COMMISSIONERATE OF MUNICIPAL ADMINISTRATION
CHEPAUK, CHENNAI 600 005

DEDICATED WATER SUPPLY SCHEME
TO
SALEM CORPORATION

DETAILED PROJECT REPORT

Volume IV

Final Environmental Impact Assessment Report

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EXECUTIVE SUMMARY

Introduction

Salem Municipality which was formed in 1866 with an area of about 21sq km has been upgraded as Municipal Corporation (SMC)with effect from 01-04-1994 by extending the adjacent areas such as Suramangalam, Jagirammapalayam Municipalities and 21 other villages to cover an extent of 91.34 sq km. The population of Salem Municipal Corporation (SMC) as per the census during 2001 was 6,93,236 and estimated to be around 7,53,800 in 2007. Salem Town receives water for distribution from the only source Cauvery River under two different schemes (i) Mettur-Salem Scheme executed in the 1950s and maintained by Salem Corporation and (ii) Salem-Attur combined water supply scheme executed in the 1990s and maintained by TWAD Board. Both are combined water supply schemes feeding identified en-route villages. Salem town is at present receiving total of 65 to 70 MLD of water from both the schemes against the present requirement of about 110 MLD.

2. Existing Water Supply Schemes

The existing water supply schemes and the quantity of water drawn for Salem Corporation and the en-route beneficiaries are as given in Table 1.1 below:

Table: 1.1 Water available to Salem through the Two Schemes

Name of Scheme	Total Drawal	Qty at WTP inlet	Qty at WTP Outlet	Supply to Salem	Supply to urban towns & villages
Salem - Mettur	27MLD	27MLD	25.7MLD	12MLD	13.7MLD
Salem – Attur	90MLD	88.30MLD	84.1MLD	53.5MLD	30.6MLD

Under the first scheme, the beneficiaries are Jalagandapurm, Vanavasi, Nangavalli, Tharamangalam Town Panchayats and 24 Rural Habitations, while the beneficiaries under the second scheme are Attur, 11 other towns and 264 Rural Habitations. Subsequently, improvement works have been carried out by TWAD Board / SMC for providing feeder mains, refurbishment of raw water and clear water pump sets, construction of additional service reservoirs and extension of the distribution system within the town. The execution of some of the works is still ongoing.

3 Dedicated Water Supply Scheme to Salem Corporation - Scope

Considering the increasing demand of water supply to Salem Municipal Corporation as per the standards prescribed for the present and future year requirements, the Dedicated Water Supply Scheme has been formulated. An underground Sewerage Scheme for Salem Corporation area has been taken up for implementation. The population adopted for Sewerage Scheme with Base Year 2010 is now adopted for Water Supply as given below:

i)	Base year	2010 - 8,20,000
ii)	Intermediate year	2025 - 10,52,000
iii)	Ultimate year	2040 - 13,24,000

3.1 Strategy for Dedicated Water Supply Scheme

Involvement of two institutions TWAD Board and SMC and distribution to multiple beneficiaries have resulted in operational constraints in sharing of responsibilities and costs. For designing the proposed water supply scheme, the Salem Municipal Corporation has decided as follows:

i) The Salem-Mettur supply scheme will continue to be maintained by Salem Corporation and all the wayside beneficiaries will be disconnected from this main to ensure about 20 MLD of water is available exclusively to Salem.

ii) Water supply to Salem Corporation will be disconnected from Salem – Attur scheme. TWAD Board will maintain this scheme and supply water exclusively for (i) wayside beneficiaries of Salem- Attur scheme as is now done and (ii) to the wayside beneficiaries disconnected from Mettur-Salem scheme.

iii) A dedicated water supply scheme will be implemented for Salem Municipal Corporation to meet the ultimate demand by taking in to account 20 MLD that will be available through Mettur- Salem scheme.

3.2 A technical analysis was carried out and it is confirmed that Salem -Attur scheme is capable of catering to the beneficiaries disconnected from Salem Mettur- Scheme as proposed above in addition to the existing beneficiaries.

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3.3 Projected Demand

The service area is the entire Salem Corporation area covered under sewerage scheme recently approved. The water demand for the ultimate year 2040 has been worked out with per capita rate of supply as 135 liters as per CPHEEO norms. There are no major water consuming industries in the Corporation area. Additional provision has been made for Industries and Institutions based on discussions with the local body. In respect of losses, CPHEEO prescribes a UFW limited to 15 %. In view of the long length of Transmission main and the age of the existing system, losses have been proposed as 15 % for the new project.

Table: 1.2 below indicates the water required for various design periods.

Table: 1.2 Water requirements for various design periods

Sl. No.	Description	Water required in MLD		
		Base year 2010	Intermediate year 2025	Ultimate year 2040
1	Population	820000	1052000	1324000
2	For Domestic requirement at 135 lpcd	110.70	142.02	178.74
3	Water Required for Industries, Institutions, IT Park, Railways, Super Specialty Hospital and Diary	10.00	12.50	15.00
4	Total Demand	120.70	154.52	193.74
5	Water available to Salem through Mettur - Salem Scheme	20.00	20.00	20.00
6	Balance Requirement	100.70	134.52	173.74
7	Add for losses in transmission and distribution at 15%	15.11	20.18	26.06
	Total quantity to be augmented in the new scheme	115.81 (say 116)	154.70 (Say 155)	199. 80 (say 200)

4. Dedicated Water Supply Scheme - Components

4.1 The location of Head works also influences the alignment of Transmission main. Four alternatives were examined for the alignment and finally it was decided on the basis of costs, land availability and convenience of construction to locate the source and WTP at Thottilpatti on the east side of the river and pipe line alignment parallel to the existing pipeline of Salem-Athur scheme with Booster at Komburankadu ridge sump at Pazhakaranur.

4.2 The source is located at Thottilpatti which is about 200m downstream of Mettur Dam. The nearest gauging station maintained by the Central Water Commission is at Urachikottai about 40km downstream of Thottilpatti. As per CWC statistics the 90% dependable flow is available at Urachikottai as below:

Sl.No		MLD	Cumecs	MCM/year
1	Water requirement	290	3.36	105.84
2	90% Dependable flow in Urachikottai (1979-2001)	12394.52	143.46	4524
3	100 % Dependable flow in Urachikottai (1979-2001)	8139.73	94.21	2971

Reliability of source is thus confirmed based on a 23 year record. Salem Corporation has taken action to obtain permission for water allocation.

5. Environmental and Social Impact Assessment Study

5.1 Environmental Assessment: The parameters taken into account for Environmental Assessment of a typical water supply project is furnished below:

- Environmental Setting
- Analysis of Alternatives
- Prediction and Assessment of Impacts

- Land Acquisition and Project Affected Persons

Drawal of 200 mld from the source will not have any impact as the quantity is marginal compared to the availability. There are no negative impacts after commissioning but some are evident during construction. The number of positive impacts due to availability of safe water outweighs the marginal negative impacts during construction stage and the project as a whole has a positive effect since it takes care of preventive health of the citizens on a long term basis.

The Environmental Management Plan (EMP) addresses the requirements for successfully mitigating the likely adverse impacts during construction and identifies the post project monitoring requirements needed for the successful implementation of the suggested mitigation measures.

5.2. Social Assessment:

No fresh land acquisition is proposed as the lands for head works, water treatment plant and booster stations are already in the custody of the Corporation. The transmission main and gravity main will be laid along (i) roads owned by the Corporation in most of the alignment and (ii) roads owned by the State Government in certain reaches for which necessary permission will be obtained. There is no cross-country alignment. Two railway crossings are involved for which culverts are available below the railway line for laying the pipe line and no fresh land acquisition is required.
Since there is no land acquisition, there are no project affected persons.

5.3. Conclusion:

Based on the above observations, it may be concluded that all the identified environmental and social risks due to the construction and operation of the project have been adequately assessed and mitigated through the recommended EMP. Also, adequate precautions have been built through elaborate environmental monitoring recommendations to provide a true picture of the performance of the project on environmental and social aspects.

DETAILED REPORT

Chapter 1
Introduction

1.1 Salem City.

Salem city, geographically located centre to the region consisting of Tamilnadu, Kerala and the Southern part of Karnataka State, is a major business center besides serving a number of small towns and villages surrounding it. Its strategic location has contributed to the fast development of Salem City as the focal point for road transportation network serving this region. The major National Highways NH 7 and NH 47 are passing through this town and the extensive railway network connects this town to the urban centers of the neighboring regions and to the other parts of the country. The prominence of Salem City is attested by the existence of major industries and institutions such as, Steel Plant, Burn Standard & Co., (Government of India Undertaking), Dalmia Magnesite Ltd, Tamilnadu Magnesite Ltd, Sago Serve Ltd (Co-operative Society), Spinning Mills, Power looms / Dyeing factories, Super specialty Hospital, IT Park, New Railway Division, Diary Farm and many educational institutions.

1.2 Salem City Municipal Corporation

Salem City is the Head Quarters of Salem District and was upgraded as a Corporation in the year 1994. Salem City Municipal Corporation encompasses a total area of 91.34 Sq.Km. and is located at a distance of 340 km South West of Chennai. Salem is considered to be the fifth largest city in Tamilnadu. The people living in the project area are mainly engaged in weaving and agriculture. Besides being an important business center Salem Town is also having a number of textile industries, Power looms, Refractory, Mining works in and around Salem in very large numbers.

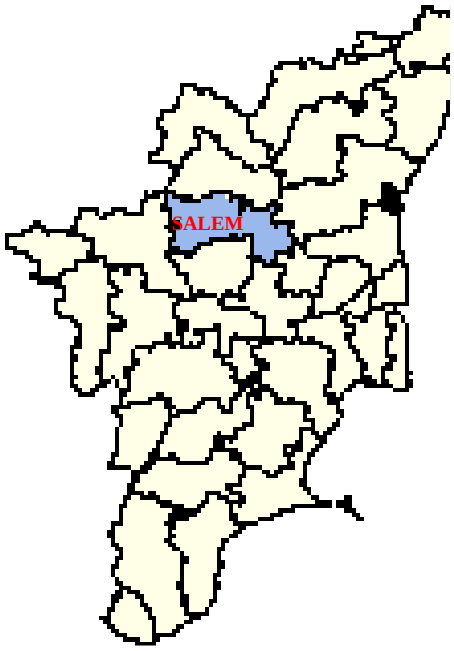
1.3 Profile of Salem Municipal Corporation

The City is situated at an altitude of 284.00 m above mean sea level. The contour ranges from 264.00 m to 324.00 m. The climate is generally moderate. The Climate during the summer is 39.8^0C (max) 31.0^0C (min) & during winter31.0^0C (max) 18.0^0 C (min). However, a very hot climate prevails during the month of April/May. The average annual mean rainfall is 920 mm.

Salem Municipality has been upgraded as Municipal Corporation with effect from 01.04.1994 as per the G.O.Ms.No.108 MA&WS Department dated 31.03.1994. Certain adjoining Village Panchayats, Town Panchayats and one Municipality have been added into the Salem Municipal Corporation. The Govt. of Tamilnadu have constituted and notified the Area comprising the Salem Corporation, 8 Town Panchayats and 154 villages around the city as Salem Local Planning area (SLPA) in G.O.Ms No.56 Housing and Urban Development Dept. dt.10.2.97.

The percentage of developed land in the city is 48.71% and the SLPA is 11.93%. About 51.29% of land in the city and 88.07% in the total SLPA remains undeveloped. Of this land, 24.8% of the land in the city and 9.7% of the land in the SLPA has the potential to

Locati on Map of Salem



develop within the coming decade itself. The Corporation comprises the following areas depicted in **Table 1.1** below:

Table 1.1: Salem Corporation Area wise Census

Sl.No.	Name of the Union/ Panchayat/ Municipality	2001 census population
1	Salem Municipality	434295
2	Suramangalam Municipality	37944
3	Kannankurichi TP Ward No. 12	1403
4	Jagir Ammapalayam	17788
5	Jagir Reddipatti	5798
6	Jagir Kammanaickenpatti	3321

8	Reddiyur	2902
9	Alagapuram	8701
10	Swarnapuri	1890
11	Alagapurampudur	10351
12	Chinnakollapatti	6797
13	Periyakollapatti	4492
14	Kumarasampatti	8878
15	North Ammapet	7184
16	South Ammapet	6860
17	Dadampatti	13460
18	Meyyanur	12159
19	Fairlands	3625
20	Seelanaickenpatti	36640
21	Sivathapuram	7696
22	Kandampatti	5786
23	Pallapatti	7534
24	Ariyagoundampatti	3830
25	Annathanapatti	20728
26	Jagirkondalampatti	17050
	Total	**693236**

Chapter 2
Existing Water Supply System

2.1 There are two existing water supply schemes, Mettur-Salem Water Supply Scheme otherwise called Salem Water Supply Scheme maintained by Salem Municipal Corporation and Salem- Attur Combined Water Supply Scheme maintained by TWAD Board, both drawn from Cauvery river with treatment plants at Nangavalli and Komburankadu respectively functioning satisfactorily. Details of drawal are given in **Table 2.1** below:

2.2

Table 2.1: Existing Water Supply Schemes

Name of Scheme	Total Drawal	Qty at WTP inlet	Qty at WTP Outlet	Supply to Salem	Supply to urban town & villages
Mettur- Salem	27MLD	27MLD	25.7MLD	12MLD	13.7MLD
Salem - Attur	90MLD	88.30MLD	84.1MLD	53.5MLD	30.6MLD

2.2 Mettur- Salem Water Supply Scheme

A protected water supply scheme with river Cauvery as source was commissioned during the year 1952. The scheme was designed for 12 MLD. Subsequently, during 1980, infrastructure for drawing additional quantity of 15 MLD had been installed. Under this combined scheme, the raw water is drawn from Stanley Reservoir (Mettur Dam) through Raman Intake Tower by means of 9500 lpm x 45 m turbine pump sets 2 Nos. and 10500 lpm x 45 m turbine pump sets 1 No. and conveyed to the online Booster station at Karumalaikoodal by two mains of 18" CI pipes for a length of 2070 m. From the online booster station, raw water is pumped by means of 5330 lpm x 165 m 2 Nos.; 9000 lpmx165 m 1No. 10000 lpmx165m centrifugal pump sets (including standby) for a length of 9140 m by two mains of 18" CI pipes to the treatment site at Nangavalli. After full scale treatment, the clear water is gravitated through two parallel CI conveying mains of size 450, 500 and 600 mm for a length of about 35 km laid along Nangavalli – Tharamangalam Road, and brought to Salem Town via Suramangalam and distributed. Also water is supplied from this scheme to Jalagandapurm, Vanavasi, Nangavalli, Tharamangalam TPs and 24 rural habitations of Salem District.

RAMAN INTAKE TOWER – METTUR SALEM SCHEME

RAMAN INTAKE TOWER – METTUR SALEM SCHEME

2.3 Salem – Attur combined water supply scheme (CWSS)

The Salem-Attur CWSS for 84.1 MLD had been commissioned during 1994 by TWAD Board for supplying water to Salem (53.5 MLD), 11 other towns and 264 rural habitations (30.6 MLD). The ultimate design period for this scheme is 2011, with base period 1981 which has been commissioned only during 1994 i.e. after 13 years of project design, almost while approaching the intermediate design period. This has resulted in a need for changing the pump sets during 2000 within a period of 6 years.

The intake tower for this scheme is located in the East side of Cauvery River downstream side close to the Stanley Reservoir. The water drawn from Cauvery is pumped to a ridge sump through a twin main of 900 mm dia. MS pipes for 520 metres and then gravitated to the WTP at Komburankadu through a 1000mm dia MS pipe for a distance of 3080 m. The capacity of the WTP is 88.30 MLD. The treated water of about 84.1 MLD is pumped to a ridge tank at Pazhakaranur, through a 1100mm dia M.S. Main for 2010 m and 1100 dia

Ammapet with 1100mm dia PSC, 700mm dia PSC and 600 mm dia CI pipes for a length of 39440 m. Before reaching Ammapet sump, the main delivers water to various ELSR's in Salem Town. From Ammapet Booster station, the water is conveyed to Athur and other beneficiaries.

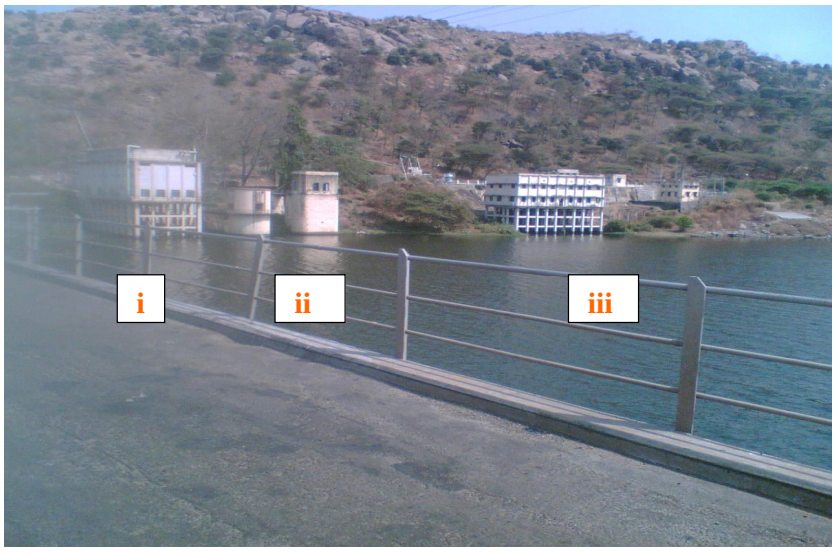
Subsequently, improvement works have been carried out for providing feeder mains, refurbishment of raw water and clear water pump sets, construction of additional service reservoirs and extension of the distribution system within the town. The execution of some of the works is still ongoing.

Recently, the Salem Corporation has installed electronic water meters at entry and exit points of the mains in Salem to assess the exact quantity of water received by Salem Corporation. The salient details of the two existing schemes are shown in **Table 2.2.**

Table: 2.2 - Salient Details of the two existing Schemes:

Sl. No	Particulars	Mettur- Salem Scheme	Salem- Attur Scheme
1	**Raw Water**		
	i) Source	Raman Tower inside Mettur Dam (Stanley Reservoir)	Down stream of Stanley Reservoir in River Cauvery
	ii) Qty drawn	27 MLD	84.1 MLD
	iii) Pump sets	9500 lpm x 45 m - 2 nos 2300 gpm x 45 m - 1 no	10500 lpm x 104 m - 4 nos and 11000 lpm x 98 m - 4 nos.
	iv) Conveying Main	CI 18" dia CI- 2 Nos - 2079 M	MS 900 mm dia x 2 nos -520 m
	v) Ridge sump		6LL(15 minutes detention time)
	vi)Booster Station Pumps capacity	Karumalaikudal 5300 lpm x 165 m - 2 Nos 9000 lpm x 165 m - 1 no 10000 lpm x 165 m – 2 nos	
	vii)Conveying Main	18" dia x 2 nos x 9140 m	MS 1000mm 3080 m
2	**WTP**		
	i) Location	Nangavalli	Komburankadu
	ii) Capacity	27 MLD	88.30 MLD
	iii) Technology	Conventional	Conventional
	iv) Length of Main from Source to WTP	11210 m	3080 m
	v) Quantity of treated water	25.70 MLD	84.134 MLD
3	**Clear Water**		
	i) Pumping / gravity	By gravity	Pumping upto Ridge Sump at Palakkaranur and then by gravity
	ii) Pump details		10500 lpmx128 m -4 nos, 10830 lpm x118- 4 nos
	iii) Length of clear water transmission main	From WTP to Salem 2 Mains- 20'' dia-25000M 2 Mains- 24'' dia-11000M	From WTP to Ridge Sump MS 1100 mm -2010 M & PSC 1100mm- 5250 m From Ridge sump to Ammapet: PSC 1100mm, 31040 m

	iv) Quantity of treated water available for Salem	12 MLD	53.5 MLD
	v) Transmission Pipe	Total length – 47210 m	Total length – 47550 m
	vi) Major ESR's served	10 nos	9 nos



EXISTING INTAKE STRUCTURES IN THE RIVER CAUVERY NEAR METTUR DAM

i) Salem-Athur Water Supply Headwork's
ii) Mettur Municipality Water Supply Headwork's
iii) M/s. SISCAL Headwork's

EXISTING PIPE CARRYING BRIDGE – SALEM ATTUR PROJECT

2.4 Need for the dedicated water supply Scheme

The population of Salem Corporation as per census 2001 is 6,93,236 which is estimated to be about 7,53,800 in the year 2007. Salem Corporation receives water for distribution to the residents from two schemes viz. Salem-Mettur Scheme maintained by Salem Corporation and Salem-Athur combined water supply scheme maintained by TWAD Board. The Salem-Mettur scheme has already served its design period and the design period of Salem-Athur Scheme is 2011. Moreover, the above schemes would have been designed for 90 lpcd (or less) rate of supply being a Municipality then. Consequent to Salem being a Corporation now, the rate of water supply to be adopted as per CPHEEO norms is 135 lpcd. Salem town is at present receiving 65 to 70 MLD of water from both the schemes whereas the present requirement itself is about 101.25 MLD. In addition, there is unequal distribution of water amongst the residents because of many extension of water mains carried out without design backup. Hence, there is an urgent need for a new scheme to satisfy the water demand as well as rectification of system constraints. While designing a new scheme, it has been proposed to have it as a dedicated system for Salem town alone to have more control and monitoring during the Operation and Maintenance of the scheme.

2.5 Dedicated Water Supply Scheme to Salem Corporation - Scope

Considering the increasing demand of water supply to Salem Municipal Corporation at the standards prescribed for the present and future year requirements, the Dedicated Water Supply Scheme has been formulated. The population projection for the design period was carried out using standard methods assuming the year 2010 as base year and design period of 30 years. The figures are as follows:

(a)	Design Period	:	30 years
	Base year	:	2010
	Intermediate Period	:	15 years (2025)
	Ultimate Period	:	30 years (2040)
(b)	Population	:	
	Population (2001)	:	6,93,236
	Base year Population (2010)	:	8,20,,000
	Intermediate Stage Population (2025)	:	10,52,000
	Ultimate Stage Population (2040)	:	13,24,000

2.6 Strategy for Dedicated Water Supply Scheme

Involvement of two institutions TWAD Board and SMC and distribution to multiple beneficiaries have resulted in operational constraints in sharing of responsibilities and costs. For designing the proposed water supply scheme, the Salem Municipal Corporation has decided as follows:

iv) The Salem-Mettur supply scheme will continue to be maintained by Salem Corporation and all the wayside beneficiaries will be disconnected from this main to ensure about 20 MLD of water is available exclusively to Salem.

v) Water supply to Salem Corporation will be disconnected from Salem – Attur scheme. TWAD Board will maintain this scheme and supply water exclusively for (i) wayside beneficiaries of Salem- Attur scheme as is now done and (ii) to the wayside beneficiaries disconnected from Mettur-Salem scheme.

vi) A dedicated water supply scheme will be implemented for Salem Municipal Corporation to meet the ultimate demand by taking in to account 20 MLD that will be available through Mettur- Salem scheme.

A technical analysis was carried out and it is confirmed that Salem -Attur scheme is capable of catering to the beneficiaries disconnected from Salem Mettur- Scheme as proposed above in addition to the existing beneficiaries.

2.7 Projected Demand

The water demand for the ultimate year 2040 has been worked out with per capita rate of supply as 135 liters as per CPHEEO norms. Provision has been made in addition for quantity required for Industries and Institutions. Minimum system loses has also been considered. Table: 1.2 below indicates the water required for various design periods:

Table: 1.2 Water requirements for various design periods

Sl. No.	Description	Water required in MLD		
		Base year 2010	Intermediate year 2025	Ultimate year 2040
1	Population	820000	1052000	1324000
2	For Domestic requirement at 135 lpcd	110.70	142.02	178.74
3	Water Required for Industries, Institutions, IT Park, Railways, Super Specialty Hospital and Diary	10.00	12.50	15.00
4	Total Demand	120.70	154.52	193.74
5	Water available to Salem through Mettur - Salem Scheme	20.00	20.00	20.00
6	Balance Requirement	100.70	134.52	173.74
7	Add for losses in transmission and distribution at 15%	15.11	20.18	26.06
	Total quantity to be augmented in the new scheme	115.81 (say 116)	154.70 (Say 155)	199. 80 (say 200)

Chapter 3
Dedicated Water Supply Scheme – Project Description

Salient Features of the Dedicated Water Supply Scheme are presented in Table 3.1 below:

Salient Features of the Project

Per capita requirement	135 lpcd
Existing water supply schemes	Salem-Mettur water supply scheme and Salem-Athur CWSS
Present level of supply	About 70 mld
Head Works	At Thottilpatti, Downstream of Mettur Dam
Raw water intake	Intermediate stage (2025) –155 mld, Ultimate stage (2040) – 206 mld
Hours of pumping	23
Raw water main	Total length – 100 m (1300 mm MS pipe)
Treatment Plant	At Thottilpatti – 155 mld (treated water), Clear water reservoir – 30minute storage
Booster station (Komburangadu)	At LS 7290 m. from WTP site. Sump capacity – 60minure storage, HSC Pumps –3 nos. of duty 37450 lpm x 120 m head each (plus 1 no. standby).
Ridge Sump	At Pazhakaranur 14555 m from WTP with a capacity of 12 minute storage.
Clear Water Transmission Main	Pumping main 14555 m (1300 mm dia MS). Gravity main 26600 m (1500 mm diaM.S pipes)
Feeder main	Pipes of sizes 1100 mm dia. to 700 mm dia MS/ pipes and 650 mm to 150 mm dia. DI pipes (K9) within the city limits.
Service Reservoirs	Construction of 21 additional SRs of varying capacities in side the City
Total Project Cost	Rs.283.09 cr.
Annual Maintenance Cost	Rs.23.20crore

3.1 Head Works

The head works (River Intake) and WTP are proposed to be located at Thottilpatti village in Block No. 56 and TS No. 5 of Mettur Taluk on the east side of River Cauvery near the bridge leading to Mettur Thermal Power Plant . The surplus course of Mettur is flowing on the right side of the site. The proposed Water Treatment Plant will be constructed in the vacant land adjacent to the existing Kadayampatty CWSS Treatment Plant at Thottilpatti. The land was earlier acquired by TWAD Board only for Salem project. An extent 12.5 Acres of land has been earmarked for the construction of the proposed Water Treatment Plant. There are no habitations nearby.

The off-take structure will be a raw water pump room rectangular of size 22 m x 10.22 m constructed over RCC framed structure resting on rock through a set of 18 independent columns and footings. The size of the pump house has been fixed to provide four pumps

ultimate demand. The raw water will be drawn from the river through a open channel excavated from deep bed of the river of length 30 m and size 2.0meter width. The construction of Head works will not affect the stream course as the head works is abetting the east side.

3.2 Raw Water Pump set

The pump sets are designed for the interim quantity to match the head required for interim demand. Considering the life of the pump sets based on the use rate, the pumps are assumed to serve for ultimate demand also by addition of one pump and replacing certain components such as shaft, impeller, bearings etc as against replacement of entire pumps.

It is proposed to install vertical turbine pump sets each of duty 38575 LPM against a head of 20 m, three working and one number standby with a total pumping capacity of 115725 LPM to meet the interim demand. The design is based on 23 hours pumping rate.

3.3 Raw Water Transmission Main

The raw water pumping main is proposed for a length of about 100 m for conveying raw water from head works to the proposed treatment plant to deliver 206 mld of raw water for ultimate demand.

Spirally welded MS pipes (with internal lining and external guniting using cement mortar) were considered in the design. The pipeline is designed for ultimate demand. The optimum size is arrived as 1300 mm dia based on the economic size design from head works to treatment plant. The working velocity is 1.45 m/sec and 1.68 m/sec for interim and ultimate requirements. The Raw water main is to be laid within head works compound from the Head works to the Aerator of WTP.

3.4 Proposed Water Treatment Plant

The treatment plant layout has been planned for the ultimate stage of capacity 200 mld but the construction will be in modules. This modular construction has been proposed for two reasons (i) to reduce the initial cost and (ii) the raw water quality is low for most of the chemical characteristics and probably a higher loading rate is possible for the various components of WTP. For this purpose components like piping, and preliminary units like cascade aerators raw water channel etc which can not be expanded later on will be constructed for the ultimate capacity while components like flash mixer, clariflocculator, filters, pumps etc will be provided for the intermediate capacity with provision to expand it later whenever required. The layout is prepared to provide space for future expansion to ultimate capacity at a later stage.

3.5 Raw Water and Treated Water Analysis

In order to arrive at the optimum treatment process and to design the treatment process units, results of Raw water, existing WTP output and Distribution system were obtained

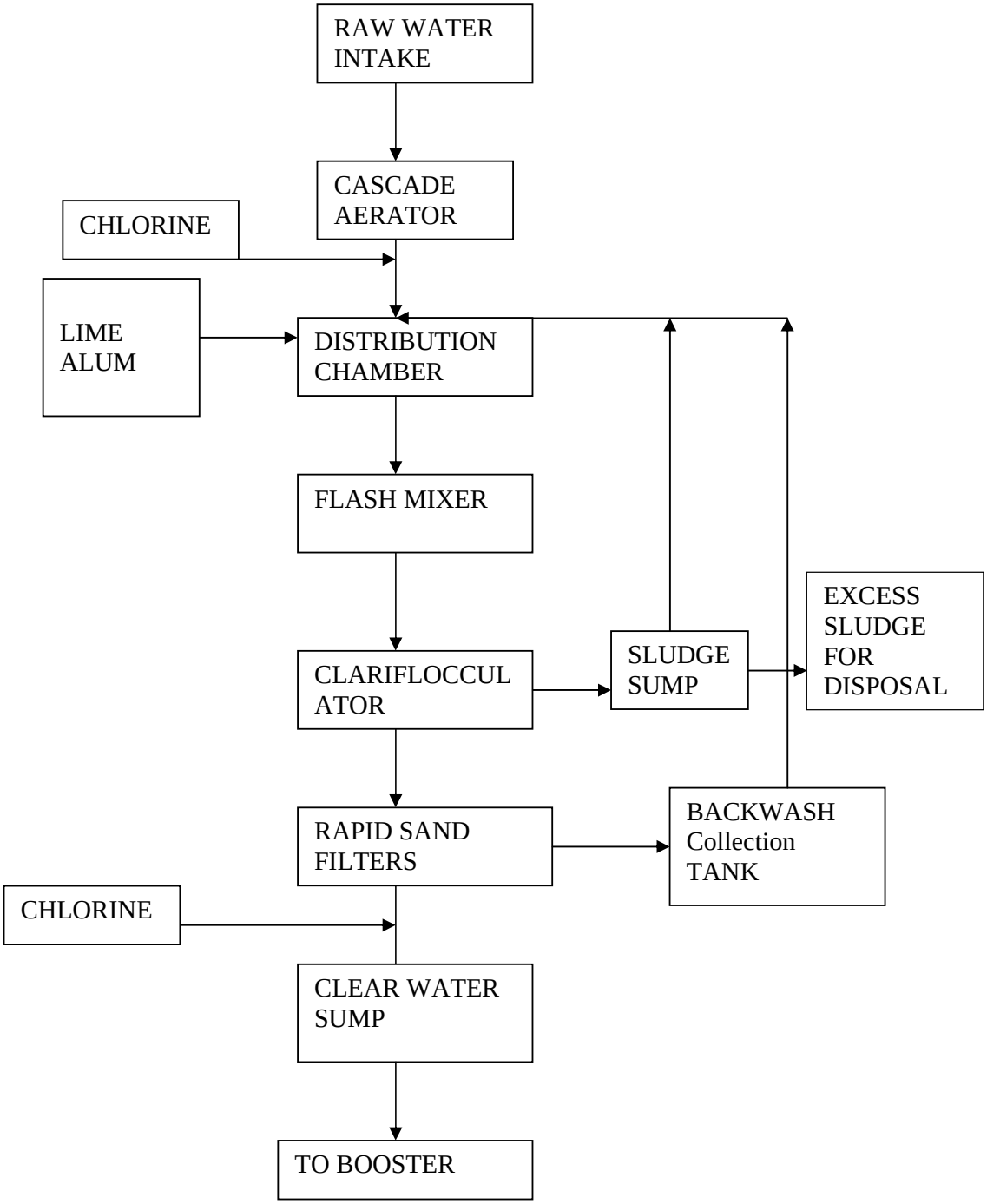
2007 and covers physical, chemical and microbial parameters. Vital parameters are given below:

Sl.No	Parameter	Range
I	PHYSICAL	
1	Turbidity NT units	2 to 3
2	Total Dissolved Solids mg/lit.	372 -146
3	Elect. Cond. microhm/cm	542 - 215
II	CHEMICAL	
1	pH	8.16 - 7.15
2	Total Alkalinity	192 - 72
3	Total Hardness as CaCO3	176 - 64
4	Calcium as Ca	38 - 16
5	Magnesium as Mg	19 - 6
6	Sodium as Na	51 - 11
7	Pottasium as K	3 to 2
8	Iron as Fe	0.2 - 0.1
9	Manganese as Mn	
10	Nitrite as No2	1.05 - 0.09
11	Nitrite as No3	5 to 1
12	Chloride as CI	40 - 11
13	Fluoride as F	0.3 - 0.2
14	Sulphate as SO4	19 - 3
15	Phosphates as PO4	
III	BIOLOGICAL	
1	Fecal Coliform per 100 ml	110 - 30

It is seen that the characteristics of raw water are within the respective permitted range of CPHEEO Manual for water supply.

3.6 Treatment Process

In view of the proven performance of the existing WTP process, the same process is considered for the proposed WTP. This is not withstanding the fact that the bidders will have an opportunity to quote for any other process. The water treatment plant shall consist of the following process operations/units:



DEDICATED WATER SUPPLY SCHEME TO SALEM CORPORATTION

WTP – PROCESS FLOW DIAGRAM

- *Pre chlorination*

  In order to keep the treatment plant units in disinfected condition and also to kill the algae in the raw water, it is proposed to provide pre-chlorination.

- *Aeration*

  The raw water contains traces of Iron and will get removed in aeration process. Cascade aeration has been proposed.

- *Coagulant dosing (Lime and Alum)*

  Lime, alum dosing has been proposed to aid coagulation of suspended solids. The exact dosing has to be arrived by conducting jar test. During major portion of the year, lime addition may not be required but provision has been made for the same to provide for any contingency for pH addition

- *Flash mixing*

  For effective mixing of the coagulants.

- *Flocculation*

  To aid formation of flocs before allowing to settle in the clarifiers.

- *Clarification*

  Various type of clarifiers is being offered like conventional radial flow clariflocculator, conventional sludge blanket clarifiers, tube settlers, pulsators etc. In order to get the most cost effective technology, it is proposed to give freedom to the Bidder to offer his technology.

- *Filtration*

  Rapid sand filters will be provided to bring down the turbidity to less than 1 NTU.

- *Post chlorination*

  The treated water shall be further chlorinated to maintain the minimum residual chlorine level in the treated water up to the entry to the city.

- *Chlorine contact tank/ clarified water sump*

  The treated water sump shall be provided with minimum 30 minutes detention time to serve the dual purpose of chlorine contact time and treated water storage.

  The treated water stored in the clear water sump will be pumped to the transmission main using Horizontal Split Casing Centrifugal pumps.

3.7 Clear Water Reservoir and Pump House

An underground sump and pump house is proposed for storing the treated water at the WTP site itself. Required Land is available within the WTP area. The pump house of size36m X 16m is proposed abutting the clear water sump which is designed to

demand. The size of tank proposed is 36.00m x 23.00m x 5.00m (effective storage). The effective storage will be about 30 minute capacity of ultimate demand.

3.8 Clear Water Pump sets

The horizontal split casing pump sets are designed to match the head required for interim demand as per reference to the CPHEEO Manual, both Centrifugal and Vertical Turbine pumps are considered optimal for this duty. Considering the experiences of using HSC pumps and its advantage in CMWSSB, HWSSB and BWSSB and also the advise of Technical Appraisal experts of World Bank Procurement wing It is proposed to install Horizontal Split Casing centrifugal pump sets each of duty 37450 LPM against a head of 76 m, three working and one number standby with a total pumping capacity of 112350 LPM for the interim demand. The design is based on 23 hours pumping rate.

3.9 Clear water pumping main from WTP to Booster at Komburankadu

In view of the long distance, the treated water to be conveyed to booster station at Komburangadu at a distance of about 7290 m from the WTP site crossing P.N.Patti and salem camp area.

The alignment of the pipes is along the existing service roads owned by the Corporation and hence no land acquisition or PAP is involved.

The land adjoining the alignment is not along thick forests. A general survey of alignment indicates that sufficient space is available trenching and no tree cutting is involved. However to avoid existing utilities etc limited tree cutting may perhaps be necessary.

The entire alignment of pumping main is in two reaches

3.10 Clear water pumping main from WTP to Ridge sump at Pazhakaranur

In view of the long distance, the treated water to be conveyed to booster station at Komburangadu at a distance of about 7290 m from the WTP site two alternatives were considered

i) a single line to reduce the cost but running the risk of dislocation of bursts; or

ii) Two parallel line for flexibility and reliability of operations.

The single line is preferred finally.

The alignment of the pipes is along the existing service roads owned by the Corporation and hence no land acquisition or PAP is involved.

The land adjoining the alignment is not along thick forests. A general survey of alignment indicates that sufficient space is available trenching and no tree cutting is involved. There may be few tree cutting to avoid existing utilities etc. Hence remedial measures will be taken by the Salem Corporation to plant new trees with respect to the cutted ones. The

3.11 Booster Station at Komburankadu

A Booster Station is proposed to pump clear water from Komburankadu to Pazhakaranur Ridge point and will be constructed at Komburankadu. The booster station is proposed to be located in Komburankadu village on the Mettur –Nangavalli Road. The Booster Station will be located within the premises of existing treatment works site of Salem – Athur CWSS. About 10000 Sq.m land has been earmarked for the Salem Dedicated water supply scheme. The site is vacant now. There is no sensitive area or residential area nearby.

The transmission main from WTP will discharge into a sump designed with a storage capacity of about 60minute with two compartments, each of size 36 m x 23.00 and 5.00 m depth and will be adjoining the pump house.

The pump house at the Booster Station is designed to accommodate pump sets for ultimate demand. The size of pump house is 30.00 m x 16 m (clear). As per reference to the CPHEEO Manual, both Centrifugal and Vertical Turbine pumps are considered optimal for this duty. Considering the experiences of using HSC pumps and its advantage in CMWSSB, HWSSB and BWSSB and also the advise of Technical Appraisal experts of World Bank Procurement wing It is proposed to install Horizontal Split Casing centrifugal pump sets each of duty 37450 LPM against a head of 120 m, three working and one number standby with a total pumping capacity of 112350 LPM for the interim demand. The design is based on 23 hours pumping rate.

3.12 Ridge Sump at Palakkaranur

To hydraulically isolate the Booster Main from Komburankadu from the Gravity Main from Palakkaranur, a partial ground level sump of 12 minutes capacity has been proposed at Palakkaranur . The ridge sump will be located at Palakkaranur village. The Sump will be constructed within the premises of existing ridge sump site for – Athur CWSS. About 2500 Sq.m of vacant land has been earmarked for the Salem DWSS. There is no sensitive area or habitations nearby. No pumping or any other processing is involved in this site.

The sump will be of Circular RCC structure of 20 m dia and 5 m depth. The maximum water level will be 357.8 m. Water will be discharged into this sump through pumping main from booster and then will be gravitated through gravity main up to Salem for further distribution. No pumping or any other machinery is involved in this site.

3.13 Gravity main from Pazhakaranur

The Clearwater from the ridge sump will further be transmitted by gravitation to feed all the Service Reservoirs inside Salem City (ELSR in most cases and GLSR in a few case). The water will be distributed to the entire City Corporation through 56 elevated service reservoirs for equitable distribution. Out of the 56 reservoirs, 8 reservoirs will be

dedicated water supply scheme proposed now. For the purpose of explaining the hydraulics of the gravity system this reach is broken into two parts:

Part 1 Gravity main from Pazhakaranur ridge sump to Salem City entry (zero point) at the junction of Reddipatti Road and NH 47.

Part 2 From zero point to feed all the reservoirs inside the town.

3.14 Interconnection at junction of NH 7 and Reddipatti Road

The total length of gravity main from the ridge sump to the Zero point at Salem City entry is 26600 m. The proposed gravity main of 1500 mm dia will be terminated at Salem city entry near junction of Reddipatti Road and NH 7. The linking of 1500 mm MS pipe with the 1100 mm PSC pipe will be taken under stage 2 works. The gravity main will be laid with appurtenances viz. 1200 mm dia. Butterfly valves – 6 nos, 600 mm dia. Scour valve – 27 nos, 200 mm dia. double air valves – 40 nos. Two electromagnetic flow meters of 1200mm dia have been proposed.

3.15 Alignment of Transmission Main

It is proposed to lay the gravity main from Pazhakaranur sump along the service road of Salem–Attur CWSS up to the railway crossing of Salem Jolarpet Broad Gauge line and will then be extended along the edge of NH 7 up to the junction point of Reddipatti Road and NH7. The existing service road from Pazhakaranur up to railway crossing will be utilized for laying pipe line for which the Salem Corporation has the ROW. Then the pipe will be laid along the berm of NH 7.

3.16 Phase 2 - Feeder Main and Distribution System

3.16.1 Feeder main

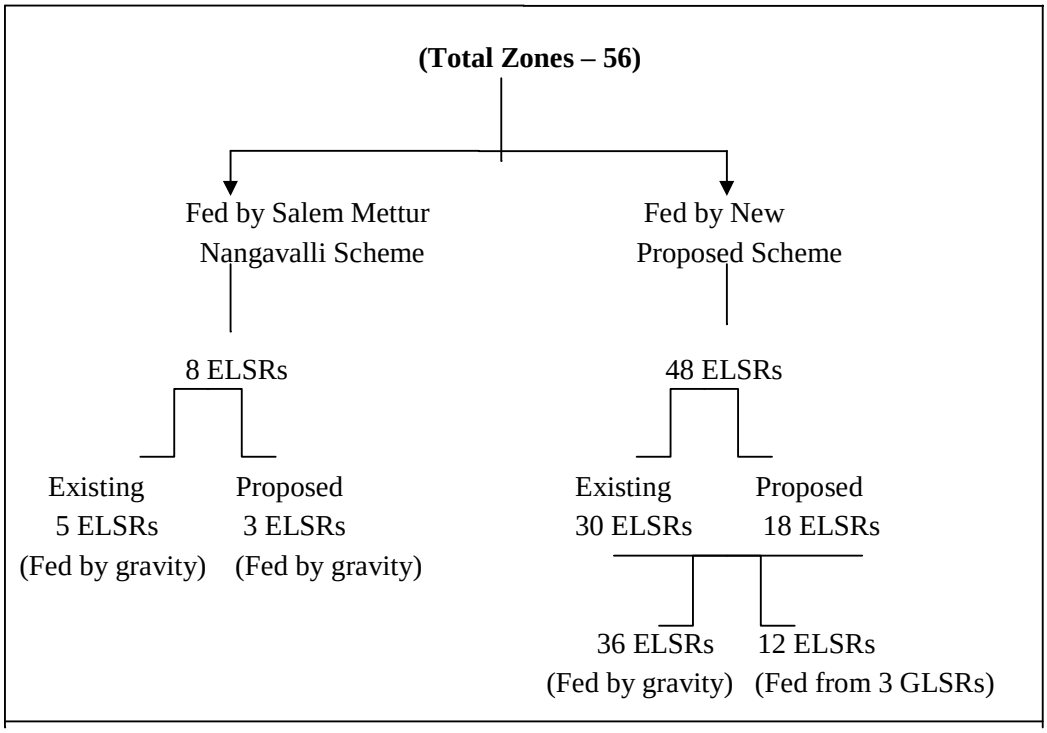
Existing System

Presently there are 35 elevated service reservoirs (ELSR) distributing water to the Corporation area. Out of these, six ELSRS. are fed from Salem Mettur scheme while the balance 29 ELSR's are fed by Salem Athur water supply scheme. In addition ,out of these 29 ELSR's as many as 21 ELSR s are getting filled directly by the feeder mains while the balance 8 (in three different locations) are fed through three ground level reservoirs constructed at Alagapuram (2 Nos.), Chinnakollapatty (3 Nos) and Ammapet (3 Nos). The length of existing feeder main under Athur scheme supplying water to 29 reservoirs is about 48 km with pipe sizes varying from 150 mm to 1100 mm

Proposed System

Now under the present project, it is proposed to divide the Corporation area into 56 distinct water supply zones. Each water supply zone shall be served by an Elevated

designed for 8 hours storage. A minimum residual head of 2 m is considered over the maximum water level of the reservoir. The feeder main is designed as a tree network supplying water to the reservoirs. The design of feeder main is done using Environmental Protection Agency (EPA) net software. The feeder mains to the service reservoirs are designed to cater projected flow for the ultimate year and checked for intermediate flow conditions. The existing feeder main will be strengthened by laying parallel mains wherever required



3.16.2 Distribution system

The length of distribution system laid under Salem Mettur water supply scheme and Salem Athur combined water supply scheme is about 270 Km. In addition to the above, the strengthening/ extension of distribution system is being executed by TWAD under different project. The total length laid under this project will be around 340 Km. The project is under implementation and most of the components have been completed. Thus the total length of distribution available with in Corporation will be around 610 Km. Under the new arrangement the city is fed by 56 zones and the average area of each zone is about 1.63 Sq.Km. Each zone is fed by an independent Elevated Service Reservoir with hydraulic level sufficient to cover the respective zone. As such distribution system will not require major augmentation.

Under this project, 21 Nos. New Elevated Service Reservoirs will be constructed. These have to be connected to the distribution system. Also formation of distinct distribution zones may require de linking and linking and provision of valves in the distribution system. The existing 270 Km of old pipelines laid under Salem Mettur and Salem Athur schemes may require replacement. Also some of the leaky mains and non functioning valves in the existing distribution system have to be rehabilitated.

3.16.3 Rehabilitation of Distribution System and replacement of House Service Connection

Under this project it is proposed to rehabilitate the distribution system and replace existing House Service connections with MDPE pipes wherever necessary

To facilitate water audit all the components like intake, WTP, Booster, ridge sump will be provided with flow meters. In addition flow meters will be installed at all ELSR's .

Chapter 4

Legal, Regulatory and Institutional Framework

4.1. Introduction

This section reviews the policies, regulations and administrative framework within which the project works are to be implemented. The review includes the Environmental and Social Framework (ESF) of TNUIFSL, Operational policies / directives of The World Bank, sector-specific Environmental Policies &Regulations of the Government of India and the institutional profile of various agencies such as Tamil Nadu Pollution Control Board (TNPCB) and other stakeholders associated with the project.

4.2 Environmental Policies and Regulations

The environmental policies and regulations reviewed are broadly divided into the following four categories:

- Environmental and Social Framework of TNUIFSL
- Operational policies / directives of The World Bank
- Environmental Policy and Regulatory Frameworks in India
- Regulatory Framework in the State of Tamil Nadu

4.2.1 Environmental and Social Framework of TNUIFSL

Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL), under which the proposed water supply project is to be funded, has formulated an exclusive Environmental and Social Framework to address environmental and social impacts associated with infrastructure projects. The TNUIFSL Environmental and Social framework (ESF) is in line with the Environmental and Social safeguard Policies and directives of the World Bank. It was approved by Government of Tamil Nadu vide G.O.Ms.no.115, dated: 6.10.2006.

4.2.1.1. Environmental Screening of the Project as per the ESF of TNUIFSL

An environmental screening is to be carried out for all projects funded by TNUIFSL by filling-up an environmental screening form by the Urban Local Body applying for the loan. The filled-up environmental screening form for the proposed project is presented as Annexure. The environmental screening form was filled-up based on the assessment of project activities and their impacts on sensitive environmental features. Based on the environmental screening form, the proposed project will have the following impacts on sensitive environmental features.

The possible impacts from the proposed project are given below:

1. Negative impacts on surrounding environmental conditions (temporary impacts due to air / Noise pollution).
2. Temporary impacts on cultural / heritage properties (i.e., temples) during construction stage
3. Water resource problems (i.e., reduction in water availability for water supply and irrigation projects downstream of Cauvery river)

4. Air pollution (during construction stage, by dust generated due to construction activities) and noise pollution during construction stage (due to construction activities) and operation stage (due to operation of pumps).
5. Pollution of water bodies (i.e. pollution of Cauvery river due to disposal of Sludge)
6. Constriction hazards to residents (due to pipe laying works).
7. Release of toxic gases (chlorine) and accident risks (due to collapse of reservoirs) which may lead to health and safety risks in the neighborhood during operation stage.

Depending upon the project location and magnitude of the impacts on sensitive components, Environmental categorization of projects is to be carried out as defined in the ESF and the projects will have to comply with the requirements of ESF. Environmental categorization of projects as per the ESF of TNUIFSL is as follows:

- ESF of TNUIFSL categorizes the projects under Category E1, E2, and E3 depending on their environmental sensitivity
- "Category E1" Projects are Sensitive Projects with respect to the identified environmentally sensitive components and require Environmental Assessment Report (EAR) and project specific EMP.
- "Category E2" projects are moderately to less Sensitive Projects and these projects require an environmental screening and EMP.
- "Category E3" projects are unlikely to cause adverse environmental impacts and hence no environmental assessment is required beyond screening.

As per the guidelines for environmental categorization of projects given in the ESF, water supply projects involving water treatment plants and river intake works are categorized as "Category E1" projects. Since the proposed project involves water treatment plant and river intake work, and due to the impacts of the project on sensitive environmental features, as presented in environmental screening form, it has been categorized as "Category E1 Project" and requires an Environmental Assessment Report (EAR) and project specific EMP.

4.2.1.2 Social Screening of the Project as per the ESF of TNUIFSL

A social screening is to be carried out for all projects funded by TNUIFSL by filling-up a social Screening form by the Urban Local Body applying for the loan. The filled-up social screening form for the proposed project is presented as **Annexure.** The social screening form was filled-up based on the assessment of project activities and their impacts on socially sensitive features. Based on the social screening form, the proposed project will have the following impacts on socially sensitive features. Depending upon the number of Project Affected Persons (PAPs) who may be affected by the project and magnitude of impact, social categorization of projects is to be carried out as defined in the ESF and the projects will have to comply with the requirements of ESF. Social categorization of projects as per the ESF of TNUIFSL is as follows:

- ESF of TNUIFSL categorizes the projects under Category S1, S2, and S3 depending on the magnitude of social impacts.
- "Category S1" Projects are those that will affect 200 PAPs (30 - 40 households) or more or if PAPs are physically displaced. S1 projects require a detailed Social Assessment Report (SAR) including a Resettlement Plan.
- "Category S2" projects are those in which no PAP is physically displaced and less than 10 % of their productive assets are lost or less than 200 PAPs are affected. S2 projects require a Social Management Plan (SMP) including an abbreviated Resettlement Plan.
- "Category S3" projects are those which will not have any households affected at all. However, S3 projects require a Social Status Report (SSR).

In this project all sites are owned by the Corporation and there is no acquisition or alienation lands consequently there is no affected PAP. In view of the above the project has been categorized as "Category S3 Project" This project requires only a Social Status Report.

4.2.2 Operational Policies / Directives of the World Bank

The following World Bank Operational Policies (OP) was found relevant with respect to the proposed project and is given below:

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

4.2.3 Environmental Policy and Regulatory Frameworks in India

The following are the key regulations in India applicable for various development projects.

- Constitutional Provisions
- Water (Prevention and Control of Pollution) Act, 1974 – and Tamil Nadu Water (Prevention and Control of Pollution) Rules, 1974
- Air (Prevention and Control of Pollution) Act, 1981 and Tamil Nadu Air (Prevention and Control of Pollution) Rules, 1983
- Wildlife Protection Act, 1972
- Forest (Conservation) Act, 1980 - as amended in 1988
- The Environment (Protection) Act, 1986
- Hazardous Wastes (Management & Handling) Rules, 1989;
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Noise Pollution (Regulation and Control) Rules, 2000
- Environmental Impact Assessment Notification, 2006

4.2.3.1 Constitutional Provisions

The Constitution of India in its Article 48 provides for the protection and preservation of the environment and states that "the state shall endeavour to protect and improve the

Further Article 51-A (g) on fundamental duties emphasises that, "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures."

These two provisions of the constitution are the guiding principles for various environmental legislations in the country and to safeguard the environment.

4.2.3.2 Water (Prevention and Control of Pollution) Act, 1974 and Tamil Nadu Water (Prevention and Control of Pollution) Rules, 1974

Water Act is the first environmental regulation that brought at the state and centre levels, pollution control boards to control / regulate environmental pollution in India. The Act was amended in 1978 and 1988. Salient features of the Act are the following:

- Vests regulatory authority on the State Pollution Control Boards and empowers them to enforce effluent discharge standards to prevent water pollution (both for industries and local authorities)
- Section 24 of the Act prohibits use of stream or well or on land disposal for polluting substances that violate disposal standards laid down by the board
- Section 25 of the Act requires an application to be made to the state board to establish any treatment and disposal system that is likely to discharge sewage or trade effluent in to a stream or well or sewer on land
- Sections 41 and 44 provide for penalties for not complying with the various provisions or directives of the board

Disposal of wash water from the water treatment plant of the proposed project will attract the provisions of the Act and requires consents to establish and operate from the Tamil Nadu Pollution Control Board.

4.2.3.3 Air (Prevention and Control of Pollution) Act, 1981 and Tamil Nadu Air (Prevention and Control of Pollution) Rules, 1983

Similar to Water Act, the Air Act vests regulatory authority on the State Pollution Control Boards and empowers them to enforce air quality standards to prevent air pollution in the country. Section 21 of the act requires an application to be made to the state board to establish or operate any industrial operation. This act however, is not of major significance for water supply projects as no air polluting activities are anticipated. However, installation and commissioning of generators and pumps by the contractor during the construction stage of the project would require NOC from the Tamil Nadu Pollution Control Board.

4.2.3.4 Wildlife Protection Act, 1972

This Act intent to protect wild life through appropriate conservation and protection strategies. It is enforced by creating protected areas, sanctuaries & advisory boards. This Act bans any kind of activities that destruct or damage wildlife in sanctuaries and National Parks. The project area does not encounter any wild life and there are no sanctuaries,

protected areas or national parks in and around the project area and *hence the provisions of this Act are not applicable to the Project.*

4.2.3.5 Forest (Conservation) Act, 1980 (as Amended in 1988)

This act Prohibits large-scale diversion of forestland for non-forest use. No State Government or authority shall make such diversions except with the prior approval of the Central Government. The Act is enforced by State Forest Departments and MoEF. The proposed project improvements do not involve any forest areas or cutting of trees and *hence the provisions of this Act are not applicable to the project.*

4.2.3.6 The Environment (Protection) Act, 1986

Popularly known as EP Act, it is an umbrella legislation that supplements existing environmental regulations. Salient features of the Act are the following:

- Section 6 empowers the Government of India to make rules to regulate environmental pollution by stipulating standards and maximum allowable limits to prevent air, water, noise, soil and other environmental pollutants
- Section 7 prohibits operations that emit pollutants in excess of standards
- Section 9 regulates handling of hazardous substances and identifies persons responsible for discharges and pollution prevention

Empowered by the EP Act, the Ministry of Environment & Forests (MoEF), Government of India has issued various notifications such as Hazardous Wastes (Management & Handling) Rules, 1989;

Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989; Noise Pollution (Regulation and Control) Rules, 2000; Environmental Impact Assessment Notification, 2006 etc. which are applicable to the proposed project, as described below.

4.2.3.7 Hazardous Wastes (Management & Handling) Rules, 1989

As per these rules, permission is required for collection, reception, treatment, transport, storage and disposal of hazardous wastes listed in the Schedule of the Rules from the competent authority. Hazardous wastes shall be collected, treated, stored and disposed of only in such facilities as may be authorized for this purpose. Every occupier generating hazardous wastes and having a facility for handling of such wastes shall make an application to the State Pollution Control Board for the grant of authorization for any of the above activities. Any person who intends to be an operator of a facility for the collection, reception, treatment, transport, storage and disposal of hazardous wastes, shall make an application to the State Pollution Control Board for the grant of authorization. The occupier who intends to get his hazardous waste treated by the operator of a facility shall give to the operator of a facility, such information as may be specified by the State Pollution Control Board

The proposed project does not generate any hazardous waste as listed in the schedule of

4.2.3.8 Manufacture, Storage and Import of Hazardous Chemical Rules, 1989

These Rules aim at controlling the generation, storage and import of hazardous chemicals. These Rules are applicable to an industrial activity or isolated storage in which there is involved a quantity of hazardous chemical listed in the Schedule of the Rules which is equal to or more than the quantity specified in the entry for that chemical in the Schedule. According to these rules, the user of hazardous chemicals has to perform the following and dispose hazardous waste as mentioned in the rules.

- Identify the potential hazards of the chemicals and take adequate steps to prevent and control such hazards
- Develop or provide information about the chemical in the form of safety data sheets
- Label the specified information on the container of the hazardous chemical

Chlorine used to disinfect water is categorized as a hazardous chemical as per these Rules. If 10 Tonnes of Chlorine is to be used in the Water Treatment Plant of the proposed project, then the same will attract the provisions of the these rules. This will be reviewed at the time of commencement of operation of the Project

4.2.3.9 Noise Pollution (Regulation and Control) Rules, 2000

The ambient air quality standards in respect of noise for different areas/zones are specified in the Schedule of these rules. The State Government may categorize the areas into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas. An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area/zone as per these rules.

The noise levels in any area/zone shall not exceed the ambient air quality standards in respect of noise as specified in the Schedule. The State Pollution Control Board is responsible for the enforcement of noise pollution control measures and the due compliance of the ambient air quality standards in respect of noise.

The proposed project in its construction and operation phases may attract the provisions of these rules if the noise level from the construction machinery and the pumps are above the standards.

4.2.3.10 EIA Notification, 2006

The notification specifies that prior environmental clearance is required for the projects listed in the schedule of the notification before any construction work, or preparation of land by the project management except for securing the land, is started on the project or activity.

The Schedule of the notification lists eight broad categories of projects that require prior

'B' based on the magnitude and environmental impacts of the project. Clearance is to be obtained from the Ministry of Environment and Forests for Category 'A' projects, and from the State Environment Impact Assessment Authority (SEIAA) for Category 'B' projects. Category 'B' projects will be further classified in to category 'B1' and category 'B2' based on their magnitude and environmental impacts. Category 'B2' projects do not require an EIA study. The scope and ToR of the EIA study for category 'A' and category 'B' projects will be decided by the MoEF and the SEIAA respectively. Since water supply projects are not included in the Schedule of the Notification, prior environmental clearance is not required for the project under the EIA notification 2006.

4.2.4 Environmental Policy / Regulations in Tamil Nadu

The Department of Environment & Forests through its regulatory institution Tamil Nadu State Pollution Control Board enforce environmental regulations and policies in Tamil Nadu. The Board follows the standards and regulations prescribed by Central Pollution Control Board and various acts promulgated by the Ministry of Environment & Forests.

4.2.5 Summary of Applicable Environmental Regulation

As per the guidelines for environmental categorization of projects given in the ESF of TNUIFSL the project has been categorized as "Category E1 Project" and requires an Environmental Assessment Report (EAR) and project specific EMP.

As per the Operational Policy 4.01 of the World Bank, the project can be categorized as "Category C project" and requires only screening. Disposal of wash water from the water treatment plant of the proposed project will attract the provisions of the Water (Prevention and Control of Pollution) Act, 1974 and requires consents to establish and operate from the Tamil Nadu Pollution Control Board.

Installation of generators and pumps by the contractor during the construction stage of the project would require NOC from the Tamil Nadu Pollution Control Board as per the Air (Prevention and Control of Pollution) Act, 1981.

If more tan 10 Tonnes of chlorine is to be used in the Water Treatment Plant of the proposed project per year, then the same will attract the provisions of the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989. The proposed project in its construction and operation phases may attract the provisions of Noise Pollution (Regulation and Control) Rules, 2000 if the noise level from the construction machinery and the pumps are above the standards.

The summary of applicable environmental regulations for the proposed project is presented in **Table 4.1.**

Table 4.1:Applicable Environmental Regulations

Sl.No.	Regulation	Requirement
1	Project Categorization as per the ESF of TNUIFSL	Environmental Category: E 1 – Environmental Assessment Report (EAR) and project specific EMP required. Social Category: S 3 – Only Social Status Report is required
2	Water (Prevention and Control of Pollution) Act, 1974	Consents to establish and operate the Water Treatment Plant required from the Tamil Nadu Pollution Control Board
3	Manufacture, Storage and Import of Hazardous Chemical Rules, 1989	Provisions are applicable if above 10 tonnes of chlorine is to be used in the Water Treatment Plant of the proposed project per year.
5	Noise Pollution (Regulation and Control) Rules, 2000	Provisions are applicable if the noise level from the construction machinery and the pumps are above the permitted levels.

4.3. Institutional Frame Work

A brief analysis of the institutional framework for environmental management in India and Tamil Nadu that is relevant for the project is discussed in this section. The objective of this analysis is to understand the role of various agencies in environmental management, with specific reference to the present project.

4.3.1. Ministry of Environment and Forests

The Ministry of Environment & Forests (MoEF) is the nodal agency in India to plan, promote, coordinate and oversee the implementation of environmental and forestry programmes. Principal activities undertaken by the Ministry of Environment & Forests consist of conservation & survey of flora, fauna, forests and wildlife, prevention & control of pollution, afforestation & regeneration of degraded areas and protection of environment, in the frame work of legislations. All the activities of the proposed Project including its execution and operation will have to comply with the present environmental regulations by MoEF and their amendments from time to time.

4.3.2. Central Pollution Control Board

Central Pollution Control Board (CPCB) is a statutory organization constituted in 1974. The Board provides field information and technical services to MoEF. The function of the board can be summarized as below:

- Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of quality of air

- Plan and cause to be executed a nation-wide program for the prevention, control or abatement of water and air pollution

- Co-ordinate activities of the State Board and resolve disputes

- Provide technical assistance and guidance to State Boards, carry out and sponsor investigations and research relating to problems of water and air pollution, and their prevention, control or abatement

- Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents, as well as for stack gas cleaning devices, stacks and ducts

- Perform such other functions as may be prescribed by the Government of India

TNPCB, the key agency to monitor the environmental compliance of the present project will be guided by the directives of CPCB and in this context, CPCB will be important for the project.

4.3.3 Environment & Forest Department, Government of Tamil Nadu

The Environment and Forest Department is the apex body in the state of Tamil Nadu, with administrative control of environmental management in the state. The department, through TNPCB, administers the enforcement of various laws and regulations of Government of India. The department formulates environmental management and policy guidelines for Tamil Nadu and grants clearances for projects under its purview.

4.3.4 Tamil Nadu Pollution Control Board (TNPCB)

TNPCB is the regulatory body in the state of Tamil Nadu to enforce various environmental legislations of the Government of India. While regulatory powers are delegated to TNPCB from CPCB, the administrative control of the board rests with The Environment and Forest Department. More specifically, the functions of the board are listed below:

- Implementing the provisions of EP, Water and Air Acts

- Advise state government in respect to suitability of particular area for industrial development

- Assess the quality of environment in terms of ambient air and water quality through monitoring

- Issue and enforce consent orders for industrial pollution control

- Oversee, supervise and regulate water, air, solid, bio-medical and hazardous waste management in urban areas

TNPCB will be the key agency for monitoring and ensuring the implementation of the various environmental regulations applicable to the project. In addition to issuing NOC to the project, the agency will also be responsible for the monitoring the implementation of EMP and its implications.

4.3.5 Urban Local Bodies

Salem Municipal Corporation is the sole beneficiary of the proposed project. They will be responsible for the operation and maintenance of the distribution network of the proposed project. Overall administration of Municipal Corporations and Municipalities is the responsibility of Commissionerate of Municipal Administration. Town Panchayat is a transitional body between Rural and Urban Local Bodies, coming under the Directorate of Town Panchayats. Commissionerate of Municipal Administration and Directorate of Town Panchayats are coming under the Municipal Administration & Water Supply Department of Government of Tamil Nadu headed by a Secretary to Government The Department has multifarious functions in terms of providing basic infrastructure, conduct of elections to these local bodies and administering the staff. The Municipalities comprise two wings - political and Executive. The political wing of the Municipalities is headed by a Chairman, an elected representative and comprises people's representatives (councilor) from each ward of the Municipalities. The executive wing of the Municipalities is headed by an Executive Officer, and is supported by functional heads for each function of the local body, such as engineering, planning, health, finance, administration, etc. A Municipal Engineer heads the engineering department of the Municipalities. He is responsible for the execution, operation and maintenance of core civic services such as water supply, sewerage, storm water drainage, roads and other engineering activities of the local body.

The Town Panchayat also comprises two wings - political and Executive. The political wing of the Town Panchayat is headed by a President, an elected representative and comprises people's representatives (ward members) from each ward of the Town Panchayat. The executive wing of the Town Panchayat is headed by an Executive Officer.

4.3.7. Tamil Nadu Urban Infrastructure Financial Services Limited

Being the funding agency for the project, TNUIFSL will appraise the project for its satisfactory compliance for all the funding requirements including the ESF formalities. TNUIFSL will monitor the project progress, compliance of EMP and RAP, and fund the project as per the agreed terms.

4.3.8. Other Stake Holder Agencies

Pipe lines of the proposed project crosses railway lines at two locations and permission for laying pipelines across the railway lines is to be obtained from the Southern Railways. Under the administrative control of govt of India but such powers are delegated to the local officers since culverts for laying the pipe line have been provided already below the railway line.

Tamilnadu Electricity Board has to extend the power line to the various pumping installations to be erected under the project .In addition it should shift its electric lines wherever required at the proposed over head tank locations. The River Cauvery is under the control of Tamil Nadu Public Works Department. Necessary permission to draw

The conditions to draw water from Cauvery river if any imposed by PWD has to be fulfilled.

4.3.9. Summary of Institutional Framework for the Project

Based on the above discussion on the institutional framework, it can be summarized that Salem Corporation is the key agency for the project execution. TNPCB and TNUIFSL will be the key agencies in monitoring the environmental compliance of the project and other project terms. Summary of the role of these stakeholders in the project is presented in Table below,

Institution	Role/ Clearance required	Status of clearance
1 Salem Corporation	Project Implementing agency – responsible for getting clearance from various agencies and implementing the Project	Not Applicable
2. TNUIFSL	Project funding agency – Monitoring and reviewing the Project Terms	Not Applicable
3. TNPCB	Regulatory agency – Environmental Compliance and issue of consent to establish and operate for the water treatment plant	Responsibility of DBOOT Contractor
4. Controller of explosives	Regulatory agency – for handling Chlorine cylinders	Responsibility of DBOOT Contractor
5. PWD	Issue of clearance to draw water from River Cauvery	Application submitted by Corporation
6. Southern Railways	To lay clear water pipeline across railway line	Application to be submitted by Corporation
7. TNEB	Power supply for the project sites	Application to be submitted by Corporation
8. NHAI, State Highway Meetur Municipality and other Panchayats	For laying/crossing pipeline along/across the roads	Application to be submitted by Corporation

Chapter - 5

Baseline Environmental Profile

5.1 Introduction

The scope of the project is to provide water supply improvement scheme to the people residing at Salem Corporation in Salem District which will evidently have a positive impact However , during the project implementation and operation, the environmental components are likely to be affected which have to be assessed and mitigation measures taken.

5.2 Objective of the Study

The object of the study is to identify and assess the likely environmental and other Socio – economical Public Health Impacts of the project and its components. The study shall derive an Environmental Management Plan for bringing out the project to environmentally sound and socially acceptable besides fulfilling their water requirement. Necessary monitoring mechanism for the proper operation and maintenance of the project with regard to environment has been focused.

5.3 Environmental and Social Screening of the project area

Baseline environmental profile of the project area comprises of the following:

- Physical Environmental Profile in terms of meteorology, ambient air quality, noise levels, surface and ground water quality, soil characteristics, geology, hydrology, topography etc.

- Biological Environmental Profile in terms of flora and fauna and ecologically sensitive locations.

- Land Environmental Profile in terms of land use and agriculture and

- Socio-Economic Characteristic in terms of industry and economy, health profile.

As the location of source for both the existing and the proposed systems are close to each other, the baseline profile is the same .On similar grounds ,the existing and proposed transmission mains run parallel for most of the lengths.

Salem is a town included by Tamilnadu Pollution Control Board for periodical monitoring of basic parameters.

5.3.1 Description of sites of Project Components

Description of sites identified for locating the project components are given in table below:

Components (Sump, Service reservoirs Booster Stations, Pumping Station, treatment plan site etc.,)	Location	Extent (in Acres)	Land Classification & Ownership	Current Land use	No. of PAF	Acquisition/Transfer/ Alienation Status (Status as on 20.06.2011)
River Water Intake & Water Treatment Plant	Thottilpatti	10.5	Revenue Porumpokku	Porampokku	Nil	Name Transfer proposal sent to CLA from District Collector, Salem on 19.7.10 The CLA forwarded the proposal to Govt. on 07.02.11
Booster Station	Komburankadu	2.55	TWAD Land	Vaccant	Nil	An amount of Rs.5,14,110/- remitted to TWAD for purchase of Land.
Ridge Sump	Pazhakkaranur	0.64	TWAD Land	Vaccant	Nil	An amount of Rs.5,14,110/- remitted to TWAD for purchase of Land.

Details of Distribution Main, Clear Water Main, Gravity Mains Right of Way (ROW) etc.

	Location	Distance (in KMs)	Whether passing through private lands, road, river banks etc.	Any structures are affected enrote.	No. of PAF	Status of permission (if required) for laying
Treatment plant to Booster Station	P.N. Patty Town Panchayat	2.00	1. P.N. Patty Town Panchayat	--	Nil	Permission obtained on 25.3.2010
	Mettur	1.20	Mettur Municipality Road		Nil	Permission obtained on 02.02.2011
	Upto Komburankadu	4.09	Salem Attur C.W.S.S. Road		Nil	--
Booster Station to Ridge Sump	From Komburankadu to Pazhakaranur	7.265	Salem Attur C.W.S.S. Road	--	Nil	--
Ridge sump to Salem City Entry Point	From Pazhakaranur to Salem	26.600	Salem Attur C.W.S.S. Road	--	Nil	--

Head Works (Raw Water Intake and WTP)

The head works (River Intake) and WTP are proposed to be located at Thottilpatti village in Block No. 56 and TS No. 5 of Mettur Taluk on the east side of River Cauvery near the bridge leading to Mettur Thermal Power Plant . The surplus course of Mettur is flowing on the right side of the site. The proposed Water Treatment Plant will be constructed in the vacant land adjacent to the existing Kadayampatty CWSS Treatment Plant at Thottilpatti. An extent 12.5 Acres of land has been earmarked for the construction of the proposed Water Treatment Plant. There are no habitations nearby. There is no water intake on the downstream of the site. The site is vacant and there is no tress or structures in the site.

The site map of head works at Thottilpatti showing the location of existing structures and

Booster Station at Komburankadu

A Booster Station is proposed to pump clear water from Komburankadu to Pazhakaranur Ridge point and will be constructed at Komburankadu. The booster station is proposed to be located in Komburankadu village on the Mettur –Nangavalli Road. The Booster Station will be located within the premises of existing treatment works site of Salem – Athur CWSS. About 10000 Sq.m land has been earmarked for the Salem Dedicated water supply scheme. The site is vacant now. There is no sensitive area or residential area nearby. The site is vacant and excepting small bushes and seven palm tress along the boundary. These trees will not be cut. There are few staff quarters within a distance of about 50 m from the site.

The site map of Booster station at Komburankadu showing the location of existing structures and proposed Booster Station is attached Figure 2.

Ridge Sump at Palakkaranur

To hydraulically isolate the Booster Main from Komburankadu from the Gravity Main from Palakkaranur, a partial ground level sump of 12 minutes capacity has been proposed at Palakkaranur . The ridge sump will be located at Palakkaranur village. The Sump will be constructed within the premises of existing ridge sump site for – Athur CWSS. About 2500 Sq.m of vacant land has been earmarked for the Salem DWSS. There is no sensitive area or habitations nearby. The site is vacant and there is no tress or structures in the site. No pumping or any other processing is involved in this site. Two staff quarters are located adjacent to the proposed site.

The site map of Ridge Sump at Palakkaranur showing the location of existing structures and proposed Ridge Sump is attached Figure 3.

Alignment of Transmission Main

The alignment of the pumping main from WTP to Ridge Sump is along roads owned by Mettur Municipality/ PN Patti Panchayat for 2 KM then along the existing service roads owned by the Corporation and hence no land acquisition or PAP is involved. The land adjoining the alignment is not along thick forests. The alignment from WTP to Booster passes through Residential areas like PN Patti and Salem Camp. A general survey of alignment indicates that sufficient space is available trenching and no tree cutting is involved. However to avoid existing utilities etc limited tree cutting may perhaps be necessary.

It is proposed to lay the gravity main from Pazhakaranur sump along the service road of Salem–Attur CWSS up to the railway crossing of Salem Jolarpet Broad Gauge line and will then be extended along the edge of NH 7 up to the junction point of Reddipatti Road and NH7. The existing service road from Pazhakaranur up to railway crossing will be utilized for laying pipe line for which the Salem Corporation has the ROW. Then the pipe will be laid along the berm of NH 7.

The alignment passes through the following villages: Periyar Nagar, Veerakal, M.Ollapatti, Tholasampatti, Annagoundanpatti.

A key plan showing the alignment of transmission main from WTP to Salem entry point

5.4 Baseline Environmental Profile

The baseline profile of the Salem region collected from the secondary sources are as below**:**

i) **Meteorological features:** The annual rainfall recorded during 2006 – 2007 (June-May) is 898.00 mm normal and 807.8 mm actual and this the general pattern over a decade" review The rain fall occurs during the North East monsoon periods during October to December. The Climate during the summer is 39.8^0C (max) 31.0 ^{0} C (min) & during winter 31.0 ^{0} C (max)-18.0 ^{0} C (min) the humidity varies from 85 to 68 %. **Geology and Minerals:** Geologically, the district is under laid by a wide range of metamorphic rocks of peninsular gneissic complex. These rocks are extensively weathered and overlaid by recent valley fills and alluvium at places. The important minerals found in Salem District are Dolamite and Magnesite.

(ii) **Soil Characteristics:** Results of the soil samples collected as part of the consultancy show that the soil type in the project area is dominated mostly sandy soil and Silty clay.

The permeability rate varies from very high to medium, depending upon the soil texture. It was reported that the over-exploitation of ground water cause heavy decline in water level in the Salem Corporation.

(iii) **Water quality:** The periodical water samples collected from river Cauvery, analyzed for various characteristics of water quality by various organizations – namely WRO and, Salem Corporation. These are found to conform to CPHEEO Guidelines.

The Secondary data for various parameters is attached in annexure 3.

(iv) **Biological environment :**

(a) **Aquatic Ecology:** No endangered fish species are reported from Cauvery river in the project area and there is no fishing activity in the project area.

Regarding the aquatic environmental status, there is no lentic habitat in the study area and no unique feature has been observed. It can be said that the aquatic environment is more or less stable. The distribution of terrestrial fauna is uniform in the study area. The dominant groups are spiders, phrynicers, Theylphonus and Galaodes. Among vertebrates, field rats, Mabuya and Calotes are common. None of them belong to the rare or endangered species.

(b) **Terrestrial Ecology:** No forest areas encountered along the pipe line alignment, no wild life sanctuaries or no protected areas are present in the project influence area and no rare/threatened species of flora or fauna is present in the project influence area. Endemic flora, herbal species, man introduced species, ornamental and non cultivated plants were identified. Neem trees and Prosopis juliflora, a thorny shrub seen all over Tamil Nadu are the important vegetation seen near the

WTP site no trees are available. Tamarind tree, Neem tree, Pongmamia pinnata Peltophorum pterocarpum and Delonix regia (Gulmohur) are found along roads as avenue trees in the pipeline routes. Neem and Tamarind are the major trees observed all over the project area. Prosopis juliflora is seen everywhere in the project area. Teak, Cassia, Mango tree, Rain tree, Badam, Cassurina, Moringa, Ficus religiosa, Gulmohur, Subabul, Eucalyptus and Palmyra tree are the other trees observed in the project area. Banana is also seen in the project area.

The main cultivated crops are ragi, maize, cotton, pulses, etc., the uncultivated lands are covered by a massive growth of species such as parthenium hystopharus, Annona squamosa, Musa paradisiacal and some Herbaceous plants like Tephrosia sps., Tephrosia purpurea etc., Regarding the status of fauna, there are no habitations or breeding place of wild life species.

The bio diversity of plant, animal and bird species are limited in the study area. The low soil fertility, shortage of water and low water table could be attributed as causing the poor status of biodiversity.

(v) Socio Economic studies:

The total present population of the study area is about 7, 53,800. The project area is about 91.34 sq.km. The literacy level of the above area is about 48.6%.

The entire project area have been provided with electricity and well connected by road. Basic amenities like water supply, transport, telephone, post and telegraph, public health and sanitations facilities, health centers, recreation facilities like cinema, etc., are moderately available to the people.

The main sources of income for the residents are of agriculture oriented nature either through lands or as agricultural labour, working in factories in nearby towns.

As the project envisages on water supply to the beneficiaries, there is no involvement of air and its impact other than the construction phase.

5.5 Environmental Profile

Baseline study was carried out for various environmental parameters based on the various activities in the proposed project. The stations identified for the study included the project sites where the components are proposed to be located and sample locations along the alignment of the pipeline.

Thottilpatti	-Site for construction of Water Treatment Plant
Komburankadu	- site for construction of Booster Sump and Pump House
Pazhakaranur	- Site for construction of Ridge Sump

All the other sites are along the Transmission main from Pazhakaranur to Salem entry Point (Kuttapatti, Olapatti, Anaigoundampatti and Reddypatti) .The sites were selected along the transmission main where residential areas are located near to the transmission main.

5.5.1 Air Quality

The ambient air quality measured at the project site is presented below. Seven sites have been identified for measuring the Ambient air quality and noise. The seven sites were selected based on the following parameters:

Ambient Air Quality Primary Data					
Sl.No	**Locations**	**Results**			
		SPM	**RPM**	**SO_2**	**NO_X**
NAAQ Standards (24 Hrs)		100	60	80	80
1	Near Kuttapatti	183.9	51.1	17.8	34.2
2	Near Olapatti	247.3	70.8	16.2	48.4
3	Near Anaigoundampatti	135.1	50.6	22.8	27.7
4	Near Reddypatti	172	61.2	17.5	24.7
5	Near Pazhakanur (Ridge Sump site)	169	74.6	19.2	28.4
6	Komburankadu (Booster site)	142.2	40.1	21.9	23.2
7	Thottilpatti (WTPSite)	138.9	44.1	13.6	23

Sampling Method	IS:5182 P:4 -2005	IS:5182 P:4 -2005	IS:5182 P:2 -2001	IS:5182 P:6 -1998
Test Method	IS:5182 P:4 -2005	IS:5182 P:4 -2005	IS:5182 P:2 -2002	IS:5182 P:6 -1999

SPM	Suspended Particulate Matter	SO_2	Sulphur Di-Oxide
RPM	Respirable Particulate Matter	NO_X	Oxides of Nitrogen

5.5.2 Ambient Noise Levels

The ambient noise measured at the project sites are given in table below.

Noise level - Primary Data					
Sl.No	**Location**	**Day Time**		**Night Time**	
		Minimum	**Maximum**	**Minimum**	**Maximum**
1	Thottilpatti	51.90	54.00	48.00	52.00
2	Komburankadu	41.30	45.00	37.60	40.00
3	Pazhakanur	58.50	60.40	55.00	58.00
4	Kuttapatti	45.90	47.00	38.70	42.00
5	Olapatti	47.00	50.80	41.20	44.00
6	Anaigoundampatti	42.60	46.20	38.90	42.00
7	Reddypatti	58.00	62.50	44.60	48.00

The noise quality in general is found to be within the limits for residential/industrial areas.

5.5.3 Raw Water Quality

The Raw water quality is given in table below:

Raw Water Quality – Primary Data

S.No	PARAMETERS	UNIT	Sample Collected on- 13.01.10	Sample Collected on - 21.01.10
1	pH		7.89	8.18
2	Turbidity	NTU	4	3.17
3	Colour	Hazen		8
4	Odour		None	Unobjectionable
5	Chlorides as Cl^-	mg/lit	24	28
6	Sulphates as SO_4^{2-}	mg/lit	1	4
7	TSS	mg/lit		7
8	Residual Chlorine	mg/lit		Nil
9	TDS	mg/lit	266	234
10	Total Hardness as CaCO3	mg/lit	128	146
11	Calcium as Ca^{2+}	mg/lit	30	27
12	Magnesium as Mg^{2+}	mg/lit	12	19
13	Total Alkalinity as CaCO3	mg/lit	152	158

It is seen that the characteristics of raw water are within the respective permitted range of CPHEEO Manual for water supply.

5.5.4 Ground Water Quality

The Ground water quality in the project area is given in Table below. Ground water samples were collected from the three construction sites namely Thottilpatti (WTP site), Komburankadu (Booster Pump House site) and Pazhakaranur (Site for Ridge Sump). In addition to the above ground water samples were collected along the transmission main alignment.

Ground Water Quality – Primary Data					
S.No	**PARAMETERS**	**UNIT**	**Thotilpatti**	**Komburankadu**	**Pazhakaranur**
1	pH		7.37	7.30	7.17
2	Turbidity	NTU	0.67	0.26	1.54
3	Colour	Hazen	8	5	10
4	Odour		Unobjectionable	Unobjectionable	Unobjectionable
5	Chlorides as Cl^-	mg/lit	77	1126	111
6	Sulphates as SO_4^{2-}	mg/lit	73	222	120
7	TSS	mg/lit	4	3	5
8	Residual Chlorine	mg/lit	Nil	Nil	Nil
9	TDS	mg/lit	609	3300	904
10	Total Hardness as CaCO3	mg/lit	371	1102	585
11	Calcium as Ca^{2+}	mg/lit	47	183	121
12	Magnesium as Mg^{2+}	mg/lit	62	157	69
13	Total Alkalinity as CaCO3	mg/lit	309	366	376

S.No	**PARAMETERS**	**UNIT**	**Kuttapatti**	**M-Olapatti**	**Toolasampatti**	**Reddipatti**
1	pH		8.07	7.80	7.49	7.06
2	Turbidity	NTU	0.27	0.72	1.63	3.56
3	Colour	Hazen	5	8	10	10
4	Odour		Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
5	Chlorides as Cl^-	mg/lit	42	507	216	257
6	Sulphates as SO_4^{2-}	mg/lit	42	158	138	177
7	TSS	mg/lit	3	4	5	7
8	Residual Chlorine	mg/lit	Nil	Nil	Nil	Nil
9	TDS	mg/lit	388	2500	1370	1590
10	Total Hardness as CaCO3	mg/lit	214	595	439	887
11	Calcium as Ca^{2+}	mg/lit	43	47	43	20
12	Magnesium as Mg^{2+}	mg/lit	26	116	81	204
13	Total Alkalinity as CaCO3	mg/lit	238	960	663	663

5.5.5 Soil Analysis

The soil characteristics in the project sites is given in Table below.

Soil Analysis Report

Sl.No	Parameters	Units	Thottilpatti	Komburankadu	Pazhakaranur
1	Texture		Sandy Loam	Sandy Loam	Clay Loam
2	Lime Status		Present	Present	Present
3	Electrical Conductivity	Mmhos/cm	0.045	0.039	0.038
4	pH Soil Reaction	No	7.2	3.9	6.9
Macro Nutrients					
5	Nitrogen	Kg/Ac	124	110	129
6	Phosphorus	Kg/Ac	38	42	46
7	Potassium	Kg/Ac	9.8	12	9.5
Micro Nutrients					
8	Iron	ppm	2.5	2.9	2.7
9	Manganese	ppm	1.4	1.1	1.3
10	Zinc	ppm	1.6	1.7	1.8
11	Copper	ppm	0.8	0.9	1.0

The secondary data collected for the Raw Water, Ground water, Ambient air and noise levels are given in the **Annexure 3**.

Chapter 6

Prediction of Impacts and Management Measures

6.1 Introduction

The environmental impacts caused due to the urban infrastructure projects can be categorized as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project where as the secondary impacts are those which are indirectly induced and typically include the associated investments and changing patterns of social and economic activities due to the proposed action.

The proposed activities of the project were discussed in Chapter 3. The impacts of these activities on the environment are predicted in the following sections. The impacts identified are a result of the screening and scoping exercise carried out for the project which has assisted in identifying the key environmental parameters getting affected due to the project.

6.2. Prediction of Impacts & measures

6.2.1. Physical Environment

6.2.1.1 Topography

The impact on land environment would be mainly due to construction activities, excavation, earthwork, filling and cutting etc. The WTP of the project is proposed in a level ground on the east side of River Cauvery. Excavation of soil is required for the structures for WTP construction. The excavated soil will be utilized in the WTP site itself for filling the building foundations, site grading. The Booster Station and Ridge Sump are also proposed in level lands and hence no cutting of soil is required for the construction. The soil excavated for the sump will be utilized for filling the building foundation and site grading at the respective sites itself. Most of the soil excavated for the clear water main pipelines will be utilized for filling the trenches after laying the pipes. The quantity of soil remaining after filling the trenches will be for filling up low lying area which is not a water body or pond. Since the quantity of earthwork involved in the project is not significant, no changes in topography of the project area are anticipated due to the project. During the excavation, suitable safety measures as summarized in the management plan shall be adopted for the safety of construction labour and local residents residing along the pipeline route.

6.2.1.2 Climate

No changes in climatic conditions of the project area are anticipated due to the project activities. Moreover, landscaping is envisaged in the Water Treatment Plant and Booster/OHT site locations, which will help in improving the overall microclimate of the area.

6.2.1.3 Soil Characteristics

The impact on soil due to the proposed project will be in terms of loss of topsoil due to construction activities, extraction of soil from the borrow areas and soil erosion. Since no new borrow pits and quarries are envisaged for the proposed construction activities, no significant impacts are anticipated due to the project. Soil erosion may take place from the pipeline alignments if the soil is not compacted properly after filling the trenches and if the excess soil is left at the site. Pollution would take place to a negligible extent due to spillage of construction material, oil, fuel and grease around the construction sites. Care should be taken to minimize spillages of construction materials.

Sludge containing Alum from the clarification units of the Water Treatment Plant (WTP) is stored on WTP site may lead to soil contamination and loss of top soil, if not disposed off in designated landfills for that purpose. Since sufficient land is not available at the proposed WTP site for dewatering of sludge and no landfill sites are available nearby the WTP, disposal of sludge along with wash water is proposed for the proposed WTP and hence no impact on soil quality is anticipated due to WTP sludge disposal.

6.2.1.4 Hydrology

The raw water intake cum pump house is proposed to be constructed on the east side of River Cauvery. The intake structure has been designed as a framed column structure abetting the east side of the river with a open channel rather than a closed wall structure to reduce the obstruction of water flow in the river. It will have negligible impact on the river flow characteristics. Minor impacts are anticipated on the surface water drainage in the project area during the construction phase due to trenching work for pipe lines. Precautions need to be taken during the pipe line work across canals and streams such that the flow in these water bodies is not obstructed thus affecting the cross drainage.

6.2.1.5 Ambient Air Quality

Construction Phase

Impacts on ambient air quality due to the proposed project activities are expected during the construction phase of the project. These impacts are primarily attributed to various construction activities of the project and associated generation of air pollutants such as dust, vehicular emissions, emissions from the DG set etc. The dust levels in the WTP and Booster Station, ridge sump areas are expected to be increased substantially during construction. Similarly, the trenching work for pipe lines will generate considerable dust pollution along the pipe line routes. The SPM standards, however, are not expected to be violated in the project area as the background levels are very low and the particulates tend to settle during low wind and stable conditions. Since heavy machineries used for the project will be minimum, impacts on ambient air quality due to vehicular emissions will be insignificant. It is also to be noted that these impacts are temporary in nature and will have moderate impacts on the settlements along the proposed pipe line alignment. However, to minimise these minor air quality impacts on the ambient air quality, measures

such as periodic watering during construction and other dust suppression measures should be implemented, as detailed out in the EMP.

Operation Phase

No component of the proposed water supply system is a source of air pollution, during operation and hence no impacts on air quality are anticipated during the operation phase of the project.

6.2.1.6 Noise Levels

Construction Phase

The major sources of noise pollution from the proposed project are the construction activities, movement of vehicles and operation of construction equipment and DG sets etc. The noise likely to be generated during excavation, loading and transportation of material will be in the range of 90 to 105 dB (A) and this will occur only when all the equipment operate together and simultaneously. This is however, is a remote possibility. The workers in general are likely to be exposed to an equivalent noise level of 80 to 90 dB (A) in an 8-hour shift, for which all statutory precautions should be taken into consideration. However, careful planning of machinery selection, operations and scheduling of operations can reduce these levels.

Staff quarters at Komburankadu (Booster Station) and Palakaranur (Ridge Sump) which are considered as sensitive receptors, Similarly, some settlements are found along the alignment of the Clear Water Main alignment. There will be an increase in the ambient noise level at these locations during the construction period. The impact on sensitive areas could be mitigated by staggering the operation of construction equipment and avoiding construction during night times so that the noise levels are reduced to the permissible limits. Considering the onsite noise levels, it is recommended to provide Personal Protective Equipment (PPE) such as ear muffs, etc. to the construction workers.

Operation Phase

Pumps will be working 23hours per day at the Water Treatment Plant and Booster Stations and hence there will be an increase in the ambient noise level at these locations. The staff quarters at these locations are considered as sensitive receptors. The increase in ambient noise level will have adverse impact on these sensitive receptors. However, to contain the impacts of noise during operation, it is recommended to use less noise generating pumps and in addition workers involved in the operation shall be provided with PPEs.

6.2.1.7 Water Resources

Surface Water Resources

Drawal of 206 mld from the source will not have any impact as the quantity is marginal

PWD according permission to draw 206 MLD of water from Cauvery River vide Lr. No. S7(4)/70830/96 dt. 08.01.2010.

Ground Water Recourses

Ground water will be extracted for construction activities of the project during the construction phase, which may lead to an insignificant reduction in ground water availability in the project area. Further, the supply of adequate protected water to the project towns will reduce any dependence on ground water there by reducing the pressure on ground water in the region. This will lead to a significant increase in ground water availability. This will be a major positive environmental impact of the project.

6.3 Water Quality

Surface Water Quality

The project envisages construction of an intake well cum pumping station on the east side of Cauvery River. No pollution causing activities are proposed in the River. However, during construction of the intake well, care shall be taken to avoid dumping of construction debris, accidental spill of hazardous materials etc. into the River. Runoff from construction sites such as WTP, Booster Stations and Service Reservoirs during rainy season may pollute the surface water bodies by increasing turbidity level.

Disposal of filter backwash water

Backwashing of filter media generates waste water containing debris, chemical Precipitates, straining of organic debris and plankton and residuals of excess chemical dosage etc. Filter wash water may be disposed by, 1) discharging in to natural receiving waters, 2) by recovery and reuse of the wash water, or 3) by using it for irrigation.

It is proposed to recover and reuse the filter backwash water. Recovery and reuse will be accomplished by mixing the filter wash water with the influent raw water before or at the rapid-mix basin. The wash water is collected in a back wash water collection sump from which it is pumped into the plant raw water inflow. Suspended solids in the wash water settle along with other solids in the plant basin. The recycling of filter wash water serves as a water conservation technique and may have economic advantages over other means of disposal.

Disposal of Water Treatment Sludge

Water treatment sludge includes sludge from sedimentation of particulate matter in raw water at pre-sedimentation basins, flocculated and precipitated material resulting from chemical coagulation at clariflocculator, or residuals of excess chemical dosage, plankton etc. Water treatment sludge may be disposed by, 1) Disposal of Sludge along with Filter Wash Water, or 2) Dewatering of Sludge and disposal in landfills.

Disposal of Sludge along with Filter Wash Water

The sludge collected in the sludge well can be disposed periodically along with the wash water in to the surplus water course at a controlled rate.

Dewatering of Sludge and Disposal in Landfills

The sludge can be dewatered by the following methods.

(a) Lagoons:

If land is available near the treatment plant, alum sludge can be placed in lagoons to effect further concentration of solids. Depending on the local climate and the properties of the sludge, the final solids content in the lagoon may be as low as 1 percent or as high as 17.5 percent. Water should be removed from the lagoon by decantation. The decanted water may be returned to natural watercourses if deemed safe, and is sometimes returned to the treatment plant for recycling.

(b) Sludge beds:

Another method of dewatering is application of the sludge to special sludge beds. These beds are usually composed of 6 to 12 inches of sand ranging in size up to 0.5 millimeter, with an under drain system of graded gravel 6 to 12 inches deep. Drain pipes 6 to 8 inches in diameter are placed in the gravel to carry away the water from the beds. Sand beds can usually achieve a 20 percent solids concentration in alum sludge.

(c) Mechanical dewatering devices:

Several mechanical devices have been used for dewatering of alum sludge, including pressure filters, centrifuges, freeze-thaw devices, vacuum filters, and dual-cell gravity solids concentrators. Two or more of these processes can be used within the same system to obtain a higher degree of solids concentration than would be attainable using only one process.

Proposed disposal

As the raw water quality is very good, the usage of chemicals (lime and alum) and generation of sludge will be minimal in quantity. Since sufficient land is not available at the proposed WTP site for dewatering of sludge and no landfill sites are available nearby the WTP, disposal of sludge in to nearby natural receiving waters is proposed.

The volume of sludge entering the river course will be a maximum of 2 % of quantity drawn as WTP has been designed for recirculation of filter back wash. This is marginal and will not affect the water quality at site. Also there is no habitation or any other water intake within a distance of 1 KM of downstream of WTP site.

During the operational phase of the project, due to the reduction in leakage and improvement in overall water supplied, additional sewage is expected to be generated. Salem Corporation has already initiated steps to implement Sewerage system. Hence, no impacts on surface water quality are anticipated.

Ground Water Quality

No ground water polluting activities are envisaged during the construction or operation phase of the project. However, ground water will be extracted during the construction phase of the project for construction activities, which may lead to an insignificant reduction in ground water availability and quality. Further, the supply of adequate protected water to the project towns will reduce any dependence on ground water there by reducing the pressure on ground water in the region. This will lead to a significant increase in ground water availability and quality. This will be a major positive environmental impact of the project.

6.4 Biological Environment

No forest areas, wild life sanctuaries or protected areas are present in the project influence area. The other ecological impacts of the project are discussed in the following sections.

6.4.1 Terrestrial Ecology

No rare/threatened species of flora or fauna is present in the project area. The proposed alignment of the transmission line does not pass through any reserve forest areas and any recognized tracks of wild life movement and habitations. No major tree cutting is envisaged for any of the project activities. However, the constructional activities may lead to inward migration of labour force in the area and thus there would be pressure on trees in the area due to increase in fuel demand. In order to prevent felling of trees in the neighboring areas, adequate alternate fuel should be arranged to meet the fuel requirement of labour force. Tree plantation and landscaping proposed at the WTP, Booster Stations, and Service Reservoir locations will have a positive impact on the terrestrial ecology of the project area.

6.4.1.1 Impacts on Aquatic Ecology

The proposed intake well will not affect the movement of fishes or any other fishery related activities. Hence no significant impacts on fish breeding or fish survival are anticipated due to the project activities. However, care should be taken to avoid deposition of construction waste / accidental spillage of construction material during the construction phase of the project and also by avoiding construction work during monsoon periods.

6.5 Land Environment

6.5.1 Impacts on Land Use

The details of sites required for various project components are given below:

Components (Sump, Service reservoirs Booster Stations, Pumping Station, treatment plan site etc.,)	Location	Extent (in Acres)	Land Classification & Ownership	Current Land use	No. of PAF	Acquisition/Transfer/ Alienation Status (Status as on 20.06.2011)
River Water Intake & Water Treatment Plant	Thottilpatti	10.5	Revenue Porumpokku	Porampokku	Nil	Name Transfer proposal sent to CLA from District Collector, Salem on 19.7.10 The CLA forwarded the proposal to Govt. on 07.02.11
Booster Station	Komburankadu	2.55	TWAD Land	Vaccant	Nil	An amount of Rs.5,14,110/- remitted to TWAD for purchase of Land.
Ridge Sump	Pazhakkaranur	0.64	TWAD Land	Vaccant	Nil	An amount of Rs.5,14,110/- remitted to TWAD for purchase of Land.

Details of Distribution Main, Clear Water Main, Gravity Mains Right of Way (ROW) etc.

	Location	Distance (in KMs)	Whether passing through private lands, road, river banks etc.	Any structures are affected enrote.	No. of PAF	Status of permission (if required) for laying
Treatment plant to Booster Station	P.N. Patty Town Panchayat	2.00	1. P.N. Patty Town Panchayat	--	Nil	Permission obtained on 25.3.2010
	Mettur	1.20	Mettur Municipality Road		Nil	Permission obtained on 02.02.2011
	Upto Komburankadu	4.09	Salem Attur C.W.S.S. Road		Nil	--
Booster Station to Ridge Sump	From Komburankadu to Pazhakaranur	7.265	Salem Attur C.W.S.S. Road	--	Nil	--
Ridge sump to Salem City Entry Point	From Pazhakaranur to Salem	26.600	Salem Attur C.W.S.S. Road	--	Nil	--

6.5.2 Agriculture

No impact on agriculture is anticipated due to the project in the project area.

6.5.3 Socio-Economic and Public Health Impacts

No negative impacts are envisaged on the socio-economic patterns of the project influence area due to the project. Sufficient protected water supply will be provided in the Project Towns during the operation phase of the project. It will improve the public health of the project area due to reduction in water born diseases. Providing sufficient number of water connections and public stand posts will help to reduce the struggle of the urban poor, especially women for collecting water. They will get more free-time, which can be used

for productive economic activities leading to improvement in the socio-economic profile the project area.

6.6 Safety Aspects of Chlorine Use in WTP

6.6.1 Introduction

Chlorine is potentially dangerous. It is, therefore, important that person engaged in a chlorine plant or in any activity involving handling of chlorine should understand the hazards of chlorine and should know preventive measures needed.

6.6.2 Storage and Handling of Chlorine Cylinders

Chlorine is stored in special grade steel containers. As per IS:4379-1967, the colour of Chlorine container should be 'golden yellow'. Chlorine cylinders of 100 Kg capacity will be suitable for the proposed WTP. It will be required to store about 18 cylinders at a time at the WTP. Instructions given in the 'Manual on Operation and Maintenance of Water Supply Systems' published by the Central Public Health and Environmental Engineering Organization (CPHEEO) in 2005 for the storage and handling of Chlorine cylinders is should be strictly followed for safe operation of the WTP.

6.6.3 Health Hazards of Chlorine

Wet chlorine being corrosive, it forms corrosive acid with body moisture. Inhalation can cause respiratory injury ranging from irritation to death depending upon its concentration and duration of inhalation. First aid - trained Personnel having the knowledge in the use of aid equipment and rendering artificial respiration should be available in the plant. First aid box with necessary contents should be available. Properly designed showers and eye fountains should be provided in convenient locations and they should be properly maintained. If oxygen is available the same should be administered by authorized person.

6.6.4 Fire & Explosion Hazards of Chlorine

Chlorine may react to cause fires or explosions upon contact with turpentine, ether, ammonia gas, hydrocarbons, hydrogen, powdered metals, sawdust and phosphorus. Due to fire in the vicinity, the temperature of the containers rises excessively which results in explosion. In order to avoid explosion of the containers, remove all the movable containers from the fire zone immediately by wearing full protective clothing with respiratory protection. In the case of immovable containers, use water for cooling provided there is no leak.

6.6.5 Emergency Response Planning

When a large quantity of chlorine is stored it is essential to have an emergency response planning as leakage of Chlorine may lead to a major accident such as emission, fire or explosion, leading to serious danger to man, immediate or delayed, inside or outside the establishment and/or to the environment, and involving one or more dangerous substances. It has, therefore, become obligatory to take all measures necessary to prevent accidents and to limit their consequences for man and the environment. The hazard control can be achieved by drawing an effective 'on-site emergency plan'.

6.6.6 Neutralization of Chlorine

A suitable provision should be available for emergency disposal of chlorine from the leaking container. Chlorine may be absorbed in solution of caustic soda, soda ash and hydrated lime. Caustic soda is recommended as it absorbs chlorine more readily. If hydrated lime is used, the slurry must be continuously agitated and recirculated for

caustic soda or hydrated lime or sodium carbonate in solution form. This system can be used only after controlling the leaking container by emergency kit and connecting it to the Neutralisation tank by inverted U tube of 11 m height. Do not push the leaking container in the alkali tank. It is recommended to provide a suitable tank to hold the alkali solution in a convenient location near the chlorination plant.

6.6.7 Personal Protective Equipment

The following personal protective equipments can be used in case of a Chlorine leakage. Breathing Apparatus: Self-contained breathing apparatus, Air-line respirator or Industrial Canister Type Mask can be used as breathing apparatus, depending on the concentration of Chlorine in the atmosphere and the availability of Oxygen. Protective Clothing: Rubber or PVC clothing is useful in massive exposure which otherwise creates mild skin burns due to formation of acid on the body.

6.6.8 Acts and Rules Applicable for Handling of Chlorine

The Gas Cylinder Rules 2004: Storage license from controller of explosives is to be obtained under Gas Cylinder Rules 2004 if the quantity of Cl2 containers to be stored is more than 5 Nos. Since it is envisaged to store more than 12 cylinders at a time at the proposed WTP, storage license from controller of explosives has to be obtained.

6.7. Occupational Health and Safety of WTP Operators

6.7.1 Potential Hazards to Health and Safety

In addition to the hazards of Chlorine, the WTP Operators will be exposed to a number of hazards such as:

- Electrical equipment,
- Rotating mechanical equipment,
- Water treatment chemicals such as Alum and Calcium Hydroxide,
- Laboratory reagents (chemicals),
- Slippery surfaces caused by certain chemicals,
- Flooding,
- Confined spaces and underground structures such as valve or pump vaults (toxic and
- explosives gases, insufficient oxygen), and
- Continuous exposure to high noise level in the WTP leading to hearing impairment

6.7.2 Management of Hazards to Health and Safety

Selection of WTP Employees: Pre-placement medical examination should be carried out of the persons to confirm that they are free from Asthma, Bronchitis and other chronic lung conditions. Follow up medical examination should be carried out once in a year.

Training for Employees: It is essential to impart training to the employees who have to

- Instructions in the action to be taken in an emergency,
- Use of emergency kit,
- Handling of containers,
- First aid,
- Use of protective equipment,
- Knowledge of Chlorine hazards,
- Fire fighting,
- Use of safety showers and eye fountains,
- Crash shut down procedure for valves and switches,
- Communication system, and
- Study of plant layout with diagram.

The Operator should use appropriate hearing protectors to prevent noise-induced hearing loss caused by exposure to loud and prolonged noise in the pump rooms. The WTP should have an Operation and Maintenance Manual with appropriate safety procedures.

6.8. Summary of Environmental Impacts

The proposed water supply project does not lead to any significant irreversible environmental impacts in the project influence area. There are no environmentally sensitive areas along the alignment of the proposed pipeline and other proposed structures of the project. Health impacts to the WTP operators include hazards from electrical and rotating mechanical equipments, water treatment and laboratory chemicals, and noise induced hearing impairment. Temporary impacts during construction phase of the project leading to pollution of air, water, noise and soil are envisaged during the construction stage of the project. Reduction in ground water use and subsequent increase in ground water availability due to supply of adequate treated river water to the project towns and recharging of ground water aquifers and subsequent increase in ground water availability around the WTP site due to disposal of wash water from WTP are two major positive impacts of the project. Providing sufficient number of water connections and public stand posts as part of the project will help to reduce the struggle of the urban poor, especially women for collecting water. Supply of adequate protected water to the project towns will improve the public health status due to reduction in water born diseases. These are the major benefits of the project to the society.

Appropriate mitigation measures to be implemented to minimize the negative impacts and enhancement measures to maximize the positive impacts are presented in Chapter 7, Environmental Management Plan (EMP). The Impact Identification Matrix used to predict the environmental impacts is presented in Table 6.1.

6.9 Summary of Social Impacts

Project Affected People (PAP): Nil

Impact on Socially and Culturally Sensitive Features: Nil

Based on the social screening and assessment of land acquisition requirements for the project, since there is no PAP and there is no physical displacement of the PAP the project has been categorized as "Category S3 Project" as per the ESF of TNUIFSL.

Table -6.1

IMPACT IDENTIFICATION MATRIX

Sl.No	Environmental Parameter	Activity	Potential Impacts	Degree of Impact	Nature of Impact
1	Topography	Construction of Intake, WTP, Booster, laying of pipes	Minor changes in the topography of construction sites due to excavation and filling of soil	Minor	- ve,P
2	Climate	Nil	Nil	Nil	Nil
3	Soil Characteristics	Construction of Intake, WTP, Booster, laying of pipes	Loss of top soil due to excavation and soil erosion Contamination of top soil due to spillage of construction materials, fuels and grease	Minor	- ve,P
4	Hydrology	Construction of intake structure	Minor changes in the river flow characteristics	Minor	- ve,P
5	Ambient Air Quality	Construction of Intake, WTP, Booster, laying of pipes	Increased air pollution in terms of dust and emission from vehicles and DG sets	Minor	- ve,T
6	Noise levels	Construction of Intake, WTP, Booster, laying of pipes	Increase in ambient noise levels	Minor	- ve,T
7	Surface water resources	Nil	Nil	Nil	Nil
8	Ground Water resources	Extraction of ground water for construction activities	Reduction in ground water availability	Minor	- ve,T
9	Surface water quality	Construction of intake structure in River Cauvery Construction of	Pollution of river water due to construction activities and spillage of construction	Minor	- ve,T

		Booster, laying of pipes	etc Pollution of surface water bodies due to runoff from construction sites during rainy season.		
10	Ground water quality	Extraction of ground water for construction activities	Reduction in ground water availability and subsequent impact on ground water quality.	Minor	- ve,T
11	Terrestrial Ecology	Inward migration of construction labour force into the project area	Pressure on trees due to increase in fuel demand	Minor	- ve,T
12	Aquatic Ecology	Construction of intake structure in River Cauvery	Pollution of river water due to construction activities and spillage of construction materials fuels etc and subsequent impact on aquatic life	Minor	- ve,T
13	Land use	Nil	Nil	Minor	- ve,T
14	Agriculture	Nil	Nil	Minor	- ve,T
15	Socio Economic Profile	Nil	Nil	Nil	Nil
16	Public Health	Nil	Nil	Nil	Nil
17	Occupational safety and health	Nil	Nil	Nil	Nil
II	**Operational Phase**				
1	Topography	Nil	Nil	Nil	Nil
2	Climate	Plantation & Landscaping	Improvement in micro climate of project site	Minor	+ ve,P
3	Soil Characteristics	Nil	Nil	Nil	Nil
4	Hydrology	Trenching for pipe laying	Obstruction to cross drainage along pipeline route	Minor	- ve,T
5	Ambient Air Quality	Nil	Nil	Nil	Nil

		pumps / blowers at intake, WTP and Booster pumping station	ambient noise levels		
7	Surface water resources	Abstraction of 206 MLD of water from River Cauvery	Reduction in quantity of water for down stream side of the river	Medium	- ve,P
8	Ground Water resources	Supply of adequate water to project area	Reduction in ground water use and subsequent increase in ground water availability and quality	Major	+ ve,P
9	Surface water quality	Generation of additional sewage due to increase in water supply	Pollution of surface water bodies to which untreated sewage will be disposed	Major	- ve,P
10	Ground water quality	Supply of adequate water to project area	Reduction in ground water use and subsequent increase in ground water availability and quality	Major	+ve,P
11	Terrestrial Ecology	Plantation & Land scaping	Positive impact on local fauna	Minor	+ve,P
12	Aquatic Ecology	Nil	Nil	Nil	Nil
13	Land use	Nil	Nil	Nil	Nil
14	Agriculture	Nil	Nil	Nil	Nil
15	Socio Economic Profile	Providing sufficient number of water connection and stand posts	Help to reduce struggle of the urban poor especially the women for collecting water	Major	+ ve,P
16	Public Health	Supply of adequate water to project area	Improvement of public health status due to reduction in waterborne diseases	Major	+ ve,P
17	Occupational safety and health	Operation of intake, Booster pumps and WTP	Hazard from electrical and rotating mechanical equipments, water treatment and laboratory chemicals, and	Major	- ve,P

			hearing impairment		

P – Permanent, T - Temporary

6.10 Positive Impacts:

The project will have considerable positive social impacts as a result of assured, adequate and safe water supply in the region. These benefits include

a. Overall improvement in the health of the community especially the children
b. It saves their time and energy and thereby paves the way for earning more
c. It leads to improved standard of living and find time for recreation and other activities.
d. The quality of potable water provided improves the health of the residents and thereby longevity of the people will also be increased
e. Quarrelling for water fetching from available sources be reduced considerably and thereby improved brotherhood activities
f. The wastewater generating from the houses and through streets could be used for green belt concept and thereby water pollution, air pollution problems could be minimized
g. Green belt concept leads to habitant for flora and fauna
h. People will get employment opportunities and thereby average earning could be increased
i. Ground water table will be raised

6.11 Negative Impacts:

a. Constructional phase of the project will lead to air pollution, noise pollution in their respective areas
b. Dust problem will be arisen which may affect some persons
c. Communication and power supply facilities are likely to get affected in the areas during construction
d. Continuous running of motors at head works, sumps likely to cause noise pollution
e. The improved water supply leads to more sullage and drainage problem unless controlled properly
f. Improper planning of construction activities may lead to traffic jam, diversion of traffic and related problems cause people to get agony.
g. As more water is to be delivered to the consumer , the generation of Sewage will be higher

6.12 Mitigation measures:

a. Avoidance of heavy construction equipments that produce noise at school and hospital zones

b. Proper planning on constructional phase could minimize all the air pollution and noise pollution

c. Sprinkling of water on the construction materials could minimize dust problem

d. Communication and power interruption problems could be minimized by getting proper coordination from the respective institutions

e. Green belt and growing more trees could minimize noise pollution at pumping stations.

f. House gardening could reduce sullage problem to certain extent at house level and the drainage collected through streets be properly collected and economical drainage through Sewage treatment plant should be provided to avoid insanitation and related problems.

g. Traffic could be regulated by putting caution board at appropriate locations and informing the concerned authorities like police can bring down the people's agony to a great extent.

h. People shall be made aware of the on going project through various means and levels and make them to co operate for the effective usage of water and disposal of wastewater

i. There are no environmentally sensitive areas along the alignment of the proposed pipeline and other proposed structures of the project

Significant negative impacts of the project would be the pollution of adjacent lands into which the wash water disposed from the WTP would reach, and pollution of surface water bodies in to which the additional sewage that would be generated in the project towns due to the increase in water supply would be disposed. To tackle the additional quantity of sewage, the Corporation has already initiated implementation of the sewerage project.

Chapter -7

Environmental Management Plan and enhancement measures

7.1 Environmental Management Plan

Table 7.1 EMP – Pre-construction and construction

Sl. No.	Potential Negative Impacts	Mitigation Measures	Time frame	Responsible agencies
	Pre Construction			
1	Clearances	All clearance required during construction shall be ensured and made available before start of work. List of clearances required are provided in Table under section 4.3.9. Salem Corporation has received minutes of the meeting by PWD according permission for drawal of 206 MLD of raw water and disposal of waste water. Other permission need to be obtained.	Before start of construction	ULB/PIA/Concerned Departments & agency / Contractor
2	Tree cutting	i) Tree cutting may be required at Booster station site. The PIA shall try to avoid tree cutting. ii) No tree cutting in other sites and in the alignment. iii) Twice the number of trees cut if any at Booster station site shall be planted as a compensatory measure.	During construction	PIA
3	Utility Relocation	iv) Identify the common utilities to be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps etc. v) Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts	Before start of construction	PIA / Concerned departments
	During Construction			
	General			
1	Baseline parameters	Adequate measures shall be taken and checked to control the Baseline parameters of Air, Water and Noise pollution. Base line parameters recorded shall be used for monitoring and conformance be ensured.	Through out Construction phase	Prospective contractor/PIA
2	Planning of temporary traffic arrangements	The activities are limited to the project sites and right of way. Hence does not require any traffic arrangements. However in case of any need in the site, necessary permissions for temporary diversion shall be obtained. Signanges and safety measures including flagmen be provided at the site.	During construction	Prospective contractor/PIA
2	Storage of	The contractor shall identify site for	Before start of	Prospective ctor / PIA

		/ storage of construction materials, etc.		
3	Construction of labour camps	Contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp). The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction. The construction will commence only upon the written approval of the Engineer. The contractor shall maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Engineer. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be planned. Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided should be prepared and shall be approved by the Engineer	During construction	Prospective contractor
4	Safety Aspects	i) Adequate precautions shall be taken to prevent the accidents and from the machineries. All machines used shall conform to the relevant Indian standards Code and shall be regularly inspected by the PIA ii) Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil. iii) Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc. iv) Welder's protective eye-shields shall be provided to workers' who are engaged in welding works. v) Earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation vi) The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs. The contractor will comply with all the precautions as required for ensuring the	During construction	Prospective contractor

		safety of the workmen as per the International Labour Organization (ILO) Convention No.62 as far as those are applicable to this contract. The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 and adhered to. The contractor shall not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form.		
5	Disposal of construction debris and excavated materials	A suitable site should be identified for safe disposal, in relatively low lying areas, away from the water bodies etc., and got approved by the Engineer.	Pre-construction and Construction	PIA / Prospective contractor
6	Barricading site	The activities would be restricted to project sites and right of way for alignment. However barricading with adequate marking, flags, reflectors etc. shall be provided along the alignment for safety of restricted traffic movement and pedestrians.	During construction	Prospective contractor During construction
7	Clearing of construction camps and restoration	i) Contractor to prepare site restoration plans, the plan is to be implemented by the contractor prior to demobilization ii) On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the contractor's expenses, to the entire satisfaction of the engineer.	After completion of Construction	Prospective contractor
8	Pollution from Fuel and Lubricants	i) The contractor shall ensure that all construction vehicle parking location, fuel / lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500m from rivers and irrigation canal / ponds ii) All location and layout plans of such sites shall be submitted by the Contractor prior to their establishment and will be approved by the Engineer iii) Contractor shall ensure that all vehicle / machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that	During Construction	Prospective contractor

		contaminate the ground. iv) Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Engineer) and approved by the Engineer. All spills and collected petroleum products will be disposed off in accordance with MoEF and state PCB guidelines. v) Engineer will certify that all arrangements comply with the guidelines of PCB / MoEF or any other relevant laws		
9	Pollution from Construction Wastes	All waste arising from the project is to be disposed off in the manner that is acceptable by the Engineer	During Construction	Prospective contractor
10	Storage of chemicals and other hazardous materials	A suitable site should be identified/construct for the safe storage and handling of chemicals and other hazardous materials with proper display of requirements and marking as protected area.	During Construction	Prospective contractor
11	Informatory signs and Hoardings	The contractor shall provide, erect and maintain informatory/ safety signs hoardings written in English and local language, wherever required or as suggested by the Engineer	During Construction	Prospective contractor
12	First Aid	The contractor shall arrange for: i) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone. ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital	During Construction	Prospective contractor
13	Risk from Electrical Equipments	The contractor shall take all required precautions to prevent danger from electrical equipment and ensure that- i) No material will be so stacked or placed as to cause danger or inconvenience to any person or the public ii) All necessary fencing and lights will be provided to protect the public in construction zones. All machines to be used in the construction will conform to the relevant Indian Standard (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Engineer	During Construction	Prospective contractor
14	Waste Disposal	i) The contractor shall provide garbage bins in the camps and ensure that these	During construction	Prospective contractor

		in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Engineer. ii) Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Engineer will have to be provided by the contractor		
15	Pollution from Construction wastes	All waste arising from the project is to be disposed off in the manner that is acceptable by the Engineer The engineer shall certify that all liquid wastes disposed off from the sites meet the discharge standard	During construction and post-construction	Prospective contractor / PIA
16	First Aid	The contractor shall arrange for: i) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone. ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital	During construction	Prospective contractor
No.	**Systems / Impacts**	**Action to be taken**	**Responsible agencies**	**Time frame for implementation**
	Water Head Works & Pumping Stations			
1	Restoring river bed / water source	Ensure the restoring of river bed to its natural shape free from any debris or construction junk material that may obstruct the flow.	Construction and Post Construction	Prospective contractor
2	Downstream users (impacts arising due to coffer dams, etc.)	Ensure that the flow stream is not obstructed, affecting the down stream users due to construction of coffer dams, etc.	During construction	PIA / Prospective contractor
3	Water quality in the River	The water quality of the source shall be monitored during construction as in the monitoring plan provided in Table 7.3 and report sent to the Engineer	Pre-construction and Construction	PIA / Prospective contractor
	Water Treatment Plant/ Booster station/Ridge Sump			
1	Protection of top soil & Environmental enhancing	Top soil from the WTP area should be stored in stock piles and that can be used for gardening purposes at WTP site which will be an environmental enhancing measure	Prospective contractor	During construction
2	Consent to Operate	Obtaining Consent to establish and consent to Operate from Tamilnadu Pollution Control Board	Prospective contractor	Before commissioning
3	Storage of chlorine	Permission from Directorate of Explosives or any other competent authorities for	Prospective contractor	Before commissioning

		on safety measures and emergency measures to be installed.		
4	Disposal of waste water	i) The waste water quality shall comply with the standards of TNPCB to let out into the river. ii) Ensure efficient working condition of treatment plant	During commissioning and Trial run	PIA/ Prospective Contractor
5	Tree plantation	Trees shall be grown in the site for a minimum width of 15m along the boundary of the WTP site. (Refer Section 7.2.1)	During construction	PIA/ Prospective Contractor
	Construction of Transmission Mains			
1	Protection of top soil	The top soil to be protected and compacted after completion of work, where the pipelines run, including open lands and agricultural lands	During construction	PIA / Prospective contractor
2	Laying of pipeline	Adequate precautions should be taken while laying the water supply mains to avoid the possibility of cross connection with sewer lines	During construction	Prospective contractor
3	Traffic diversion	Before taking up of construction activity, a Traffic Control Plan shall be devised and implemented to the satisfaction of the Engineer. Construction shall be taken phase-wise so that sections are available for traffic Temporary diversion will be provided with the approval of the engineer. The Detailed traffic control plans prepared and submitted to the engineers for approval one week prior to commencement of works shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, SIGNAGES, safety measures for transport of hazardous materials and arrangements of flagmen. The arrangement for the temporary diversion of the land shall ensure to minimize the environmental impacts like loss of vegetation, productive lands etc., prior to the finalization of diversion and detours. Special consideration will be given to the preparation of the traffic control plan for safety of pedestrians and workers at night. The contractor will ensure that the diversion/detour is always maintained in	During construction	Prospective contractor / PIA

		monsoon to avoid disruption to traffic flow. He shall inform local community of changes to traffic routes, conditions and pedestrians access arrangements. This plan will be periodically reviewed with respect to site conditions. The temporary traffic detour will be kept free of dust by frequent application of water.		
4	Temporary flooding due to excavation	Proper drainage arrangements to be made, to avoid the overflowing of existing drains due to excavation during the laying of mains.	During construction	Prospective contractor / PIA
5	Using of modern machineries	Using of modern machineries such as JCBs, backhoes etc, shall be used to minimize the construction period, it will reduce the construction period impacts to the near by residents	During construction	Prospective contractor
6	Dust pollution near settlements	i) All earth work will be protected in manner acceptable to the engineer to minimize generation of dust. Area under construction shall be covered & equipped will dust collector. ii) Construction material shall be covered or stored in such a manner so as to avoid being affected by wind direction. iii) Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day iv) Trucks carrying construction material to be adequately covered to avoid the dust pollution and to avoid the material spillage	Prospective contractor	During construction
7	Protection of residential sensitive receptors	i) Noisy construction operations in residential and sensitive areas should be done only between 7.30 am and 6.00 pm ii) Preventive maintenance of construction equipment and vehicles to meet emission standards and to keep them with low noise iii) Provision of enclosing generators and concrete mixers at site. iv) Sound barriers in inhabited areas shall be installed during the construction phase. v) Adequate barricading / other measures to protect dust pollution near sensitive receptors like schools and hospital etc. to be ensured	During construction	Prospective contractor / PIA
8	Vehicular noise pollution	i) Idling of temporary trucks or other equipment should not be permitted	During construction	Prospective contractor / PIA

	sensitive receptors	or when they are not in active use. The practice must be ensured especially near residential / commercial / sensitive areas. ii) Stationary construction equipment will be kept at least 500 m away from sensitive receptors. iii) All possible and practical measures to control noise emissions during drilling shall be employed. The PI A may direct to take adequate controls measures depending on site conditions.		
9	Noise from vehicles, plants and equipments	i) Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. ii) Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Engineer to keep noise levels at the minimum	During construction	Prospective contractor / PIA
10	Storage of construction materials	Site for storage of pipes and construction materials to be identified, without affecting the traffic and other common utilities	Prospective contractor	During construction
11	Pollution from Construction wastes	The Contractor shall take all precautionary measures to prevent the wastewater generated during construction (e.g., during the testing of pipeline) from entering into streams, water bodies or the irrigation system.	During construction and post-construction	Prospective contractor / PIA

Table 7.2 EMP – During Operation

No.	Issues	Action to be taken	Responsibility
1	Impact on water quality and therefore to public health due to treatment deficiencies or contamination of water	Monitoring at regular intervals of water quality parameters at intake point followed by immediate measures to remedy the situation if there is an impairment of water quality. Monitoring at regular intervals of water quality parameters during distribution at the consumer end, followed by immediate measures to remedy the situation if there is a impairment of water quality	Corporation/ Operator
2	Transportation and storage of hazardous	Guidelines and procedures in Motor vehicle Act 1986 for transportation ;	Corporation/ Operator

		Hazardous Chemicals Rules 1989 to be followed for storage and handling of Hazardous chemicals : Insurance covers to be taken for accidents and cost of clean up operations.	
3	WTP	(i) Providing equipments like ear plugs to workers near the noise source. (ii) Providing PPEs for safe working of personnel in critical areas like chlorination plant shall be ensured. (iii) Display boards on safety measures and emergency measures to be installed. (iv) Regular training for the staffs operating the WTP with various aspects of maintaining water quality and safety. (v) Regular maintenance of the greenbelt and the entertainment facilities at the site.	Corporation/Operator
4	Booster station	(i) PPEs for the workers exposed to high noise. (ii) Regular maintenance of the greenbelt.	Corporation/ Operator
5	Ridge sump	Regular maintenance of the landscaping made at the site.	Corporation/ Operator

7.2 Environmental Enhancement measures

Environmental Enhancement Measures (EEM) as presented in table below., are proposed at the project sites such as WTP, booster stations and service reservoir sites for the attenuation of environmental impacts such as noise pollution from the pumps, creation of an aesthetic environment, tourist attraction and for improving the living standards of the project affected community.

Table 7.3 Proposed Environmental Enhancement Measures

Sl.No.	Project Sites	Environmental Enhancement Measures Proposed
1	Head Works & WTP	➢ Development of park /Green spaces. ➢ Planting of trees all along the boundary of the WTP site
2	Transmission Line	➢ Upgrade and maintain the road along the alignment ➢ Plantation of trees along the alignment
3	Booster Stations & Service Reservoirs	➢ Development of Parks / Play Grounds / Green Spaces at Booster Stations and Service Reservoir Sites
4	Water Supply Distribution lines	➢ Supply of potable water quality monitoring kits to the community for on site water quality monitoring

7.2.1 Greenbelt development plan

It is proposed to plant trees and shrubs at the project sites such as water treatment plant, booster stations and service reservoir sites to the extent possible.

It is also recommended that tree and shrub plantation in a project site be completed at the earliest practical stage of engineering works. Adequate protection for the plants, necessary care and monitoring should be carried out to ensure their growth.

A study on the local flora has been carried out as part of the field surveys to enable a choice of the suitable species for plantation at the project sites. The criteria for selection of species for plantation are that the species is indigenous and suited to the soil and rainfall of the area, and hardy and needs no attention after the maintenance period. Table below presents a list of some of the tree species that are suitable for plantation at the project sites.

Table 7.4 List of Trees suggested for Plantation at Project Sites

Sl.No.	Botanical Name	Common Name	Remarks
1	Albizia lebbek	Lebbek tree	Broader crown species
2	Azadirachta indica	Neem tree	Broader crown species
3	Eucalptus globules	Nilgiri	Broader crown species
4	Ficus bengalensis	Banyan tree	Broader crown species
5	Ficus religiosa	Sacred fig tree	Broader crown species
6	Samanea saman	Rain tree	Broader crown species
7	Terminalia-arjun	Arjun tree	Broader crown species
8	Terminalia catappa	Indian almond	Broader crown species
9	Acacia mangium	Mangium	Moderate crown species
10	Leucaena leucocephala	Subabul	Moderate crown species
11	Pongamia pinnata	Pongam oil tree	Moderate crown species
12	Sapindus mukorossi	Soap nut tree	Moderate crown species
13	Thespesia populnea	Portia tree	Moderate crown species
14	Artocarpus heterophyllus	Jack fruit tree	Fruit yielding species
15	Borassus flabellifer	Palmyra tree	Fruit yielding species
16	Mangifera indica	Mango tree	Fruit yielding species
17	Phyllanthus emblica	Amla tree	Fruit yielding species
18	Syzygium cumini	Jamun tree	Fruit yielding species
19	Tamarindus indica	Tamarind tree	Fruit yielding species
20	Cassia Verities	Cassia	Ornamental species
21	Delonix regia	Gulmohar	Ornamental species
22	Jacaranda mimosaefolia	Blue Jacaranda	Ornamental species
23	Lagerstroemia speciosa	Pride of India	Ornamental species
24	Peltophorum pterocarpum	Copper pod	Ornamental species
25	Spathodia campanulata	Fountain tree	Ornamental species

Some of the shrubs that are suitable for plantation at the project sites are below:

Table 7.5 List of Shrubs suggested for Plantation at Project Sites

Sl.No.	Botanical Name	Common Name
1	Ixora sp.	Ixora
2	Nerium Oleander, Nerium Sp.	Oleander
3	Hibiscus sp.	Rose of Sharon
4	Tabernae Montana Sp.	Blue star
5	Caesalpinia Sp.	Caesalpinia

It is suggested that the components be designed in such a way to provide for planting of trees atleast for a width of 15 m along the boundary of the WTP site. Trees shall be interspaced by around 7m within and between rows and shrubs may be planted in between two trees.

In booster station site, the tree cutting shall be avoided, and in addition, trees and shrubs shall also be planted as above, along the boundary.

In ridge sump site, shrubs shall be planted along the boundary.

Table 7.6 Environmental Monitoring Plan

S. No.	Monitoring Requirement	Specifications	Responsible Entity
	Construction Phase		
1	Environmental parameters		
	i) Air quality at the construction sites and along alignment to understand the impact of construction activities (7 stations)	24 hourly monitoring for three days for three seasons (excluding monsoon)	Salem Corporation/Contractor
	ii) Noise levels at the construction sites and along alignment to understand the impact of construction activities (7 stations)	Hourly basis for 24 hour period - Seasonal	Salem Corporation/Contractor
	iii) Surface water quality at the headworks site	Chemical and Bacteriological quality - Grab samples thrice a day (covering the diurnal cycle) seasonal	Salem Corporation/Contractor
	iv) Ground water quality at the WTP site	Chemical quality, Bacteriological quality - annual.	Salem Corporation/Contractor
2	Disposal of construction debris	Periodic inspection at haul roads and sites for construction debris for safe collection and disposal to landfill sites	Salem Corporation
3.	Traffic and Transportation	Measures for diverting the traffic during construction across National Highways,	Salem Corporation

		monitored. Public consultations should be conducted well in advance in order to take an informed decision on the proposed detours and diversions	
4	Procurement of construction material	Check that procurement of construction material should be only from permitted sites and quarries	Salem Corporation
5	Plantation of trees	Plantation to be completed before completion of construction	Salem Corporation
	Operation Phase Impacts		
1	Water quality at intake point and WTP (throughout the project)	Chemical quality, seasonally for 3 locations (@3 samples per location) Bacteriological quality, monthly for 3 locations. Grab samples thrice a day (covering the diurnal cycle)	Salem Corporation
2	Water quality at the outlet of the WTP	Chemical quality, seasonally for 1 location (@3 grab samples) Residual chlorine and bacteriological quality, monthly for 1 location (@ 3 samples)	Salem Corporation
	Surface water quality at the point where wash water and sludge are disposed	Chemical quality seasonally @ 3 grab samples. Bacteriological quality, monthly 3 Nos.	Salem Corporation
	Ground water quality at WTP site	Chemical quality, Bacteriological quality annually.	Salem Corporation
3	Transportation and storage of hazardous chemicals, e.g., chlorine at water treatment plants	To check whether guidelines and procedures in Motor Vehicle Act 1986 for transportation; and in Manufacture, Storage and Import of Hazardous Chemical Rules 1989 for storage are being followed.	Salem Corporation
4	Greenbelt maintenance at WTP and booster station site	The greenbelt survival to be monitored and watered regularly.	Salem Corporation/ Contractor

7.3 Cost Estimates

The cost is estimated to be about Rs 35 lakhs and will be met from contingencies etc provided in the project cost estimate. The breakup of the cost estimate is given in table below:

Table 7.7 Cost estimates for EMP and EEM

S.No	Item	Description	Estimate
	CONSTRUCTION PHASE		
	Package 1 Providing Dedicated Water Supply Scheme to Salem City Municipal Corporation under Package - I covering Raw Water Intake well, Booster station & Ridge sump and providing Pumping arrangements for Raw water & Clear water. .		
1	Air Quality monitoring (Kombrankadu, Ridge sump site – Pazhakaranur,)	Rs 2000/ location x 2 location x 8 Season	32000
2	Surface Water Quality monitoring (River Cauvery – near intake)	Rs 2500/ location x 1location x 8 season	20000
3	Ground Water quality monitoring (Booster site Komburankadu and Ridge sump site Pazhakaranur)	Rs 2500/ location x 2 location x 4 season	20000
4	Noise level monitoring (Komburankadu)	Rs 500/ location x 1 location x 8 season	4000
5	Barricading	400m @ 15 Rs per RM	6000
		Total	**82000**
	Package 2 Providing Dedicated water supply scheme to Salem City Municipal Corporation under package II covering of construction of Water Treatment Plant of capacity 155MLD at Thottilpatti on Lump Sum Turnkey Contract basis.		
1	Air Quality monitoring (WTP site –Thottilpatti)	Rs 2000/ location x 1location x 8 Season	16000
2	Ground Water quality monitoring (WTP site – Thottilpatti)	Rs 2500/ location x 1 location x 4 season	10000
3	Noise level monitoring (WTP site –Thottilpatti)	Rs 500/ location x 1 location x 8 season	4000
4	Plantation of trees and controlled and well managed recreational facilities at WTP etc	Lump Sum	280000
		Total	**310000**
	Package 3 Providing Dedicated Water Supply Scheme to Salem City		

	Clear Water pumping main from Water Treatment Plant to Ridge Sump at Pazhakaranur through Komburankadu Booster Station..		
1	Dust Suppression by water sprinkling (WTP to Booster site)	Rs 500/ trip x 370 trips	185000
2	Dust Suppression by water sprinkling (Booster site to Ridge sump site)	Rs 500/ trip x 370 trips	185000
3	Air Quality monitoring (CWTM from WTP to Booster site and Booster site to Ridge sump site)	Rs 2000/ location x 2 location wherever work is in progress x 8 Season	32000
4	Barricading	29000 Rm x Rs.15 / m	435000
		Total	**837000**
	Package 4 Providing Dedicated Water Supply Scheme to Salem City Municipal Corporation under Package - IV Covering Supplying, laying, testing and commissioning of 1500 mm Dia Mild steel gravity main from Pazhakaranur ridge sump to the junction of Omalur- Tharamangalam main road.		
1	Dust Suppression by water sprinkling	Rs 500/ trip x 790 trips	395000
2	Air Quality monitoring (Along the alignment where work is in progress)	Rs 2000/ location x 1 location wherever work is in progress x 8 Season	16000
3	Barricading	29600 Rm x Rs.15 / m	444000
		Total	**855000**
	Package 5 Providing Dedicated Water Supply Scheme to Salem City Municipal Corporation under Package - V Covering Supplying, laying, testing and commissioning of 1500 mm Dia Mild steel gravity main from Omalur- Tharamangalam main road to Salem entry point.		
1	Dust Suppression by water sprinkling	Rs 500/ trip x 630 trips	315000
2	Air Quality monitoring (Along the alignment where work is in progress)	Rs 2000/ location x 1 location wherever work is in progress x 8 Season	16000
3	Barricading	23600 Rm x Rs.15 / m	360000
		Total	**691000**
S.No	**Item**	**Description**	**Estimate**
	CONSTRUCTION PHASE		
II	**OPERATION PHASE–Per year**		
1	Surface Water Quality	Rs 2500/ location x 1location x	10000

	monitoring (Downstream of point of disposal of wash water)	4season	
2	Ground Water quality monitoring (WTP site)	Rs 2500/ location x 3 location x 2 season	15000
3	Noise level monitoring (WTP site and Booster station)	Rs 500/ location x 2 location x 4 season	4000
4	Provision for water quality kits and other contingencies		275000
		Total	**304000**
		Total for Construction & O&M	**3085000**
	Provision for tree plantation by Corporation and Contingencies		**415000**
		Grand Total	**3500000**

7.4 Institutional Setup

The PIA Engineers in charge of the project will be responsible for supervising the implementation of the mitigation measures proposed in the EMP by the Contractor and they will be reporting to the ESS Managers at TNUIFSL who will monitor the implementation of Environmental Management Plan (EMP) and related measures regarding other environmental matters related to the project.

7.4.1 Environmental Training

A short-term training shall be provided for the PIA Engineers in charge of the project and the contractor staff to raise their level of environmental awareness and for the effective implementation of the EMP. Help of State Pollution Control Board shall be sought in this regard.

7.4.2 Environmental Monitoring

In order to ensure that the prescribed environmental norms are maintained during the constructional and the operational phases, regular monitoring is one of the most important components of the institutional arrangement. The regular monitoring of Air pollution, Water quality, Noise pollution, and maintenance of trees, etc. shall be done as per Environmental Monitoring Plan. The field reports of various environmental components shall be received monthly by the ESS Manager, and lapses, if any, have to be taken care of.

A reporting mechanism is proposed to provide necessary feedback for project management about the implementation of the EMP. The reporting system will operate linearly with the contractor who is at the lowest rung of the implementation system reporting to the PIA Engineer, who in turn shall report to the ESS Manager of TNUIFSL. All reporting by the contractor and PIA Engineer shall be on a monthly basis. The ESS Manager shall be responsible for preparing targets for each of the identified EMP activities. All subsequent reporting by the contractor shall be monitored as per these targets set by them before the Contractor proceeds with the work. The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the ESS Manager monthly during the implementation period. The operation stage monitoring reports may be submitted quarterly.

During the implementation period, a compliance report may include description of the items of EMP, which were not complied with by any of the responsible agencies. It would also report the management and field actions taken to enforce compliance. It may however, be noted that certain items of the EMP might not be possibly complied with in the field due to a various reasons. The intention of the compliance report is not to suppress these issues but to bring out the circumstances and reasons for which compliance was not possible (such as jurisdictional issues). This would help in rationalising the implementation of the EMP during the remaining duration of implementation. Solutions for further effective implementation should also come out as a result of the compliance monitoring reports.

7.5 Conclusion

The proposed project envisages water supply to Salem Municipal Corporation. The implementation and maintenance of the project has no major adverse impact on environmental components either or during the constructional phase. The likely impact arising out of the project is discussed in depth and recommended for mitigation. Necessary Environmental Monitoring Plan at a cost of Rs 25 lakhs has been suggested for implementing the project to keep the environment safe.

A major aspect of the project from the point of view of social constraints is that no land acquisition is involved and all pieces of land required for the project vests with SMC or TWAD

In general, the project as a whole is a warm welcoming scheme and will have positive impact on the people of the area who were longed for the dependable and potable water.

Annexure 1 furnishes the environmental Screening Format as prescribed by the World Bank

Annexure 2 furnishes the Social Screening Format as prescribed by the World Bank

Annexure 3 secondary data collected for Raw water,Ground water, Ambient air and Noise level.

Annexure 1

Environmental Screening Format:

PART A

Name of Applying Urban Local Body:	SALEM MUNICIPAL CORPORATION
Name of the Sub-component:	Water Supply
Name of Sub-project:	Dedicated Water Supply Scheme to Salem Municipal Corporation
Geographical areas covered by Sub-Project : Mettur and Salem in Salem District	
Name of Line Department/Organization Responsible: Salem Municipal Corporation	
Name and address of Officer responsible: Executive Engineer, SMC	

1. Does the Sub-project is adjacent to : Please √ in

i)	Cultural Heritage site	Yes	No √
ii)	Protected Area	Yes	No √
iii)	Wet Land	Yes	No √
iv)	Mangrove	Yes	No √
v)	Estuarine Region	Yes	No √
vi)	Other SECs as listed in ERF	Yes	No √

2. Does the proposed sub-project could cause negative impacts on: Please √ in

i)	Surrounding Environmental Conditions	Yes		No √
ii)	Degradation of land / eco-systems	Yes		No √
iii)	Loss or impacts on Cultural / heritage properties	Yes		No √
iv)	Occupation of low lying lands / flood plains, etc.	Yes		No √
v)	Water Resource Problems	Yes		No √
vi)	Air / Noise Pollution	Yes		No √
vii)	Pollution of Water bodies / ground water	Yes		No √
viii)	Cutting of Trees / Loss of Vegetation	Yes	√	No
ix)	Health & Safety Risks in the neighbor hood	Yes		No √
x)	Constriction hazards to workers / residents	Yes		No √
xi)	Release of toxic gasses or accident risks	Yes		No √

3) Any other features of the projects that could influence ambient environment:
Temporary impacts during construction phase may lead to pollution of air, water, noise and soil environment.

NIL

Date: Signature and Name of the Responsible

Annexure 2
Social Screening Format

PART A

Name of Applying Urban Local Body:	SALEM MUNICIPAL CORPORATION
Name of the Sub-component:	Water Supply
Name of Sub-project:	Dedicated Water Supply Scheme to Salem Municipal Corporation
Geographical areas covered by Sub-Project : Mettur and Salem in Salem District	
Name of Line Department/Organization Responsible: Salem Municipal Corporation	
Name and address of Officer responsible: Executive Engineer, SMC	

1. Does the Sub-project involve: Please √ in one box

i)	Acquisition of homestead land	Yes	No √
ii)	Acquisition of private "patta" land	Yes	No √
iii)	Acquisition of village "poramboke" land	Yes	No √
iv)	Alienation of any type of Government land including that owned by Urban Local Body	Yes	No√
v)	Transfer of land	Yes	No √
vi)	Clearance of encroachments from Government/Urban Local Body Land	Yes	No √
vii)	Clearance of squatting from Government/ Urban Local Body Land	Yes	No √

2. Does the proposed sub-project adversely affect: Please √ in one box

i)	Any type of sources of livelihood	Yes	No √
ii)	Any type of homes/structures	Yes	No √

3. PART B [If any of the above is 'Yes', provide approximate information required below]

i)	Number of households to be acquired	- NIL
ii)	Number of structures, both authorized and/or unauthorized to be acquired/cleared	-NIL
iii)	Number of households to be displaced	- NIL
iv)	Acres of "patta" land to be acquired	- NIL
v)	Acres of Government land to be alienated	-
vi)	Acres of land to be transferred	-NIL
vii)	Details of village common properties to be alienated	
	Pasture land (acres) Cremation/burial ground	-NIL
	Others - specify	
viii)	Number of encroachments to be cleared	-NIL

ix) Number of squatting to be cleared -NIL
Number of persons affected

4. Adversely affected sources of livelihood: Please √ in all applicable boxes

Loss of Agricultural Land	- NIL
Petty Shops	- NIL
Vegetable/Fish/Meat vending	- NIL
Cycle repair shop	- NIL
Garage	- NIL
Tea stalls	- NIL
Loss of Grazing	- NIL
Loss of access to forest produce (NTFP)	- NIL
Any others - specify.	

5.	Approximate number of persons affected	- NIL
	Acquisition of homestead land	- NIL
	Acquisition of "patta" land	- NIL
	Petty shops	- NIL
	Vendors	- NIL
	Cycle repair shops	- NIL
	Garage	- NIL
	Tea stalls	- NIL
	Loss of grazing	- NIL
	Loss of access to NTFP	- NIL

Others including community assets/temples etc. - NIL
(Specify)

Annexure 3

Secondary data collected for Raw water, Ground water, Ambient air and Noise level.

Ground Water Quality- Secondary Data					
S.No	**PARAMETERS**	**UNIT**	**Shevapet**	**Shevapet**	**Sanjivirapettai**
1	pH		7.7	7.40	7.10
2	Turbidity	NTU	4	3.80	2.90
3	Colour	Hazen	-	-	-
4	Chlorides as Cl^-	mg/lit	129	140	78
5	Sulphates as SO_4^{2-}	mg/lit	45	52	32
6	TSS	mg/lit	4	3	2
7	TDS	mg/lit	540	590	314
8	Total Hardness as CaCO3	mg/lit	208	220	108
9	Calcium as Ca^{2+}	mg/lit	55	59	27
10	Magnesium as Mg^{2+}	mg/lit	16	18	9
11	Total Alkalinity as CaCO3	mg/lit	152	178	76
12	Sodium	mg/lit	87	102	55
13	Potassium	mg/lit	20	22	10
14	Fe	0.3	0.2	0	

Noise level - Secondary Data					
All values in dB(A)					
Sl.No	**Location**	**Max**	**Ave**	**Day. Eq**	**Night Eq**
1	Shevpet -Behind Telephone Exchange	72	58.3	64.2	46.7
2	Shevpet	73.8	61.6	64.9	55.1
3	Sanjivirayapettai	71.2	61.8	64.9	55.5
4	Near Central Jail	89.7	68.5	72.9	59.9
5	Ramanathapuram	88.7	68.1	74.3	55.9
6	Pallapattai	86.6	68.9	73.2	60.3
7	Erumapalayam	87.9	66.8	78.6	58.5
8	Salem Railway Station	81.7	63.8	69.5	52.5

Source : TNPC

Raw Water Quality – Secondary Data

Date of Collection			**18.4.06**	**18.4.06**	**11.5.06**	**15.5.06**	**27.6.06**	**10.8.06**	**10.8.06**	**15.9.06**	**15.9.06**	**18.10.06**	**18.10.06**	**15.11.06**	**15.11.06**	**23.2.07**	**18.12.09**	**Range**
Water Sample No.			27115	27107	27199	27220	27440	27614	27620	27746	27740	27865	27871	27947	27941	28338	32367	
PHYSICAL EXAMINATION	**(A)**	(B)																
Appearance			C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	C & C	
Colour (Pt. co Scale)	5	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Odour	un objectionable		None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	
Turbidity NT units	2.5	10	3	3	2	2	3	3	2	2	2	3	2	2	2	2	3	2 to 3
Total Dissolved Solids mg/lit.	500	2000	330	352	372	371	307	194	177	136	146	146	154	266	268	212	306	372 -146
Elect. Cond. microhm/cm				509	542	537	442	280	257	200	215	214	225	380	383	310	438	542 - 215
CHEMICAL EXAMINATION																		
pH	7 - 8.5	6.5 - 9.2	8.16	8.02	7.74	8.02	7.43	7.15	7.34	7.66	7.8	7.68	7.63	7.56	7.49	7.89	7.79	8.16 - 7.15
Total Alkalinity			168	176	192	192	164	100	96	80	72	92	88	128	124	124	152	192 - 72
Total Hardness as CaCO3	200	600	148	148	176	164	144	80	84	64	72	84	72	152	148	116	138	176 - 64
Calcium as Ca	75	200	32	32	38	37	34	19	19	16	18	19	16	35	35	29	30	38 - 16
Magnesium as Mg	30	130	18	16	19	17	14	8	9	6	7	9	8	15	14	11	14	19 - 6
Sodium as Na			38	40	51	45	34	24	23	15	17	11	17	23	23	16	40	51 - 11
Pottasium as K			6	6	7	7	5	3	3	2	2	2	2	3	3	2	5	2 to 5
Iron as Fe	0.1	1	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2 - 0.1
Date of Collection			**18.4.06**	**18.4.06**	**11.5.06**	**15.5.06**	**27.6.06**	**10.8.06**	**10.8.06**	**15.9.06**	**15.9.06**	**18.10.06**	**18.10.06**	**15.11.06**	**15.11.06**	**23.2.07**	**18.12.09**	**Range**
Manganese as Mn	0.05	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Nitrite as No2			0.15	0.1	0.09	0.18	1.05	0.16	0.12	0.12	0.11	0.12	0.09	0.14	0.11	0	0.06	1.05 - 0.06
Nitrite as No3	45	100	4	5	5	5	4	2	2	1	1	1	1	4	4	1	2	5 to 1
Chloride as Cl	200	1000	40	36	40	36	28	24	24	12	16	11	11	30	34	20	24	40 - 11
Fluoride as F	1	1.5	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3 - 0.2
Sulphate as SO4	200	400	13	16	19	12	7	5	5	3	4	3	4	16	15	6	34	19 - 3
Phosphates as PO4				0	0	0	0	0	0	0	0	0	0	0	0	0		
Tidy's Test 4 Hours as 0			1.52	1.8	1.68	1.8	1.92	1.72	1.64	1.2	1.32	1.12	1.2	1.12	1.04	1.12		
BOD								5	4.8	4.7	4.5	4.2	4.3	4	4.2	4.8		
COD								16	16	16	16	12	12	12	12	16		
BACTERIOLOGICAL EXAMINATION																		
Water Sample No.			27116	27108	27200	27221	27441	27615	27621	27747	27741	27866	27872	27948	27942	28339		
Fecal Coliform per 100 ml			TNTC	TNTC	TNTC	TNTC	TNTC	60	40	30	80	40	60	110	90	56		110 - 30

(A) CPHEEO Standards - Acceptable Limit

(B) CPHEEO Standards - Cause of rejection when exceeds result of

Acceptable limit for MG can go upto 125mg/lit with an allowance of 1 mg per 25 mg SO4

Chemical Parameters are expressed in mg/lit

Ambient Air Quality Secondary Data					
All values in µg/m3					
Sl.No	Year	SO_2	NO_2	PSPM	SPM
1	2004	7	35	36	70
2	2005	7	33	41	72
3	2006	8	31	41	69
4	2007	8	25	59	100
5	2008	8	25	78	122
5	Range	8-Jul	25 - 35	36 -78	69-122
6	Average	7.6	29.8	51	86.6

Source- Air quality monitoring by TNPCB -at Sowdeswari College Salem

All values in µg/m3				
Sl.No	**Location**	**SO_2**	**NO_2**	**SPM**
1	Pallapatti	14.7to6.9	8.2 to15	70 to65
2	Shevpet	19to11.2	18.7 to11.2	95 to 85
3	Ramanathapuram	15.9 to8.9	17.7 to9.2	89 to76
4	Near Central Jail	15.9 to8.9	14 to 8	67 to 60