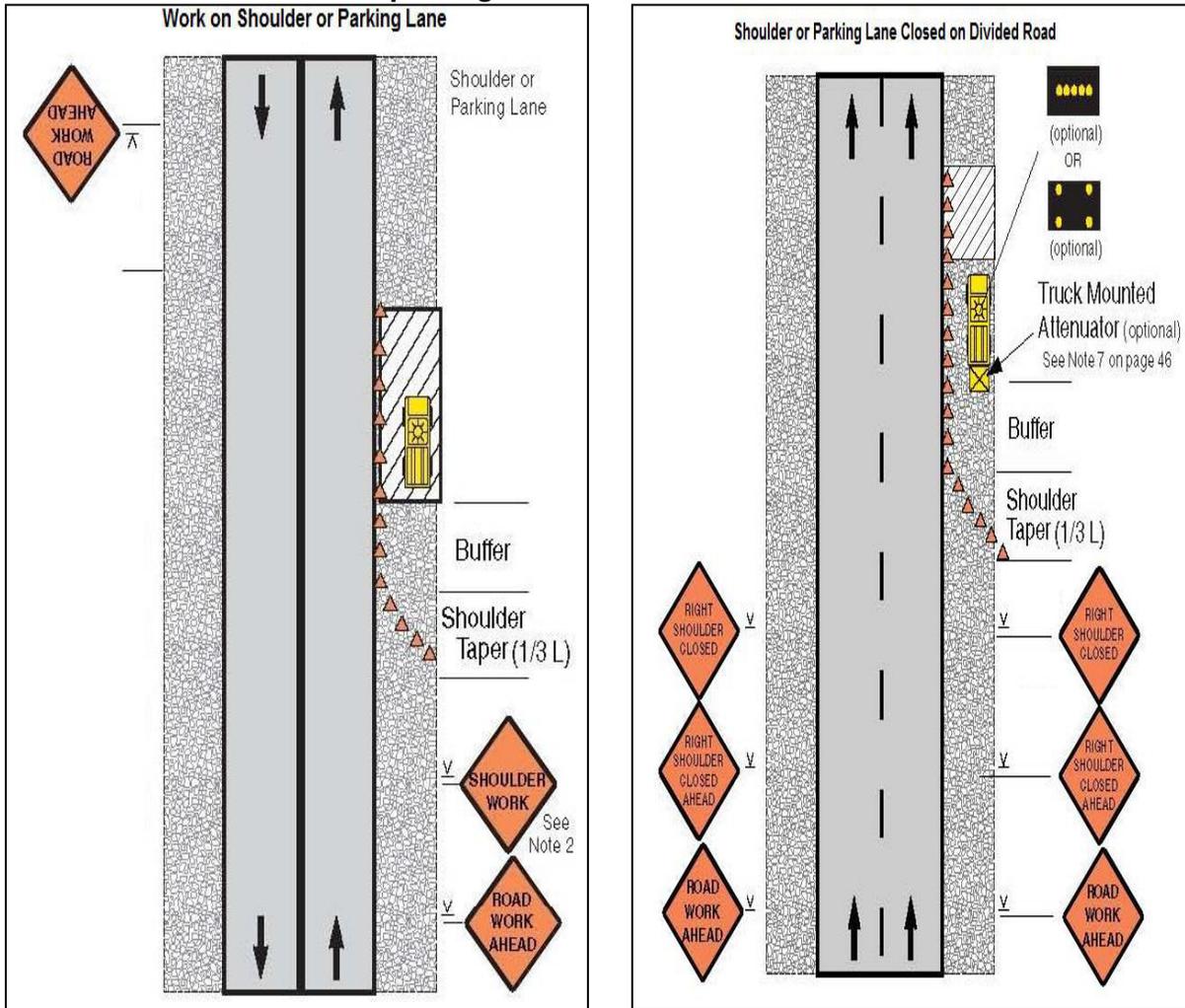


Figure A6.4 and A6.5: Work in Travel lane and Lane closure on road with low volume

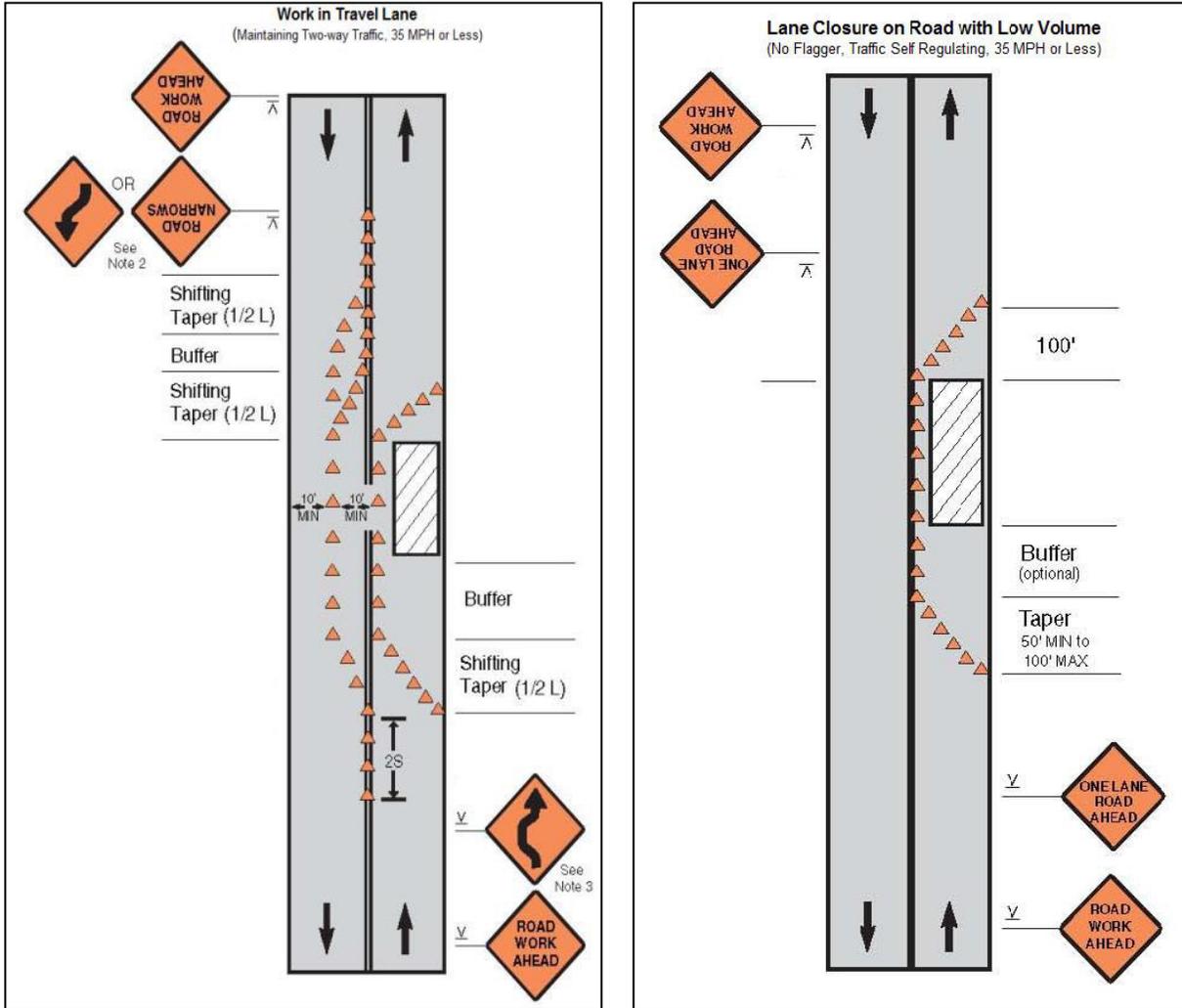
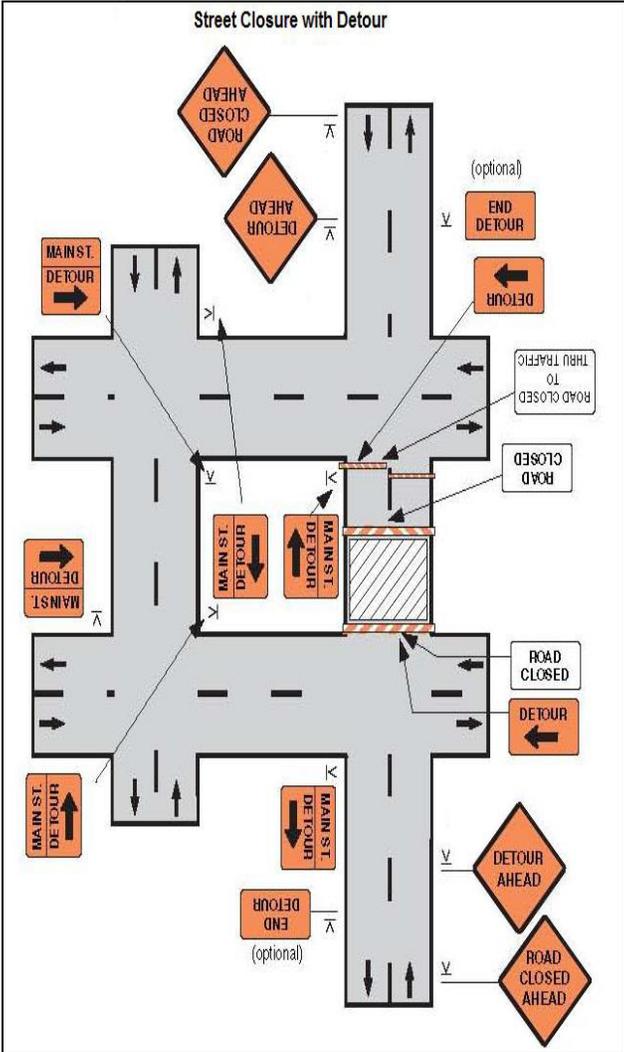


Figure A6.6: Street closure with detour



SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name _____
 Contract Number _____

NAME: _____ DATE: _____
 TITLE: _____ DMA: _____
 LOCATION: _____ GROUP: _____

WEATHER: _____

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Monitoring Items	Compliance
Compliance marked as Yes / No / Not applicable (NA) / Partially Implemented (PI)	
EHS supervisor appointed by contractor and available on site	
Construction site management plan (spoils, safety, schedule, equipment etc.) prepared	
Traffic management plan prepared	
Dust is under control	
Excavated soil properly placed within minimum space	
Construction area is confined; no traffic/pedestrian entry observed	
Surplus soil/debris/waste is disposed without delay	
Construction material (sand/gravel/aggregate) brought to site as and when required only	
Tarpaulins used to cover sand and other loose material when transported by vehicles	
After unloading, wheels and undercarriage of vehicles cleaned prior to leaving the site	
No AC pipes disturbed/removed during excavation	
No chance finds encountered during excavation	
Work is planned in consultation with traffic police	
Work is not being conducted during heavy traffic	
Work at a stretch is completed within a day (excavation, pipe laying and backfilling)	
Pipe trenches are not kept open unduly	
Road is not completely closed; work is conducted on edge; at least one line is kept open	
Road is closed; alternative route provided and public informed, information board provided	
Pedestrian access to houses is not blocked due to pipe laying	
Spaces left in between trenches for access	
Wooden planks/metal sheets provided across trench for pedestrian	
No public/unauthorized entry observed in work site	
Children safety measures (barricades, security) in place at works in residential areas	
Prior public information provided about the work, schedule and disturbances	
Caution/warning board provided on site	
Guards with red flag provided during work at busy roads	
Workers using appropriate PPE (boots, gloves, helmets, ear muffs etc)	
Workers conducting or near heavy noise work is provided with ear muffs	
Contractor is following standard and safe construction practices	
Deep excavation is conducted with land slip/protection measures	
First aid facilities are available on site and workers informed	
Drinking water provided at the site	
Toilet facility provided at the site	

Monitoring Items	Compliance
Separate toilet facility is provided for women workers	
Workers camps are maintained cleanly	
Adequate toilet and bath facilities provided	
Contractor employed local workers as far as possible	
Workers camp set up with the permission of PIU	
Adequate housing provided	
Sufficient water provided for drinking/washing/bath	
No noisy work is conducted in the nights	
Local people informed of noisy work	
No blasting activity conducted	
Pneumatic drills or other equipment creating vibration is not used near old/risky buildings	

Signature

Sign off

Name
Position

Name
Position

QUARTERLY REPORTING FORMAT FOR TCMC/PIU

1. Introduction

- Description of sub-project implemented by PIU
- Environmental category of the sub-project
- Details of site personnel and/or consultants responsible for environmental monitoring
- Sub-project status

No.	Sub-Project Name	Subproject status	List of Works	Progress of Works
		Design <input type="checkbox"/> Pre-Construction <input type="checkbox"/> Construction <input type="checkbox"/> Operational Phase <input type="checkbox"/>		

2. Compliance status with National/ State/ Local statutory environmental requirements

No.	Sub-Project Name	Statutory Environmental Requirements	Status of Compliance	Action Required

3. Compliance status with environmental loan covenants, if any

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

4. Compliance status with the environmental management and monitoring plan

- Provide the monitoring results as per the parameters outlined in the EMP. Append supporting documents where applicable, including Environmental Site Inspection Reports.
- There should be reporting on the following items which can be incorporated in the checklist of routine Environmental Site Inspection Report followed with a summary in the semi-annual report send to ADB. Visual assessment and review of relevant site documentation during routine site inspection needs to note and record the following:
 - What are the dust suppression techniques followed for site and if any dust was noted to escape the site boundaries;
 - If muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads;
 - adequacy of type of erosion and sediment control measures installed on site, condition of erosion and sediment control measures including if these were intact following heavy rain;
 - Are their designated areas for concrete works, and refuelling;

- Are their spill kits on site and if there are site procedure for handling emergencies;
- Is there any chemical stored on site and what is the storage condition?
- Is there any dewatering activities if yes, where is the water being discharged;
- How are the stockpiles being managed;
- How is solid and liquid waste being handled on site;
- Review of the complaint management system;
- Checking if there are any activities being under taken out of working hours and how that is being managed.

Summary Monitoring Table

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

Overall Compliance with EMP

No.	Subproject Name	EMP Part of Contract Documents (Y/N)	EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

5. **Approach and methodology for environmental monitoring of the project**
 - Brief description on the approach and methodology used for environmental monitoring of each sub-project

6. **Monitoring of environmental impacts on project surroundings (ambient air, water quality and noise levels)**
 - Brief discussion on the basis for monitoring

- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 µg/m ³	SO ₂ µg/m ³	NO ₂ µg/m ³

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM10 µg/m ³	SO ₂ µg/m ³	NO ₂ µg/m ³

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Noise Quality Results

Site No.	Date of Testing	Site Location	LA _{eq} (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA _{eq} (dBA) (Monitoring Results)	
			Day Time	Night Time

7. Summary of key issues and remedial actions

- Summary of follow up time-bound actions to be taken within a set timeframe.

8. Appendixes

- Photos
- Summary of consultations conducted, if any
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- Other

DETAILS OF PUBLIC CONSULTATION

திருநெல்வேலி மாநகராட்சி

திருநெல்வேலி மாநகராட்சியில் புதிதாக மேற்கொள்ளப்பட உள்ள பாதாள சாக்கடை திட்டம் அங்குத் பகுதி -1 2016-17 குறித்த பொதுமக்கள் மற்றும் அரசு துறை அலுவலர்கள் 03.11.2017 அன்று மாலை 4.30 மணியளவில் மாநகராட்சி ஆணையாளர் (பி) அவர்கள் தலைமையில் நடைபெற்ற கலந்துரையி்வு கூட்ட நடவடிக்கைகள்.

- ❖ திருநெல்வேலி மாநகராட்சியில் அங்குத் திட்டம் 2016-17 -ல் பகுதி 1-ன் கீழ் ரூ.289.01 கோடி மதிப்பீட்டில் தாமிர்பரணி ஆற்றின் மேற்கு பகுதியில் அமைந்துள்ள திருநெல்வேலி மற்றும் தச்சதல்லூர் மண்டலம் பகுதிகளில் பாதாள சாக்கடை திட்டம் நிறைவேற்றப்பட உள்ளதாக விளக்கக் காட்சி (Power Point) மூலம் விளக்கப்பட்டது.
- ❖ மேலும், இம்மாநகராட்சி தாமிர்பரணி ஆற்றின் கிழக்குப் பகுதியில் அமைந்துள்ள பாளையங்கோட்டை மற்றும் மேல்பாளையம் மண்டலப் பகுதிகளில் விடுபட்ட பகுதிகளுக்கு அங்குத் திட்டம் 2017-18 -ன் கீழ் ரூ.315.04 கோடியில் பாதாள சாக்கடை பணிகள் செய்யப்பட உள்ளதாக விளக்கக் காட்சி (Power Point) மூலம் விளக்கப்பட்டது.
- ❖ முன்னாள் மாமன்ற உறுப்பினர் திரு.ஐ.விஜயன் அவர்கள் சாந்திநகர் பகுதி முழுவதும் பாதாள சாக்கடை திட்டம் செயல்படுத்தப்பட வேண்டும் எனவும் குடிசை பகுதிகளுக்கு முன்னுரிமை அளிக்கப்பட வேண்டும் எனவும் தெரிவித்தார். மாநகராட்சிப் பகுதிகளில் விடுதலின்றி அமைத்துப் பகுதிகளிலும் பாதாள சாக்கடை திட்டம் நிறைவேற்றப்படும் என ஆணையாளர் (பி) அவர்களால் தெரிவிக்கப்பட்டது.
- ❖ முன்னாள் மாமன்ற உறுப்பினர் திரு.பாலன் அவர்கள் பாளை, ஹைகிரவுண்ட் ஆஸ்பத்திரி பகுதியையும் பாதாள சாக்கடை திட்டத்தில் சேர்க்க வேண்டும் என தெரிவித்தார். மாநகராட்சிப் பகுதிகளில் விடுதலின்றி அமைத்துப் பகுதிகளிலும் பாதாள சாக்கடை திட்டம் நிறைவேற்றப்படும் என ஆணையாளர் (பி) அவர்களால் தெரிவிக்கப்பட்டது.
- ❖ தெற்கு பாலையநகர் பகுதியை சாந்த பொதுமக்கள் தெற்கு பாலையநகர் 7 தெருக்களிலும் பாதாள சாக்கடை திட்டம் விடுபட்டுள்ளது என தெரிவித்தனர். அதற்கு மேற்படி பாலையநகர் பாதாள சாக்கடை திட்டம் பகுதி -1 ல் சேர்க்கப்பட்டுள்ளது என ஆணையாளர் (பி) அவர்களால் தெரிவிக்கப்பட்டது.
- ❖ மனித நேய மக்கள் கூட்சி உறுப்பினர் மேல்பாளையத்தில் விடுபட்ட பகுதிகளில் பாதாள சாக்கடை திட்டத்தை செயல்படுத்த வேண்டும் என தெரிவித்தார். அதற்கு மேற்படி மேல்பாளையம் பகுதி பாதாள சாக்கடை திட்டம் பகுதி -2 ல் சேர்க்கப்பட்டுள்ளது என ஆணையாளர் (பி) அவர்களால் தெரிவிக்கப்பட்டது.

A consultative public opinion meeting regarding the implementation of the extension of the UGD system was held at the corporation premises on 3.11.17 at 4.30 pm. Representatives of various associations, former corporation councilors and the public participated in the meeting. The Commissioner (i/c), Tirunelveli Corporation said that the government has given administrative sanction for the phase II and Phase III phase of Under Ground Drainage Scheme at the left out areas of Thatchanallur, Tirunelveli situated in western bank of Tamirabarani River, and Palayamkottai and Melapalayam Ward Office in eastern bank of Tamirabarani River.

Representatives requested that left out areas in Balabhagya Nagar be included in the proposal, and uncovered areas like Melapalayam be provided with sewerage system. After listening to the queries, the Commissioner (D) also informed that the above scheme will be implemented in entire corporation area without any omission. The Commissioner (i/c) also

informed that the UGD work will be implemented in two phases covering the entire corporation without any omission. Further, it is proposed to implement the UGSS scheme in phased manner including the areas on the banks of the Tamirabarani River, preventing pollution of Tamirabarani river. The sanction for the above work has been given for the first phase, the tender process would begin soon. The Minutes of the meeting in Tamil is stated below.

Newspaper Clippings announcing about consultation

தினகரன் (தினகரன்) 2/11/2017

விடுபட்ட பகுதிகளில் பாதாள சாக்கடை திட்டம் அமல்

நெல்லை மாநகராட்சியில் நாளை கலந்தாய்வு கூட்டம்

நெல்லை, நவ. 2: விடுபட்ட போன பகுதிகளில் பாதாள சாக்கடை திட்டத்தை அமல்படுத்துவது குறித்து நெல்லை மாநகராட்சியில் நாளை (3ம் தேதி) கலந்தாய்வு கூட்டம் நடக்கிறது.

நெல்லை மாநகராட்சியில் அம்மூத்த திட்டத்தின் (2016-17) கீழ் ரூ. 289.01 கோடியில் நெல்லை, தச்சநல்லூர் மண்டலத்தில் 1வது வார்டு முதல் 7வது வார்டு மற்றும் 39வது வார்டு முதல் 55வது வார்டுகளில் விடுபட்டு

போன பகுதிகளில் பாதாள சாக்கடை அமைக்க நிர்வாக அனுமதி வழங்கப்பட்டுள்ளது. இதையடுத்து திட்டத்தின் கீழ் நெல்லை மாநகராட்சியில் பாதாள சாக்கடை திட்டத்தை விரிவாக்கம் செய்வதற்கும், இத்திட்டம் செயல்பாட்டில் இல்லாத மீதி அனைத்து பகுதிகளிலும் எவ்வித விடுதலும் இன்றி செயல்படுத்துவது குறித்தும் நெல்லை மாநகராட்சியில் நாளை (3ம் தேதி) மாலை 4.30 மணிக்கு கலந்தாய்வு கூட்டம் நடக்கிறது. இதில் பொதுமக்கள் அரசுத் துறை அலுவலர்கள் தவறாமல் பங்கேற்று ஆலோசனை தெரிவிக்க மாநகராட்சி நிர்வாக தரப்பில் வேண்டுகோள் விடப்பட்டுள்ளது.

கும், இத்திட்டம் செயல்பாட்டில் இல்லாத மீதி அனைத்து பகுதிகளிலும் எவ்வித விடுதலும் இன்றி செயல்படுத்துவது குறித்தும் நெல்லை மாநகராட்சியில் நாளை (3ம் தேதி) மாலை 4.30 மணிக்கு கலந்தாய்வு கூட்டம் நடக்கிறது. இதில் பொதுமக்கள் அரசுத் துறை அலுவலர்கள் தவறாமல் பங்கேற்று ஆலோசனை தெரிவிக்க மாநகராட்சி நிர்வாக தரப்பில் வேண்டுகோள் விடப்பட்டுள்ளது.

கும், இத்திட்டம் செயல்பாட்டில் இல்லாத மீதி அனைத்து பகுதிகளிலும் எவ்வித விடுதலும் இன்றி செயல்படுத்துவது குறித்தும் நெல்லை மாநகராட்சியில் நாளை (3ம் தேதி) மாலை 4.30 மணிக்கு கலந்தாய்வு கூட்டம் நடக்கிறது. இதில் பொதுமக்கள் அரசுத் துறை அலுவலர்கள் தவறாமல் பங்கேற்று ஆலோசனை தெரிவிக்க மாநகராட்சி நிர்வாக தரப்பில் வேண்டுகோள் விடப்பட்டுள்ளது.

மக்கள்
லந்து
என
ள் ஆவு
சித்துள்

தலைநார்.
நேற்று

பாத்திருந்
ப

க்த
மாக நார்ஜு
சென்றது.

பை
எளி
பை
ந்து
க
வ
ட்
ஆழ்
சார்

புறனர்

நெல்லை மாநகராட்சி பகுதியில்
பாதாள சாக்கடை திட்டம் குறித்து
நாளை ஆலோசனைக்கூட்டம்

நவ. 2-
கராட்சி
ாளச்ச
குறித்த
கூட்டம்
ஆலோசனைக்
கூட்டம்
நாளை
நடக்கிறது.
நெல்லை
கராட்சியில்

17ன் கீழ் ரூ. 289.01 கோடி
யில் நெல்லை மற்றும் தச்ச

செய்வதற்கும் மேலும் இத்
திட்டம் செயல்பாட்டில்
இல்லாத மீதமுள்ள பகுதி
கள் அனைத்திற்கும் எவ்
வித விடுதலுமின்றி பாதா
ளச்சாக்கடை திட்டத்தினை
செயல்படுத்தும்
பொருட்டு நாளை (3-
நாளை)

மணிக்கு நெல்
ராட்சி கூட்ட
கில்

தாய்வுக்கூட்டத்தில் பொது
மக்கள் மற்றும் இதர அரசு

ட்டம் நிறைவேற்றப்பட
ர்வாக அனுமதி வழங்கப்
இந்த

ரிவிக்கலாம்.

சத்தியமூர்த்தி தெரு
பேருந்து நிலையம்
நெல்லை மாநகராட்சி

நெல்லை - அம்மூத்த பகுதிகளில்

List of Participants

#	Name	Phone Number	Address	Signature
1	P. Santanam Narayanan	9787486786	Dist. Secretary Congress	[Signature]
2	P. Sakthimothy	9442520549	Retired A.T.O.	[Signature]
3	K. [Name]	8760452646	4th ward	[Signature]
4	[Name]	9952216955	12 ward	[Signature]
5	S. [Name]	9486481108	12 ward	[Signature]
6	I. VIJAYAN	9443194953	12th ward	[Signature]
7	[Name]	9443559600	44 ward	[Signature]
8	R. [Name]	9845534443	A. [Address]	[Signature]
9	V. Gopalan	9442572214	2628 [Address]	[Signature]
10	S. [Name]	9487007754	103 [Address]	[Signature]
11	L. [Name]	9442166445	192 [Address]	[Signature]
12	[Name]	9442317492	20 [Address]	[Signature]
13	P. [Name]	9442269750	[Address]	[Signature]
14	S. Sreedharan	[Number]	[Address]	[Signature]
15	P. Abraham Johny	[Number]	[Address]	[Signature]
16	Mr. Arumugam	[Number]	[Address]	[Signature]
17	C. SIVAKUMAR	9442891668	N.G.O. NEW COLONY VICE PRESIDENT	[Signature]
18	S.S. Muthu	9442628035	N.G.O. New Colony	[Signature]
19	B. Gopala Krishna	94432-90522	[Address]	[Signature]
20	D. Joseph	9345134551	St. Xavier Colony	[Signature]
21	M. A. JESUCELIN	9790205455	Secretary [Party]	[Signature]
22	M. [Name]	[Number]	C.P.I.M. [Address]	[Signature]
23	V. Thangavel	9489437387	President [Party]	[Signature]
24	M. Thangavel	9442514542	[Address]	[Signature]
25	S. Balasubramanian	9443241303	[Address]	[Signature]
26	A. Balasubramanian	9445363300	Melichinaga	[Signature]
27	K. Velu Sarani	[Number]	[Address]	[Signature]
28	P. Esuvaranthy	9443508664	C.P.I.M. Nellore	[Signature]
29	C. [Name]	94421-29374	B.J.P. Nellore	[Signature]
30	A. [Name]	9442061203	DMK-Exc NC	[Signature]
31	[Name]	[Number]	[Address]	[Signature]
32	[Name]	[Number]	[Address]	[Signature]

Report in Newspaper

Govt sanctions UGD scheme at left out areas

Phase I work will be carried out at an estimated cost of ₹289 crore

EXPRESS NEWS SERVICE
@ Tirunelveli

TIRUNELVELI Municipal Corporation Commissioner (In-charge), V Narayanan Nair, said that the government has given administrative sanction for the 1st phase of underground drainage (UGD) scheme at an estimated cost of ₹289 crore at the areas left out in Thatchanallur and Tirunelveli zones of the municipal corporation.

A consultative meeting regarding the implementation of the extension of the UGD system was held at the corporation premises on Friday. Representatives of various associations, former corporation councillors and the public participated in the meeting. After listening to their opinions, Nair, who chaired the meeting, said that the government had given administrative sanction under the AM-

RUT (Atal Mission for Rejuvenation and Urban Transformation) Scheme for implementing the UGD system at the left out areas in Wards 1 to 7 and Wards 39 to 55 of Thatchanallur and Tirunelveli zones.

Nair pointed out that the UGD work would be conducted in two phases. With around 59 thousand connections, UGD Phase-1 will cover 234 km, including the areas on the banks of the Thamirabarani River. He noted that as the sanction has been given for the first phase, the tender process would begin soon.

Nair further said that government gave permission in principle for the second phase of the scheme at an estimated

cost of ₹315.04 crore.

Stating that around ₹700 crore is required for implementing the scheme, Nair said that part contributions would come from Central and State governments. It is also proposed to get a loan from Asian Development Bank, he said.

Nair mentioned that when implementing the scheme, the problems in the areas where the scheme was implemented in 1989 and 2009 would be identified and rectified. He added that the sewage was getting mixed at 16 locations in the Thamirabarani and that the UGD would now prevent it.

Assistant commissioners Geetha, Subbulakshmi, Kavitha and Vasantharajan among others participated.



The UGD scheme is being implemented considering the population in 2050. Opinions aired at meeting will be sent to government. An expert committee will consider the opinions

V Narayanan Nair, Commissioner (in-charge)

Photographs of Stakeholder Consultations Held on 3 November 2017

