Environmental Impact Assessment

for

Proposed (1×660 MW) Ennore TPS Expansion Project at Ernavur Village, Tiruvottiyur Taluk, Thiruvallur District, Tamil Nadu

Final Report

Submitted To

Ministry of Environment, Forest & Climate Change

Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi - 110003

Submitted by

TANGEDCO (TNEB Limited)

5th Floor Western Wing, 144, Anna Salai,
NPKRR Maaligai, Chennai-600 002

Prepared by

Ramky Enviro Services Private Limited.,

Ramky Grandiose, Ramky Towers, Gachibowli,
Hyderabad,Telangana-500032

(QCI/NABET/EIA/ACO/19/0978)

July 2019

FOREWORD

M/s. Tamil Nadu Generation and Distribution Corporation (TANGEDCO), proposes to set up a 1x660 MW coal based Supercritical Ennore Thermal Power Station (ETPS) Expansion Project within the existing ETPS complex located near Ernavur village, Tiruvottiyur taluk, Thiruvallur district of Tamil Nadu state. The proposed plant will be constructed in 90 acres of land which includes vacant land of 84 acres within the existing ETPS complex (plant boundary) and 6 acres for corridor of pipeline and conveyor system (outside the plant boundary). Total water required for project is about 7113 m3/hr which is sourced from Bay of Bengal. Total estimated cost of the project is about Rs 5421.38 crores and Environmental Management Plan cost is 977 crores and Corporate Environmental Responsibility Cost (CER) is 13.65 crores.

With a view to assess the potential environmental impact due to the proposed Power plant, M/s. TANGEDCO, retained Ramky Enviro Services Private Limited (RESPL), Hyderabad, to conduct Rapid Environmental Impact Assessment (REIA) study of the proposed activities as a prerequisite to preparation of appropriate Environmental Management Plan (EMP).

The Rapid Environmental Impact Assessment report presents details of baseline data covering monitoring for air, noise, water, soil, land, ecology and socio-economic components of environment with a view to identify, predict and evaluate the potential impacts due to the proposed project. A detailed EMP has also been delineated to mitigate the adverse impacts.

The co-operation and the assistance rendered by the officials of M/s. TANGEDCO, in preparation of this report are greatly acknowledged.

Dr.B. Chakradhar

Head of the Department

Ramky Enviro Services Private Limited

Table of Contents

Contents

List of Tables

List of Figures

List of Attachments

QCI –NABET Accreditation Certificate of Consultant

Quality Council of India

National Accreditation Board for Education & Training

Certificate of Accreditation

Ramky Enviro Services Private Limited

Ramky Grandiose, Ramky Towers Complex, Gachibowli,
Hyderabad – 500032

Accredited as Category - A *organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:*

Sl.No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including opencast/ underground mining	1	1 (a) (i)	A
2	Onshore oil and gas exploration, development & production	2	1 (b)	A
3	River Valley projects	3	1 (c)	A
4	Thermal power plants	4	1 (d)	A
5	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes)	20	5 (e)	A
6	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
7	Industrial estates/ parks/ complexes/ Areas, export processing zones(EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
8	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7(d)	A
9	Bio-Medical Waste Treatment Facilities	32 A	7 (da)	B
10	Ports, harbours, jetties, marine terminals, break waters and dredging	33	7(e)	B
11	Common municipal solid waste management facility (CMSWMF)	37	7 (i)	B
12	Building and construction projects	38	8 (a)	B
13	Townships and Area Development projects	39	8 (b)	A

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in SA AC minute dated Jan 19, 2018 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/18/0595 dated March 28, 2018.The accreditation needs to be renewed before the expiry date by Ramky Enviro Services Private Limited, following due process of assessment.

Sr. Director, NABET
Dated: March 28, 2018

Certificate No.
NABET/EIA/1518/ SA 061

Valid upto
May 20, 2019

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

National Accreditation Board for Education and Training

(Member - International Accreditation Forum & Pacific Accreditation Cooperation)

May 13, 2019

QCI/NABET/EIA/ACO/19/0978
Ramky Enviro Services Private Ltd.
12th Floor| Ramky Grandiose, Ramky Towers Complex,
Gachibowli, Hyderabad – 500 032
(Kind Attention: **Dr. B. Chakradhar**)

Sub: Validity of Accreditation

Dear Sir,

This has reference to the accreditation of your organization under QCI-NABET EIA Scheme, the validity of **Ramky Enviro Services Private Ltd.** is hereby extended till November 20, 2019 or completion of assessment process, whichever is earlier.

The above extension is subject to the submission of required information/documents related to assessment on time to NABET.

You are requested not to use this letter after expiry of the above stated date.

With best regards,

13/05/2019

A.K Jha
Senior Director| NABET

REEL/MoEF&CC/Renewal/136
Date: 28.07.2018

Ramky Enviro Engineers Limited
CIN: U74140TG1994PLC018833
Registered Office:
13th Floor, Ramky Grandiose
Ramky Towers, Gachibowli
Hyderabad - 500 032, Telangana
T: +91 40 2301 5000
F: +91 40 2301 5100
www.ramkyenviroengineers.com

Towards sustainable growth

To
The Director/addl. Director (CP Division)
Ministry of Environment, Forest and Climate Change
Paryavaran Bhavan
CGO complex, Lodhi Road
New Delhi-110003

31/7/18

Respected Sir/Madam,

Sub: Application for renewal of recognition as Environmental Laboratory under the Environment (Protection) Act, 1986 of M/s. Ramky Enviro Engineers Ltd., Hyderabad- Regarding.

Ref: MOEF lab recognition Notification REGD.NO.D.L-33004/99, S.O. 21(E) dated 3rd January, 2014 with Sl.No: 57.

Sir,

With reference to above, please note that M/s.Ramky Enviro Engineers Limited was recognized with MoEF&CC under Environment Protection Act 1986 with REGD.NO.D.L-33004/99, with MoEF notification No. S.O. 21(E) dated 3rd January, 2014 with Sl.No: 57. The recognition will expire on 1st January 2019. We intend to renew our lab recognition with MoEF&CC.

In this regard we are submitting application in prescribed Proforma (Anexure –I) along with annexures (3 copies) for renewal of recognition with MoEF&CC. We are proposing Mr. D.S.S Srinivas as one of the Govt. analyst in place of Mr. K. Venkateswara Rao, due to his higher experience and requesting you to kindly consider the same. Mr. V.Vijay Kumar and Mr. Mad an Kumar D. Tiwari will remain as it is for the renewal of the application.

Kindly do the needful for processing our lab renewal application with Ministry of Environment & Forest, New Delhi, under the Environmental (Protection) Act, 1986

Thanking you,
For Ramky Enviro Engineers Limited

RAMKY ENVIRO ENGINEERS LIMITED

Dr. B Chakradhar
Director and Vice President

Documents Enclosed.

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (ii)
PART II—Section 3—Sub-section (ii)
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 21] नई दिल्ली, शुक्रवार, जनवरी 3, 2014/पौष 13, 1935
No. 21] NEW DELHI, FRIDAY, JANUARY 3, 2014/PAUSHA 13, 1935

पर्यावरण और वन मंत्रालय

अधिसूचना

नई दिल्ली, 3 जनवरी, 2014

का.आ. 21 (अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) नियम, 1986 के नियम 10 के साथ पठित पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 12 और धारा 13 की उपधारा (1) के खंड (ख) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, पर्यावरण और वन मंत्रालय, भारत सरकार की अधिसूचना संख्यांक का. आ. 1174(अ) तारीख 18 जुलाई, 2007 का और संशोधन करती है, अर्थात् :—

उक्त अधिसूचना से संलग्न सूची में, —

(क) क्रम संख्यांक 3, संख्यांक 46, संख्यांक 55, संख्यांक 57, संख्यांक 58, संख्यांक 61, संख्यांक 65, संख्यांक 68 और संख्यांक 69 और उससे संबंधित प्रविष्टियों के स्थान पर निम्नलिखित संख्यांक और प्रविष्टियां रखी जाएंगी, अर्थात् :—

(1)	(2)	(3)	(4)
"3	मैसर्स भगवती अन्ना लैब्स प्रा0 लि0, रजिस्ट्रीकृत कार्यालय और केन्द्रीय प्रयोगशाला, प्लाट सं0 7-2 सी7 और 8, एग्रोमेक औद्योगिक एस्टेट संतनगर, हैदराबाद-500018 (आंध्र प्रदेश)	(1) श्री भगवती हरि बाबू (2) श्री ए.वी.हनुमंता राव (3) श्री वी.राघवाचार्यलू	3.01.2014 से 2.01.2019
46	मैसर्स कोसमो कॉशियस रिसर्च लैबोरट्री "सर्वे हाउस" # 121, 2nd क्रॉस, नेहरु कालोनी, बैलारी-583103 (कर्नाटक)	(1) श्री जी.धावलेश्वर (2) श्रीमती वी.स्वर्णलता (3) श्री के.सोमशेखर राव	3.01.2014 से 2.01.2019
55	मैसर्स अनाकॉन लैबोरट्रीज़ प्रा0लि0, एफपी-34, 35 फूड पार्क, 5 स्टार ओद्यौगिक एस्टेट, बुटीबोरी, नागपुर-441122 (महाराष्ट्र)	(1) डा. (सुश्री) सुगंधा डी.गर्वे (2) सुश्री कविता सेगांवकर (3) श्री के.वेंकटेश्वर राव	3.01.2014 से 2.01.2019

57	मैसर्स रामकी एनवाईरो इंजीनियर्स लि. हैदराबाद वेस्ट मैनेजमेंट प्रोजक्ट, सर्वे नं. 684/1, डंडीगल (वी) कुतुबल्लापुर (एम) रंगारीडी जिला-रामकी-500 043 (आंध्र प्रदेश)	(1) श्री वी.विजय कुमार (2) श्री मदन कुमार डी.तिवारी (3) श्री के.वेंकटेश्वर राव	3.01.2014 से 2.01.2019
58	मैसर्स इंटरनेशनल टेस्टिंग सेंटर प्लॉट नं0 86, इंडसट्रीयल एरिया फेस-1, पंचकुला-134109 (हरियाणा)	(1) डा. प्रकाश कौर (2) श्री प्रेम कुमार (3) सुश्री पूनम शर्मा	3.01.2014 से 2.01.2019
61	मैसर्स मित्रा एस.के. प्राइवेट लि. (बेहाला लैबोरट्री) 620, डायमंड हार्बर रोड बेहाला इंडस्ट्रीयल एस्टेट, टूल रूम नं. 2/3/, 2/4 और 2/5, कोलकाता-700034 (पश्चिमी बंगाल)	(1) श्री सुदीप मुखुटी (2) सुश्री सुतापा भोमिक (3) सुश्री मौसमी सेनगुप्ता	3.01.2014 से 2.01.2019
65	मैसर्स एनवाइरोडिज़ाइन ईको लैब्स इको टावर, जानथा जंक्शन, पलारीवोत्तम, कोच्ची-682025 केरल	(1) श्री के.एल.एंटनी (2) सुश्री सुज़न अब्राहम (3) सुश्री सिमी के.के.	3.01.2014 से 2.01.2019
68	मैसर्स सांईटिफिक रिसर्च लैबोरट्रीज़ "श्यामली अपार्टमेंट" 90, लेक ईस्ट 4th रोड संतोषपुर, कोलकाता-700075 (वेस्ट बंगाल)	(1) डा. जोइरमोय मजुमदार (2) श्री कल्याण घोष (3) सुश्री पुर्बा खुखर्जी	3.01.2014 से 2.01.2019
69	मैसर्स साडेकर एनवाइरो इंजिनीयर्स प्रा.लि., बी-306/307, प्लाट नं. 61, पटेल एस्टेट, रेइस मगोस, वेरेम, आल्टो, ओल्ड बेटिम रोड, बर्डेज़, पोरवोरिम,पणजी-403101 (गोवा)	(1) श्री विशाल बासावन्नी सन्नाकी (2) श्री विनायक गंगाराम कुडकर (3) श्री स्वाति वैभव मोरे	3.01.2014 से 2.01.2019";

(ख) क्रम संख्यांक 113 और उससे संबंधित प्रविष्टियों के पश्चात्, निम्नलिखित क्रम संख्यांक और प्रविष्टियां अंतःस्थापित की जाएगी, अर्थात् :--

(1)	(2)	(3)	(4)
"114	मैसर्स इकोमेन लैबोरट्रीज़ प्रा.लि., फ्लैट नं0 8, 2nd फ्लोर, आरिफ चैंबर-v, सैक्टर- H, अलिगंज, लखनऊ-226024 (उत्तर प्रदेश)	(1) सुश्री रीना त्रिपाठी (2) डा0 ओम प्रकाश शुक्ला (3) श्री प्रवीण कुमार दुबे	3.01.2014 से 2.01.2019
115	मैसर्स टीम लैब्स एंड कंसलटेंटस् बी-115 तथा 509, अण्णापूर्ण ब्लाक आदित्य एन्कलेव, अमीरपेट हैदराबाद-500038 आंध्र प्रदेश	(1) श्री अंबावती रवि पवन कुमार (2) श्री एस.रमेश (3) श्री टी.रवि किरन	3.01.2014 से 2.01.2019
116	मैसर्स टीयूवी एसयूडी साउथ एशिया प्रा0 लि0, सी-153/1, ओखला ओद्यौगिक एस्टेट, फेस-1, नई दिल्ली-110020	(1) श्री प्रमोद कुमार (2) श्री अजय कुमार प्रमाणिक (3) श्री विजयानंद	3.01.2014 से 2.01.2019";

[फा.सं. क्यू-15018/23/2013-सीपीडब्ल्यू]

डा. राशिद हसन, सलाहकार

टिप्पण : मूल अधिसूचना भारत के राजपत्र, असाधारण, में संख्यांक. का.आ. 1174(अ), तारीख 18 जुलाई, 2007 द्वारा प्रकाशित की गई थी और तत्पश्चात् अधिसूचना सं0 का.आ. 1539(अ), तारीख 13 सितंबर, 2007, का.आ. 1811(अ), तारीख 24 अक्तूबर, 2007, का.आ. 55(अ), तारीख 9 जनवरी, 2008, का.आ. 428(अ), तारीख 4 मार्च, 2008, का.आ. 865(अ), तारीख 11 अप्रैल, 2008, का.आ. 1894(अ), तारीख 31 जुलाई, 2008, का.आ. 2728(अ), तारीख 25 नवंबर, 2008, का.आ. 1356(अ), तारीख 27 मई, 2009, का.आ.1802(अ) तारीख 22 जुलाई, 2009, का.आ.2399(अ) तारीख 18 सितंबर, 2009, का.आ. 3122(अ), तारीख 7 दिसंबर, 2009, का.आ. 3123(अ), तारीख 7 दिसंबर, 2009, का.आ. 142(अ), तारीख 21 जनवरी, 2010, का.आ. 619(अ), तारीख 19 मार्च, 2010, का.आ. 1662(अ), तारीख 13 जुलाई, 2010, का.आ. 2390(अ), तारीख 30 सितंबर, 2010, का.आ. 2904(अ), तारीख 8 दिसंबर, 2010, का.आ. 181(अ), तारीख 28 जनवरी, 2011, का.आ. 692(अ), तारीख 5 अप्रैल, 2011, का.आ. 1537(अ), तारीख 6 जुलाई, 2011, का.आ. 1754(अ), तारीख 28 जुलाई, 2011, का.आ. 2609(अ), तारीख 22 नवंबर, 2011, का.आ. 264(अ), तारीख 13 फरवरी, 2012, का.आ. 1150(अ), तारीख 22 मई, 2012, का.आ. 2039(अ), तारीख 5 सितंबर, 2012, का.आ. 2802(अ), तारीख 27 नवंबर, 2012 और का.आ. 2850(अ), तारीख 7 दिंसबर, 2012 तथा का.आ. 592(अ), तारीख 8 मार्च, 2013, का.आ. 945(अ), तारीख 8 अप्रैल, 2013, का.आ.2287(अ), तारीख 27 जुलाई, 2013, का.आ.2288(अ), तारीख 27 जुलाई, 2013, और का.आ.3489(अ), तारीख 26 नवंबर, 2013, द्वारा उसका संशोधन किया गया था ।

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 3rd January, 2014

S.O. 21 (E).—In exercise of the powers conferred by clause (b) of sub-section (1) of section 12 and section 13 of the Environment (Protection) Act, 1986 (29 of 1986) read with rule 10 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following further amendments in the notification of the Government of India in the Ministry of Environment and Forests, number S.O. 1174(E), dated the 18th July, 2007, namely :—

In the Table appended to the said notification,—

(a) for serial numbers 3, 46, 55, 57, 58, 61, 65, 68 and 69 and the entries relating thereto, the following serial numbers and entries shall be substituted, namely :—

(1)	(2)	(3)	(4)
"3	M/s Bhagavati Ana Labs Pvt. Ltd., Regd. Office and Central Laboratory Plot No. 7-2-C7 & 8/4, Industrial Estate Near Agromech Industries Santhnagar, Hyderabad - 500018 (Andhra Pradesh)	(1) Mr. Bhagavathi Hari Babu (2) Mr. A.V. Hanumantha Rao (3) Mr. V. Raghavacharyulu	3.01.2014 to 2.01. 2019
46	M/s Cosmo Conscious Research Laboratory" SURVEY HOUSE" # 121, 2nd Cross, Nehru Colony, Bellary - 583103 (Karnataka)	(1) Mr. G. Dhavaleshwar (2) Smt. V. Swarnalatha (3) Mr. K. Somasekhar Rao	3.01.2014 to 2.01. 2019
55	M/s Anacon Laboratories Pvt. Ltd., FP-34, 35 Food Park, 5 Star Industrial Estate, Butibori, Nagpur - 441122 (Maharashtra)	(1) Dr. (Ms.) Sugandha D. Garway (2) Ms. Kavita Saygaonkar (3) Mr. Yogesh Dhoke	3.01.2014 to 2.01.2019
57	M/s. Ramky Enviro Engineers Ltd. Hyderabad Waste Management Project, Survey No.684/1, Dundigal (V), Qutabullapur (M) Rangareedy District – 500 043 (Andhra Pradesh)	(1) Mr.V. Vijay Kumar (2) Mr.Madan Kumar D. Tiwari (3) Mr. K. Venkateswara Rao	3.01.2014 to 2.01.2019";
58	M/s. International Testing Centre, Plot No. 86, Industrial Area Phase-1, Panchkula-134109 (Haryana)	(1) Dr. Prakash kaur (2) Mr. Prem Kumar (3) Ms. Poonam Sharma	3.01.2014 to 2.01.2019
61	M/s Mitra S.K. Private Ltd., (Behala Laboratory) , 620, Diamond Harbour Road,	(1) Mr. Sudip Mukhuty (2) Ms. Sutapa Bhowmik	3.01.2014

	Behala Industrial Estate, Tool Room No. 2/3, 2/4 & 2/5, Kolkata – 700034 (West Bengal)	(3) Ms. Mousumi Sengupta	to 2.01. 2019
65	M/s Envirodesigns Eco Labs Eco Tower, Janatha Jn. Palarivattom, Kochi – 682025 Kerala	(1) Mr. K.L. Antony (2) Ms. Susan Abraham (3) Ms. Simi K.K.	3.01.2014 to 2.01. 2019
68	M/s Scientific Research Laboratory "SHYAMALI APARTMENT" 90, Lake East 4th Road 'Santoshpur, Kolkata - 700075 (West Bengal)	(1) Dr. Jyotirmoy Majumdar (2) Shri Kalyan Ghosh (3) Ms. Purba Mukherjee	3.01.2014 to 2.01. 2019
69	M/s Sadekar Enviro Engineers Pvt. Ltd., B-306/307, Plot No.61, Patel Estate, Reis Magos, verem, Alto, Old Betim Road, Bardez, Porvorim, Panaji – 403101 (Goa)	(1) Mr. Vishal Basawanni Sannakki (2) Mr. Vinayak Gangaram Kudkar (3) Ms. Swati Vaibhav More	3.01.2014 to 2.01.2019

(b) after serial number 113 and the entries relating thereto, the following serial numbers and entries shall be inserted, namely :—

(1)	(2)	(3)	(4)
"114	M/s Ecomen Laboratories Pvt. Ltd., Flat No. 8, 2nd Floor, Arif Chamber - V, Sector - H, Aliganj, Lucknow - 226024 (Uttar Pradesh)	(1) Ms. Reena Tripathi (2) Dr. Om Prakash Shukla (3) Mr.Praveen Kumar Dubey	3.01.2014 to 2.01.2019
115	M/s Team Labs and Consultants B-115 & 509, Annapurna Block Aditya Enclave, Ameerpet Hyderabad – 500038 Andhra Pradesh	(1) Mr. Ambati Ravi Pavankumar (2) Mr. S. Ramesh (3) Mr. T. Ravi Kiran	3.01.2014 to 2.01. 2019
116	M/s TUV SUD South Asia Pvt. Ltd., C-153/1, Okhla Industrial Estate, Phase-1, New Delhi - 110020	(1) Mr. Pramod Kumar (2) Mr. Ajay Kumar Pramanik (3) Mr. Vijayanand	3.01.2014 to 2.01. 2019";

[F. No. Q.15018/23/2013-CPW]

Dr. RASHID HASAN, Advisor

Note.- The principal notification was published in the Gazette of India, Extraordinary *vide* number S.O. 1174 (E), dated the 18th July, 2007 and subsequently amended *vide* notification numbers S.O. 1539 (E), dated the 13th September, 2007, S.O.1811(E), dated the 24th October, 2007, S.O.55(E), dated 9th January, 2008, S.O.428(E), dated the 4th March, 2008, S.O.865(E) dated the 11th April, 2008, S.O.1894(E), dated the 31st July, 2008, S.O.2728(E) dated the 25th November, 2008, S.O.1356(E), dated the 27th May, 2009, S.O.1802(E), dated the 22nd July, 2009, S.O.2399(E), dated the 18th September, 2009, S.O. 3122(E), dated the 7th December, 2009, S.O. 3123(E), dated the 7th December, 2009, S.O.No.142(E), dated the 21st January, 2010, S.O.619(E), dated the 19th March, 2010, S.O.1662(E) dated the 13rd July, 2010, S.O.2390(E), dated the 30th September, 2010, S.O.2904(E), dated the 8th December, 2010, S.O.181(E), dated the 28th January, 2011, S.O. 692(E), dated the 5th April, 2011, S.O.1537(E), dated the 6th July, 2011, S.O.1754(E), dated the 28th July, 2011. S.O.2609 (E) dated the 22nd November, 2011, S.O.264 (E), dated the 13 February, 2012, S.O.1150(E), dated the 22nd May, 2012, S.O.2039(E), dated the 5th September, 2012, S.O. 2802(E) dated the 27th November, 2012, S.O. 2850(E), dated the 7th December, 2012, S.O. 592 (E), dated the 8th March, 2013, S.O.945(E), dated the 8th April, 2013,S.O.2287(E), dated the 27th July, 2013, S.O.2288(E), dated the 27th July, 2013 and S.O.3489(E) dated the 26th November, 2013.

Printed by the Manager, Government of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054

Declaration of Experts

Declaration by Experts contributing to the EIA – "1x660MW Supercritical Ennore Thermal Power Station expansion project, Ernavur (V), Ennore (D), Tamil Nadu by M/s. Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)".

I hereby certify that I was a part of the EIA team in the following capacity that developed this EIA report.

EIA Coordinator:

Name : **Mr. V. Vijay Kumar**

Sign & Date : 9/7/19

Period of involvement: **April, 2019 – Till date**

Contact information : vvijaykumar@ramky.com

Functional Area Experts:

S. No	Functional Area	Name of the Expert	Involvement		Sign & Date
			Period	Task	
1	AP	Mr. V. Vijay Kumar	April, 2019 – till date	Selecting ambient air monitoring sites based on IMD data, Review of the meteorological data and AAQ data, suggesting air pollution control measures	
2	WP	Mr. V. Vijay Kumar	April, 2019 – till date	Identification of water monitoring sites, estimating water requirements & waste water treatment methods	
3	SHW	Dr. B. Chakradhar	April, 2019 – till date	Inventorization of wastes, suggesting treatment measures	
4	SE	Mr. M A Fasi	April, 2019 – till date	Generating primary data & estimating economic, infrastructure & employment benefits	9/7/19
5	EB	Mr. M. A. Fasi	April, 2019 – till date	Collected secondary data from forest department, field studies for generation of primary flora and fauna data & suggested species for greenbelt development	9/7/19

6	AQ	Mr. V. Vijay Kumar	April, 2019 – till date	Meteorological & Air Pollution dispersion studies, suggesting environmental management plan for air pollution control	
7	NV	Dr. Hemanth Rajkumar	April, 2019 – till date	Identification of noise sources, sampling locations, calculation of noise equivalents, comparing with standards, suggesting noise mitigation measures.	09/07/19
8	LU	Mr. Uttam Kumar B	April, 2019 – till date	Collection of GPS readings for identification of topo sheets and satellite imagery, preparation of base map from topo sheets, preparation of monitoring location map	09/07/19
9	RH	Dr. B. Chakradhar	April, 2019 – till date	Estimating risks such as construction failures, electrical or civil accidents, fires etc. & suggesting control measures	9.7.19.

Declaration by the Head of the accredited consultant organization/ authorized person:

I, **Dr. B. Chakradhar**, hereby, confirm that the above mentioned experts prepared the EIA Report for the "**1x660MW Supercritical Ennore Thermal Power Station expansion project, Ernavur (V), Ennore (D), Tamil Nadu by M/s. Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)".** I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Signature	:
Name	: Dr. B. Chakradhar
Designation	: Director
Name of the EIA Consultant Organization	: Ramky Enviro Services Private Limited
NABET Certificate No. & Issue date	: Ltr. No. QCI/NABET/EIA/ACO/19/0978 dt. 13.05.2019 (Extension)

Annexure – IE

Format for information on Team Member

(only for in-house employees)

Name of project: "**1x660MW Supercritical Ennore Thermal Power Station expansion project, Ernavur (V), Ennore (D), Tamil Nadu by M/s. Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)**".

1. Name and address of EIA consultant organization

   M/s. Ramky Enviro Services Private Limited
   Ramky Grandiose,
   Ramky Tower Complex, Gachibowli,
   Hyderabad – 500 032

   a. Head Office : ✓

   b. Branch Office/s :

2. Name of the head of the organization with designation

   Dr. B. Chakradhar
   Director

3. Contact details with name of the contact person

   a. Name of Contact person / Address: Dr. B. Chakradhar
   M/s. Ramky Enviro Services Private Limited
   Ramky Grandiose, 12th Floor,
   Ramky Tower Complex, Gachibowli,
   Hyderabad – 500 032

   b. Tel. No. 040 23015369 Mob. : +91-9000604455

   c. Email drchakradhar@ramky.com Alt. Email : vvijaykumar@ramky.com

   d. Website www.ramky.com

4. Team Members proposed

Sl	Name	Qualification#	EC/ FAE	Sector/ FA	Approved Sr. Expert	Jobs to be assigned
With Environmental Coordinator						
1	G. Anil Kumar	M.Tech - Environment Planning (1992-94) (School of Planning and Architecture, CEPT Campus, Ahmedabad) B.Tech - Civil Engineering (1988-92) (Krishnadevaraya University Ananthapur)	EC	Sector 4	Mr. V. Vijay Kumar	Assisted in fulfilling the compliance of ToR, organizing baseline monitoring and EIA report preparation.
With Functional Area Expert						
2	Manikandan Nachiappan	M.Sc.- Oceanography and Coastal area studies (Year of Passing – 2007) M.Phil. – Oceanography and Coastal area studies (Year of Passing – 2009)	FAE	WP	Mr. V. Vijay Kumar	Assisted FAE in identification of water monitoring sites, collection and analysis of water samples and sediment samples. Compilation of data and preparation of EIA and EMP report.
3	Mr. Vishnu Vardhan Reddy	M.Sc.- Mathematics (Year of Passing- 2001)	FAE	AQ	Mr. V. Vijay Kumar	Assisted FAE in collection of micrometeorological parameters in site, these parameters are used in WRPLOT for preparation of wind diagram & frequency distribution. Comparing primary meteorological data & secondary meteorological data. Estimated air pollutants for modeling & GLC maps.
4	Mr. M.A. Fasi	M.Sc.- Environmental Sciences (Year of Passing – 2003), Kakatiya University, Warangal M.Sc. – Psychology (Year of Passing – 2013), Kakatiya University, Warangal	FAE	HW BMW	Dr. B. Chakradhar	Assisted FAE in identifying the sources of waste and suggesting disposable options based on characteristics of waste. HW & BMW will be disposed as per existing guidelines. Suggesting occupation health care services for the employees.

Qualification – Bachelor degree in Technical subjects and Master's degree in Science, Humanities and other subjects, year of passing and name of university

Declaration by the employer

We have carefully read the provisions in respect of 'Team Members' in the NABET's Scheme for accreditation of EIA Consultants organizations and commit to abide by the same. The conformity of eligibility of the candidates proposed as Team Member in respect of qualification and other aspects has been verified by us at our end. We confirm that the information provided in the application is correct to the best of our knowledge and belief.

We understand that in case the information provided is found wrong/mis-leading, it may result in cancellation of accreditation granted to the organization.

Signature

Name (authorized signatory)	Dr. B. Chakradhar
Designation	Director
Organization	M/s. Ramky Enviro Services Private Limited
Date	16/07/2019

Terms of Reference (TOR)

F.No. J-13012/15/2018-IA-I(T)
Government of India
Ministry of Environment, Forest and Climate Change

3rd Floor, Vayu Block,
Indira Paryavaran Bhawan, Jor Bagh Road,
Aliganj, New Delhi-110003

Dated: 21.1.2019

To

The Chief Engineer (Projects)
M/s Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)
144, Anna Salai, Chennai-600002.

Email: cepr@tnebnet.org; **Telephone No.** 044-28520878; **Fax No.** 044-28520878.

Sub: 1x660 MW Supercritical Ennore Thermal Power Station expansion Project, Ernavur Village, District Ennore, Tamil Nadu by M/s Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)- reg. ToR.

Sir,

The undersigned is directed to refer to your online application No. **IA/TN/THE/84128/2018** dated 03.11.2018 and the documents submitted vide your letter dated 27.12.2018 and 4.1.2019 on the above mentioned subject.

2. It has been noted that you have proposed an expansion project with capacity of 660 MW within the premises 450 MW Ennore Power Station. It has been noted that the Environmental Clearance for the proposed Ennore Expansion Project (1x660 MW) had already been accorded vide Ministry's letter NosJ-13011/62/2008-IA.II(T) dated 3.6.2009 and 24.1.2013 which was valid for five years. The said EC has been extended for further period of five years, i.e. till 2.6.2019 vide Ministry's letter dated 18.9.2014. It has been noted that the project has not achieved significant progress and would not be able to be commissioned within the validity period of 10 years, i.e. before 2.6.2019. The overall progress of the project is about 17% which include civil construction of boiler, chimney, ESP and pump house, water treatment plant etc. Subsequently, an application was submitted to Ministry for extending the said Environmental Clearance for further period of four years. As there is no provision in the EIA Notification to extend the validity beyond 10 years, the Ministry vide letter dated 20.9.2018 informed the Project Proponent to initiate the EC process de-novo as per the provisions of the EIA Notification. Accordingly, the present application for grant of ToR has been submitted.

3. The following power projects which are under operation or planned at the Project Site.

Name of the Project	Capacity	Commissioning	Remarks
Ennore Power Station	450 MW (3x110 MW + 2x60 MW)	1970-75	De-commissioned on 31.3.2017

Ennore Expansion Project	1x660 MW	EC accorded on 3.6.2009 and extended for a period of five years, i.e. till 2.6.2019 on 18.9.2014. CRZ clearance for coal conveyor, intake and outfall waterlines accorded on 23.12.2008 and validity extended up to 22.12.2018 on 31.3.2014.	However, the project could not be constructed within the validity period. Accordingly, the present proposal is submitted for obtaining ToR.
Ennore Replacement Project	1x660 MW	Proposed. EAC in its meeting held on 26.10.2017 recommended to conduct certain studies such as cumulative impacts, one season baseline data collection, etc. PP is yet to complete the study.	-

4. It has been informed that the proposed 1x660 MW Power Project is based on Supercritical Technology and will be constructed in 90 acres of land which includes 6 acres for corridor of pipelines and conveyor systems outside the plant boundary. The area for the ash dyke is already available for the existing plant, will be used for disposing the wet bottom ash regularly and 50% dry fly ash in case of emergency. There is no need of land acquisition for this project. There is no rehabilitation or resettlement issued involved this project.

5. The distances of Ennore back waters, Korattaliyar river and Bay of Bengal from the project boundary are 70 m, 575 m and 815 m respectively. The laying of sea water intake and outfall pipelines and coal conveyors through CRZ area is required for the power project. However, the CRZ clearance (which was earlier obtained on 23.12.2008) will get expired on 22.12.2018. A separate application for obtaining CRZ recommendations under CRZ Notification, 2011 is to be submitted to TNCZMA.

6. The project is based on the various combinations of Imported and Domestic Coal (100% Imported Coal; 70% Imported Coal & 30% domestic coal; and 50% Imported Coal & 50% domestic coal) which will be brought to Ennore Port by Ship and further it is transported to the Project Site by Pipe Conveyor. The calorific value of Imported coal and Domestic Coal is estimated to be 5805 kcal/kg and 3800 kcal/kg, respectively. The maximum quantity of coal requirement is 2.70 MTPA at 85% PLF.

7. The coal from the Ennore Port will be transported by belt conveyors upto crusher plant. The crushed coal will be brought by pipe conveyor to the project site. Capacity of the coal handling plant will be 2x1000 tph for two shifts operation based on blended coal of 50:50 ratio (worst condition). Crushed coal, stacking, reclaiming & feeding systems have been envisaged. The stockpiles of the two types of coal will have capacity for seven (7) days when domestic & imported coal mixed at 50:50 ratio.

8. The project will require about 7,113 m^3/hr of sea water which will be sourced from Bay of Bengal. The intake point from Bay of Bengal is at a distance of 3 Km from project site. The said water quantity is sufficient for condenser cooling water as well as plant water requirements.

9. The Boiler will be designed to take the Imported Coal and Domestic Coal in the ratio of 70:30. The steam generator will be semi outdoor, once through, radiant reheat, dry bottom and balanced draft unit of super-critical parameters designed for firing pulverized coal as prime fuel. Steam generator will be sized for 2100 tph at 256 Kg/cm^2 (a), super heater outlet steam pressure, 568 ^{0}C steam SH temperature and 593 ^{0}C reheat temperature. Steam turbine of 660 MW unit will be three / four cylinder, 3000 RPM, multistage, tandem compound, single reheat condensing reaction unit with uncontrolled extractions for regenerative cycle. The Generator will be directly coupled, horizontal shaft cylindrical rotor continuously rated at rated power factor of 0.85 lagging, 3 phase 50 Hz.

10. The total ash generation is 516 TPD (Bottom Ash: 103.2 TPD, Fly ash: 412.8 TPD) as considering calorific value of 6000 kcal/kg and Ash content of 8%. Fly ash generated is proposed to be handled in dry form. Bottom and coarse ash will be extracted and disposed off in wet condition through scraper feeder and clinker grinders to the existing ash pond.

11. To minimize emission of Suspended Particulate Matter (SPM) from boiler flue gases, Electrostatic Precipitators (ESPs) of high efficiency of the order of 99.98% and of adequate size will be provided at exit end of each boiler to bring down SPM emission level less than 50 mg/Nm^3. Waste water from the plant will be properly treated before re-use and/or disposal. One (1) no. of Single Flue RCC stack of 275 meter high will be provided.

12. The estimated Project Cost is Rs.5,421.38 Crores. The project is scheduled to commission within 42 months from the zero date.

13. The proposal has been considered by the Re-constituted EAC (Thermal Power) in its 23rd meeting held on 30.11.2018. Based on the recommendations of the Re-constituted EAC (Thermal Power) and the information/clarifications and documents submitted by you with regard to the above-mentioned project proposal, **the Ministry hereby prescribes the following TOR along with the standard ToR (as applicable)** for preparation of the EIA and EMP Report.

i) Information regarding engaging QCI-NABET Consultants for carrying out EIA studies shall be submitted before initiating the studies.

ii) *Recommendations of the TNCZMA for seawater intake &outfall pipelines and coal conveyor proposed in the CRZ area shall be obtained as per the CRZ Notification, 2011 and its amendments.*

iii) *The power project and its boundary shall not be located in the CRZ area. A fresh CRZ demarcation inline with the Coastal Zone Management Plans of Tamil Nadu State as per the CRZ Notification, 2011 or any amendments thereof, shall be carried out by the authorised agency. The mapping shall clearly show Project Facilities, LTL, HTL, 100 m, 200m and 500 setback lines, classification of CRZ areas (CRZ-I, II,III & IV), mangroves, eco-sensitive areas, etc. The mapping shall also include Ennore replacement project, the present project and the existing 450 MW power plant along with proposed marine facilities.*

iv) *Recommendations of the sub-committee in its site visit held during 13th-14th October, 2017 shall be complied with.*

v) *The cumulative impact assessment for the Ennore replacement project (1x660 MW) and the present proposal shall be carried out in addition to the industries located within 10 km radius.*

vi) *Public Hearing for the proposed project shall be conducted in close proximity to the project site.*

vii) *Baseline data collected for Ennore replacement Project (1x660 MW) may be utilised for the proposed project, provided the data should not be older than 3 years at the time of submission of application for grant of EC to the Ministry.*

viii) *Marine EIA and EMP shall also be prepared for the facilities proposed in the CRZ area.*

ix) The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.

x) Vision document specifying prospective long term plan of the project shall be formulated and submitted.

xi) Latest compliance report duly certified by the Regional Office of MoEF& CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be submitted.

xii) The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.

xiii) Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.

xiv) Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.

xv) The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.

xvi) Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.

xvii) Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.

xviii) Present land use (including land class/kism) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.

xix) If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.

xx) The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.

xxi) Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.

xxii) Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.

xxiii) Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.

xxiv) A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it

shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.

xxv) A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.

xxvi) Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The plan shall also include disposal method / mechanism of bottom ash.

xxvii) The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re-circulation of effluents.

xxviii) Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.

xxix) It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system / streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.

xxx) Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted.

xxxi) Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.

xxxii) Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.

xxxiii) Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.

xxxiv) Feasibility of near zero discharge concept shall be critically examined and its details submitted.

xxxv) Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.

xxxvi) Plan for recirculation of ash pond water and its implementation shall be submitted.

xxxvii) Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.

xxxviii) Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.

xxxix) Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.

xl) If the area has tribal population it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.

xli) A detailed CSR plan along with activities wise break up of financial commitment shall be prepared. CSR component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified. Separate budget for community development activities and income generating programmes shall be specified.

xlii) While formulating CSR schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CSR details done in the past should be clearly spelt out in case of expansion projects.

xliii) R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependant on land

falling in the project, as well as, population who were dependant on land not owned by them.

xliv) Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.

xlv) Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conducive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.

xlvi) One complete season site specific meteorological and AAQ data (except monsoon season) as per latest MoEF Notification shall be collected and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM10, PM2.5, SO2, NOx, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration of the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre-dominant downwind direction at a location where maximum ground level concentration is likely to occur.

xlvii) In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).

xlviii) A list of industries existing and proposed in the study area shall be furnished.

xlix) Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modeling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.

l) Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.

li) Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc should also be furnished.

liii) Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted

liii) Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.

liv) For proposals based on imported coal, inland transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.

lv) Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.

lvi) EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.

lvii) A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Mock drills shall be suitably carried out from time to time to check the efficiency of the plans drawn.

lviii) The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.

lix) Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary with tree density of 2000 to 2500 trees per ha with a good survival rate of around 80% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO_2 and other gaseous pollutants and hence a stratified green belt should be developed.

lx) Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months.

lxi) Corporate Environment Policy

i. Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.

ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.

iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. Details of this system may be given.

iv. Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.

All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.

lxii) Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.

14. Besides the above, the following general points shall be followed:
   a. All documents to be properly referenced with index, page numbers and continuous page numbering.
   b. Where data is presented in the report especially in table, the period in which the data was collected and the source should invariably be indicated.
   c. Where the documents provided are in a language other than English, an English translation should be provided.
   d. The Questionnaire for environmental appraisal of thermal power projects as devised earlier by the Ministry shall also be filled and submitted.
   e. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India (QCI) / National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA/ EMP reports prepared by them and data provided by other organization / Laboratories including their status of approvals etc. In this regard circular no. F.No. J-11013/77/2004-IA-II (I) dated 2nd December, 2009 is posted on the Ministry's website http://www.moef.nic.in may be referred.

In addition to the above, information on the following may also be incorporated in the EIA report.

1. Is the project intended to have CDM-intent?

(i) If not, then why?
(ii) If yes, then

a. Has PIN (Project Idea Note) {or PCN (Project Concept Note)} submitted to the ?NCA? (National CDM Authority) in the MoEF?
b. If not, then by when is that expected?
c. Has PDD (Project Design Document) been prepared?
d. What is the Carbon intensity? from your electricity generation projected (i.e. CO_2 Tons/MWH or Kg/KWH)
e. Amount of CO_2 in Tons/year expected to be reduced from the baseline data available on the CEA?s web-site (www.cea.nic.in)

2. Notwithstanding 1(i) above, data on (d) & (e) above shall be worked out and reported.

15. **The Environmental Clearance shall be applied only after fuel and water linkages are firmed up.**

16. After preparing the Draft EIA (as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006) covering the above mentioned issues, the same shall be submitted to the SPCB for conducting the public hearing as per procedure of EIA notification 2006. The issues emerged during public hearing shall be further incorporated in the Draft EIA/EMP report. The final EIA/EMP report along with public hearing report and the requisite documents (*including written objections, if any*) shall be submitted to the Ministry for appraisal by the Expert Appraisal Committee for consideration of awarding environmental clearance under the provisions of Environmental Impact Assessment notification dated September 14, 2006.

17. The TORs prescribed shall be valid for a period of **three years** from the date of issue for submission of final EIA/ EMP reports, after public consultation.

This issues with the approval of the Competent Authority.

Yours faithfully,

(Dr. S. Kerketta)
Director, IA.I

Copy to: -

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
4. The Additional Principal Chief Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (SEZ), Ist and IInd Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai – 34.

5. The Principal Secretary to Government, Environment and Forests Department, Government of Tamil Nadu, No.1, Jeenis Road, Panagal Building, Ground Floor, Saidapet, Chennai-600 015
6. The Chairman, Tamil Nadu Pollution Control Board, 76, Mount Salai, Guindy, Chennai - 600 032.
7. The District Collector, Ennore District, Govt. of Tamil Nadu, Tamil Nadu -623 503.
8. Guard file/Monitoring file.
9. Website of MoEF&CC.

(Dr. S. Kerketta)
Director, IA.I

Terms of Reference (TOR) Compliance

ToR Compliance

S.No	ToR	Compliance
i.	Information regarding engaging QCI-NABET Consultants for carrying out EIA studies shall be submitted before initiating the studies.	Noted and followed, we have engaged Ramky Enviro Services Private Limited, QCI-NABET accredited consultant for carrying out EIA studies; Certificate no QCI/NABET/EIA/ACO/19/0978.
ii.	Recommendations of the TNCZMA for seawater intake &outfall pipelines and coal conveyor proposed in the CRZ area shall be obtained as per the CRZ Notification, 2011 and its amendments.	TNCZMA recommended the foreshore facilities of seawater intake &outfall pipelines and Pipe coal conveyor proposed in the CRZ area as per the CRZ Notification, 2011 on 31.7.2019.
iii.	The power project and its boundary shall not be located in the CRZ area. A fresh CRZ demarcation in line with the Coastal Zone Management Plans of Tamil Nadu State as per the CRZ Notification, 2011 or any amendment thereof, shall be carried out by the authorised agency. The mapping shall clearly show Project Facilities, LTL, HTL, 100 m, 200 m and 500 setback lines, classification of CRZ areas (CRZ I,II,III & IV), mangroves, eco-sensitive areas, etc. The mapping shall also include Ennore replacement project, the present project and the existing 450 MW power plant along with proposed marine facilities.	The power project is away from CRZ area. CRZ Demarcation Map of the site is prepared by M/s. IRS, Anna University, Chennai as per CRZ notification 2011. The summary of the study & CRZ Map is enclosed in **Annexure I**
iv.	Recommendations of the sub-committee in its site visit held during 13th-14th October, 2017 shall be complied with.	As recommended by EAC subcommittee, additional AAQ was conducted in July-Sep 2018 the AAQ data was included in **Chapter-3 Section 3.5** Other recommendations like AAQ results & Bioaccumulation report are attached as **Annexure II**
v.	The cumulative impact assessment for the Ennore replacement project (1x660 MW) and the present proposal shall be carried out	The cumulative impact assessment considering ETPS replacement project along with proposed expansion

	in addition to the industries located within 10 km radius.	project and all other existing industries located within 10km radius was considered for AAQ modelling • The modelling input details and outlet values for the cumulative impacts are given in **Chapter-4, Section 4.4.2 Table 4.5 and 4.7** • The Air quality contour map (GLC modelling) is shown in **Chapter- 4, Section 4.4.2, Figure 4.6 to 4.9.**
vi.	Public Hearing for the proposed project shall be conducted in close proximity to the project site.	The Public hearing was exempted by MOEFCC vide letter no F.No.J-1302/15/2018-IA-I(T) dated 10-07-2019.The letter is enclosed as **Annexure IIA**
vii.	Baseline data collected for Ennore replacement Project (1x660 MW) may be utilised for the proposed project, provided the data should not be older than 3 years at the time of submission of application for grant of EC to the Ministry.	Baseline data collected for Ennore Replacement project (1X660MW) by M/S.Chennai Testing laboratory Pvt. Ltd in the season of July-Sep 2018 was utilised for this project details are given in **Chapter-3, Section 3.5.**
viii.	Marine EIA and EMP shall also be prepared for the facilities proposed in the CRZ area.	Marine EIA study is carried out by M/s. Cholamandalam MS Risk Services Limited, Chennai. Executive summary of report is enclosed as **Annexure III**
ix.	The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.	"ETPS Expansion TPP of capacity (1 X 660MW)".
x.	Vision document specifying prospective long term plan of the project shall be formulated and submitted.	A Vision document specifying prospective long term plan is attached **as Annexure IV**
xi.	Latest compliance report duly certified by the Regional Office of MoEF& CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be	EC compliance is not applicable as the existing ETPS (450 MW) plant was decommissioned on 31-3-2017 Fresh CRZ recommendations of TNCZMA issued on 31.7.2019

	submitted.	
xii.	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.	Not applicable, since the project was decommissioned on 31.03.2017. Proposed project is going to be an expansion of power project within the premises of ETPS complex and exemption of this clause has been issued by MoEF&CC vide letter dt 1.5.19 is attached as **Annexure XI**
xiii.	Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.	The proposed project is an Expansion project with capacity of 660MW super critical thermal power plant within the premises of 450 MW (decommissioned) of ETPS. The total land area is 90 acres (with in Plant boundary is 84 acres and 6 acres outside plant boundary). The total water requirement of the proposed project 170712 m^3/day which will be sourced from sea. The fuel requirement is 100% imported coal (2.0 MTPA). The total cost for the proposed project is Rs. 5421.38 Crores. The effluent from the proposed project will be treated, partly reused and excess discharged into sea meeting CPCB effluent discharge standard through marine outfall. Executive Summary of the project is provided in the EIA report as **Chapter-10** Recent photographs of the proposed site are given in **Chapter-2, Figure 2.5.** The Public hearing was exempted by MOEFCC vide letter no F.No.J-1302/15/2018-IA-I(T) dated 10-07-2019.The letter is enclosed as

		Annexure IIA
xiv.	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.	A proposal for harnessing solar power within the premises of the plant particularly at available roof tops is formulated. The proposed solar power panels installation capacity is 0.735 MW. Details are given in **Chapter-9, Section 9.9,Table 9.3**
xv.	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.	• Map showing plant site & ash pond with geo coordinates on (satellite &topo) is given **in Chapter-2, Figure 2.6 &Figure 2.7** • The GPS points of the plant boundary are given in **Chapter-1, Table 1.3** • Satellite imagery map of the study area showing plant boundary is given in **Chapter-3, Figure 3.9** • The elevation of the plant site is in the range of 2 to 9.15 m above the mean sea level. • The plant level will be elevated to MSL+9.15m to maintain safelevel considering HFL of Kosasthalaivar river (MSL+8.55m) • The HFL details are given in **Chapter 4, Section 4.13.2 Table 4.26**
xvi.	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. Shall be provided.	The breakup of plant area with particulars such as ash pond, infrastructure and roads, green belt etc., are given in **Chapter-2, Table 2.1.** The layout plan showing various facilities of the existing as well as proposed plant is shown in **Chapter-2, Figure 2.4.**
xvii.	Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA	Complied as per CEA norms, Land requirement for the expansion project has been optimized. The land required

	from time to time. Item wise break up of land requirement shall be provided.	for the proposed project is 33.99 ha (84 Acres). Which is 0.13 acres/MW. This is less than the existing CEA norms of 0.20 acres/MW for 660 MW unit station using 100% imported coal. The breakup of land requirement is given in **Chapter-2, Table 2.1**
xviii.	Present land use (including land class/kism) as per the revenue records and State Govt. Records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. Shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.	• The present land use of the ETPS project site is under Industrial use (as it is proposed in existing area).The land is owned by TANDGEDCO known as ETPS complex. • No additional land is required to be acquired for coal conveyor & pipe line as the existing facilities will be used. • Right Of Way is free from encumbrance. CMDA issued land use map is attached as **Annexure V**
xix.	If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.	There is no forest land involved for the project.
xx.	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.	Not applicable, as there are no R&R issues are involved as the project is a proposed expansion TPP within the existing plant of ETPS complex(owned by TANGEDCO)
xxi.	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river	Land Use Land Cover (LULC) Map, Satellite Imagery and authenticated topo maps indicating the environment

	system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.	setting representing 10 Km radius of study area is given in**Chapter-3, Figure 3.8 & Figure 3.9** respectively.
xxii.	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes/ wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	There are no National park, Sanctuary, Elephant/Tiger Reserve (Existing as well as Proposed), and migratory routes/wildlife corridor within 10 Km radius of the ETPS site. The sensitivity map of the project site with 15 Km radius is given in **Chapter-3, Figure 3.6.**
xxiii.	Topography of the study area supported by topo sheet on 1 :50,000 scale of Survey of India, along with a large scale map preferably of 1 :25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.	The topographical features of the proposed project site and study area shown in Topo sheet of 1:50,000 scale are given in **Chapter-2, Figure 2.2.** For construction of the power plant facilities elevation will be maintained at 9.15m + MSL
xxiv.	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land is acquired and developed and detailed plan submitted.	The proposed project is coming up in existing ETPS complex no new land is proposed to be acquired. • The land use land cover classification of the study area is given in **Chapter-3, Section 3.11. Table 3.23** and the same is furnished in **Figure 3.8.** • No damage/ impact is envisaged to the common properties in the nearby villages due to the proposed project.
xxv.	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.	As proposed expansion project is within ETPS complex. As such no minerals are present within the site, mineralogical map is not prepared.
xxvi.	Details of fly ash utilization plan as per	Ash utilization/Management shall be

	the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. Shall be submitted. The plan shall also include disposal method / mechanism of bottom ash.	done as per MoEF&CC gazette notification on utilization of ash dated 03.11.2015. ➢ Ash utilization plan will be implemented for 100% extraction and utilization of dry fly ash along with suitable collection, storage, segregation, loading, transportation and disposal etc. facilities. ➢ Ash in dry form is pneumatically transported to fly ash silos. ➢ Fly ash shall be taken to high concentration slurry disposal system (HCSDS) and bottom ash through wet slurry disposal system for ultimate disposal. ➢ The technical as well as utilization details are explained in **Chapter-2, Section 2.8.8 and Chapter-9, Section 9.5.1** ➢ 100% Fly ash through e-auction only
xxvii.	The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re-circulation of effluents.	The source of water is Bay of Bengal, the details of water requirement and water balance are given in**Chapter-2, Section 2.6, Table 2.2 & Table 2.3 and Figure 2.8 and 2.9 respectively.** Part of the cooling tower blow down is used for fly ash dust conditioning and ash slurry formation, excess is discharged into marine out fall after meeting sea discharge standards
xxviii.	Water body/ Nallah (if any) passing across the site should not be disturbed as far as	Not Applicable. No water body/nallah is passing

	possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.	through the proposed site. Hence diversion of any is not envisaged.
xxix.	It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system / streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.	The proposed site is >500m away from sea, Korattaliyar river is around 575m from project site. The nearest highway is Manali highway around 600m and Ennore Express highway about 200m. The nearest railway station is Kathivakkam around 2km.
xxx.	Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted	The proposed project area is already a developed/ graded area with necessary drains etc. Hydrogeological study details and drainage pattern details are given in **Chapter-3, Section 3.13** The impacts on drainage and mitigation measures are given in **Chapter-4, Section 4.9 & 4.10**
xxxi.	Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.	The ecological studies have been carried out during the study period and the observations representing the flora and fauna of the study area are presented in **Chapter-3, Section 3.10** Marine EIA study carried out by M/s. Cholamandalm Risk Services Limited, Chennai and the report is submitted for CRZ clearance and the summary of the marine impact study is enclosed in **Annexure III**
xxxii.	Source of water and its sustainability even	Source of water is from sea water it is discussed in **Chapter-2, in Para 2.6**

	in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter/ document stating firm allocation of water	Entire water required will be drawn from sea at a distance of 650m offshore.
xxxiii.	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.	The rain water from roof areas will be collected after necessary preliminary treatment into rain water collection tank and used for plant activities. Storm water drainage system consists of well-designed network of open surface drains will be developed to prevent water logging in the site. The details of the rainwater harvesting system is given in **Chapter-4, Sub Para 4.11 Table 4.23**
xxxiv.	Feasibility of near zero discharge concept shall be critically examined and its details submitted.	The source of the water is Bay of Bengal, the major quantity of wastewater generated is from cooling tower blow down, RO1 reject, etc. Part of the wastewater is reused for fly ash dust conditioning, ash slurry formation, the balance wastewater is discharged into sea through marine outfall. The RO2 reject will be utilised for dust suppression, CHP dry fogging, etc. Whereas domestic wastewater treated in STP and reused greenbelt development.
xxxv.	Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall	The water required for the project is optimized by considering the COC of 1.3.

	be specified.	The rain water from roof top is harvested and utilised for various uses in the plant.
xxxvi.	Plan for recirculation of ash pond water and its implementation shall be submitted.	The ash pond water is recovered treated and reused in ash water sump makeup.
xxxvii.	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface/ ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.	Detailed plan for conducting monitoring of water quality (surface and ground water) is given in **Chapter 6, Section 6.1.3.**
xxxviii.	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.	Socio-economic study was carried out around 10 Km radius of the study area. Detailed impact assessment survey was carried out and mitigation measures are proposed. The details of demography and the prevailing socio-economic conditions are given in **Chapter-3, Section 3.12** The socio economic studies of the study area were conducted by Madras school of Social Works. The summary of the report given in **Annexure VI**
xxxix.	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.	Action plan is in place for local employable youth to develop skills through special training. A provision is made for training as part of CSR plan. Budgetary provision has been made for the proposed project to impart training/skill development programmes to make them self-

		employable. This budget will be utilized during plant operation stage through CSR. It will be carried out based on the recommendations of "The socio economic studies by Madras school of Social Works. The summary of the report given in **Annexure VI** The employment/ man power details are given in **Chapter-2, Section 2.7.5 & Table 2.8.**
xl.	If the area has tribal population it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.	The proposed project is within the existing ETPS complex, so there is no tribal population.
xli.	A detailed CSR plan along with activities wise break up of financial commitment shall be prepared. CSR component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in uplift merit of affected section of society, which is consistent with the traditional skills of the people shall be identified. Separate budget for community development activities and income generating programmes shall be specified.	Details of CSR activities for the proposed project are given **Chapter-8 Section 8.6.** Details of CSR activities for the proposed project are given in the socio economic studies report conducted by Madras school of Social Works. The summary of the report given in **Annexure VI**
xlii.	While formulating CSR schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the	Based on socio economic study report conducted by Madras School of Social Works action plan will be prepared, CSR budget allotment will be made and in-built monitoring mechanism will be implemented.

	scheme from time to time and dovetail the same with any Govt. Schemers]. CSR details done in the past should be clearly spelt out in case of expansion projects.	
xliii.	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependant on land falling in the project, as well as, population who were dependant on land not owned by them.	The proposed unit will be set up within the existing land of TANGEDCO. Hence, it is envisaged that there is no R&R.
xliv.	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.	There is no specific endemic disease in the area. General sanitation and hygiene shall be maintained in the labour camp. However mitigation measures are proposed in **Chapter-9, Section 9.6**
xlv.	Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conducive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an	Basic health care facilities like First-aid and ambulance facility will be made available to the workers during the construction period. Contractors will be responsible for all the basic amenities during construction other than sanitation, firewood and basic health care. Company will engage qualified doctors and conduct health camps for the workers. Required treatment and medicines will be provided free of cost under CSR activity. Workers will not be allowed to work without personal protective equipments like safety jackets, safety shows, helmets etc.

	excellent follow up plan of action wherever required.	• In **Chapter-7** detailed analysis given on Occupational health and safety. • Minimum one full time qualified doctor is available at First-Aid center – given in **Para 7.2.6.2** • Mock drills will be conducted for all the employs for effective emergency response.
xlvi.	One complete season site specific meteorological and AAQ data (except monsoon season) as per latest MoEF Notification shall be collected and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration of the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre-dominant downwind direction at a location where maximum ground level concentration is likely to occur.	The ambient air quality monitoring was carried out during Pre-Monsoon season from July - September, 2018 covering predominant wind directions and population zones. Villages in the vicinity are considered. • AAQ monitoring locations for the study area is given in **Chapter 3, Table 3.4** and locations showing in Topo map are shown in **Figure 3.2.** • The meteorological data is given in **Table 3.2 and 3.3**. AAQ results are given in **Table 3.5 to 3.7**
xlvii.	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/ stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs.).	Regarding 104 observations, as per amendment of ToR issued on 1.5.2019, AAQ monitoring data of 104 observations are not required. "Committee after detail deliberations, recommended for Baseline data collected during July- September, 2018 can be used in preparation of EIA/EMP.
xlviii.	A list of industries existing and proposed in the study area shall be furnished.	List of industries in the study area are Ashok Leyland, ETPS Replacement TPP (Proposed), Ennore Foundries, Vallur TPS (3x500 MW) NCTPS – Stage I, Stage II, Stage III & Ennore SEZ TPP.

xlix.	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modeling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the predicted maximum GLC of 24 hours average of PM10, PM2.5, SO2, &NOx concentrations considering mean meteorological data of the study season are superimposed on the maximum baseline concentrations obtained during the study period to estimate the post project scenario, which would prevail at the post operational phase. The air quality contour maps of overall post project scenario of 660 MW are given in **Chapter-4, Section 4.4.2.3 Table 4.4 to 4.7 and Figure 4.1 to 4.9** The AERMOD software model used for predicting the incremental air quality levels in the study area due to the proposed project.
l.	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.	The analysis report examining Radio Activity and heavy metal content in coal are their laboratory reports are enclosed as **Annexure VII**
li.	Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc should also are furnished.	The coal quantities and characteristics under various options is given in **Chapter-2 Section 2.7.** The details of auxiliary fuel, quantity and their storage details are furnished in **Chapter-2, Section 2.9.**
lii.	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal	100 % imported coal will be used for proposed project and MOU (Lr. Dt 24/07/21012) has been signed with MMTC for supply of imported coal. Letter provided as **Annexure- VIIIA**

	shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted.	The characteristics of coal are given in **Chapter-2, Section 2.7, Table 2.5** and coal quantities and characteristics under various options is given in **Table 2.6.** The Ministry's Notification dated 02.01.2014 regarding ash content in coal is complied.
liii.	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/ conveyor belt.	It is planned to handle coal to the plant from Ennore port in Coal Berth III to the plant boundary through the Pipe conveyors (2x1000) Tonnes per hour for the ETPS Expansion Project. The above conveyors are having spare capacity of 10,000 Tonnes/day to accommodate the requirement for the ETPS replacement project also. given in **Chapter-2, Section 2.7.1**
liv.	For proposals based on imported coal, inland transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.	The 100% imported coal is considered No inland transportation, rail movement etc. are envisaged. Further no bottle neck in port handling is anticipated. The imported coal is to be unloaded in existing coal berths 1 &2 or future berth 3 to be established by Ennore port limited, which is 5Km from the site. The approval of Dept. PWD for the coal transport from port is attached as **Annexure IX**
lv.	Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.	Basic health care facilities i.e. first-aid and ambulance facilities will be made available to the workers during the construction period. Temporary sanitary facilities will be provided. Contractors will be responsible for all the basic amenities during

		construction other than sanitation and basic health care. Necessary conditions will be imposed in the work order of contractors.
lvi.	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.	Item wise EMP discussed in **Chapter-6.** The stage wise Environment quality monitoring programme is given in **Table 6.1 and 6.2.** The list of equipment proposed for Environmental laboratory is given in **Table 6.3** EMP to mitigate adverse impacts due to the proposed project and EMP cost towards pollution control measures are given in **Chapter-6, Section 6.3.3. Table 6.4**
lvii.	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Mock drills shall be suitably carried out from time to time to check the efficiency of the plans drawn.	Details of Disaster Management Plan, Onsite Emergency Plan, Hazardous Assessment and Evaluation, along with risk assessment study including fire and explosion issues due to storage and use of fuel is given in **Chapter-7, Section 7.1 and 7.2** Risk contours plotted on the plant layout map are shown in **Figure 7.1 to 7.5**
lviii.	The DMP so formulated shall include measures against likely Fires/ Tsunami/ Cyclones/ Storm Surges/ Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely	Detailed of Disaster Management Plan (DMP) covering all the hazards like Fires/Tsunami/Cyclones/Storm surges/Earthquakes etc are discussed in **Chapter-7, Section 7.2**

	disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.	
iix.	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary with tree density of 2000 to 2500 trees per ha with a good survival rate of around 80% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for C02 and other gaseous pollutants and hence a stratified green belt should be developed.	Detailed scheme of greenbelt development action plan and no of species are given **in Chapter-4, Section 4.6 & Chapter-9, Section 9.8,Table** 9.4 greenbelt plan is in **Figure 9.1** The survival rate is also monitored by periodical enumeration of new plantation.
Ix.	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months.	In consultation with the District Forest Department, additional plantation will be done within the identified blocks of degraded forest under CER. Budgetary allocation & action plan is given in **Chapter-8 , Table 8.2**
lxi.	Corporate Environment Policy	
i.	Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	TANGEDCO has Environmental cell under the control of Chief Engineer/ Projects to monitor the issues and make necessary report to Directors & CMD.
ii.	Does the Environment Policy prescribe for standard operating process/ procedures to bring into focus any infringement/ deviation/ violation of the environmental or forest	TANGEDCO has an environmental wing in each power station to monitor and implement the requisite measures to protect the environment as directed

	norms/ conditions? If so, it may be detailed in the EIA.	by the statutory authorities and TANGEDCO has Environmental cell under the control of Chief Engineer/ Projects to monitor the issues and make necessary report to Directors & CMD.
iii.	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions Details of this system may be given.	The hierarchical system/ administrative setup of the company to deal the environmental related issues for ensuring compliances with the environmental clearance conditions is given in **Chapter-6, Section 6.3.2, Figure 6.1**
iv.	Does the company has compliance management system in place wherein compliancestatus along with compliances/ violations of environmental norms are reported to the CMD and the Board of Directors of the company and/ or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.	TANGEDCO has an environmental wing in each power station to monitor and implement the requisite measures to protect the environment as directed by the statutory authorities and TANGEDCO has Environmental cell under the control of Chief Engineer/ Projects to monitor the issues and make necessary report to Directors & CMD.
All the above details should be adequately brought out in the EIA report and in the presentation to the Committee		
ixii.	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.	No Litigation/complaints are pending against the proposed project.
14	Besides the above, the following general points shall be followed:	
a.	All documents to be properly referenced with index, page numbers and continuous page numbering.	Noted and followed
b.	Where data is presented in the report especially in table, the period in which the data was collected and the source should invariably be indicated.	Noted and followed
c.	Where the documents provided are in a language other than English, an English translation should be provided.	Noted and followed
d.	The Questionnaire for environmental	Noted and followed attached as

	appraisal of thermal power projects as devised earlier by the Ministry shall also be filled and submitted.	**Annexure X**
e.	The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India (QCI)/ National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA/ EMP reports prepared by them and data provided by other organization/ Laboratories including their status of approvals etc. In this regard circular no. F.No. J-11013/77/2004-IA-II (I) dated 2nd December, 2009 is posted on the Ministry's website http://www.moef.nic.in may be referred.	Noted and followed
In addition to the above, information on the following may also be incorporated/ in the EIA report.		
1	Is the project intended to have CDM-intent?	
i	If not, then why?	-
ii	If yes, then a. Has PIN (Project Idea Note) {or PCN (Project Concept Note)} submitted to the? NCA? (National CDM Authority) in the MoEF?	Yes
	b. If not, then by when is that expected?	6 months after commissioning
	c. Has PDD (Project Design Document) been prepared?	No
	d. What is the Carbon intensity? from your electricity generation projected (i.e. CO_2 Tons/ MWH or Kg/ KWH)	0.885 CO_2 Tons/MWH
	e. Amount of CO_2 in Tons/year expected to be reduced from the baseline data available on the CEA?s web-site (www.cea.nic.in)	287041.7 T CO_2/annum (Baseline CO_2 emission factor is considered as 0.944)
2	Notwithstanding 1 (i) above, data on (d) &	Noted and followed.

	(e) above shall be worked out and reported.	
STANDARD TERMS OF REFERENCE		
Additional TOR for coastal based Thermal Power Plants Projects(TPPs)		
	Over and above the TOR mentioned in Thermal Power Plants Projects, the following shall be strictly followed (as applicable):	
a)	Low lying areas fulfilling the definition wetland as per Ramsar Convention shall be identified and clearly demarcated w.r.t the proposed site.	The project site is not falling in low lying area.
b)	If the site includes or is located close to marshy areas and backwaters, these areas must be excluded from the site and the project boundary should be away from the CRZ line. Authenticated CRZ map from any of the authorized agencies shall be submitted.	The project boundary is not located in CRZ area. CRZ Demarcation Map of the site is prepared by M/s. IRS, Anna University, Chennai as per CRZ notification 2011. The summary of the study & CRZ Map is enclosed in **Annexure I**
c)	The soil leveling should be minimum with no or minimal disturbance to the natural drainage of the area. If the minor canals (if any) have to be diverted, the design for diversion should be such that the diverted canals not only drains the plant area but also collect the volume of flood water from the surrounding areas and discharge into marshy areas/major canals that enter into creek. Major canals should not be altered but their embankments should be strengthened and desilted.	There is no disturbance to the natural drainage pattern and no diversion of canals/drains as the proposed project is already levelled and graded (as it is coming up in the existing ETPS Complex).
d)	Additional soil required for leveling of the sites should as far as possible be generated within the site itself in such a manner that the natural drainage system of the area is protected and improved.	No additional soil is required as it is already graded and levelled.
e)	Marshy areas which hold large quantities of flood water to be identified and shall not be disturbed.	Not present in the site
f)	No waste should be discharged into Creek, Canal systems, Backwaters, Marshy areas and seas without appropriate treatment. Wherever feasible, the outfall should be first treated in a Guard Pond and then	Noted and will be followed

	only discharged into deep sea (10 to 15 m depth). Similarly, the Intake should be from deep sea to avoid aggregation of fish and in no case shall be from the estuarine zone. The brine that comes out from Desalinization Plants (if any) should not be discharged into sea without adequate dilution.	
g)	Mangrove conservation and regeneration plan shall be formulated and Action Plan with details of time bound implementation shall be specified, if mangroves are present in Study Area.	Some patches of mangroves are present near back waters in the study area. Will be provided.
h)	A common Green Endowment Fund should be created by the project proponents out of EMPbudgets. The interest earned out of it should be used for the development and management of greencover of the area.	Will be provided.
i)	Impact on fisheries at various socio economic level shall be assessed.	The details are given in socio-economic study report prepared by Madras school of social work, Chennai
j)	An endowment Fishermen Welfare Fund should be created out of CSR grants not only to enhance their quality of life by creation of facilities for Fish Landing Platforms / Fishing Harbour / cold storage, but also to provide relief in case of emergency situations such as missing of fishermen on duty due to rough seas, tropical cyclones and storms etc.	Will be provided.
k)	Tsunami Emergency Management Plan shall be prepared wherever applicable and Plan submitted prior to the commencement of construction work.	Noted & will be followed as per requirement.
L)	There should not be any contamination of soil, ground and surface waters (canals & village pond) with sea water in and around the project sites. In other words necessary preventive measures for spillage from pipelines, such as lining of Guard Pond used for the treatment of outfall before discharging into the sea and surface RCC channels along the pipelines of outfall and	Noted and will be followed

	intake should be adopted. This is just because the areas around the projects boundaries could be fertile agricultural land used for paddy cultivation.	

Executive Summary

Executive Summary

1.0 Introduction

Tamil Nadu Generation and Distribution Corporation (TANGEDCO), proposes to set up a 1x660 MW coal based Supercritical Ennore Thermal Power Station (ETPS) Expansion Project within the existing ETPS complex located near Ernavur village, Tiruvottiyur taluk, Thiruvallur district of Tamil Nadu state.

Proposed plant consists of Coal Fired Boiler, Steam Turbine Generator Units and Balanced of Plant (BOP) Units. Based on proposed capacity, project is supposed to fall under category A of Project Activity 1(d), Thermal Power Plants (≥ 500 MW coal/ lignite/ naptha & gas based) under the schedule as per EIA notification issued on 14th September, 2006. In order to assess likely impacts from proposed project on the surrounding environment and evaluating means of alleviating likely negative impacts, if any, from proposed project, TANGEDCO has retained Ramky Enviro Services Private limited (RESPL) as their environmental consultant.

Environment clearance for ETPS expansion project was accorded by MoEF&CC 03/06/2009 and extended for a period of 5 years on 08/09/2014(till 02/06/2019). CRZ clearance for coal conveyor intake and treated effluent outfall waterlines accorded on 23/12/2008 and validity extended up to 22/12/2018 on 31/3/2014. However, project could not be constructed within the validity period. Accordingly present proposal is submitted for obtaining fresh environmental clearance. The proposal was considered by Re- constituted Expert Appraisal Committee (Thermal Power) in its 23rd meeting held on 30th November, 2018 for determination of the Terms of Reference (ToR) for undertaking detailed EIA Study in accordance with the provisions of the EIA notification. The EAC has issued ToR vide its Letter No. F. No. J-13012/15/2018- IA. I (T) dated: 21st January 2019. Report has been prepared as per the recommendations of ToR.

ToR amendment issued vide its letter No. F. No. J-13012/15/2018- IA. I (T) dt:1.5.2019 for the following:

(a) Base line data collected during July-September 2018 can be used in preparation of EIA/EMP report and collecting 104 readings a year may also be exempted.

(b) Examination of alternate sites may also be exempted as it is ongoing project and environmental clearance had already been issued for the project.

MoEF&CC-New Delhi have exempted conducting fresh Public hearing for the captioned project vide letter dt.10.7.2019

Proposed expansion project is located adjacent to the proposed replacement project (capacity 1 X660 MW) within the existing ETPS complex. The project site is located near Ernavur village, Tiruvottiyur taluk, Thiruvallur district of Tamil Nadu state. The site is located at latitude of 13° 11' 30" to 13° 12' 04" N and longitude of 80° 18' 14"E to 80° 18' 30"E.

Project boundary is at a distance of about 70 m, 575 m and 815 m from Ennore back waters, Korattaliyar river and Bay of Bengal respectively. Project site is about 600 m, 1.2 km, 5 km & 20 km from Manali Highway, Ernavur village, Ennore port and Chennai city respectively.

2.0 Project requirements

2.1 Land requirement

The proposed plant will be constructed in 90 acres of land which includes vacant land of 84 acres within the existing ETPS complex (plant boundary) and 6 acres for corridor of pipeline and conveyor system (outside the plant boundary). In comparison to CEA guidelines the land required for similar capacity power plant (Coastal station based on imported coal with conveyor and Natural Draft Cooling Towers (NDCT) cooling towers) is about 135 acers which are well within the limits in terms of area utilization. There is no additional land acquisition and no rehabilitation or resettlement issues involved for the project.

2.2 Fuel requirement

Project is based on 100% imported coal supplied by M/s. MMTC limited. Coal is brought to Ennore Port by ship and further transported to project site by pipe conveyor. Boiler fuel (coal) consumption is 263 TPH and quantity of coal required is 2.0 Million tons /annum. Calorific value of imported coal is around 5805 Kcal/kg, ash & Sulphur content is 6.62% & 0.53% respectively. Support fuel used is Heavy Furnace Oil (HFO)/ Light Diesel Oil (LDO) supplied by nearby refinery at Chennai. Quantity of support fuel required is 5782 KL/ annum.

2.3 Water requirement

Total water required for project is about 7113 m^3/hr. Source of water is Bay of Bengal with intake point about 650 m from shore line. Major water requirement is for cooling water make-up 5700 m^3/hr and Reverse Osmosis Plant (RO) 1413 m^3/hr. Water required during construction phase is 200 m^3/day, which is supplied by CMWSSB and stored in underground water tank. No groundwater will be used during construction or operation phases of project.

2.4 Process description

Proposed plant will use supercritical plant (SCP) technology with boilers designed to take imported coal. Coal received is crushed in the crusher house to bring down the size to -20mm, which is subsequently pulverized in the coal mill. The powdered coal is burnt in the furnace to generate steam in the boiler. The steam generated will be semi outdoor, once through, radiant reheat, dry bottom and balanced draft unit of super-critical parameters, designed for firing pulverized coal as primary fuel. Stream generated will be sized for 2100 TPH at 256 kg/cm2 (a), super-heated outlet pressure, 568 ^oC stream SH temperature and 593^oC reheat temperature. The generators will be directly coupled, horizontal shaft cylindrical rotor continuously rated at rated power factor of 0.85 lagging, 3 phase 50 Hz.

Steam after expansion in turbine is condensed in condenser (Cooling tower type: NDCT) and condensed steam is circulated back to the boiler. Hot gasses from furnace after losing heat

in different areas go through Electrostatic Precipitators (ESPs) with efficiency of 99.98%, where ash is collected. The clean gas goes through 275 m chimney. Flue gas desulphurization (FGD) with efficiency of 95% is used for controlling sulphur dioxide emission and Advanced combustion technology with low NOx burners.

3.0 Baseline environmental status

Field investigations were undertaken for collecting existing baseline data for Land Use Land Cover (LULC) Air, Water, Noise, Soil, Ecological and Socio-economic conditions. A study area of 10 Km radius from project site is identified to establish present environmental conditions for above environmental components. The main aim of the EIA study is to identify critical environmental attributes affected and their adverse impacts on surrounding environment due to the proposed. The field data generation was undertaken as detailed below

- Ambient air quality (AAQ) monitoring during July to September 2018.
- LULC, Water, Noise, Soil, Ecological and Socio-economic conditions April- May 2019.

3.1 Land Use Land Cover (LULC)

LULC features of the study area was collected by analyzing Survey of India topo sheets, Satellite imageries supplied by NRSC and Ground validation for interpretation of False Color Composite (FCC) imageries through site visits. The land use pattern of study area mainly falls under following categories Sea: 43%; Built-up: 29%; Agriculture 8%; In-land water bodies: 7%; Waste land 12%; Others 1% and Forest: 0 %.

3.2 Meteorology (Climate)

Metrological data is collected from nearest IMD station at Chennai and also at project site with the help of weather station. The pre dominant wind direction recorded is from South West (SW) closely followed by West South West (WSW). Calm conditions prevailed for 2.38% of the total time. Average wind speed observed for the season is around 2.85 m/s.

3.3 Ambient Air Quality

AAQ was monitored at 9 locations within study area. Monitoring locations were identified in downwind, cross & up wind directions. Air pollutants monitored are Particulate Matter ($PM_{2.5}$ & PM_{10}), Sulphur dioxide(SO_2), Oxides of nitrogen (NO_x), Ozone, Carbon Monoxide as per standard MoEF&CC guidelines and results compared with NAAQ 2009 CPCB Standards.

The minimum and maximum 24hr concentration of $PM_{2.5}$ recorded is in the range of 35.6 to 58.4 µg/m^3 against a standard of 60 µg/m^3 whereas the PM_{10} values are in the range of 74.8 to 98.5 µg/m3 against a standard of 100 µg/m^3. The maximum Particulate Matter values are just within the Standards. The SO_2 and NO_x 24 hr concentrations observed are in the range of 12.1 to 26.5 µg/m^3 and 20.8 to 38.5 µg/m3 respectively against a standard of 80 µg/m^3. Maximum SO_2 & NO_X values are found to be well within the NAAQ 2009 CPCB Standards. Ozone 1 hr concentration values are in range of 7.6 to 22.4µg/m^3 against a standard of 180 µg/m^3, whereas CO levels are found to be below detectable limits.

3.4 Water quality monitoring

Ground water 10 samples and surface water 3 samples were collected from different sources and analyzed for all important physico-chemical and biological parameters to establish quality of water prevailing in the study area. Ground water samples were collated from open well, hand pumps & bore wells. Surface water collected from Kosasthalaiyar river near bridge at Vichoor village, Buckinghum channel and sea water near Ennor beach.

Ground water samples: The pH values are in the range of 7.0 to 7.8; TDS levels between 462 to 2545 mg/l (samples from Ennore & Vallur village are above permissible limit); Chloride concentrations between 120 to 762 mg/l; hardness observed is 295 to 983 mg/l (samples from Site, Ponniamman nagar and Vallur village are above permissible limit); Fluoride concentrations between 0.5 to 1.5 mg/l. Except for samples from Project site, Ennore, Ponniamman nagar and Vallur village other samples values are within permissible limits of 10500: 2102 Dirking water-specifications and fit for drinking use purpose.

Surface water sample: (Kosasthalaiyar river near bridge at Vichoor village): The pH values is 6.9; TDS is 1850 mg/l; Chloride concentrations is 604 mg/l; hardness observed is 413 mg/l: Fluoride concentrations is 1.5 mg/l; DO: 3.4 mg/l and BOD: 18 mg/l. Sample analysis indicates water is suitable for Irrigation, Industrial cooling, Controlled Waste disposal based as per "CPCB Water Quality Criteria Designated-Best-Use updated 11th Sep 2017". The other 2 surface water samples collected are sea water.

3.7 Noise monitoring

Noise was monitored at 10 locations within the study area of the project site. The locations were identified for assessment of existing noise level status(keeping in view of the land use pattern, residential areas in villages, schools, bus stands, etc (Industrial: 2 no; Commercial: 2 no; Residential: 4 no; Silent: 2 no). Day equivalent noise levels (dB (A)) are in the range for Industrial area 57.6 to 62.4; Commercial area is 55.7 to 62.2; Residential area is 53.8 to 54.8; Silence zone is 49.8 to 49.9 whereas in night noise levels are in the range for Industrial area 44.1 to 45.3; Commercial area is 43.8 to 44.7; Residential area is 42.8 to 43.5; Silence zone is 39.8 to 39.9. Noise values in the study area are within the Noise Pollution Rules 2000.

3.8 Traffic survey

Traffic survey was carried out at 2 locations (Ernavur village road & New Manali Express Road). Ernavur village road is a 2 lane 2 way road with 7 m width. Traffic volume recoded were 406 to 702 PCU/H. As per IRC guidelines Level of Service of this road falls under category "C" (Acceptable level of driving comfort, some delays). New Manali Express Road is a 4 lane divided 2 way road. Traffic volumes recoded are 1355 to 3473 PCU / H. As per IRC guidelines Level of service of this road falls under category "E" (High level of driving frustration, high levels of delays).

3.9 Soil quality

Soil Quality was monitored at 9 locations within the study area. The locations were selected to assess the existing soil conditions representing various land use conditions and geological features. The important physical, chemical parameter concentrations were determined and compared with Standards of Indian Council of Agriculture Research, New Delhi.

The pH values of samples in the study area are varying from 6.9 to 8.4 falling under normal to saline, the electrical conductivity is varying from 111 to 387 µmhos/cm , the organic carbon is varying from 0.18 to 0.54% falling under low & medium category, the available nitrogen is varying from 45.4 to 78.3 kg/ha falling under low category, the available phosphorus is varying from 4.01 to 22.8 kg/ha falling under low(3) & medium category(6), and the available potassium is varying between 65.5 to 256 kg/ha falling under low(3) & medium(6) category. NPK values of soil samples collected are in low to medium category indicating need for fertilizers with high NPK values for agriculture and horticulture activities

3.10 Ecological environment

A detailed analysis was done in the study area which includes compilation of secondary data from published literature of Forest Division and Primary data generation through systematic studies. Primary data was collected through visual observation of species in the study area.

There are no National Parks, Wildlife Sanctuaries, Biosphere Reserves and Important Bird Areas (IBA) within study area. There are no reports of occurrence of any rare or endangered or endemic or threatened (REET) fauna in study area. None of species reported or recorded from the study area are placed in Schedule I of the Indian Wildlife (Protection) Act, 1972.

3.11 Socio-Economic environment

Total population in study area is 433177 people with sex ratio of 986. In study area 0.45%, 21.35% and 15.98% belong to ST, SC & socially weaker section respectively. Main workers, marginal workers constitute 32 & 6% respectively. Most of villager surveyed are benefited by government schemes and are aware of welfare schemes and programs of government. Youth in area are devoid of employment opportunities and are potential source of workers.

4.0 Anticipated environmental impacts and mitigation measures

4.1 Impacts during construction phase

The possible construction activities that contribute to the environmental impacts are:

- Dust generation during leveling of earth, movement of vehicles on unpaved roads, unloading of raw materials and removal of unwanted waste material from site
- Emission of pollutants from vehicular exhaust
- Accumulation of excavated earth material

Impacts due to above activities would be temporary and confined within project boundary

4.2 Impacts during operation phase

4.2.1 Impact on air quality

Plant utilizes 100% imported coal. Major source of pollution are flue gas emissions from stack (Dust particulates, SO_2 and NO_X) and fugitive dust emissions from coal handling & material transfer points, fly ash dust particles from ash silos, ash disposal area and fly ash vented out during the unloading of fly ash from ESP hoppers to silos.

GLC of air pollutants released from 275 m height stake were estimated using study state dispersion model based on Gaussian Plume (AERMOD Version 7.0.3) software. The emission rates in stack estimated for PM, SO2 and NOx without control measures are 3875 g/s, 776 g/s and 172 g/s respectively. Whereas emission rates in stack for PM, SO2 and NOx with ESP (99.98% efficiency), FGD (95% efficiency) and Advanced combustion technology with low NOx burners are 0.78 g/s, 39 g/s and 62.6 g/s respectively.

Without control measures result of dispersion modeling shows increase in maximum GLC for PM is 745 µg/m^3, SO2 is 14.1 µg/m^3 and NOx is 3.2µg/m^3. With Control Measures result of dispersion modeling reveals a likely increase in maximum GLC for PM is 0.02 µg/m^3, for SO_2 is 0.75 µg/m^3 and for NOx is 1.2 µg/m^3. From above value we can see installation of control equipment helps in considerably reducing GLC values. Overall concentration (with control equipment) including existing baseline status for PM is 98.52 µg/m^3, SO2 is 27.25 µg/m^3 and NOx is 39.7 µg/m^3. These values are within NAAQ standards 2009. Proposed mitigation measures are

- Dust suppression/extraction facilities will be provided to mitigate the dust generated at coal transfer points and coal stockyard.
- Dust collection system will be provided in coal bunkers to evacuate dust and hazardous gases like methane from the coal bunkers.
- To reduce the dust nuisance while loading the ash into the trucks from fly ash silos, the fly ash would be conditioned with water spray
- To control SPM, SO2 and NOx in flue gas, ESP with 99.98%, efficiency, FGD with 95% efficiency and Advanced combustion technology with low NOx burners will be provided.

4.2.2 Impact on water quality

Total waste water of 5140 m^3/h is generated from Cooling tower blow down 4114 m^3/h, Clarifier rejects 88 m^3/h, RO1 reject 928 m^3/h, Neutralization pit 10 m^3/h. Waste water is discharged into sea through pipeline meeting discharge standards of maximum temperature not more than 5^o and salinity not exceed 50 PPT wrt to ambient seawater at release point.

Waste water from RO2 rejects 22 m^3/h will be reused for dust suppression, CHP dry fogging etc. Domestic waste water will be treated in the Sewage Treatment Plant of capacity 250 KLD and used for green belt development and Ash handling.

4.2.3 Impact on noise levels

The major sources of noise generation within plant are crusher unit; induced draft & forced draft fans; boiler feed pumps; turbines; generators; cooling towers; vehicular movement. The proposed mitigation measures are

- Properly designed plant and machinery (i.e. by providing inbuilt mechanisms like silencers, mufflers, and enclosures for noise generating parts) and shock absorbing pads at the foundation of vibrating equipment will be provided.
- In high noise intensity working areas/zones ear muffs or ear plugs or any other suitable personal protective equipment would be provided to the workmen.
- Development of greenbelt around plant boundary will diffuse noise pollution.
- Provision of isolation for major noise generating equipment's.
- Regular noise monitoring carried out for taking corrective action, wherever required.
- Restricted vehicular movement, drivers informed to blow horns only when required.
- Periodical medical examination on hearing loss shall be carried out for all the workers and maintain audiometric record and for treatment of any hearing loss including rotating to non-noisy/ less noisily areas.

4.2.4 Solid and hazardous wastes

Plant, being coal-fired, would generate coarse (bottom ash) & fly ash of about 84 & 336 TPD. Ash Management Plan will be developed for 100% utilization of fly ash (will be sent to needy vendors on e-auction basis) within time period prescribed by MoEF&CC. The unused ash, till such time, would be disposed in the existing ash pond.

Sludge generated from oil storage tank will be collected, stored in a safe and covered place to be disposed as per CPCB/SPCB/Hazardous wastes rules. Used oil from Lube oil & Transformer will be sold to authorized re-processor registered with CPCB.

4.2.5 Emergency preparedness plan in case of natural or in plant emergencies

To handle consequences of a major emergency inside factory or immediate vicinity of plant, a detailed disaster management plan is formulated. Emergency control center will be set up with emergency response team and communication system. It is essential that emergency plan be regularly tested to identify and correct any defect by keeping plan up to date.

4.2.6 Occupational health measures

Plant will be equipped with a full-fledged Occupational Health Centre (OHC) within plant premises as mandated under the Factories Act, 1948. As part of surveillance program, following minimum medical examination will be undertaken during pre-employment phase: General physical examination and blood pressure, X-Ray of chest & ECG, Sputum examination, detailed routine blood & urine examination, Audiometry and Spirometer. As part of routine & annual medical examination on people working in high noise levels, stress and dust exposure areas, a comprehensive surveillance program will be adopted.

5.0 Environmental management plan

Environmental Management Plan (EMP) is required to ensure a sustainable development of plant and surrounding areas. EMP will be integrated in all major activities of the project, with clearly defined policies, to ensure ecological balance of area is maintained and adverse effects are minimized. EMP requires multi-disciplinary approach with mitigation, management, monitoring and institutional measures taken during implementation and operation phases, to eliminate adverse impacts or reduce them to acceptable levels.

The mitigation measures are planned for construction and operation phases and the overall management plan helps to improve the supportive capacity of the receiving bodies. The EMP aims to control pollution at the source level to the possible extent with the available and affordable technology followed by the standard treatments before getting discharged. The recommended mitigation measures will synchronize the economic development of the study area with the environmental protection of the region.

Project Cost estimates

- Project Cost (Estimated) : Rs. 5421.38 crores (Rs 8.21 crores/MW)
- EMP (Capital Cost) : Rs. 977 crores
- EMP (Recurring expenditure) : Rs. 98 crores
- CER Cost : Rs. 13.65 crores

6.0 Environmental monitoring program

Environmental Monitoring Program is designed for assessing efficiency of implementation of Environment Management Plan (EMP) and to take corrective measures in case of any degradation in surrounding environment. Different activities involved in proposed project (during construction and operation phases) and their impact on various environmental attributes is taken into account for designing a detailed environmental monitoring program.

Implementation of EMP and periodic monitoring is proposed to be carried out at plant level and area level for the proposed thermal power plant and allied activities like coal handling facilities, workshop, colony, etc. A comprehensive monitoring mechanism shall be devised for monitoring of impacts due to proposed project as a part of compliance to CTE/CTO.

Plant level environmental protection measures like dust suppression, treatment and recycling of wastewater, plantation and noise control in the plant premises, housekeeping, implementation of EMP and Environmental Clearance conditions will be monitored by the plant authorities in accordance with compliance to EC/CTE/CTO.

7.0 Project benefits

Contribution of the plant on local social infrastructure is expected to be significant by stimulating growth of industrial and commercial activities in and around the district, by improving availability of the power. This project will provide a significant amount of direct

and indirect employment opportunities to the local people with different skills and trades. Infrastructure & socio-economic status of surrounding areas will be benefited as follows:

- Improvement in education, housing, banking, postal & communication services
- Improvement in power supply, water supply and sanitation
- Improvement in economic conditions and Recreation facilities
- Training will be given to local people to improve employment potential
- Increase in revenue to state from taxes & duties from development of local businesses

8.0 Conclusions

EIA study made an overall assessment of potential environmental impacts due to proposed plant and proposed mitigative measures to eliminate adverse environmental impacts or reduce them to acceptable levels as part of the EMP.

The demand for electricity has been steadily increasing. Setting up of Power Plant in this area will benefit society by providing better infrastructural, educational, medical facilities, improvement in indirect employment and economic growth of the area.

Chapter-1

Introduction

Chapter 1

Introduction

1.1 Introduction

The indian power system for planning and operational purposes is divided into five regional grids. The integration of regional grids, and therby establishment of National Grid was conceptualized in early nineties. The integration of regional grids which began with asynochronous back to back inter regional links facilitating limited exchange of regulated power was subsequently graduated to high capacity synchronous links between the regions.

The electric power grid for the southern region of india comprises the states of Andhra pradesh, Telangana, Karnataka, Kerala, Tamil Nadu and UT of Puducherry with rapid industrialization, successful rural electrification and large scale use of electricity for the irrigation purpose, the demand of electricity has registered a significant growth and steep increase in the southern region. Also, it is expected that the ongoing liberalization of country's economic policy would accelerate the industrial growth which would further increase the power demand.

Earlier in Tamil Nadu state, the power generation along with power transmission and distribution was being managed by the erstwhile Tamil Nadu Electricity Board (TNEB). As mandated by Indian Electricity Act 2003 TNEB was bifurcated to form separate entities as Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) in the field of power generation & distribution and Tamil Nadu Transmission Corporation Limited (TANTRANSCO) for transmission of power, which are subsidiary of TNEB Ltd.

As such, the TANGEDCO has assumed the lead role of power generation in Tamil Nadu State. To meet the growing demand of electricity, TANGEDCO established by government of Tamil Nadu under the Indian Electricity Act 2003 is planning to develop Supercritical Ennore Thermal Power Station (ETPS) expansion 1x660 MW Thermal Power Project at Ernavur village, Thiruvottiyur dist, Tamil Nadu, in the same ETPS complex where ETPS replacement 1x660 MW Thermal Power Plant is also proposed.

1.2 Purpose of the report

The existing ETPS was established during 1970-75 in an area of about 237 acres having an installed station capacity of 450 MW (3x110 MW + 2x60 MW) and were operating at capacity de rated to 340 MW. These units have served for more than 40 years and reached the last leg of their life span and decommissioned on 31.03.2017. In place of this aged units TANGEDCO has proposed to establish ETPS replacement TPP (1x660MW) after dismantaling the existing ETPS units adopting modern technology. TANGEDCO has proposed to install

"1x660 MW Supercritical ETPS Expansion Project" in the vacant land inside the existing ETPS complex.

As per EIA notification S.O. No 1533 issued on 14th September, 2006 and its subsequent amendments the proposed project is falling under project/ Activity 1(d) – Thermal Power Plants and Category A ≥ 500 MW (Coal/ Lignite/ Naphtha & gas based) project, and requires Environmental Clearance from Expert Appraisal Committee (EAC), MOEFCC, New Delhi. TANGEDCOhas submitted Form-1 application for obtaining Terms of Reference (TOR) from EAC. MOEFCC, New Delhi.

The proposed project was discussed in the 23rd meeting of Re-constituted EAC (Thermal Power) held on 30.11.2018, and the terms of reference was issued by MOEFCC vide its letter No. J-13012/15/2018-IA-I (T), dated: 21.01.2019.

As per the requirement of TOR, the following studies are conducted.

I. Terrestrial EIA/ EMP report-Consultant M/s Ramky Enviro Services Private Limited, Hyderabad.
II. Marine EIA/EMP- Consultant M/s Cholamandalm Risk Services Limited, Chennai.
III. Socio Economic survey report of surrounding villages within 10 Km from the project site-Consultant-Madras School of Social Works, Chennai
IV. CRZ Map demarcating the project site with foreshore facilities viz., cooling water intake and out fall, coal conveyor system of the proposed project in 1:4000 scale-consultant-Institute of Remote sensing, Anna University/ Chennai and CRZ map delineating CRZ zones in 7 km radius around the project site.
V. Chennai Testing Laboratoy Private Limited, Chennai is generated AAQ data

1.3 Identification of project

Lack of availability of sufficient electric power has always been one of the greatest deterrents to the economic growth of the State. To mitigate the gap between demand and supply, TANGEDCO has proposed to study the feasibility of establishing of 1x660 MW supercritical coal based ETPS expansion Thermal Power Plant, inside ETPS Complex, Ernavur village, Tiruvottiyur Taluk, Thiruvallur District.

The southern region is predominantly of hydel power generating stations. The potential from hydel plants is already exploited to the maximum. Further, the hydel generation which is being restricted only to the monsoon period, could not cater to the overall power requirement of the region and hence the capacity addition in thermal power sector has become necessary. In such a situation implementation of base load power plants using thermal power generation is the preferred alternative.

The actual growth in industrial, agricultural and domestic demand will establish that there is an appreciable shortfall in the installed capacity, demand and energy availability as on date.

This shortfall will continue even after the commissioning of the proposed power plants in various parts of the State and in the southern region. As Tamil Nadu State is the most preferred State for industrialization, the industrial demand for power will be ever increasing. Added to the industrial demand the agriculture need as well as domestic consumption coupled with the improved standard of living of the population will be on the rise. Further, the grid is large enough to accommodate this proposed 1x660 MW coal fired power plant.

Taking all these into consideration, establishment of the proposed ETPS Expansion Thermal power plant of 1x660 MW is justified in all aspects, since this will only meet a part of the projected power demand.

1.3.1 Project proponent

Tamil Nadu Electricity Board (TNEB) came into being on 1st July 1957 and has remained the energy provider and distributor all these years. during the period the Government has extended the electrical network to all the villages and towns throughout the state. During 2008 Government of Tamil Nadu has accorded in –principle for the re-organization of TNEB by the establishment of a holding company by the name TNEB Ltd and two subsidiary companies, namely TANTRANSCO and TANGEDCO with the stipulation that the aforementioned companies shall be fully owned by Government of Tamil Nadu.

- TANGEDCO is a 100% Government of Tamil Nadu owned company.
- TANGEDCO realizes its social obligation and is very much conscious of the importance of prevention of degradation of environment due to its various Thermal Stations.
- TANGEDCO's thermal power stations are being operated at high PLF and are being awarded productivity awards year after year.

To meet the ever-increasing energy demand in the coming years, proposed several TPP details of the same are given in **Table1.1.**

Table 1.1: Status of the thermal power plants proposed by TANGEDCO

	Capacity	**Estimated cost (Rs. in Crores)**	**Remarks**
Thermal Power Projects			
ENNORE SEZ TPP	2x660MW	7688	Expected commissioning schedule 2021-22
ETPS Replacement project	1x660MW	4800	Expected to get statutory clearences in 2019-20
NC TPP Stage III	1x800MW	5533	Expected commissioning schedule 2019-20
UPPUR TPP	2x800MW	12700	Expected commissioning schedule 2021-22
Udangudi TPP Stage I	2x660MW	9000	Expected commissioning schedule 2021-22

1.4 Brief description of the project

The ETPS Complex is in the Ernavur village, Tiruvottiyur Taluk in Thiruvallur District in the state of Tamil Nadu. The proposed power plant is to be located within the existing Ennore Thermal Power Station complex as expansion to the existing units of 2x60 MW & 3x110 MW decommissioned on 31.03.2017.

After the demarcation of project site under CRZ purview by Anna University, around 84 acres of land is clearly available for setting up this power plant. The proposed site is easily approachable by road and the nearest railway station is Kathivakkam. The nearest airport is at Chennai, which is about 30 km from the ETPS Station. The nearest seaport is Ennore Port, which is about 5 km from the site. The chronological order of various clearances obtained for the projects in the ETPS complex and the status are given in the **Table 1.2.**

Table 1.2: Details of the projects in the ETPS complex

Project & capacity	Status	Remarks
Ennore Power Station 450 MW (3x110 + 2x60 MW)	Commissioned during 1970-75	De-commissioned on 31.03.2017
ETPS Replacement project 1x660 MW	Proposed - TOR obtained 24.07.2014 and extension on 20.08.2016 - PH on 30.05.2017 - DCRZMA recommendation on 19.04.2017 - SCRZMA recommendation on 09.10.2017 - EAC meeting held on 26.10.2017 recommended to conduct studies like cumulative impacts, one season baseline data collection, etc	Additional studies suggested by EAC on 26.10.17 are completed the compliance report will be submitted
ETPS Expansion 1x660MW	Proposed - EC obtained for 1x600MW on 3.6.2009 - Amendment to EC for 1x660MW obtained on 24.1.2013 - EC validity extension for 1x660MW obtained on 18.9.2014 - CRZ clearance on 23.12.2008 - TOR obtained (fresh) 21.01.2019	EC valid till 2.6.2019 Project construction is partly completed (around 17%)

1.4.1 Nature, location and size of the project

The Ennore Thermal Power Station is located about 20 kms from Chennai city. The total land available inside the ETPS complex is about 237 acres out of which 84 Acres (southern side) is earmarked for the proposed ETPS expansion Project (1x660 MW). The balance area (northern side) is available for the proposed replacement plant. The proposed site is easily approachable by road and the nearest railway station is Kathivakkam. The nearest airport is at Chennai, which is about 26 km from the ETPS Station. The nearest sea port is Ennore Port, which is about 5 km from the site.

The existing (decommissioned) power plant within the ETPS compound is proposed to be dismantled and the land thus made available after dismantling will be utilized to develop 1x660 MW Supercritical ETPS replacement project. This site is located at a distance of about 70 meters from the Ennore backwaters, 575 meters from the Koratalıyar river and 815 meters from the sea.

1.5 Importance/need of the project

Presently TANGEDCO has four major coal based Thermal Power Station with a total capacity of 4320 MW and four gas based power plants with a total capacity of 516 MW. Tamil Nadu is facing an increasingly growing demand for electric power as a result of the rapid population growth, urbanization and industrialization in the state. currently the state depends on the central power sector and independent power producer for nearly 50% of its requirement. In view of acute shortage of power in the State and in order to bridge the demand-availability gap of power, TANGEDCO is exploring the possibility of establishing more thermal power projects. The government of Tamil Nadu has approved to establish the ETPS expansion Thermal Power Project with a capacity of 1 x 660 MW within the existing ETPS complex in Thiruvallur District.

1.6 Objective and scope of the study

The primary objective of the EIA studies is to internalise and integrate the environmental concerns / aspects, and mitigation measures into the project planning stages like basic design, detailed design, and construction and operation phases of the project. monitoring and feedback on Health, Safety and Environment (HSE) and training activities can be planned thoroughly and effectively with the help of these studies. To achieve the above objectives the following strategy is recommended.

1 EIA report is to be prepared with base line data collection and making use of preliminary design specifications/data of the proposed operations.
2 The findings and recommendations of the study are to be incorporated into the project planning, design, construction and operations of the project.

3 EIA report will cover one season baseline environmental data, as per TOR of MOEFCC, New Delhi. The scope includes collection of baseline data with respect to major environmental components, viz. air, noise, water, land, biological and socio-economic components along with the parameters of human interest and prediction and evaluation of environmental impacts to delineate Environmental Management Plan.

In all power projects, the plant activities must co-exist satisfactorily with its surrounding environment so as to reduce the environmental impact caused due to project activities. To control the adverse impacts, sound and safe environmental management plan has to be implemented by the proponents, which makes environmental protection as essential requirement along with power generation.

In order to assess the likely impacts arising out of the proposed project on the surrounding environment and recommending environmental safeguards to alleviating the likely negative impacts, TANGEDCO has engaged M/s Ramky Enviro Services Private Limited (RESPL) 100% Subsidery of M/s Ramky Enviro Engineers Limited as their environmental consultant. RESPL had carried out the Environmental Impact Assessment (EIA) studies for various environmental components which are likely to be affected and suggested Environmental Management plan.

1.6.1 Scope of EIA

The scope of study includes detailed characterization of existing status of environment in an area of 10 km from the project boundary. The envisaged scope of EIA is as follows:

- Assessment of present status of air, noise, water, land, biological and socio-economic components of environment.
- Identification and quantification of significant impacts of proposed operations on various components of environment.
- Evaluation of proposed pollution control facilities.
- Preparation of sound Environmental Management Plan (EMP) outlining control technologies to be adopted for mitigation of adverse impacts (if any)
- Delineation of the post-project environmental quality monitoring program to be followed.

Any developmental activity in general is expected to cause impacts on surrounding environment of the project site during its implementation and operation phases, which can be both positive and negative. The nature and intensity of impacts on different components of environment depend on the type of project activities and geographical conditions of the study area. The impacts of the project activities on environmental components can be quantified through EIA Studies within the impact zone of the project activities. The results of EIA Studies form the basis for the preparation of a viable EMP for mitigation of the impacts.

1.6.2 Study period

For preparation of EIA report for the proposed project, the data was collected during July to September 2018 in the study area. The micro climatic parameters were recorded using Automatic weather station for the study period. Wind speed, wind direction and relative humidity were recorded on hourly basis. minimum & maximum temperatures were also recorded during the study period.

1.6.3 Air environment

For the environmental impact studies, an area covering 10 km radial distance surrounding the proposed project site was identified as study area (Impact Zone). The topographical information of project site, study area and details about different activities related to the proposed project was collected. Different air pollution parameters like PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO and O_3 were identified as related to the project activities for representing baseline status of ambient air quality within the study area. Sampling locations were selected in the downwind, upwind, cross wind directions, critical locations of human habitations where combined impact of traffic, industrial operations and domestic operations are expected to be accumulated, nearby reserve forest etc. In order to attend the recent concerns on mercury pollution and radio activity due to thermal power stations. Coal being used by proposed unit has been analysed for mercury, radio activity and heavy metal.

Pre-calibrated Respirable Fine Dust Samplers have been used for monitoring air pollutants. Modelling of air quality predictions was carried out using the USEPA AERMOD.

1.6.4 Noise environment

Excessive noise levels cause adverse effects on human beings and associated environment including domestic animals, wild life, natural eco-system and structures. Hence noise survey is carried out at the proposed site and nearby villages. Noise levels (A-Weighted) were measured by using precision sound level meters. The principle of propagation of sound waves was used to estimate the noise levels at various locations due to the proposed project activities.

1.6.5 Water environment

Information on water resources in the study area was collected. The water resource in the study area mainly comprises of groundwater, surface water etc. The parameters of prime importance for water quality studies were selected under physical, chemical and biological groups and were analysed. Samples were collected at different locations in the study area.

1.6.6 Land environment

Soil samples were collected from the plant site, not only at its immediate vicinity but also in the surrounding villages within 10 km radial zone. Physico-chemical properties of the soils were determined. Information on land use pattern in the study area was also collected.

Information regarding existing cropping pattern, their types and yield of the crop was collected from various sources. Based on the attenuation factors for dust aerosols and air pollutants, green belt species have been identified.

1.6.7 Ecosystem

Information on eco-system within 10 km radius was studied and important flora species native to the area is enumerated. Relevant data was also collected from the state Forest department. A test check survey was also under taken to judge the correctness of the data collected.

1.6.8 Socio-economic environment

A field survey was conducted within 10 km radius of the plant and the surrounding impact zone. The parameters selected under socio-economic component were demographic structure of the study area, provision of basic amenities, industries likely to come up in the study area, welfare facilities proposed by the project proponent, safety training and management, community and occupational health hazards. Relevant information was collected from selected villages and analysed.

The details of the Site Features of the Proposed Project are given in **Table: 1.3.**

Table 1.3: Site features of the proposed project

<table>
<tr><th>Particulars</th><th>Details</th></tr>
<tr><td>Location</td><td>ETPS Expansion 1x 660 MW Thermal Power Project at Ernavur (V), Tiruvottiyur (T), Thiruvallur (D)
(Within the existing ETPS complex)</td></tr>
<tr><td>Ground elevation</td><td>The ground elevation of the site is 9.5 m above MSL.</td></tr>
<tr><td>Available Land</td><td>84 Acres</td></tr>
<tr><td>Topo sheet No.</td><td>66 C/8 (D4407)</td></tr>
<tr><td>Latitude & Longitude</td><td>
<table>
<tr><th>Code</th><th>Latitude</th><th>Longitude</th></tr>
<tr><td>A</td><td>13° 11' 51.4" N</td><td>80° 18' 44.4" E</td></tr>
<tr><td>B</td><td>13° 11' 35.3" N</td><td>80° 18' 39.8" E</td></tr>
<tr><td>C</td><td>13° 11' 37.9" N</td><td>80° 18' 29.1" E</td></tr>
<tr><td>D</td><td>13° 11' 30.1" N</td><td>80° 18' 24.9" E</td></tr>
<tr><td>E</td><td>13° 11' 35.1" N</td><td>80° 18' 14.3" E</td></tr>
<tr><td>F</td><td>13° 12' 00.8" N</td><td>80° 18' 25.0" E</td></tr>
<tr><td>G</td><td>13° 12' 04.5" N</td><td>80° 18' 27.7" E</td></tr>
<tr><td>H</td><td>13° 12' 04.1" N</td><td>80° 18' 28.8" E</td></tr>
<tr><td>I</td><td>13° 11' 58.3" N</td><td>80° 18' 27.1" E</td></tr>
<tr><td>J</td><td>13° 11' 57.3" N</td><td>80° 18' 30.9" E</td></tr>
<tr><td>K</td><td>13° 11' 59.1" N</td><td>80° 18' 31.7" E</td></tr>
<tr><td>L</td><td>13° 11' 58.2" N</td><td>80° 18' 35.0" E</td></tr>
</table>
</td></tr>
</table>

	M	13° 11' 56.5" N	80° 18' 34.6" E
	N	13° 11' 56.1" N	80° 18' 36.3" E
	O	13° 11' 58.0" N	80° 18' 36.9" E
	P	13° 11' 56.5" N	80° 18' 42.1" E
	Q	13° 11' 52.4" N	80° 18' 40.8" E
Nearest City	Chennai at 20 km (South)		
Distance for CRZ	>500m (Away from CRZ Regulations 1991)		
Seismicity Zone	Earth Quake Zone-III as defined in IS: 1893-2002		
Nearest Villages	Ernavur 1.2km(South)		
Nearest Railway Station	Kathivakkam 2 km(East)		
Nearest Highway	Manali Highway 600m (South) Ennore Express Highway 200 m (East)		
Nearest Air Port	Chennai (Meenambakkam) at 26 km South-West direction		
Nearest Lake/River	Koratliyar River, West 575 m		
Nearest Sea	Bay of Bengal, East 815 m Ennore backwaters 70 m		
Nearest Sea Port	Ennore Port 5 km (North East)		
Project cost (Estimated)	Rs 5421.38 Crores		

Chapter-2

Project Description

Chapter 2

Project Description

2.1 Type of project

The proposed Ennore Thermal Power Station (ETPS) expansion supercritical TPP capacity of 1X660 MW at Ernavur (V), Tiruvottiyur (T), Thiruvallur (D) is within the ETPS complex. The supercritical technology will enhance operational affiance over sub-critical technology, which is the most prevalent and commonly used for thermal power generation in India.

The supercritical technology is a superior technology having advantages like controlled greenhouse emissions, environmental friendly/ CDM benefits, operational flexibility to grid fluctuations, shorter start-up times, reduced coal consumption, savings on coal cost, reduced O&M cost and improved ash management.

The existing ETPS was established during 1970-75 in an area of about 237 acres having an installed station capacity of 450 MW (3x110 MW + 2x60 MW) running with the de-rated capacity of 340 MW. These units have served for more than 40 years and during the last leg of their life span, the units were operating at a very low PLF and hence it was prudent to replace these aged units with higher capacity and efficient units adopting modern technology. TANGEDCO has proposed to install “1x660 MW supercritical ETPS expansion project” in the vacant land in an area inside the existing ETPS and remaining land (decommissioned plant area) was allotted for proposed replacement project. After the demarcation of project site under CRZ purview by Anna University, the remaining land was allotted for both 1x660 MW supercritical ETPS replacement project and 1x660 MW Supercritical ETPS Expansion Project.

2.2 Need of the project

Lack of availability of sufficient electric power has always been one of the greatest deterrents to the economic growth of the ~~s~~tate. To mitigate the gap between demand and supply, TANGEDCO has proposed to establish 1x660 MW supercritical coal based ETPS expansion thermal power plant, inside ETPS complex. The southern region predominantly consists of hydel power generating stations. The potential from hydel plants is already exploited to the maximum. Further, the hydel generation which is being restricted only to the monsoon period, could not cater to the overall power requirement of the region and hence the capacity addition in thermal power sector has become necessary. In such a situation implementation of base load power plants using thermal power generation is the preferred alternative. The actual growth in industrial, agricultural and domestic demand will establish that there is an appreciable shortfall

in the installed capacity, demand and energy availability as on date. This shortfall will continue even after the commissioning of the proposed power plants in various parts of the state and in the southern region. As Tamil Nadu state is the most preferred state for industrialization, the industrial demand for power will be ever increasing. Added to this, the agricultural needs and the domestic consumption due to improved standard of living will also be on the rise. Further, the grid is large enough to accommodate this proposed 1x660 MW coal fired power plant.

Taking all these into consideration, establishment of the proposed ETPS Expansion 1x660 MW TPP is justified in all aspects, since this will only meet a part of the projected power demand.

2.3 Project location

The ETPS expansion is in Ernavur (V), Tiruvottiyur (T), Thiruvallur (D), Tamil Nadu. The proposed power plant is to be located within the existing ETPS complex as expansion to the existing (decommissioned) units (2x60 MW & 3x110 MW).

The nearest airport is at Chennai, which is about 26 km from the ETPS complex. The nearest sea port is Ennore Port, which is about 5 km from the site.

The location map of the project site is given in **Figure 2.1**; the 10 km radius base map is given as **Figure 2.2** and 10km radius Google map of the project site is shown in **Figure 2.3**.

2.4 Plant layout

The plant layout has been designed by considering various aspects like operational convenience and cost economics. The power plant equipment are suitably located at appropriate places such that operation of respective equipment is carried without any hindrance to other nearby activities. Plant layout showing the details of location of equipment proposed is shown as **Figure 2.4.** The photographs of the site showing present status of construction are given in **Figure 2.5**. The map showing geo ordinates of plant site and ash pond on satellite imagery and topo sheet are given in **Figure 2.6**.and **2.7**

Figure 2.1: Map showing general location of the project

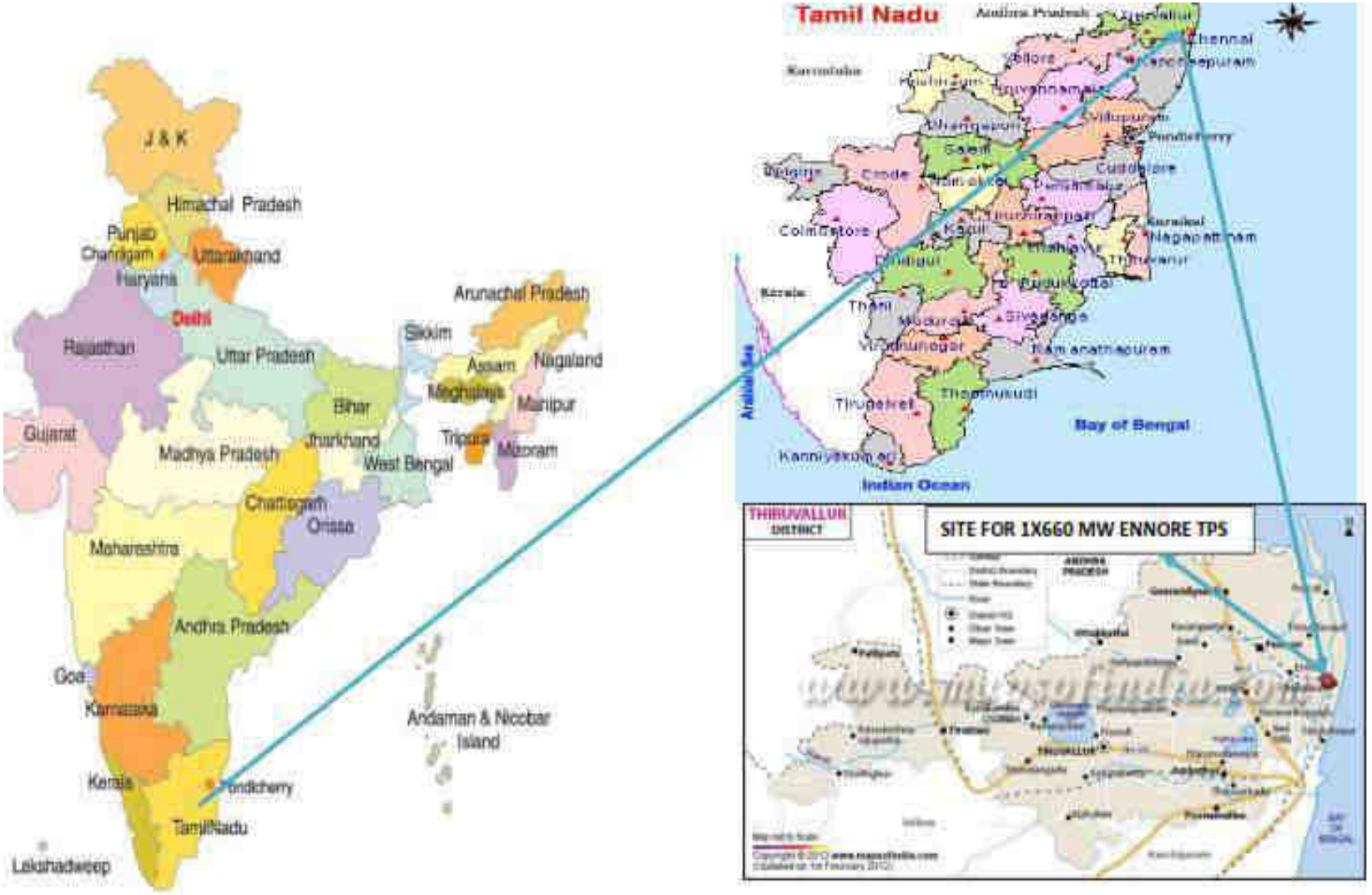


Figure 2.2: Topographical map of the project site (10 Km radius)

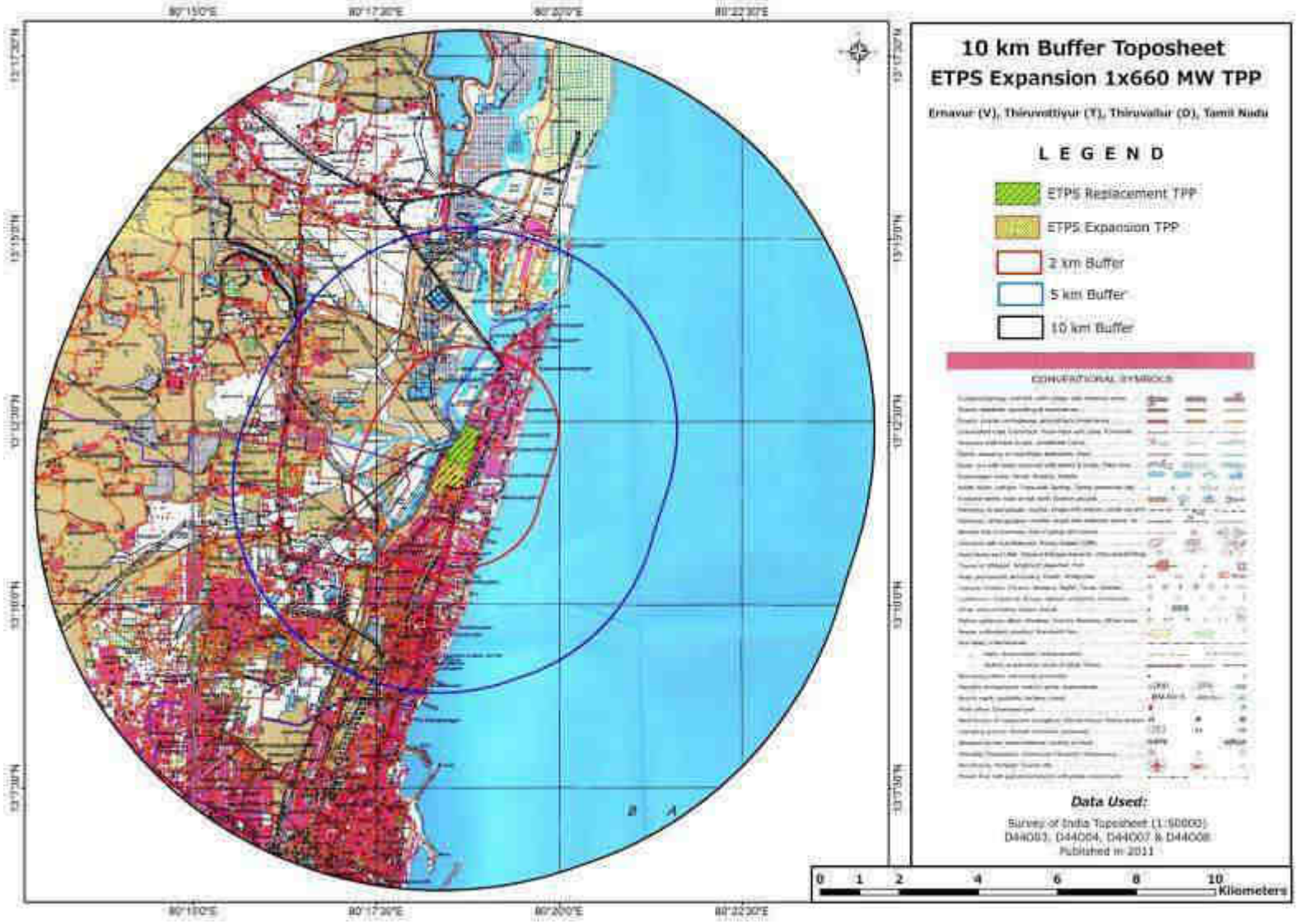


Figure 2.3: Google map of the project site (10 Km radius)

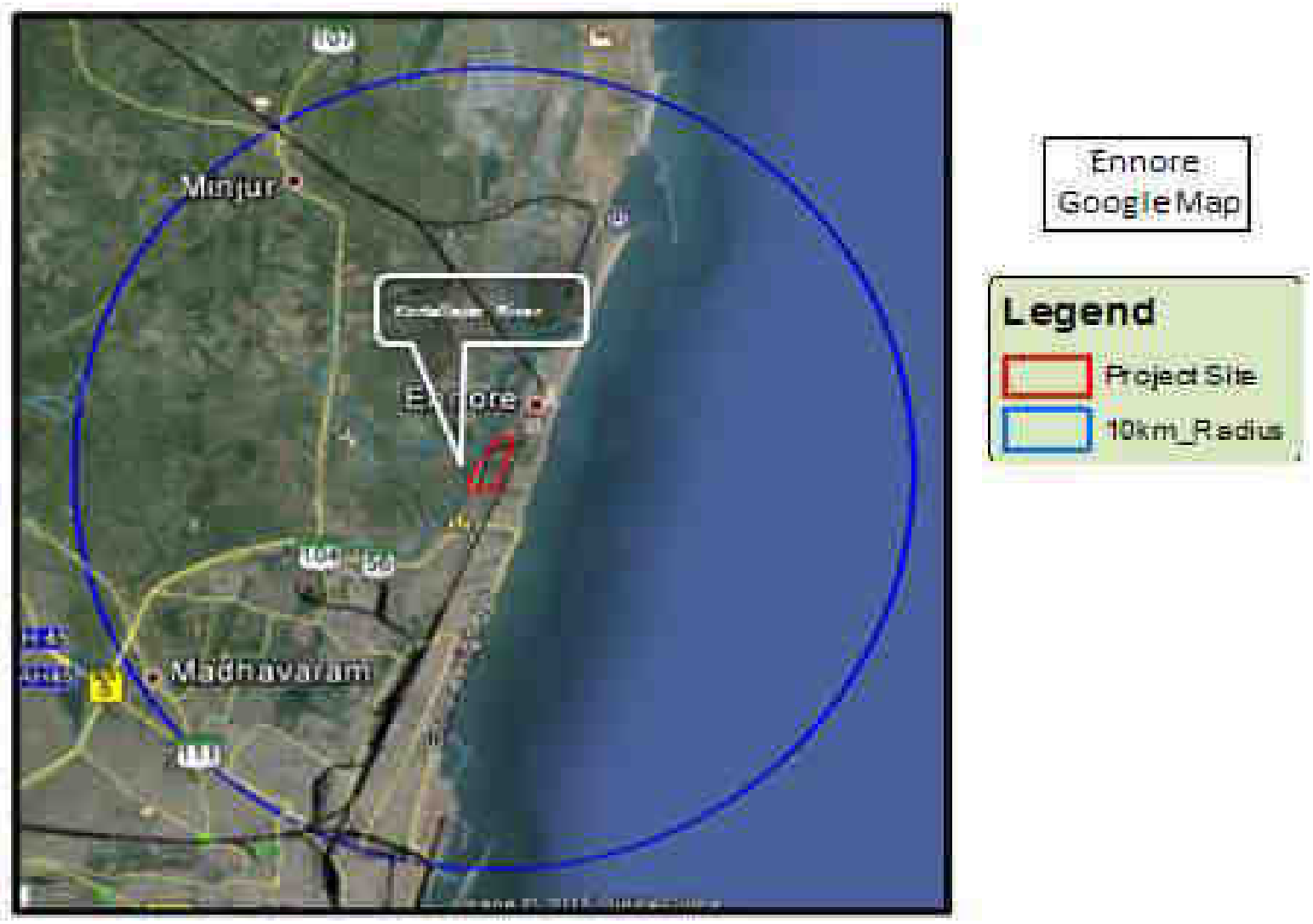


Figure 2.4: Proposed project layout

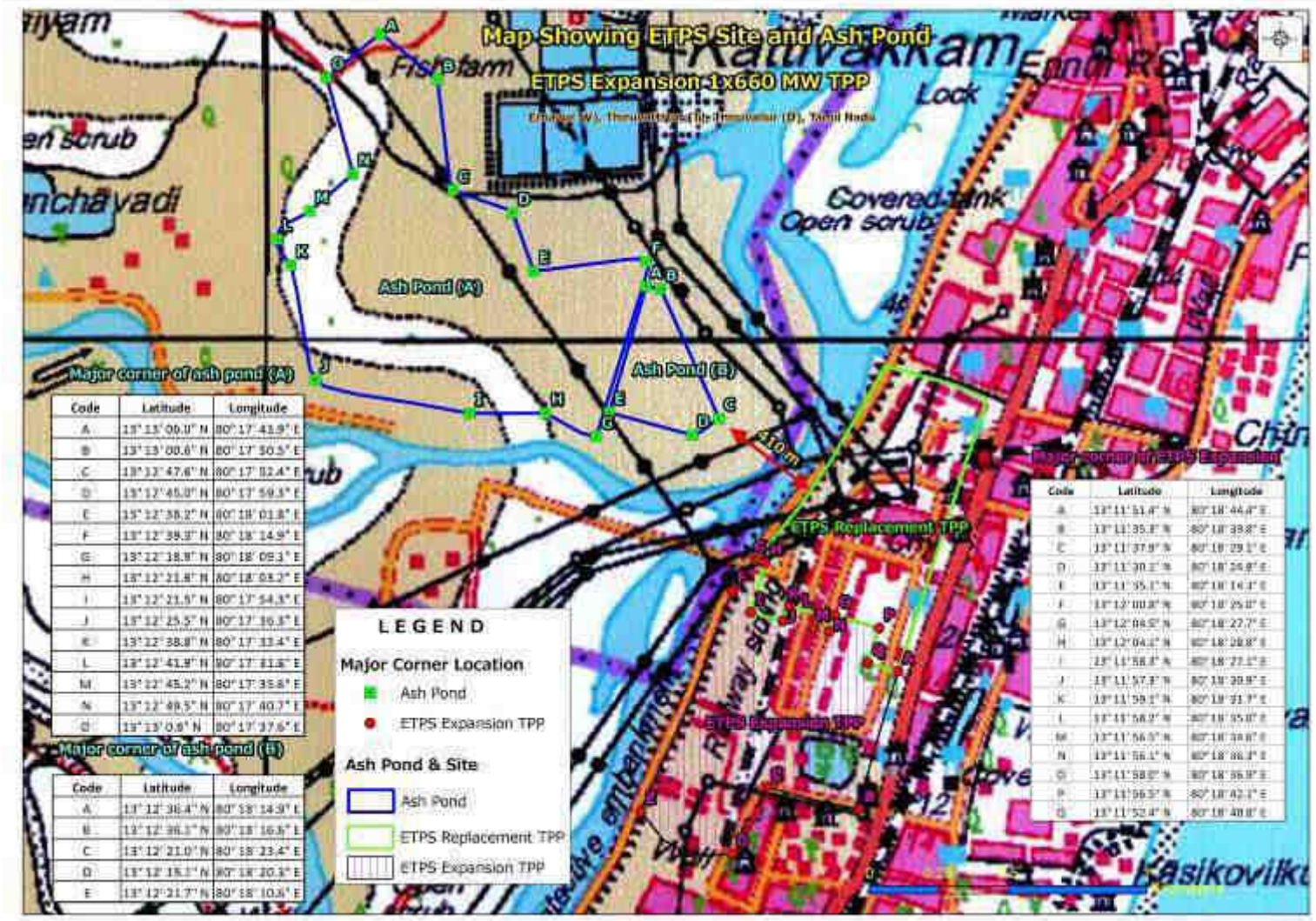
Figure 2.5: Photographs of the site showing present status of construction

Figure.2.6: Map showing geo coordinates of plant site and ash pond (Satellite map)

Code	Latitude	Longitude
A	13°13'09.0" N	80°17'41.9" E
B	13°13'00.6" N	80°17'50.5" E
C	13°12'47.6" N	80°17'52.4" E
D	13°12'45.0" N	80°17'59.3" E
E	13°12'38.2" N	80°18'01.8" E
F	13°12'39.3" N	80°18'14.9" E
G	13°12'18.8" N	80°18'09.1" E
H	13°12'21.8" N	80°18'03.2" E
I	13°12'21.5" N	80°17'54.3" E
J	13°12'25.5" N	80°17'36.3" E
K	13°12'38.8" N	80°17'33.4" E
L	13°12'41.9" N	80°17'31.8" E
M	13°12'45.2" N	80°17'35.8" E
N	13°12'49.5" N	80°17'40.7" E
O	13°13'0.9" N	80°17'37.6" E

Code	Latitude	Longitude
A	13°12'36.4" N	80°18'14.9" E
B	13°12'36.1" N	80°18'16.3" E
C	13°12'21.0" N	80°18'23.4" E
D	13°12'15.1" N	80°18'20.3" E
E	13°12'21.7" N	80°18'10.6" E

Figure.2.7: Map showing geo coordinates of plant site and ash pond (Topo map)



Code	Latitude	Longitude
A	13°13'00.0" N	80°17'43.9" E
B	13°13'00.6" N	80°17'50.5" E
C	13°13'47.6" N	80°17'52.4" E
D	13°12'45.0" N	80°17'59.3" E
E	13°12'38.2" N	80°18'01.8" E
F	13°12'39.3" N	80°18'14.9" E
G	13°12'18.8" N	80°18'09.1" E
H	13°12'21.8" N	80°18'03.2" E
I	13°12'21.5" N	80°17'54.3" E
J	13°12'25.5" N	80°17'39.3" E
K	13°12'38.8" N	80°17'33.4" E
L	13°12'41.9" N	80°17'31.8" E
M	13°12'45.2" N	80°17'35.8" E
N	13°12'49.5" N	80°17'40.7" E
O	13°13'0.8" N	80°17'37.6" E

Code	Latitude	Longitude
A	13°12'36.4" N	80°18'14.9" E
B	13°12'36.1" N	80°18'16.3" E
C	13°12'21.0" N	80°18'23.4" E
D	13°12'19.1" N	80°18'20.3" E
E	13°12'21.7" N	80°18'10.3" E

2.5 Size and magnitude of operation

TANGEDCO intends to construct a supercritical coal fired power project of capacity 1X660 MW ETPS expansion project with CDM intent. Adopting supercritical technology results in enhanced plant efficiency resulting in reduced coal consumption. The proposed project specific CO_2 emissions per MW of generated electricity of a supercritical coal fired power plant are lower than the emissions of the existing sub critical power plants. The associated activities proposed are auxiliary plants like water de-mineralization plant/RO plant, steam boiler, cooling water system, fuel storage systems, wastewater treatment plant, ash pond, etc. to support the process operations.

2.5.1 Extent of land requirement

The total land available inside the ETPS complex is about 237 acres out of which 84 acres (southern side) is earmarked for the proposed ETPS expansion project .

It shall be noted that the land available within ETPS is sufficient to accommodate this power plant of 1x660MW capacity unit, with common coal stock yard and common cooling water intake system for both proposed units (i.e.) ETPS expansion project and ETPS replacement project (1x660 MW).

For all other facilities, vacant land can be utilized. The fly ash generated from the proposed power plant would be collected in dry form and fully utilized and disposed through e-auction. The bottom ash would be disposed off in slurry form to the existing ash Pond. Existing housing colony will be renovated to accommodate the essential O & M staff of this proposed power plant.

The land required for putting up the proposed plant is summarized in **Table 2.1.**

Table 2.1: Land requirement details

Description	Area(Acres)
(A) Inside power plant boundary	
Main power block & auxiliaries	24
Switchyard & Transformers yard	2
Water storage & facilities, cooling tower, etc.	18
Coal storage & handling facilities	12
Greenbelt area	14
Miscellaneous	14
Ash dump area & Staff colony	Existing
Sub Total	**84**
Corridor for water pipeline	3
Corridor for pipe conveyor	3
Sub Total	6
Grand Total	**90**
(B) Facilities outside the plant boundary	
Note: 1) In addition to 14 acres greenbelt proposed, additional 14 acres of land in the purview of CRZ area will be developed as greenbelt to meet 33% of the total land area as greenbelt. 2) As per CEA guidelines the land required for similar capacity power plant (Coastal station based on imported coal with conveyor and NDCT cooling towers) is about 135 acers which are well within the limits in terms of area utilization.	

2.6 Plant water requirement

The water is used in different process of the thermal power plant. The main uses are cooling tower and auxiliary cooling water systems, water for bearing cooling and other auxiliary systems through closed loop circulation, boiler makeup, potable water for plant, services water for plant, fire fighting, ash handling, etc. Consumptive water (sea water) requirement will be made available at the forebay through a channel connected to intake well through underground pipeline. Stop log gate and coarse screen shall be provided at inlet and coarse screen at outlet of channel respectively. The total requirement of water would be drawn from Bay of Bengal at a distance of 650 m from the shoreline. Intake pipeline is being laid for with drawl of water from intake well to draw the quantity of 25000m^3/h for both ETPS expansion TTP and ETPS replacement TTP. The entire pipeline is proposed to be buried in the sea bed.

The following **Table 2.2** and **Table 2.3** are showing potable water and clarified water requirement and total sea water requirement respectively. The wastewater generation details area given in **Table 2.4**. Water balance of one time requirement is shown in **Figure 2.8** and daily requirement of water is showing in **Figure 2.9.**

Water required for construction purposes (200m^3/day) will be obtained from CMWSSB and stored in an underground water tank. From underground tank water will be pumped into overhead tank for further distribution by gravity to various points.

Table 2.2: Potable water (for sweet water) and clarified water requirement

Details	Section	Water required	
		m^3/h	m^3/d
RO II / DM plant permeate	Makeup water power cycle	33	792
	Chemical feed	2	48
	Hydrogen generator	2	48
	DM water cooling makeup	3	72
	Condensate polishing unit regeneration	7	168
	DM regeneration	3	72
	Sub Total	50	1200
RO II concentrate water	Hopper quenching	2	48
	Dome valve cooling	1	24
	Coal handling plant dry fogging	3	72
	Dust suppression	16	384
	Sub Total	22	528
	Total	**72**	**1728**
RO I treated water	RO II Feed	72	1728
	FGD makeup	120	2880
	Ash handling Seal water	140	3360
	Service water	30	720
	Heat ventilation & Air conditioning	25	600
	Domestic / portable	10	240
	Total	**397**	**9528**

Table 2.3: Sea water requirement

S. No.	Description	Estimated Quantity		Remarks
		m^3/h	m^3	
1	Natural draft cooling tower system		79000	Source of water is Bay of Bengal; The intake point is 600 m from shore line.
2	Ash water system requirement		22490	
	One Time Requirement – Total		**101490**	
			m^3/day	
3	Cooling water make up requirement	5700	136800	
4	Sea water requirement for RO	1413	33912	
	Daily Requirement - Total	**7113**	**170712**	
Concentration Ratio 1:1.3 COC				

Table 2.4: Wastewater generation details

Details	Wastewater		Remarks
	m^3/h	m^3/d	
Cooling tower blow down	4114	98736	• Wastewater from CPU and DM generation will be neutralised and sent to guard pond. • Clarifier & RO I reject sent to guard pond • CW blow down and guard pond water meeting sea discharge standards, sent to sea through dedicated marine pipeline
Clarifier reject	88	2112	
RO I condensate	928	22272	
Condensate polishing unit regeneration	7	168	
DM regeneration	3	72	
Total	**5140**	**123360**	
Domestic / portable	9	216	Domestic wastewater will be treated in STP and treated water used for greenbelt
Total	**9**	**216**	

Fig: 2.8: Schematic diagram of the water balance (onetime requirement of sea water) – m^3

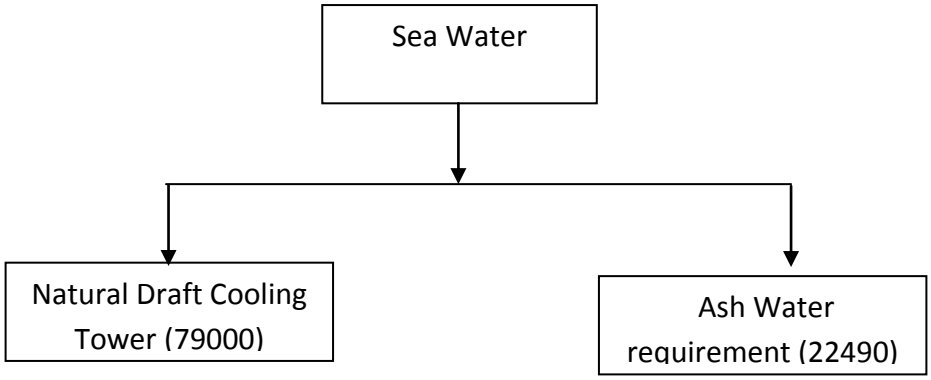
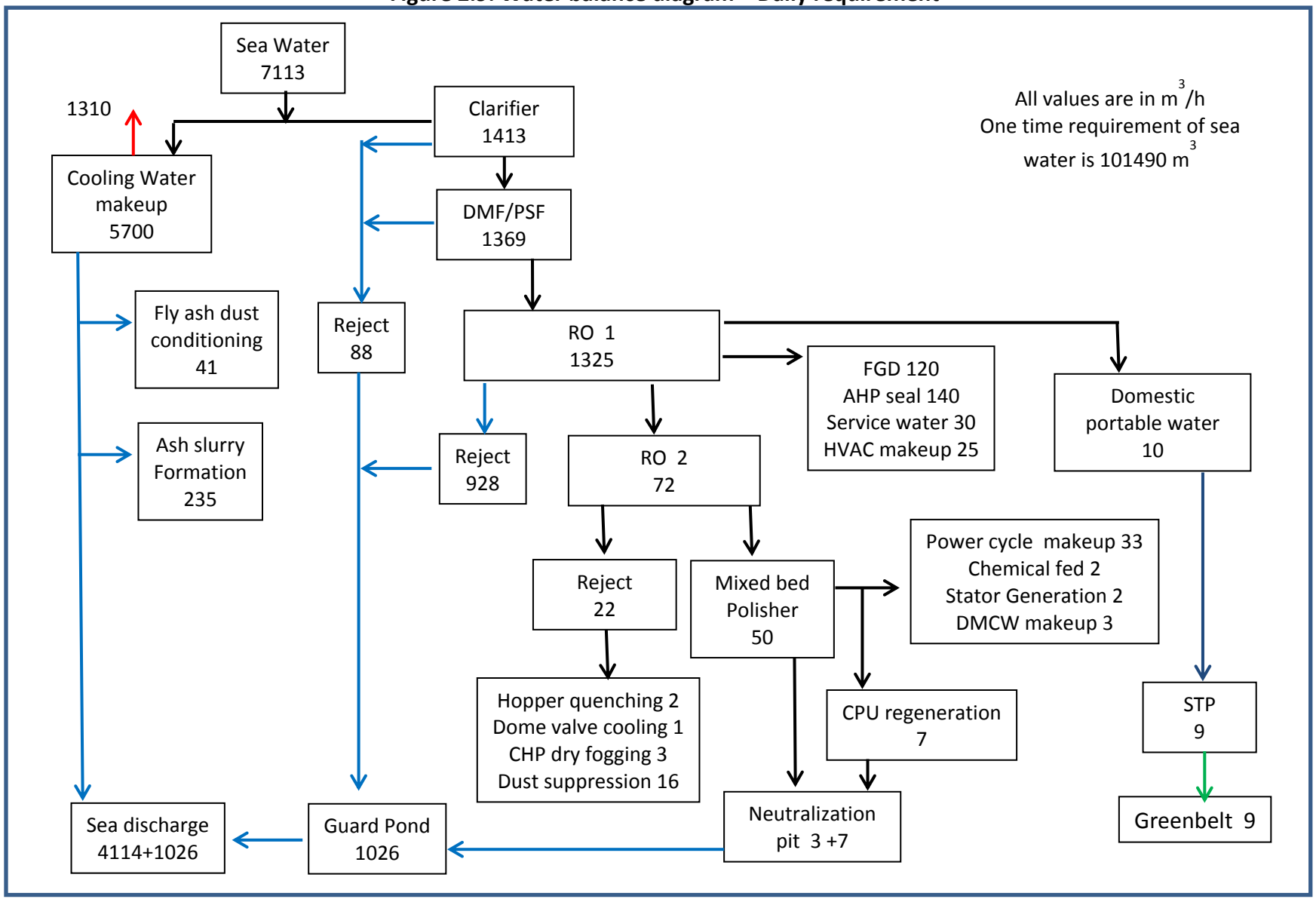


Figure 2.9: Water balance diagram – Daily requirement



2.6.1 Cooling water blow down and makeup water requirement

The present environmental regulations stipulate that the thermal power projects using sea water should meet discharge standards of maximum temperature not more than 5^{o} C wrt to ambient seawater at release point. Considering that project is near to the sea, sea water could be drawn directly from the sea for condenser cooling.

Make-up water requirement of CW system is the sum of drift and evaporation losses from the cooling tower and blow down from the CW system. Part of the blow down water will be used for fly ash dust conditioning, coal handling plant dust suppression and ash slurry formation and the balance will be discharged into the sea.

2.6.2 Pretreatment system

The water will be pumped to clariflocculator, necessary chemicals (ferric chloride / lime / polyelectrolyte will be added in the pretreatment plant to accelerate coagulation process. The dosing system shall consist of dosing tanks, pumps with necessary piping arrangements. Sludge from the clarifiers will be taken into reject sump / guard pond through sludge disposal pumps. The clarified water will be treated in dual media filter followed by pressure sand filter.

2.6.3 Permeate water systems (RO plants)

The clarified water after passing through dual media filter and pressure sand filter is fed to RO I. The permeate water is further distributed to various areas (RO II, service water, HVAC makeup, AHP seal, FGD, domestic needs, etc.) of the plant through dedicated pump sets. The concentrate from the RO I will be sent to guard pond. Part of RO I permeate is fed to RO II system for further treatment and permeate from RO II is fed to mixed bed polisher. This treated water will be used for power cycle makeup, chemical fed, stator cooling, etc. The wastewater generated in mixed bed regeneration and condensate polishing unit will be sent to neutralization unit and then to guard pond.

2.6.4 Chemical feed systems

The chemical feed system is provided for adding neutralizing amines (hydrazine & ammonia) in the condensate pump discharge / boiler feed suction line to maintain the chemical concentration in the water / steam cycle within permissible limits for trouble free operation of the plant along with oxygen dosing arrangement to control water chemistry regime.

2.6.5 Condenser cooling water system

Closed cycle condenser cooling is envisaged with natural draught cooling tower (NDCT). Makeup water will be pumped to the circulating water sump from there is pumped to condenser and will discharge back to NDCT having cooling range of 9°C and maintaining a cycle of concentration of 1.3. The recooled water from cooling tower will be channeled to cooling water sump. Suitable arrangement for adding NaOCl to curb organic growth will be taken.

2.6.6 Bearing cooling water system

Demineralized water in a closed cycle is envisaged for all auxiliary equipment cooling of the power plant. This will be recooled by water, circulating on the secondary side of the plate head exchangers.

2.6.7 Mixed bed (MB) unit

The final polishing of DM water will be done in MB unit. The MB unit will be designed to limit the silica less than 0.02 ppm as SiO_2 and conductivity will be restricted to 0.1micro Siemens/cm at $25^{o}C$.

2.6.8 Fire protection system

For protection against fire, all yard equipment and plant equipment will be protected by a combination of hydrant system, automatic sprinkler spray system (emulsifier system), fixed foam system for oil handling areas, automatic high velocity and medium velocity sprinkler spray system, auto modular inert gas based system for control rooms apart from portable and mobile fire extinguishers located at strategic areas of plant buildings and adequate passive fire protection measures. The systems will be designed as per the recommendations of NFPA or approved equivalents in accordance with the Tariff Advisory Committee of the Insurance Association of India stipulations.

a. In view of vulnerability to fire and its importance in the running of the power station, effective measures will be taken to tackle fire in the susceptible areas such as cable galleries, fuel oil handling areas, coal handling plant areas including transfer points, crusher houses and tunnels, etc.

b. For containment of fire and preventing it from spreading in cable galleries, unit wise fire barriers with self-closing fire doors will be provided. In addition, all cable entries / openings in the cable galleries, tunnels, floors will be sealed with non-inflammable / fire resistant sealing materials to prevent fire propagation for at least three (3) hour. Fire protection cable coating compound over cables at switchgear entry points, power station

building entry points and trays shall be provided to prevent damage from fire for at least thirty (30) minutes.

Adequate separating distances will be maintained between different process blocks and hazardous equipment. To prevent fire from spreading through ventilation & air conditioning ducts, dampers with auto closing arrangements will be provided at appropriate locations. FRLS power and control cables will be used.

Fire water pumps will be installed in the filtered water pump house. In the filtered water storage tank water will be stored as dedicated dead storage for meeting firewater requirement in exigencies.

2.7 Coal requirement

Total coal requirement is 2.0 MTPA (imported coal) based on 85% PLF. TANGEDCO has signed an MOU with MMTC on 23.07.2012 for supply of imported coal over 2.0 MTPA. The coal will be brought to Ennore port by ship and further it is transported by belt conveyors up to crusher plant. The crushed coal will brought by pipe conveyor to the project site.

However the plant will be designed for operation with worst case scenario (50:50 Imported and domestic coal combination). Details of the coal requirements of the proposed project considering the calorific values of imported and domestic coal is given in **Table 2.5** and coal quantities and characteristics under various options are given in **Table 2.6**.

Table 2.5: Details of coal & characteristics

S.No	Particulars	Details	Remarks
1	Annual generation at 100% PLF	8760 hr (365days)	**Imported:** MOU (Lr. Dt 24/07/21012) has been signed with MMTC, New Delhi for supply of imported coal
2	Annual generation at 85% PLF	7440 hr (310 days)	
3	Plant heat rate (approx.)	2317 Kcal/ Kwh	
4	Calorific value (imported coal)	5805 Kcal/kg	
5	Ash content (imported coal)	6.62 %	
6	Sulphur content (imported coal)	0.53%	

Table 2.6: Details of coal and stack emissions

Details	units	Imported 100%
Coal consumption	TPA	1.96
Coal consumption	TPH	263.43
Ash content	%	6.62
Ash content	TPH	17.44
Ash content	TPD	419
Sulphur content	%	0.53
Sulphur dioxide	TPH	2.79
Particulate matter with ESP	g/s	3875
Particulate matter (with ESP)	g/s	0.78
Particulate matter (outlet STD)	g/s	18.80
Sulphur dioxide	g/s	776
Sulphur dioxide (with FGD)	g/s	39
Sulphur dioxide (outlet STD)	g/s	63
Nitrogen dioxide (outlet STD)	g/s	63
ESP efficiency 99.98% FGD efficiency 95% Outlet standards as per MOEFCC Notification dated 07.12.2015 Particulate matter 30 mg/Nm^3, Sulphur dioxide 100 mg/Nm^3, Oxides of Nitrogen 100 mg/Nm^3,		

2.7.1 Coal transport

For the proposed ETPS expansion power plant imported coal is going to be used. The Imported coal will be brought to Ennore port by ship and from port to crusher site by belt conveyor and from crusher to plant site through pipe conveyor. The conveyors are planned to handle coal to the plant from Ennore port in Coal Berth III to the plant boundary through the conveyors (2x1000) TPH for the ETPS expansion project. The above conveyors are having spare capacity of 10000 TPD to accommodate the requirement for the ETPS replacement project also. Coal movement by Pipe conveyor for ETPS expansion and ETPS replacement projects would be considered for transporting about 17000 Tons of coal daily directly from Ennore port to power plant for one shift operation of the conveyors.

2.7.2 Coal handling plant

There is no separate external coal handling system for this project as the crushed coal from the North Chennai Thermal Power Station (NCTPS) stockyard will be transported to the ETPS through Pipe conveyors directly which is at a distance of 3 km. Crushed coal will be fed through the pipe conveyors of capacity 2x1000 TPH up to the Junction tower JNT- 1. From the junction tower a provision will be made to send the coal directly to the bunkers or to the stock yard. The

coal handling plant (CHP) will be designed to operate throughout the year. It is proposed to make two different stock piles of coal as received from NCTPS through use of tripper conveyor and at the same time reclaim two types of coal by use of rotary discharge machines. The mixing of two types of coal will be carried out at ETPS premises (in plant coal handling system) by reclaiming through rotary discharge machines on to tunnel conveyor (one working and one standby) from two different stock piles.

Capacity of the internal coal handling plant will be 2x 1000 TPH for one shift operation based on the worst condition of coal. The coal stock piles shall have shed over it to ensure that dry coal is available during monsoon. The shed will have water sprinkler system as well as fire protection provision to cover entire area within the shed. The coal stockpiles capacity will be for 7 days requirement.

At present the coal from NCTPS yard is transported through rail wagons to ETPS complex. It is now proposed to transport the coal through a set of belt pipe conveyors thereby eliminating spillage of coal, dependency of railways and ensuring pollution free atmosphere.

The typical analysis of the coal is given as **Table 2.7.**

Table 2.7: Typical coal analysis

S. No	Parameters	Foreign Coal	Remarks
1	Moisture	16.50	Proximate Analysis
2	Ash Content	6.62	
3	Volatile matter	36.45	
4	Fixed Carbon	40.43	
	Total	**100.00**	
1	Carbon	60.12	Ultimate Analysis
2	Hydrogen	4.38	
3	Nitrogen	1.48	
4	Sulphur	0.53	
5	Oxygen	10.37	
6	Moisture	16.50	
7	Ash	6.62	
	Total	**100.00**	
8	Gross Calorific Value	5805 Kcal/kg	
Source: Detailed project report – March 2016			

2.7.3 Switchyard & power evacuation

Since the proposed project is in coastal area, an indoor gas insulated switchyard (GIS) type (either 400 KV or 765 KV) is proposed in order to avoid possible corrosion problems. The Sub-

station to the generator transformer and the station transformer will be connected through gas insulated bus bars.

It is proposed to evacuate the power generated from the proposed 1x660 MW power plant through 400 kV lines. The power evacuation lines would be double circuit 400kV lines which will act as Line in and Line out circuit. This will be connected to the existing 400 kV/765 pooling station proposed to be formed at a distance of about 2 km near the proposed power plant site at ETPS.

The power evacuation lines would be through 400KV system (Type 400KV gas insulated switchgear) connected to the 400KV SS (Sub-Station) available in and around the project site:

I. Sunguvarchattram
II. Alamathy
III. North Chennai TPS Stage-II
IV. Thiruvalam
V. Vallur TPS
VI. Sriperumpudur

2.7.4 Power requirement (Construction period)

The construction power requirement shall be met from the 33/11KV substation from the nearby ETPS expansion project. Temporary power supply for construction supply will be made available at three different locations. These locations are the power house, external coal handling plant and at the Intake sea water system area.

2.7.5 Manpower

The manpower required for the project will be sourced from the nearby neighboring areas to the maximum extent in case of non-availability of skilled manpower; persons from other districts will be taken. The details of the manpower required during construction and operation are given **Table 2.8**

Table 2.8: Details of the manpower

S.No.	Phase	Permanent	Contract/ Temporary	Total
1	Construction	100	2000	2100
2	Operation & maintenance	330	220	550
Source DPR – 0.5 persons/MW				

2.7.6 Raw material (construction)

Construction materials (Stone aggregate, sand, bricks, cement & steel etc.) are available within a reasonable distance from the site.

2.8 Technology and process description

India has quite a few 500 MW units in successful operation from eighties onwards. Higher size units like 660 MW units, have started functioning in recent years. Now entrepreneurs have proposed to manufacture large unit size of 800 MW to 1000MW as the next size in the country with super critical technology to increase the pace the programme of capacity addition.

Super-critical conditions occur when the boiler pressure increases above the critical pressure of 221.2 bar. Above this point two phase mixtures of water and steam cease to exist because latent heat is zero, and are replaced by a single supercritical fluid. This eliminates the need for water / steam separation in drums during operation and allows a simpler separator to be employed during start-up conditions. Water and steam generated in the furnace water walls passes through only once and hence called once-through system. Adoption of once through boiler technology has advantage of operational flexibility to respond quickly to load changes and grid fluctuations, siding pressure operation and shorter start-up times. The drive for enhancing the efficiency of generating plants in an environmentally friendly manner has been realized mainly through advancing the steam conditions, i.e. increasing pressure and temperature. Main focus about super critical boiler is on minimizing CO_2 emission originating from the fossil fired plants. CO_2 increase is linked to Global warming. Hence it offers advantage of "Burn less fuel for the same output" thus economical use of energy resources and low emission.

Steam generators/ boiler, steam turbine generators, coal handling plant, ESP, FGD, chimney etc. are the main equipment, the detailed description of the same are given below.

2.8.1 Steam generator/ boiler & its auxiliaries

The supercritical plant technology is being adopted by number of independent power producers & utilities in India with 660 MW and 800 MW unit sizes. The main plant equipment will comply with the requirements including the turbine heat rate as specified in the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 issued vide notification dated 20.08.2010. The steam generator will be of supercritical technology designed for firing coal by weight as primary fuel, balanced draft furnace suitable for semi-outdoor installation. Steam generator will be designed to meet the Indian Boiler Regulation (IBR) requirement. Wherever IBR is not specific, ASME or equivalent reputed international code will be used.

Steam and water system will essentially comprise of steam separator, evaporator, down comers, water walls, super heater, reheater, de-super heater, economizer, valves, fittings, piping, insulation, supporting hangers, instrumentation etc. The furnace will be designed to withstand pressure regimes without permanent deformations and will be made of gas tight welded membrane walls, with required openings for wall blowers, observation ports, access doors and instruments. The furnace will have bottom hopper with stainless steel seal plates suitable for connection to an ash hopper. A suitable sealing arrangement (Seal Trough) shall be provided for connecting to Boiler and BAH. Dry bottom ash hopper with scrapper, clinker grinder for connecting to sea water mixing and wet ash disposal to the existing pond

The water / steam separators will be arranged at the evaporator outlet and will be sized to ensure adequate steam separation. The water / steam mixture will be fed into the separators by connecting pipe work which will enter around the circumference at an inclined angle to ensure mixture moving spirally downwards and the water / steam separation is done by means of applied centrifugal force. The water will be led downwards to the collecting vessel and the steam escapes centrally upwards to the connections towards the first super heater stage.

The super heater and reheater will be designed to maintain superheat and reheat steam temperatures at super heater and reheater outlet over the entire steam temperature control range. The main auxiliaries of the steam generator are given below.

- Air and flue gas draft system
- Pulverized fuel preparation system
- Secondary fuel oil system
- Soot blowing system
- Electrostatic precipitators
- Flue gas desulphurising system
- Auxiliary boiler

The steam generator will be designed to achieve the maximum continuous rate BMCR of 2100 TPH with an appropriate control margin. The steam generator performance data at BMCR and firing design coal are given in **Table 2.9.**

Table 2.9: Typical boiler parameters

Particulars	Units	Parameter
SH steam flow	TPH	2100
SH outlet pressure	Kg/cm^2 (a)	256
SH temperature	°C	568
RH steam flow	TPH	1600

RH pressure	Kg/cm^2 (a)	46.48
Temperature at RH	°C	593
Temperature at economizer inlet	°C	294
Gas temperature at APH outlet	°C	140
SH temperature control		By spray
RH temperature control		As per manufactures practice
Safety valves		As per IBR
FD fans	Nos/type	2 nos radial / axial, variable blade pitch control
ID fans	Nos/type	2 nos radial / axial, variable blade pitch control
PA fans	Nos/type	2 nos radial / axial, variable blade pitch control
Soot blowers		Rotary and long / short retractable

2.8.2 Steam turbine & its auxiliaries

The turbine will be designed based on modular design approach and consists of three main parts a) High pressure section, b) Intermediate pressure section and c) Low pressure section. Steam turbine shall be tandem compound, reaction type, double reheat, regenerative, condensing, multi-cylinder design with throttle governing, directly coupled with generator suitable for indoor installation. The turbine will have one HP, one double flow IP or HP-IP combined and one /two double flow low pressure casings.

The regenerative feed cycle starts from the condenser at low pressure and ends at economizer inlet high pressure. Feed heating cycle for each unit consists of 2 nos. condensate extraction pumps (2x100%), gland steam condenser, condensate polishing unit, drain cooler, four low pressure heaters of horizontal type, variable pressure de-aerator, 2X50% turbine driven boiler feed pumps and 1X30% motor driven boiler feed pumps and required high pressure heaters of horizontal type along piping connecting steam and water sides.
The condensate extraction pumps take suction from condenser hot well and pump the condensate to de-aerator through gland steam condenser, condensate polishing unit, drain cooler and low pressure heaters.

Boiler feed pumps take suction from de-aerator and pump the feed water to boiler through high pressure heaters. The condensate/ feed water gets heated up progressively by bled steam from turbine extractions together with gland leak off steam. 2 No's. Vacuum pumps (2X100%) are provided to create or maintain vacuum in the condenser.

The condensers will be of multi shell. Single pass surface condenser capable of maintaining the required vacuum while condensing maximum steam flow through LP turbine will be provided.

The divider water box arrangement will be such that it is possible to isolate one half of the condenser from cooling water inlet & outlet sides.

2.8.3 Air pollution control systems

Electro Static Precipitators (ESP) to control suspended particulate matter in the flue gas as per the Environment (Protection) Act, 1986 & Amendment Rules, 2015 is proposed to limit the emission to 30mg/Nm^3 (to be installed from 01-01-2017). ESP shall be designed to take care of the above requirements. High efficiency electrostatic precipitators with 99.98% would be installed to control the emission of ash particles. The precipitators would be designed such that the particulate emission is limited to the above requirement under all operating conditions. To ensure the safe and optimum operation of the ESPs, the flue gas stream would be supervised and monitored by a microprocessor based rapper control ESPs Management system.

Advanced combustion technology for lower emission of nitrogen dioxide is proposed to control NO_X emissions in the boilers.

To control the Sulphur dioxide emissions, Flue Gas Desulphurization (FGD) system is proposed. The design and layout of steam generator and its auxiliaries will be designed such that wet / dry FGD system can be installed.

2.8.4 Chimney

For proper dispersion of SO_2 emissions and to meet the MoEFCC &TNPCB guidelines, single flue RCC stack of 275m height will be provided. The chimney would be provided with personal access for regular monitoring of stack emissions. The exit velocity would be more than 22 m/sec and minimum chimney internal diameter at exit will be 7.0m.

2.8.5 Effluent treatment plant

Adequate treatment facilities would be provided to all the waste streams emanating from power plant to control water pollution. This includes closed cycle condenser cooling with Natural Draught Cooling System (NDCS) with sea water to control thermal pollution and physico-chemical and biological treatment for other effluents. Efficient operation of these treatment plants would be ensured so that the quality of the treated effluents conforms to relevant standards prescribed by regulatory agencies. An effluent management scheme would be implemented with the objective of optimization of various water systems so as to reduce intake water requirement and consequently lesser discharge. The effluent management scheme would essentially involve collection, treatment and re-circulation/disposal of various effluents.

The effluents can be broadly classified into the following categories:

- Thermal discharges from condenser and auxiliary cooling
- Effluents from DM plant and RO plant from treating raw water
- Miscellaneous wastes like coal handling plant waste, service wastewater, oily wastewater etc.
- sanitary waste from plant and township
- Bottom ash system

The treatment proposed for the above effluents are briefly discussed below:

- The DM/RO Plant effluent will be neutralized independently with Acid/Alkali addition prior to discharge to guard pond.
- The brines from desalination plant will be diluted with cooling water and discharged into sea.
- Plant service water, used for cleaning and floor washing purposes, etc., is discharged through guard pond
- Oily waste will be processed through oil separators and then reused for dust suspension
- The sanitary waste water will be led in closed drains to Biological Treatment Plant (Septic Tank) and treated anaerobically. Water from septic tank will discharged through Sewage Treatment Plant for irrigation purpose for Green Belt
- Wet bottom ash will be disposed in the existing Ash Pond through wet disposal system. A re-circulation system for ash pond effluent has been envisaged.

The effluent recycling/ reuse system will be designed for maximum reuse of all the plant effluents. This system will not include storm water / rain water reuse in the plant during monsoon seasons.

Provision for suitable treatment will be made in the ETP to ensure that the effluent meets stipulated norms.

2.8.6 Noise control systems

The major noise generating sources are turbines, generators, compressors, pumps, fans, coal handling plant etc. Acoustic enclosures shall be provided to control the noise level below 90 dB (A). Personal protective equipment shall be provided to the persons working in high noise area. Ambient noise inside and outside the plant area will conform to the prescribed noise levels for various landuse categories as per National Standards for Ambient Noise. This will be ensured through proper designing of the equipment with adequate acoustics permitting the ambient noise levels without exceeding the specified criteria from the source.

2.8.7 Switchyard

The 400kV switching equipment comprising circuit breakers and associated isolators would be controlled from the main control room. The control, measurement, indication and annunciation functions would be performed by microprocessor based Supervisory Control and Data Acquisition System (SCADA). All the associated RTUs would be located in the switchyard control room and operator interface would be located in the main control room. For increased reliability, a back-up control system with control panel comprising miniature switches for breaker control, minimum number of indicating instruments and facia type window annunciators are proposed. This hard wired backup control panel would be located in common switchyard control room.

The SCADA system consists of PLC and CRT based colour graphic operator interface. Further, the system would be connected to a printer to generate periodical logs, malfunction and sequence of event report in the event of a forced outage. The operator interface would also have features to help operator with operating instructions when a complicated switching operation is to be performed.

Interconnection between SCADA and DCS would be made through soft link in order to acquire the plant parameters in the control room. All control operations would be performed at operator interface. The entire switching scheme in whole or in part is displayable on the screen with all the associated parameters indicated near the relevant circuits. The annunciations would also be displayed on the CRT. Control of GT bay breaker would be permitted only from the respective control room and control of other switchyard bays would be permitted at all three control rooms through selection scheme.

OPGW optical fibers shall be used for the further power line communication. Fiber optic approach cable shall be armoured fibre optic cable required to connect overhead Fibre optic cable (OPGW) between the final in live splice enclosure on the gantry/ tower forming the termination of Distribution Panel (FODP) installed within the building.

All switchyard protection panels would be of either simplex type or duplex and would be located in switchyard ~~R~~ relay room. Separate control rooms for the ash / coal handling / EPS / Compressors / DM & WT plants, water intake and other offsite systems will be provided.

However, the output trip of each the relays group shall trip the respective circuit breaker through both trip coils I & II.

2.8.8 Ash handling system

Dry ash 100% (Fly ash) disposal system is envisaged for the proposed power project. The bottom ash is proposed to be collected in the wet form and disposed into the existing ash dyke of the ETPS. Only in case of emergency, a portion of the fly ash is proposed to be collected as wet extraction and disposed to the ash bund.

Ash formed due to combustion of pulverized coal in the steam generator will be collected as bottom ash in the bottom ash hopper, coarse ash in economizer, APH & duct hoppers and fly ash in ESP and stack hoppers.

Bottom ash will be collected in the bottom ash hopper and conveyed to ash slurry sump through scrapper feeder chain conveyors and jet pumps. The ash slurry conveyed to ash slurry sump will be further conveyed to ash disposal area by means of Ash Slurry Pumps (ASP). Coarse ash will be automatically extracted and conveyed to the feeder ejectors located below each hopper. Necessary vacuum/momentum required for extracting the ash from the hoppers shall be created by the feeder ejectors.

The coarse ash slurry thus produced shall be routed to coarse ash tank located in boiler area. The slurry collected in the coarse ash tank shall be conveyed to the proposed ash slurry sump through coarse ash slurry pumps.

Fly ash from ESP and stack hoppers will be extracted through vacuum and conveyed to fly ash silos through pressure conveying system. The fly ash will be further disposed in dry form through e-auction or in wet form to ash disposal area through HCSD system.

Pneumatic conveying system (either vacuum system or pressure system) shall be employed for extraction of fly ash from the electrostatic precipitator hoppers in dry form. This dry ash shall either be taken to buffer hoppers or to the wetting head/collector tank units. The dry ash buffer hoppers and wetting head/collector tank units shall be located adjacent to the ESPs. Dry ash from buffer hoppers shall be transported to main storage silos to be located near the plant boundary. Silo area shall be provided with fencing, office block, gate complex and passage for entry/exit of vehicles.

There shall be three nos. of ash silos. The storage capacity of each silo shall be provided for 24hrs production of fly ash (based on performance coal analysis) of unit. The user industries shall take the dry fly ash from these silos in closed tankers. For wet disposal of dry ash extracted from various ESP hoppers, the same shall be diverted to wetting head/collector tank units (by passing buffer hoppers meant for handling ash in dry form).

Improved ash management: The proposed project employs supercritical coal fired power generation unit of 660 MW gross capacity. Supercritical technology enables Rankin cycle to be operated at higher operating pressures thereby increasing the cycle efficiency. Higher efficiency means a reduction in fuel consumption and thereby a reduction in emissions per unit of electricity generated. The supercritical technology will enhance operational efficiency over sub-critical technology, which is the most prevalent and commonly used for thermal power generation in India. Hence adopting super critical technology for higher size of coal based unit's leads to enhanced plant efficiency, less fuel consumption and reduced greenhouse emissions.

2.8.9 Ash disposal

The quantum of fly ash and bottom ash generated from 100% imported coal is furnished in the following table:

(Assumed Ash content): Imported Coal : 6.62%
Fly Ash : 80%
Bottom Ash : 20%

Table 2.10: Quantum of fly ash and bottom ash generated for the two options of coal

S. No	Coal Combination	Fly Ash generated(dry)		Bottom Ash (Wet)	
		TPH	Mode of Disposal	TPH	Mode of Disposal
1	100% Imported	14	Disposed through e-auction	3.5	The bottom ash slurry will be disposed to the existing ash dyke.

100% dry ash (fly ash) disposal system is envisaged for the proposed new plants and the entire fly ash generated from the project will be evacuated through e-auction. The existing ash pond of ETPS will be utilized for bottom ash disposal and portion of fly ash in case of emergency.

2.8.10 Bottom ash handling system

Bottom Ash (BA) will be collected continuously in a bottom ash hopper. BA hopper will be located directly below the bottom water wall header of boiler and will have an effective storage capacity of 4 hours bottom ash generated while firing worst coal. To unload contents of the BA hopper, its feed gates will be opened by a remotely controlled/ operated four way solenoid valve. It will be ensured that full quantity of ash is removed during de-ashing cycle.

BA hopper will discharge BA into two scrapper feeder chain conveyors below the feed gate assembly. After the scrapper chain conveyor BA shall be led to clinker grinder through transition

chute where ash shall be crushed to limit the ash size to 25 mm and from there led to a jet pump and subsequently to Ash slurry sump. Ash slurry sump shall convey the slurry to Ash disposal area.

Bottom AHS of each unit will be sized such that the bottom ash generated in 8 hours will be evacuated within 90 minutes.

2.8.11 Fly ash handling system

Fly ash collected in various ESP and Stack hoppers will be extracted and conveyed to buffer hoppers automatically and sequentially by means of vacuum generated by mechanical exhauster and will be transported to fly ash silos by means of pressure conveying system. Adequately rated oil free rotary screw type conveying air compressors will be provided to supply compressed air required for conveying fly ash from buffer hoppers to fly ash silos. One (1) buffer hopper will be provided for each vacuum stream. Adequately sized bag filters will be mounted on buffer hopper. Two (2) streams will be provided to evacuate fly ash from buffer hoppers to fly ash silos. Below each buffer hopper, two ash vessels will be provided to convey ash to fly ash silos. Three (3) fly ash storage silo in RCC construction will be provided, having an effective storage capacity of storing fly ash generated in 24 hours with worst coal. The fly ash silo will be provided with four outlets; one for unloading ash in dry form into closed trucks through telescopic chute; one for unloading ash in conditioned form into open trucks through ash conditioner, one for unloading ash to mixing tanks for slurry disposal system (50% emergency wetting) and fourth outlet blind flanged for future use. The fly ash storage silo will be provided with adequately rated vent filter on silo roof.

- Three adequately rated mechanical exhausters will be provided (one working per stream and one common stand by) for extracting fly ash from various hoppers to buffer hoppers.
- Two adequately rated oil free screw compressors will be provided (one working and one standby) for supplying compressed air for conveying fly ash from buffer hoppers to fly ash silo.
- Two (2) adequately rated low speed, oil free, lobe type fluidizing air blowers with heaters will be provided; one working with one common standby.
- Two (2) adequately rated low speed, oil free, lobe type fluidizing air blowers with heaters will be provided for fly ash silo; one working and one standby.

These blowers will be located on the operating floor of the silo. Two (2) adequately rated oil free screw compressors with refrigerant type air driers and air receivers will be provided for supplying instrument air for various valves and cleaning of pulse jet type bag filters; One (1) working with one common standby.

Ash collected in ESP and stack hoppers in a shift of eight (8) hours will be evacuated within 270 minutes. The capacity of the individual lines and grouping of various ash hoppers will be based on the standard vacuum pump capacity.

Pneumatic conveying system either vacuum or pressure system shall be employed for extraction of fly ash from the electrostatic precipitator hoppers in dry form. This dry ash is usually sent to buffer hoppers or to the wetting head/ collector tank units. The dry ash buffer hoppers and wetting head collector tank units shall be located adjacent to ESPs. Dry ash from buffer hoppers shall be transported to maintain storage silos to be located near the plant boundary. Silo area shall be provided with fencing, office block, gate complex and passage for entry/ exit of vehicles. There shall be two numbers of ash silos. The storage capacity of each silo shall be provided for 24 hrs production of fly ash based on the performance coal analysis of unit. The user industries shall take the dry fly ash from these silos either in closed tankers or in open tankers. For wet disposal of dry ash extracted from various ESP hoppers, the same shall be diverted to wetting head/collector tank units (by passing buffer hoppers meant for handling ash in dry form).

2.8.12 Fly ash slurry disposal system

There will be a wet disposal system wherein ash from the hopper can be diverted to the wetting unit and then to the air separator collector for tank for each unit. In the wetting unit slurry will be formed under the injection of HP water and from the separator, air will be suitably vented out and slurry will be drained. This wet mode FA disposal system shall have a capacity to handle 50% of the fly ash generated. Concentration of fly ash slurry shall be about 30% while in cross-country transfer.

It is further to clarify that either the Silo bypass (Wet) mode will be operated or dry mode system up to remote Storage Silo shall be operated. Dry Mode will operate at 100% capacity while wet mode shall be designed for 50%.

2.8.13 Ash dyke

The ash pond is located near to the power plant and it is an existing ash pond. The slurry pump chain head shall be designed to enable discharge at farthest point in the dyke area up to ultimate dyke height (5 m, from present existing earth level).

The ash slurry pipes will discharge into the ash pond and ash particles will settle inside the ash pond. An ash water recovery, collection and transfer system is to be provided near ash pond area. Water due to slurry disposal shall be tapped from the recovery collection system and taken to a treatment plant (inside plant boundary) for ash handling systems for reuse in ash water sump make up.

2.9 Fuel oil system

The fuel oil system comprises of provision for unloading, storages and forwarding of Heavy fuel oil & Light diesel oil common for all units. LDO system consists of unloading system, storage tank and forwarding skid. HFO/LDO will be transported through road/rail tankers. Fuel oil consumption for the proposed project shall be about 5700 KL/Year.

Start-up, warm up and low load (up to 30%) carrying shall be done by Heavy Furnace Oil (HFO)/Light Diesel Oil (LDO). Boiler will be designed such that oil firing for flame stabilization will not be required beyond 30% MCR. Necessary pumps, filters and heaters shall be provided. The burners, air registers etc., will have independent pneumatic drives and the entire operation of purging, insertion, air and fuel sequencing removal and blow off shall be automatic. Ignition of heavy oil shall be directly by high energy arc igniters. There shall be LDO firing at least in one burner elevation having a minimum capacity of 7.5% BMCR to facilitate a cold start-up of the unit when no auxiliary steam is available for HFO heating and atomization. LDO system shall be sized for 7.5% BMCR capacity for the boiler.

HFO tanks of capacity 2000 KL 1 No. and 1000 KL 1 No., are proposed. The fuel oil tanks are proposed to be installed in the Fuel oil dyke of the ETPS Expansion project located adjacent to the project.

2.10 Compressed air system

To cater for the plant requirements, it is proposed to install required number of instrument air compressors and service air compressors of adequate capacity for the compressed air at 8.4 kg/cm^2. The instrument air compressors will be oil free type, complete with HOC (Heat of Compression) type dryers and individual air receivers to absorb pressure pulsations and for acting as reserve supply of compressed air to permit continued operation following failure of the operating compressor until the standby one is put into service. The instrument and service air headers will be interconnected in a manner that in case of emergency the service air be used for the plant instrument air. Station service air requirement for normal cleaning purposes, atomizing air for warm-up guns and igniters, motive power for burner drive mechanism and emergency air for air drive motors of air pre-heaters will be met from service air compressors. It is proposed to install these compressors in a separate building.

The air drying plants shall be capable of achieving a dew point of (-) 40°Cat atmospheric pressure. Individual air receiver shall be provided near each air compressor and further unit air receivers shall be provided near main plant of unit.

2.10.1 Advantages of super critical technology

- Superior technology
- Reduced greenhouse emissions
- Environmental friendly /CDM benefits
- Operational flexibility to grid fluctuations
- Shorter start-up times
- Reduced coal consumption
- Savings in coal cost
- Reduced O&M cost

2.11 Balance of plant package (Mechanical)

Balance of plant mechanical scope includes CW pumps, NDCT, Raw water treatment plant, CW chlorination system, RW chlorination system, condensate polishing unit, DM plant, Effluent treatment plant, Coal handling plant, Fuel oil unloading, storage and handling, Ash handling plant, Air conditioning system, Fire protection system, Hydrogen generation plant, Ventilation & Air conditioning system, Fire protection system, Compressed sir system, Elevators, Miscellaneous cranes & Hoists, Workshop equipment's, Environmental laboratory etc shall be designed to meet the plant requirement.

The Boiler Feed Pumps (TDBFP & MDBFP), ID, FD & PA fans and Coal Mills shall also be supported on RCC top deck which in turn shall be supported by springs cum viscous dampers (Vibrating Isolation System). The spring cum viscous dampers shall in turn rest on RCC raft/strip foundation supported on piles. The grade of concrete for top deck of Boiler Feed Pumps, fans and mills shall be M25 and that for the raft / strip footing shall also M25.

All main plant foundations shall be on piles. The actual load carrying capacity of piles shall be ensured during detailed design and also from field load tests by conducting initial load test on test piles.

2.12 Other salient features of the plant

- The plant has latest state of the art control and instrumentation system based on max DNA or only other improved technology.
- Separate control arrangement in control room.
- The plant have about crushed coal capacity of 7 days

The boiler parameters of typical 660 MW power plants are given in **Table 2.11.**

Table 2.11: Boiler parameters (typical for 660MW unit)

S. No.	Description	Units	Parameter
1.	SH steam flow	TPH	2100
2.	SH outlet pressure	Kg/cm^2 (a)	256
3.	SH temperature	°C	568
4.	RH steam flow	TPH	1600
5	RH pressure	Kg/cm^2 (a)	46.48
6	Temperature of RH outlet	°C	593
7	Temperature at economiser inlet	°C	294
8	Gas temperature at APH outlet	°C	140
9	SH temperature control	-	By Spray
10	RH temperature control	-	As per manufactures practice
11	Safety valves	-	As per IBR
12	FD fans	Nos/type	2 nos, radial/axial, variable blade pitch control
13	ID fans	Nos/type	2 nos, radial/axial, variable speed with hydraulic coupling

2.13 Solar energy harvesting

The entire plant flat roof buildings are potential area for harvesting solar energy and convert in to useful solar power. This will be based on solar photo voltaic cell panels, which will convert the solar energy to electric energy. All the panels will be wired to a common storage cell, where-from further distribution can be made to different utilities. TANGEDCO will approach to such expert agencies that are capable of installing such plant for a proper assessment of the derivable electricity from solar power.

Chapter-3

Description of the Environment

Chapter 3
Description of the Environment

3.1 Introduction

Baseline environmental status in and around the proposed project depicts the existing conditions of Air, Water, Noise, Soil, Ecological Studies, Land utilization and Socio-economic environment. The baseline data was collected for various environmental components to compute the impacts that are likely to be arising out of the proposed Ennore Thermal Power Station (ETPS) expansion activities covering an area of 10 km radius around the power project to compute the impacts that are likely to be arising out of the Ennore Thermal Power Station (ETPS) expansion activities covering an area of 10 km radially, from the expansion of Thermal Power Project 1x 660 MW at Ernavur Village, Tiruvottiyur Taluk, Thiruvallur District, Tamil Nadu by M/s Tamil Nadu Generation and Distribution Copporation Ltd (TANGEDCO).

3.2 Baseline environmental Studies

The main aim of the impact assessment study is to find out the impact of the project on the environment. This study is carried out during the project planning stage itself, so that the proponent can implement the project in a technically, financially and environmentally viable way.

The success of any impact assessment study depends mainly on two factors. One is estimation of impact from proposed project on the environment and the second one is assessment of the environmental condition. Both are key factors to arrive at the post project scenario. The estimated impact due to the proposal can be superimposed over the existing conditions to arrive at the post project scenario. The scope of the baseline studies includes detailed characterization of following environmental components, which are most likely to be influenced by setting up an industry

- Meteorological conditions
- Ambient Air quality
- Noise levels
- Water quality (Surface & Ground water)
- Soil quality
- Socio Economic studies
- Ecological studies
- Land utilization

3.2.1 Monitoring period

Field investigations were undertaken for collecting existing baseline data for Land Use Land Cover (LULC) Air, Water, Noise, Soil, Ecological and Socio-economic conditions. A study area of 10 Km radius from project site is identified to establish present environmental conditions for above environmental components. The main aim of the EIA study is to identify critical environmental attributes affected and their adverse impacts on surrounding environment due to the proposed. The field data generation was undertaken as detailed below

- Ambient air quality (AAQ) monitoring is carried out during July to September 2018.
- LULC, Water, Noise, Soil, Ecological and Socio-economic conditions were carried out during April- May 2019.

3.3 Meteorology

Regional meteorological scenario helps to understand the trends of the climatic factors. It also helps in determining the sampling stations in predicting the post project environmental scenario. Meteorological scenario exerts a critical influence on air quality as the pollution arises from the interaction of atmospheric contaminants with adverse meteorological conditions such as temperature inversions. Atmospheric stability and topographical features like hills, canyons and valleys.

The study of meteorological conditions forms an intrinsic part of the environment impact assessment study. The meteorological conditions of an area have a definite influence over the other. Summary of the climatological data (IMD station Chennai) is taken from India Meteorological Department, Climatological Tables 1981 to 2010 and given in **Table 3.1.**

Table 3.1: Meteorological data – statistics

IMD Station Chennai - Lat:13 04 58 N & Lon:80 16 14 E, MSL 11m, Distance from proposed site 10 km S										
Month	Temperature °C				Humidity %		Rainfall		Mean Wind speed (m/s)	pre dominant direction
	Mean Max	Mean Min	Highest	Lowest	Max	Min	Monthly mm	No. of rainy days		1st
Jan	29.5	20.8	31.6	18.6	83	54	31.5	1.5	1.4	E
Feb	31.4	21.8	34.1	19.1	81	62	4.6	0.5	1.7	E
Mar	33.7	23.8	37.0	21.2	76	63	4.8	0.4	2.1	SE
Apr	35.7	26.2	39.4	23.6	72	67	14.2	0.9	2.5	S
May	38.2	27.7	42.2	24.2	64	62	52.9	1.8	2.7	S
Jun	37.5	27.4	40.6	23.8	60	57	63.5	4.2	2.8	W
Jul	35.6	26.3	38.7	23.0	66	60	107.8	6.7	2.4	W
Aug	34.8	25.8	37.4	23.0	71	63	137.2	8.6	2.3	W
Sep	34.3	25.4	36.9	22.6	75	69	145.8	7.7	1.9	W

Oct	32.2	24.5	35.5	22.2	81	74	298.1	10.6	1.5	E
Nov	30.0	23.0	32.8	20.2	83	75	373	10.9	1.4	N
Dec	29.0	21.6	30.9	18.9	83	69	166	5.8	1.4	NE
Source: GOI, Ministry of Earth Sciences, IMD, Climatological Tables 1981-2010										

3.3.1 Climatic conditions

The climate in the study region is generally dry, humid and hot and is characterized with seasonal variations as follows:

Summer	April to June
Pre Monsoon	June to September
North-East Monsoon	Oct to Dec

Project area falls under the hot temperate climate zone and hence it experiences very hot and dry climate. Summer season starts from April to stays till June. It receives its bountiful rains from the North-east monsoon from October through December. Rainfalls occur usually from October to December. December to February is the mildest months. Temperature- (19^0 C - 28^0 C). The critical weather elements that influence air pollution are wind speed, wind direction, temperature, which together determines atmosphere stability. Hence it is an indispensable part of any air pollution studies and required for interpretation of baseline information. The details of the temperature, relative humidity and rainfall observed during study period are given in **Table 3.2.**

Table 3.2: Observed meteorological data

Period	Temperature (^{o}C)		R. Humidity (%)		Predominant wind direction Blowing from
	Min	Max	Min	Max	
July-2018	22.5	37.8	55	80	SW
Aug-2018	24.2	36.7	62	87	
Sep-2018	25.3	36.8	65	89	

3.3.1.1 Wind pattern during study period

Dispersion of different air pollutants released into the atmosphere has significant impacts on neighborhood air environment. The dispersion/dilution of the released pollutant over a large area will result in considerable reduction of the concentration of a pollutant. The dispersion in turn depends on the weather conditions like the wind speed, direction, temperature, relative humidity, mixing height, cloud cover and also the rainfall in the area. Normally the impacts surrounding the project site are studied in detail.

Wind speed and direction data recorded during the study period is useful in identifying the influence of meteorology on the air quality of the area. Based on the IMD meteorological

data, wind roses that is the diagrammatic representation of wind speed and wind direction along with their persistence for a fractional period of occurrence at a given location is constructed. Wind roses on sixteen sector basis have been drawn. Wind directions and wind speed frequency observed during study period month wise and for full season is given in **Table 3.3** wind rose diagrams are given in **Figure 3.1.**

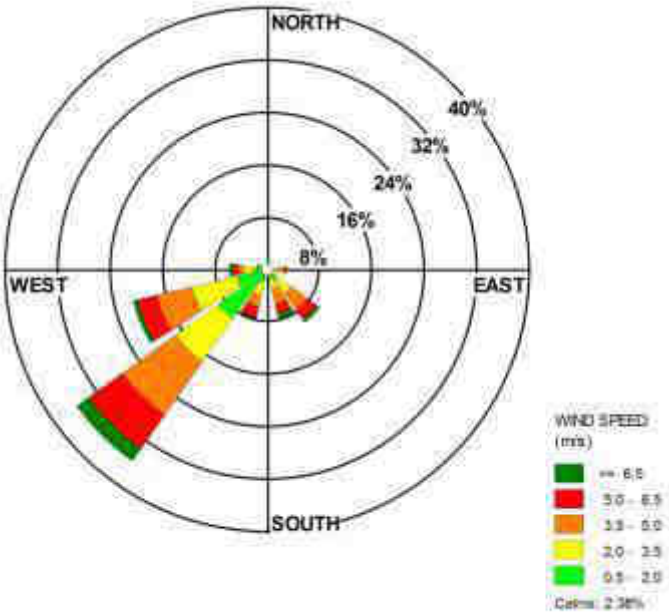
- During season (July to September 2018), the winds were predominantly recorded from SW closely followed by WSW. Calm conditions prevailed for 2.38 % of the total time and the average wind speed for the season is 2.85 m/sec.

Table 3.3: Frequency distribution table for the season (July to Sepetember 2018)

Wind Directions	Wind Classes (m/s)					Total (%)
	0.5-2.0	2.0-3.5	3.5- 5.0	5.0-6.5	> 6.5	
N	0.28	0.09	0.00	0.00	0.00	0.37
NNE	0.19	0.14	0.09	0.00	1.02	1.43
NE	0.14	0.05	0.05	0.00	0.05	0.27
ENE	0.23	0.33	0.19	0.09	0.00	0.82
E	1.03	0.66	1.08	0.23	0.09	3.02
ESE	0.23	0.33	0.23	0.23	0.05	1.05
SE	2.02	2.58	3.01	1.74	2.61	9.71
SSE	1.32	1.83	2.4	1.46	0.85	7.65
S	0.33	0.47	0.14	0.28	1.50	1.69
SSW	2.02	2.21	1.69	1.64	0.23	7.6
SW	9.21	7.98	9.96	6.29	2.25	34.8
WSW	4.88	6.9	5.54	3.05	0.61	20.47
W	2.25	1.41	0.8	0.85	0.56	5.72
WNW	1.08	0.28	0.28	0.05	0.05	1.69
NW	0.05	0.00	0.00	0.00	0.00	0.05
NNW	0.23	0.05	0.00	0.00	0.00	0.27
Sub-Total	24.86	24.68	24.82	15.52	5.22	97.62
					Calms (< 0.5 m/s)	**2.38**
					Total	**100**

Note: 1. Average wind speed 2.85 m/s
2. All values are in Percentage

Figure 3.1: Wind rose diagram –for the season (July to Sepetember 2018)



3.4 Sampling locations

In order to identify the base line quality of Air, Noise, Water (Surface and Groundwater) and Soil surrounding the project area, sampling locations were identified.

3.4.1 Basis for selection of the monitoring locations

The selection of the monitoring site criteria is based on the

- Wind flow direction
- Drainage pattern like upstream and downstream of water bodies
- Topography /Terrain of the study area
- Density of population within region
- Residential and Sensitive areas
- Magnitude of surrounding industries, if any
- Proximity of industrial activity,

3.5 Ambient air quality

The Ambient air quality was monitored in the impact area as per MOEFCC guidelines. The study area represents mostly rural environment. The prime objective of the baseline air quality study was to assess the existing ambient air quality of the area.

Note: Ambient air quality monitoring was carried out by the M/s. Chennai Testing Laboratory Private Limited as per the recommendations of EAC sub committee during its site visit held on 13th to 14th October 2017. Except air quality monitoring all others baseline studies were carried out by Ramky Enviro Services Private Limited.

3.5.1 Parameters for sampling & sampling frequency

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality network. The design of monitoring network in the air quality surveillance programme has been based on the following considerations.

- Meteorological parameters on synoptic scale
- Topography of the study area
- Representatives of regional background air quality for obtaining baseline status
- Representatives of likely impact areas.

Ambient air quality monitoring (AAQM) stations were set up at 9 locations with due consideration to the above mentioned points. AAQ locations were selected in cross wind and upwind direction of the proposed Project location.

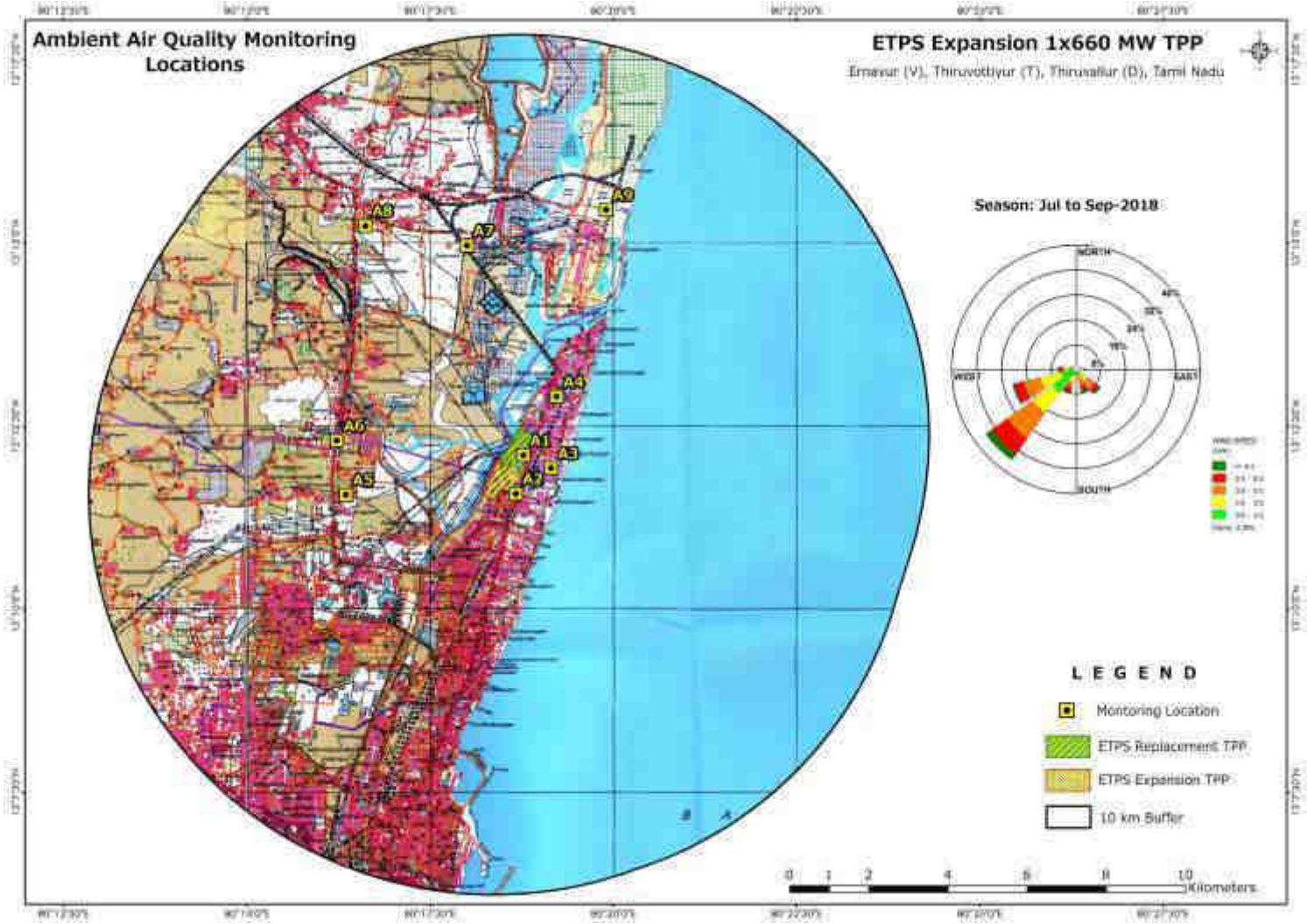
At each sampling station monitoring was carried out for a frequency of 2 days per week for 4 weeks in a month during study period. The common air pollutants namely Particulate Matter (SPM, PM<2.5µm, PM<10µm), Sulfur dioxide (SO_2), Oxides of Nitrogen (NO_x), and Ozone (O_3), and Carbon Monoxide(CO) were sampled on 8/24 hourly and results were averaged to 24 hours to meet the requirements of the MOEFCC and compared with the standards stipulated by CPCB. In addition to above parameters Ozone also monitored. The air quality sampling locations and details are given in **Table 3.4.** The sampling locations selected for studying the environmental quality of the study area are shown in the **Figure 3.2.**

Table 3.4: Ambient air quality monitoring locations

Code	Name of the Locations	W.R.T. Site		Latitude (North)	Longitude (East)	Remarks
		Distance (km)	Direction			
A1	ETPS, Site	-	-	13^0 12’ 05.9”	80^0 18’ 46.5”	Near Security Main Gate
A2	Ernavur	0.2	S	13^0 11’ 34.4”	80^0 18’ 40.2”	Near Main road(Top of the S.V.Raja House)
A3	Shivakami nagar	0.3	E	13^0 11’ 55.4”	80^0 19’ 09.1”	Top of the S. Ganesh House Near Sea
A4	Ennore	1.3	NE	13^0 12’ 53.9”	80^0 19’ 13.6”	Near Bus stand(Top of the Kurinji Hotel) Mr.Raju
A5	Manali new town	3.5	W	13^0 11’ 33.6”	80^0 16’ 21.2”	Village Junction(Top of the S.Durai Raj House)

Code	Name of the Locations	W.R.T. Site		Latitude (North)	Longitude (East)	Remarks
		Distance (km)	Direction			
A6	Ponniamman nagar	3.9	W	13^0 12’ 18.1”	80^0 16’ 13.7”	Top of the Mr.K. Senthil Kumar House. Opp Shakthi Steel
A7	Athipattu	5.5	NW	13^0 14’ 57.8”	80^0 18’ 00.2”	Near Railway Station(Top of the D.Mallinga House)
A8	Vallure	6.1	NW	13^0 15’ 13.9”	80^0 16’ 37.1”	Top of the Ms. Indira madam House. NCTPS Employee
A9	NCTPS-Stage - II	6.5	N	13^0 15’ 27.1”	80^0 19 54.1”	Near Fire Station

Figure 3.2: Air quality sampling locations in the study area



3.5.2 Air quality scenario in the study area

The existing concentration levels of air pollutants are presented in **Table 3.5** to **Table 3.7** respectively**.**

Statistical parameters like minimum, maximum mean and 98th percentiles have been computed from the observed raw data for all sampling stations. The observed values were compared with the standards as prescribed by Central Pollution Control Board (CPCB) for industrial, residential and rural & other areas.

Table 3.5: Particulate matter PM_{10} & $PM_{2.5}$ levels in the study area (µg/m^3) during the season

Location	PM_{10}			$PM_{2.5}$		
	Min	Max	98th Percentile	Min	Max	98th Percentile
ETPS,Site	61.1	86.0	86.0	30.1	46.8	46.8
Ernavur	47.6	74.8	74.8	21.8	35.6	35.6
Shivagami Nagar	67.5	89.5	89.5	32.1	48.5	48.5
Ennore	53.8	74.9	74.9	23.5	35.7	35.7
Manali New Town	55.4	87.3	87.3	25.6	46.3	46.3
Ponniamman Nagar	52.6	83.3	83.3	24.7	41.5	41.5
Athipattu	72.5	96.8	96.8	35.2	57.5	57.5
Vallure	52.5	88.7	88.7	24.8	43.5	43.5
NCTPS-Stage -II	76.5	**98.5**	**98.5**	37.9	58.4	58.4
98 Percentile	**74.8 to 98.5**			**35.6 to 58.4**		
NAAQ Standards 2009(24 hr)	**100**			**60**		
Source: Chennal Testing Laboratory Private Limited						

Table 3.6: Ambient air quality SO_2, NOx,levels in the study area (µg/m^3)

Location	SO2			NOx		
	Min	Max	98th Percentile	Min	Max	98th Percentile
ETPS,Site	8.2	15.2	15.2	16.2	31.4	31.4
Ernavur	4.6	14.5	14.5	10.2	29.0	29.0
Shivagami Nagar	7.5	13.5	13.5	15.6	24.8	24.8
Ennore	6.2	12.1	12.1	14.5	28.6	28.6
Manali New Town	3.8	12.6	12.6	7.7	24.1	24.1
Ponniamman Nagar	3.7	15.1	15.1	5.2	33.7	33.7
Athipattu	4.7	12.3	12.3	10.2	26.5	26.5
Vallure	3.5	13.5	13.5	6.5	20.8	20.8
NCTPS-Stage -II	13.2	**26.5**	**26.5**	22.5	**38.5**	**38.5**
98 Percentile	**12.1 to 26.5**			**20.8 to 38.5**		
NAAQ Standards 2009(24 hr)	**80**			**80**		
Source: Chennal Testing Laboratory Private Limited						

Table 3.7: Ambient air quality O_3 & CO levels in the study area

Location	O_3 (µg/m^3)			CO (mg/m^3)		
	Min	Max	98th Percentile	Min	Max	98th Percentile
ETPS,Site	15.5	40.5	40.5	BDL	BDL	BDL
Ernavur	12.5	34.1	34.1	BDL	BDL	BDL
Shivagami Nagar	14.6	33.7	33.7	BDL	BDL	BDL
Ennore	14.6	34.5	34.5	BDL	BDL	BDL
Manali New Town	5.6	32.8	32.8	BDL	BDL	BDL
Ponniamman Nagar	9.1	41.3	41.3	BDL	BDL	BDL
Athipattu	7.7	37.9	37.9	BDL	BDL	BDL
Vallure	13.2	28.3	28.3	BDL	BDL	BDL
NCTPS-Stage -II	21.5	**50.8**	50.8	BDL	BDL	BDL
98 Percentile	**28.3 to 50.8**			BDL		
NAAQ Standards 2009	**180 (1 hr)**			**04 mg/m^3(1 hr)**		
Source: Chennal Testing Laboratory Private Limited						
BDL(DL 1.15)						

a) Particulate matter ($PM_{2.5}$µm & PM_{10}µm)

Particulate matter (PM) is the term used for a mixture of solid particles and liquid droplets suspended in the air. These particles originate from a variety of sources, such as power plants, industrial processes, and diesel trucks, and they are formed in the atmosphere by transformation of gaseous emissions. Their chemical and physical compositions depend on location and time of year. Particulate matter is composed of both coarse and fine particles.

Coarse particles (PM_{10} µm) have an aerodynamic diameter between 2.5µm and 10µm. They are formed by mechanical disruption (e.g. crushing, grinding and abrasion of surfaces) evaporation of sprays, and suspension of dust. PM_{10} µm is composed of alumina silicate and other oxides of crustal elements, and major sources including fugitive dust from roads, industry, agriculture, construction and demolition, and fly ash from fossil fuel combustion. The lifetime of PM_{10} is from minutes to hours, and its travel distance varies from <1 km to 10 km.

Fine particles have an aerodynamic diameter less than 2.5µm ($PM_{2.5}$). They differ from PM_{10} µm in origin and chemistry. These particles are formed from gas and condensation of high temperature vapors during combustion, and they are composed of various combinations of sulfate compounds, nitrate compounds, carbon compounds, ammonium, hydrogen ion, organic compounds, metals (Pb, Cd, V, Ni, Cu, Zn, Mn and Fe), and particle bound water. The major sources of $PM_{2.5}$ are fossil fuel combustion, vegetation burning, and the smelting and processing of metals. Their lifetime is from days to weeks and travel ranges from hundreds to thousands of kilometers.

The 98thpercentile of particulate matter PM_{10}, recorded with in the study area in the range of **74.8 to 98.5 µg/m^3.**

The 98thpercentile of particulate matter$_{2.5,}$ recorded with in the study area range of **35.6 to 58.4 µg/m^3**.

The 24 hourly average values of particulate matter <2.5µm & particulate matter <10µm were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits of residential and rural area limits for all locations in study area.

b) Sulfur dioxide

Sulfur dioxide gas is an inorganic gaseous pollutant. Sulfur dioxide emissions are expected to be emitted wherever combustion of any fuel containing sulfur takes place. The sulfur in the fuel will combine with oxygen to form sulfur dioxide. Sulfur trioxide and sulfuric acid mist are the other important pollutants in the sulfur group. In general, some of the important sources of sulfur dioxide are power stations, sulfuric acid plants, oil refining, boilers in utilities in any industry and domestic use of coal.

The following sources of sulfur dioxide in the study area are identified:

1. Emissions from domestic fuel (coal, diesel etc.)
2. Emissions from DG sets used by industries and local residents

Information in the literature has indicated that the presence of sulfur dioxide in the photochemical smog reaction enhances the formation of visibility enhancing aerosols.

Sulfur dioxide in atmosphere is significant because of its toxicity. Sulfur dioxide is capable of producing illness and lung injury. Further it can combine with water in the air to form toxic acid aerosols that can corrode metal surfaces, fabrics and the leaves of plants. Sulfur dioxide is irritating to the eyes and respiratory system. Excessive exposure to sulfur dioxide causes bronchial asthma and other breathing related diseases as it affects the lungs.

The 98th percentile of SO_2 recorded within the study area are in the range of **12.1 µg/m^3 to 26.5 µg/m^3**.

The 24 hourly average values of SO_2 were compared with the national ambient air quality standards and it was found that the recorded values, of all the monitored locations, were much lower than the applicable limit of 80µg/m^3 for residential and rural area.

c) Oxides of nitrogen

Oxides of nitrogen are also inorganic gaseous pollutants, similar to Sulfur dioxide. The emission of oxides of nitrogen occurs wherever combustion at high temperatures takes place. Nitrous oxide and nitric acid mist are the other important pollutants in the inorganic nitrogen group.

In general, some of the important sources of oxides of nitrogen are boilers (Utilities) in any industry and auto exhaust. In a metropolitan city, the NO_x levels are predominant due to automobile exhaust.

The sources of oxides of nitrogen in the study area are identified:

1. Emissions from industrial and domestic burning of coal.
2. Emissions from automobiles.

Oxides of nitrogen have far greater significance in photochemical smog reaction than any of the other inorganic gaseous contaminants**.** NO_x in the presence of sunlight will undergo reactions with a number of organic compounds to produce all the effects associated with photochemical smog. NO_x has inherent ability to produce deleterious effects by themselves like toxicity. It acts as an asphyxiate when in concentrations great enough to reduce the normal oxygen supply from the air. The 98th Percentile of NO_x recorded within the study area was in the range of **20.8 to 38.5 µg/m^3**.

The 24 hourly average values of NO_x were compared with the national ambient air quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 80 µg/m^3 for residential and rural areas.

d) Ozone

Ozone (O_3) or Trioxygen, is a triatomic molecule, consisting of three oxygen atoms. It is an allotrope of oxygen that is much less stable than the diatomic allotrope (O_2). Ozone in the lower atmosphere is an air pollutant with harmful effects on the respiratory systems of animals and will burn sensitive plants; however the ozone layer in the upper atmosphere is beneficial, preventing potentially damaging ultraviolet light from reaching the earth's surface. Ozone is present in low concentrations throughout the earth's atmosphere.

The 1 hourly average values of ozone were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits (180µg/m^3) of residential and rural area limits for all locations in study area. The 98th percentile of O_3 recorded within the study was in the range of **28.3 to 50.8 µg/m^3.**

e) Carbon monoxide (CO)

It is a colorless, odorless, and tasteless gas that is slightly less dense than air. It is toxic to humans and animals when encountered in higher concentrations, although it is also produced in normal animal metabolism in low quantities, and is thought to have some normal biological functions. In the atmosphere, it is spatially variable and short lived, having a role in the formation of ground-level ozone. Along with aldehydes it is part of series of rections that form photochemical smog.

Carbon monoxide is present in small amounts in the atmosphere, chiefly as a product of volcanic activity but also from natural and man-made fires (such as forest and bush fires, burning of crop residues and sugarcane fire-cleaning).

Carbon monoxide is a temporary atmospheric pollutant in some urban areas, mainly from the exhaust of internal combustion engines (including vehicles, portable and back-up generators, lawn mowers, power washers, etc.), but also from incomplete combustion of various other fuels (including wood, coal, charcoal, oil, paraffin, propane, natural gas, and trash). Carbon Monoxide (CO) Concentration in the study area was below detectable limit.

The 1 hourly average values of Corbon monoxide were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits (4mg/m^3) of residential and rural area limits for all locations in study area. The 98th percentile of CO recorded within the study was in the range of BDL.

3.6 Water quality & water quality assessment

Surfacewater and groundwater samples were collected from different sources within the study area during the study period and some important physical and chemical parameters including heavy metals were considered for depicting the baseline status of the study area.

Ten number of groundwater samples and three no of surfacewater samples were collected from the study area to assess the water quality during the study period. The water samples were drawn from the hand pumps and open wells being used by the villages for their domestic needs. The water quality locations and details of the monitoring locations are given in **Figure 3.3 & Table 3.8** respectively.

Figure 3.3: Water quality sampling locations in the study area

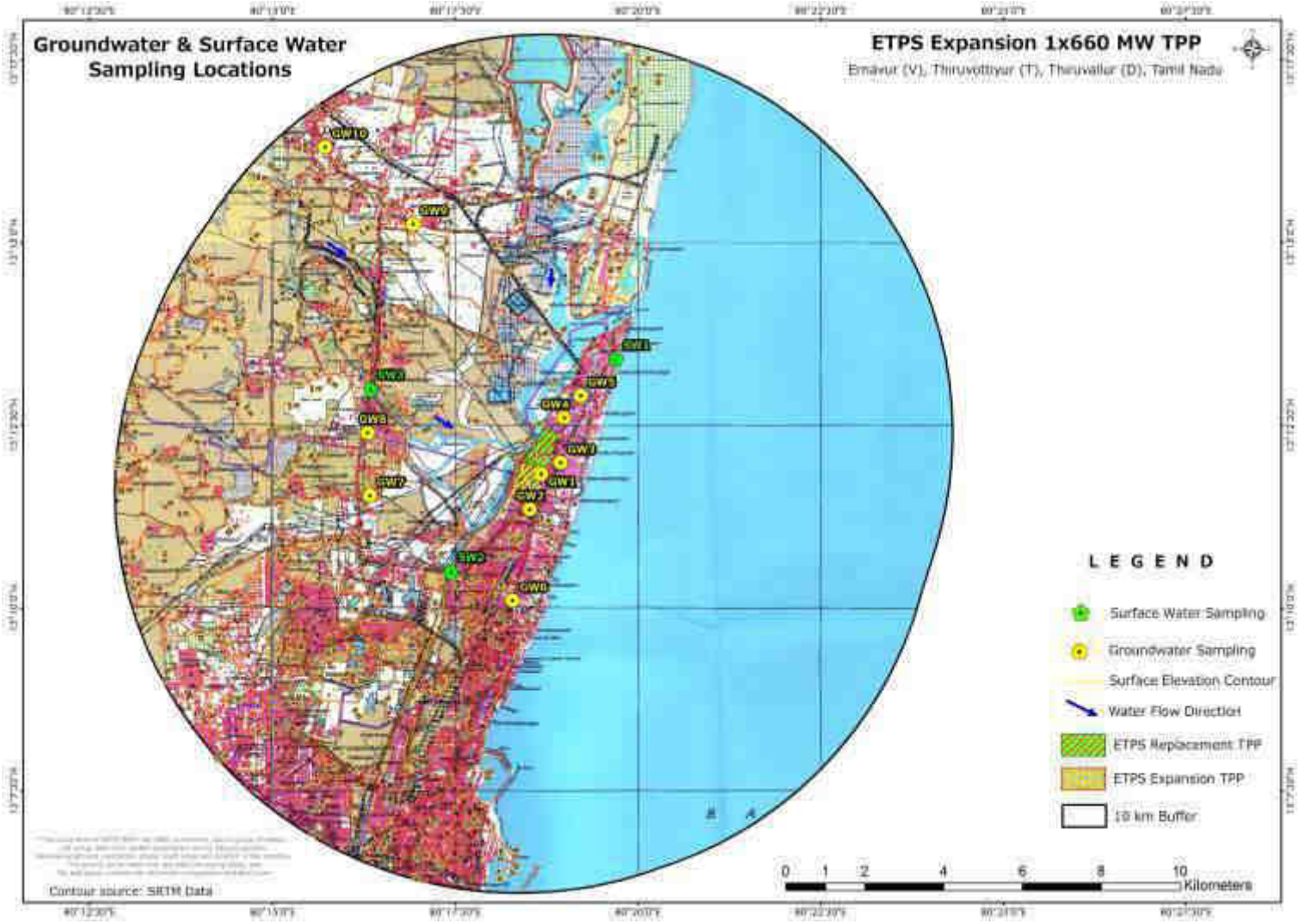


Table 3.8: Water sampling locations

S.No	Locations	Directions wrt site	Distance wrt site(km)	Coordinates		Description & Address
				Latitude	Longitude	
1	Site	-	-	13^0 11’ 49.8’’	80^0 18’ 40.8”	Well water inside the site
2	Ernavur	S	0.3	13^0 11’ 20.9’’	80° 18' 31.2"	Not drinking water, Near vehicle service center
3	Shivakami Nagar	E	0.3	13^0 11’ 59.8’’	80^0 18 56.1”	Hand pump(Not drinking water) inside the ground
4	Kattivakkam	N	0.4	13° 12' 36.1"	80° 18' 59.6"	Bore well(Not drinking water) near Junction
5	Ennore	NNE	1.1	13° 12' 54.2"	80° 19' 13.2"	Bore well(Not drinking water) near bus stand
6	Tiruvottiyur	S	2.6	13° 10' 06.1"	80° 18' 17.3"	Bore well(Not drinking water) Mr.S.V.Raja house
7	Manali New Town	W	3.4	13° 11' 32.2"	80° 16' 20.1"	Bore well(Not drinking water) Mr.G Sudhakar house
8	Ponniamman nagar	W	3.9	13° 12' 23.7"	80° 16' 18.1"	Bore well(Not drinking water) Near Junction
9	Vallur	NW	6.1	13° 15' 18.1"	80° 16' 50.5"	Bore well(Not drinking water) water loading area
10	Minjur	NW	8.9	13° 16' 18.3"	80° 15' 43.2"	Bore well(Not drinking water)
Surface Water						
1	Sea Water	NE	2.3	13° 13' 24.3"	80° 19' 42.2"	Near Ennore Beach
2	Buckingham Canal	SSW	2.4	13° 10' 30.1"	80° 17' 26.5"	Near manali high road
3	Kosasthalaiyar Rive	W	4.4	13^0 12 59.7”	80^0 16 20.4”	Near vichoor village Near Bridge

The water samples collected from the above locations were analyzed for important major and minor ions, and the analytical results of the ground water samples were compared with IS: 10500 - 2012 drinking water standards and the results are shown in **Tables 3.9.**

Table 3.9: Groundwater sample analysis

S. No	Parameter	Unit	Analysis results										Standard as per IS - 10500:2012	
			Ground water											
			GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	Acceptable Limit	Permissible Limit
1	Odour	--	Agreeable										Agreeable	
2	TSS	mg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		
3	pH Value	--	7.2	7.3	7.0	7.1	7.5	7.4	7.4	7.8	7.7	7.2	6.5-8.5	No Relaxation
4	Turbidity	NTU	2.6	8.2	1.1	1.5	5.2	1.5	2.8	7.4	0.8	12	1	5

5	Electrical Conductivity	µS/cm	1939	2025	784	1950	3854	1854	2445	2476	3632	1660	--	--
6	Dissolved Solids	mg/l	1136	1245	462	1355	2545	1212	1660	1456	2132	1125	**500**	**2000**
7	Alkalinity	mg/l	186	254	146	225	512	234	455	550	562	122	**200**	**600**
8	Chloride (as Cl)	mg/l	398	418	120	278	385	265	264	412	762	194	**250**	**1000**
9	Sulphate (as SO_4)	mg/l	186	72	34	326	490	145	218	84	148	255	**200**	**400**
10	Nitrate (as NO_3)	mg/l	2.9	44.8	0.9	4.8	42.8	23.5	13.6	3.6	10.8	8.3	**45**	**No Relaxation**
11	Phosphates	mg/l	0.8	2.8	<0.5	1.5	4.8	2.5	2.5	0.6	1.2	0.8	-	-
12	Total Hardness (as $CaCO_3$)	mg/l	790	508	295	452	457	413	363	607	983	562	**200**	**600**
13	Calcium (as Ca)	mg/l	212	123	68	134	96	102	75	156	240	188	**75**	**200**
14	Magnesium (as Mg)	mg/l	48	48	30	28	52	38	42	52	92	22	**30**	**100**
15	Sodium as Na	mg/l	105	208	80	224	628	205	280	234	342	153	--	--
16	Potassium as K	mg/l	24	23	8	22	54	28	112	32	48	16	--	--
17	Fluoride (as F)	mg/l	1.2	1.4	<0.5	1.2	1.6	0.67	1.2	1.1	0.72	1.3	**1.0**	**1.5**
18	Iron (as Fe)	mg/l	0.39	0.55	0.26	0.24	0.33	0.23	0.23	0.25	0.22	0.32	**0.3**	**No Relaxation**
19	Lead (as Pb)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**	
20	Cadmium (as Cd)	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	**0.003**	
21	Chromium as Cr	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**0.05**	
22	Chromium as Cr^{+6}	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**0.05**	
23	Copper (as Cu)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**0.05**	**1.5**
24	Arsenic as As	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**0.01**	**0.05**
25	Zinc (as Zn)	mg/l	<1	<1	<1	< 1	<1	<1	<1	<1	<1	<1	**5**	**15**
26	Boron as B	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.5**	**1**
27	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.001**	**No Relaxation**

Table 3.10 Surface water sample analysis results

Parameter	Units	SW1	SW2	SW3	IS: 10500-2012	
					Accp. Limit	Per.Limit
pH	---	8.2	8.1	6.9	6.5 – 8.5	No Relaxation
EC	µS/cm	62455	5305	2954	-	-
Odor	-	Unobjectionable			Agreeable	
TDS	mg/l	39417	3072	1850	500	2000
TSS	mg/l	58	285	16.8	-	-
Turbidity	NTU	8.8	30.5	22.2	1	5
Alkalinity as CaCO3	mg/l	525	650	288	200	600
Chloride as Cl-	mg/l	19134	1396	604	250	1000
Sulphate as $SO4^{-2}$	mg/l	2950	224	456	200	400
Nitrates as NO3	mg/l	14.5	18.1	15.6	45	No Relaxation
Phosphates	mg/l	1.2	4.4	5.2	---	---
Total Hardness $caco_3$	mg/l	4817	1907	413	200	600
Calcium as Ca	mg/l	485	526	75	75	200
Magnesium as Mg	mg/l	865	142	54	30	100
Sodium as Na	mg/l	10370	414	520	---	---
Potassium as K	mg/l	660	52	68	---	---
Fluoride as F-	mg/l	0.94	1.4	1.5	1.0	1.5
Iron as Fe	mg/l	0.28	0.85	0.28	1.0	No Relaxation
Lead as Pb	mg/l	<0.01	<0.01	<0.01	0.01	No Relaxation
Cadmium as Cd	mg/l	<0.003	<0.003	<0.003	0.003	No Relaxation
Arsenic as As	mg/l	<0.05	<0.05	<0.05	0.01	0.05
Chromium (as Cr)	mg/l	<0.05	<0.05	<0.05	0.05	No Relaxation
Chromium (as Cr^{+6})	mg/l	<0.05	<0.05	<0.05	0.05	No Relaxation
Boron as B	mg/l	<0.1	<0.1	<0.1	0.5	1.0
Zinc as Zn	mg/l	<1	<1	1.4	5	15
Copper as Cu	mg/l	<0.05	<0.05	<0.05	0.05	1.5
Mercury as Hg	mg/l	<0.001	<0.001	<0.001	0.001	No Relaxation
DO	mg/l	5.8	3.2	3.4	-	-
COD	mg/l	112	382	97	-	-
BOD	mg/l	25	86	18	-	-
E-Coli	MPN/100ml	14	31	25	-	-
Total Coliform	MPN/100ml	280	920	430	-	-

3.6.1. Regional scenario

Ground water

- The pH limit fixed for drinking water samples as per IS: 10500-2012 Standards is 6.5 to 8.5 beyond this range the water will affect the mucus membrane and or water supply system. pH was varying for ground water from **7.0 to 7.8** indicating that all samples are in acceptable limits.

- The acceptable limit for total dissolved solids as per IS: 10500 are 500 mg/l where as the permissible limits in absence of alternate source are 2000 mg/l, beyond this palatability decreases and may cause gastro intestinal irritation. In ground water samples collected from the study area**,** the total dissolved solids are varying from **462 mg/l to 2545 mg/l**. Sample from one location is below acceptable limit, all samples are within the permissible limit.

- The acceptable limit for chloride is 250 mg/l as per IS: 10500 where as the permissible limit of the same is 1000 mg/l beyond this limit taste, corrosion and palatability are affected. The chloride levels in the ground water samples collected in the study were ranging from **120 mg/l to 762 mg/l**. Sample from two location is below acceptable limit all samples are within the permissible limit.

- The acceptable limit as per IS:10500 for hardness is 200 mg/l where as the permissible limit for the same is 600 mg/l beyond this limit encrustation in water supply structure and adverse effects on domestic use will be observed. In the ground water samples collected from the study area, the hardness is varying from **295 mg/l to 983 mg/l**. where the 3 samples are exceeding the permissible limit.

- Fluoride is the other important parameter, which has the accaptable limit of 1 mg/l and permissible limit of 1.5 mg/l. However the optimum content of fluoride in the drinking water is 0.6 to 1.5 mg/l. If the fluoride content is less than 0.6 mg/l it causes dental carries, above 1.5 mg/l it causes staining of tooth enamel, higher concentration in range of 3 - 10 mg/l causes fluorosis. In the ground water samples of study area**,** the fluoride value were in the range of **<0.5 to 1.6 mg/l**.except 1 sample all are with in permissible limit.

Surface water

- pH was varying for ground water from **6.9 to 8.2** indicating that all samples are in acceptable limits.
- The total dissolved solids are varying from **1850 mg/l to 39417 mg/l.**
- The chloride levels in the ground water samples collected in the study were ranging from **604 mg/l to 19134 mg/l**.
- The hardness is varying from **413 mg/l to 4817 mg/l.**

- The fluoride value were in the range of **0.94 to 1.5 mg/l**.

3.7 Noise environment

Noise can be defined as unwanted sound or sound in the wrong place at the wrong time. It can also be defined as any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing or is otherwise annoying. The definition noise as unwanted sound implies that it has an adverse effect on human beings and their environment, including land, structures, and domestic animals. Noise can also disturb natural wildlife and ecological systems.

Sound can be transmitted through gases, liquids, and solids. Noise impacts can be of concern during the construction and the operational phases of projects. Noise should also be considered in relation to present and future land use zoning and policies.

Construction noise can be a significant source of community noise. Of concern are impacts on people near the construction site, who are totally unrelated to construction activities (e.g. area residents, office workers, school children, staff, etc). Factors which are important in determining noise levels that will potentially impact such populations include distance from the noise source, natural or man-made barriers between the source and the impacted population, weather conditions which could potentially absorb, reflect, or focus sound (such as wind speed, direction, temperature inversions), and the scale and intensity of the particular construction phase (excavation, erection, or finishing). The environment/health impacts of noise can vary from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise levels and tolerance levels of individual.

3.7.1 Sources of noise

The main sources of noise in the study area are domestic activities, industrial activities and vehicular traffic.

3.7.2 Noise levels in the study area

Baseline noise levels have been monitored at 10 different locations within the study zone, using Noise Level Meter. Random locations for noise level measurement were identified for assessment of existing noise level status, keeping in view the land use pattern, residential areas in villages, schools, bus stands, etc., the day levels of noise have been monitored during 6 AM to 10 PM and the night levels during 10.0 PM to 6 AM. The noise sampling locations and details of the monitoring locations are given in **Figure 3.4** & **Table 3.11.** The results are presented in **Table 3.12** respectively.

Figure 3.4: Noise sampling locations in the study area

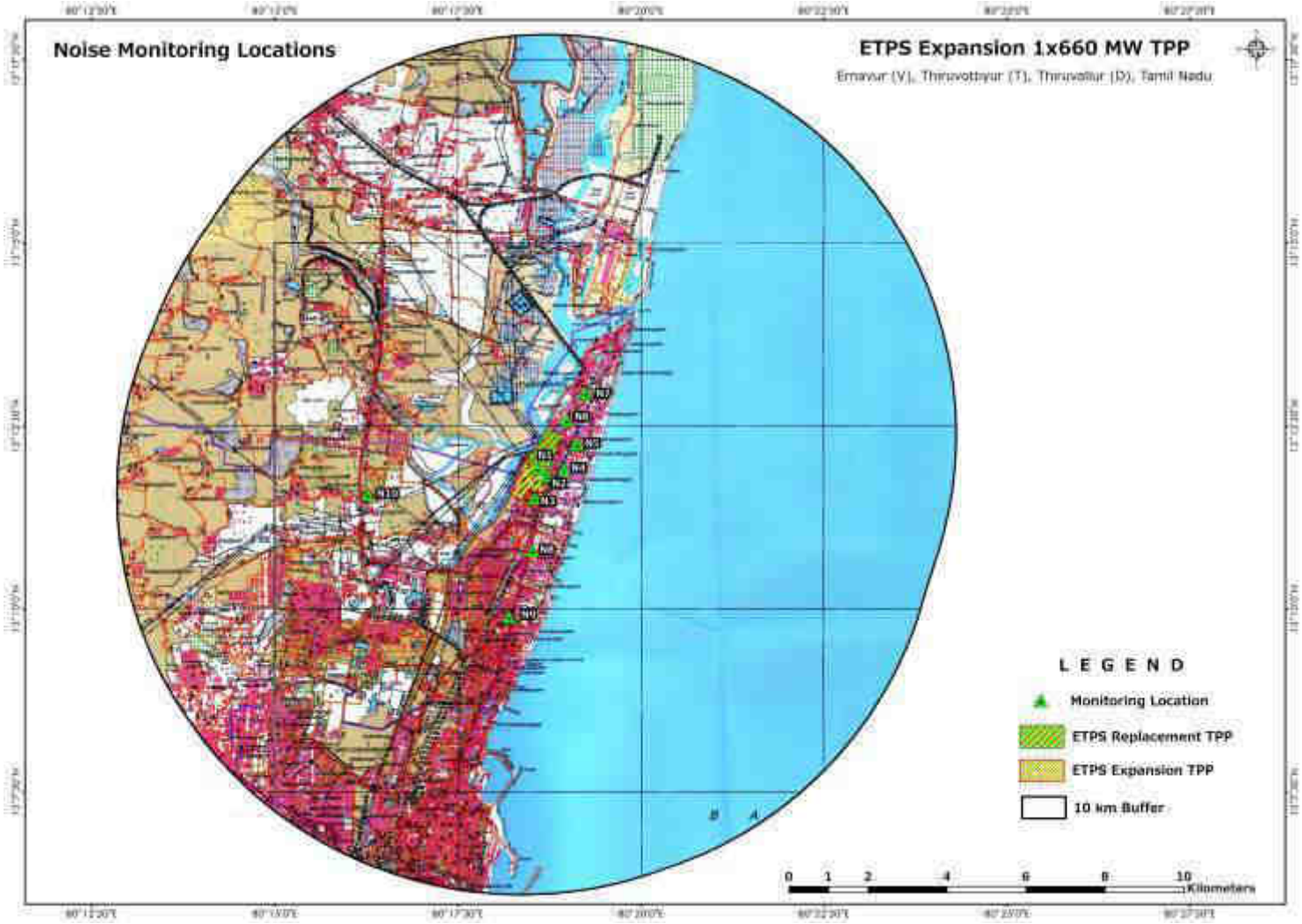


Table 3.11: Noise monitoring locations

Code	Name of the Locations	W.R.T. Site		Latitude (North)	Longitude (East)	Remarks
		Distance (km)	Direction			
N1	ETPS, Site	-	-	13^0 11' 54.9"	80^0 18 35.2"	Inside the site
N2	Near Main gate	-	-	13° 11' 49.6"	80° 18' 43.3"	Near Security Main Gate
N3	Ernavur	0.2	S	13° 11' 31.1"	80^0 18 32.7"	Near S.T.Antony's School.
N4	Shivagami Nagar	0.3	E	13^0 11' 54.4"	80^0 18 57.1'	Near Village Junction and Bridge.
N5	Kattivakam	0.4	E	13° 12' 15.2"	80° 19' 08.1"	Near Temple
N6	Bharath Nagar	0.4	NE	13° 12' 35.2"	80° 18' 59.1"	Near Ashok Leyland
N7	Ennore	1.3	NE	13^0 12' 56.7"	80^0 19 14.7"	Near Bus stand
N8	Wimco Nagar	1.3	SSE	13° 10' 47.8"	80° 18' 30.9"	Near Junction
N9	Thiruvottiyur	3.1	S	13° 9' 53.63"	80° 18' 11.9"	Near village center
N10	Manali New Town	3.5	W	13^0 11 34.1"	80^0 16 16.3"	Near Village Junction

3.7.3 Regional scenario

The noise levels observed in some of the rural areas are primarily owing to vehicular traffic and other anthropogenic activities. In rural areas, wind blowing and chirping of birds would contribute to noise levels especially during the nights.

Noise was monitored at 10 locations within the study area of the project site. The locations were identified for assessment of existing noise level status, keeping in view of the land use pattern, residential areas in villages, schools, bus stands, etc (Industrial: 2 no; Commercial: 2 no; Residential: 4 no; Silent: 2 no). Day equivalent noise levels (dB (A)) are in the range for Industrial area 57.6 to 62.4; Commercial area is 55.7 to 62.2; Residential area is 53.8 to 54.8; Silence zone is 49.8 to 49.9 whereas in night noise levels are in the range for Industrial area 44.1 to 45.3; Commercial area is 43.8 to 44.7; Residential area is 42.8 to 43.5; Silence zone is 39.8 to 39.9. Noise values in the study area are within the Noise Pollution Rules 2000.

Table 3.12: Noise levels in the study area – dB (A)

Hours	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	AAQ Standards in respect of Noise SO 123 (E) dt 14th Feb 2000 – Residential Area	AAQ Standards in respect of Noise SO 123 (E) dt 14th Feb 2000 – Commercial Area	AAQ Standards in respect of Noise SO 123 (E) dt 14th Feb 2000 – Silence Area
	ETPS Site	Near main gate	Ernavur	Shivagami Nagar	Kattivakkam	Bharath Nagar	Ennore	Wico Nagar	Thiruvottiyur	Manali New Town			
1	43.4	42.3	40.1	42.2	40.1	42.3	42.3	41.2	42.2	41.6			
2	44.5	43.5	40.2	43.4	40.2	43.6	44.5	42.6	43.4	42.4			
3	45.5	45.2	40.5	44.1	40.3	45.3	45.7	43.8	45.3	43.3			
4	46.5	46.5	42.3	45.2	42.1	46.3	46.2	43.5	45.5	44.4			
5	47.4	48.9	43.4	46.2	43.2	47.1	46.6	44.5	47.5	45.1			
6	48.8	49.9	45.6	47.8	44.3	49.2	47.6	48.5	47.9	46.8			
7	52.1	52.1	48.3	55.3	48.5	55.4	52.3	51.2	53.4	55.3			
8	56.3	56.6	49.3	57.9	50.3	57.2	56.7	54.5	55.6	56.9			
9	59.7	57.8	52.3	57.5	49.3	59.3	59.2	55.4	56.4	55.4			
10	65.3	63.4	54.2	55.6	50.2	58.2	62.3	56.5	56.1	57.3			
11	66.5	62.3	53.2	57.4	49.3	56.1	64.9	56.4	57.1	55.3			
12	68.4	59.6	49.8	55.4	51.2	57.1	67.1	54.5	54.3	53.4			
13	64.3	58.7	50.1	53.4	50.3	56.2	64.7	55.4	55.7	55.9			
14	64.2	56.4	51.2	56.3	48.7	54.5	62.1	54.3	53.4	56.3			
15	62.3	55.3	48.3	53.9	50.2	55.3	61.7	55.4	54.5	54.9			
16	59.2	57.3	50.2	54.3	51.2	55.9	63.9	52.3	55.6	55.9			
17	60.3	56.3	48.9	55.3	52.3	57.1	65.2	51.2	56.4	54.9			
18	62.1	55.1	47.5	53.6	52.3	54.9	62.9	54.3	54.3	52.7			
19	58.4	53.4	46.5	52.3	49.3	52.5	59.3	52.1	52.3	52.9			
20	56.3	48.6	46.1	49.3	47.5	50.4	56.3	49.3	50.4	51.9			
21	47.4	46.3	44.7	47.1	45.4	49.5	49.1	46.4	47.3	48.2			
22	46.5	45.3	41.2	45.6	41.2	45.1	47.6	45.4	44.7	45.3			
23	47.8	44.8	40.1	44.2	39.9	44.2	45.3	43.4	43.2	44.7			
24	45.3	43.5	38.3	43.2	38.6	42.5	43.6	42.3	41.2	42.9			
Min	**43.4**	**42.3**	**38.3**	**42.2**	**38.6**	**42.3**	**42.3**	**41.2**	**41.2**	**41.6**			
Max	**68.4**	**63.4**	**54.2**	**57.9**	**52.3**	**59.3**	**67.1**	**56.5**	**57.1**	**57.3**			
Lday	**62.4**	**57.6**	**49.9**	**54.8**	**49.8**	**55.7**	**62.2**	**53.8**	**54.5**	**54.7**	**55**	**65**	**50**
Lnight	**45.3**	**44.1**	**39.9**	**43.5**	**39.8**	**43.8**	**44.7**	**42.8**	**43.3**	**43.1**	**45**	**55**	**40**

3.8 Traffic study

The automobile sources are the major sources of air pollutant emissions in many air quality impact analyses. A traffic study is required for the no-build alternative as well as the build-out alternative. This information is required to assess the traffic density pattern of the region and to assist the proponent in planning vehicular movement during the project and the air quality due to vehicular emissions for the study period, should the project not be implemented whereas the latter information is required to assess the air quality for the study period should the project be implemented.

Anthropogenic emissions not only contribute to the green house effect but also participate in the reaction that results in photochemical oxidants. The effect of photochemical oxidants is well known for forming smog particularly in the urban areas.

Among the anthropogenic sources of pollutants forming the green house gases, burning of fossil fuels constitute a major source. Highway mobile sources that contribute significantly to poor quality have been regulated for the past two decades in countries like India. The absence of regulation in developing countries has caused a global concern regarding potential environmental damage on a larger scale.

In countries like India automobiles especially two-wheelers are a very popular mode of personal transport for socio-economic reasons. They constitute to about 70-95% of the total passenger's vehicles. About the same percentage of two-wheeler vehicles are powered by two-stroke engines because of low initial and maintenance costs. However these two stroke engines have high emission levels which are of the major concern. Moreover, these emissions are concentrated in urban area, further contributing to already polluted "heat islands". Poor public transportation and high transportation fares, increasing cost of living and greater demand for mobility may be attributed to a surge in the number of personal vehicles during the last decade.

The objective of traffic study and emission quantification is to assess the magnitude of the emissions resulting from two-wheelers, three wheelers, and four wheelers that are extensively used as a means of common transport within the urban areas.

A detailed traffic survey was conducted in the study area during baseline data generation at 2 major traffic intersections in order to arrive at the traffic density in the study area and also to evaluate the impacts of the increased traffic due to the proposed activity. Vehicular emissions are the major source of air quality impacts in the study area. The principal cause of air pollution during the construction phase is the diesel-powered vehicles used in haulage of aggregates, earth and other construction material. Air quality could be affected by dust & particulate matter arising due to site clearing, vehicular emissions etc. Gaseous emissions like sulphur dioxide, nitrous oxide, CO and HC might be released from the vehicular movement, which has a direct impact on the environment.

Increase in the traffic in the study area has a direct impact on the resources as a heavy release of automobile exhaust is envisaged which has a direct impact on the air quality and the ambient noise levels in the study area.

The methodology adopted for carrying out the traffic study was to select the major roads around the project site and count the various categories of vehicles moving on these roads. The traffic survey was carried out on the approach roads to the project from the Ernavur village road this road connected to Manali new express highway.

The traffic study details and various categories of vehicles moving on the roads are given in **Table 3.13 & 3.14**.

Table 3.13: Ernavur village road (To & Fro)

Hours	Two wheeler		Three Wheeler		Passenger Car,Pick-up Van		Heavy commercial Vehicles (HCV)		Total vehicles	
	v/hr	PCU/hr	v/hr	PCU/hr	v/hr	PCU/hr	v/hr	PCU/hr	Total	Total PCU's / hr
06-07 am	112	84	50	100	44	44	48	178	**254**	**406**
07-08 am	152	114	66	132	70	70	72	266	**360**	**582**
08-09 am	184	138	73	146	94	94	78	289	**429**	**667**
09-10 am	190	143	80	160	103	103	80	296	**453**	**702**
10-11 am	175	131	76	152	112	112	75	278	**438**	**673**
11-12 pm	164	123	64	128	87	87	60	222	**375**	**560**
12-01 pm	156	117	65	130	82	82	53	196	**356**	**525**
01-02 pm	152	114	58	116	74	74	48	178	**332**	**482**
02-03 pm	143	107	50	100	68	68	45	167	**306**	**442**
03-04 pm	126	95	43	86	58	58	47	174	**274**	**412**
04-05 pm	134	101	58	116	69	69	52	192	**313**	**478**
05-06 pm	183	137	69	138	79	79	69	255	**400**	**610**
06-07 pm	174	36	62	124	83	83	70	259	**389**	**502**
07-08 pm	155	116	55	110	73	73	64	237	**347**	**536**
08-09pm	162	122	46	92	62	62	51	189	**321**	**464**
09-10pm	128	96	35	70	51	51	41	152	**255**	**369**
10-11pm	118	89	32	64	36	36	34	126	**220**	**314**
The highest peak observed is 702 PCU/hr during 9 am to 10 am (worst case)										
Total width of the Road in meters (Sub Arterial Road)										**7**
Carrying capacity of the road (the road is 2 lane 2 way road) As per IRC:106-1990 (PCU's per hour)										**1200**
Existing V/C Ratio										**0.58**
LOS=Level of Service (Existing)										**"C"**

Indicators for LOS			
V/C	**LOS**	**Performance**	**Description**
<0.60	A	Excellent	Highest drive comfort, free flowing
0.60-0.70	B	Very good	Highest drive comfort, little delay
0.70-0.80	**C**	**Good**	Aceptable level of drive comfort, some delay
0.80-0.90	D	Fair/Average	Some driver frustration, moderate delay
0.90-1.00	E	Poor	High level of driver frustration, high levels of delay
>1.00	F	Very poor	High level of driver frustration, excessive delays

Note: *As per IRC Guidelines 1990

Table 3.14: New manali express road (To & Fro)

Hours	Two wheeler		Three Wheeler		Passenger Car,Pick-up Vans		Heavy commercial Vehicles (HCV)		Total vehicles	
	v/hr	PCU/hr	v/hr	PCU/hr	v/hr	PCU/hr	v/hr	PCU/hr	Total	Total PCU's / hr
06-07 am	372	279	156	312	213	213	245	907	**986**	**1711**
07-08 am	553	415	213	426	264	264	293	1084	**1323**	**2189**
08-09 am	745	559	265	530	273	273	374	1384	**1657**	**2746**
09-10 am	860	645	342	684	322	322	435	1610	**1959**	**3261**
10-11 am	940	705	389	778	343	343	445	1647	**2117**	**3473**
11-12 pm	855	641	299	598	295	295	422	1561	**1871**	**3096**
12-01 pm	848	636	345	690	270	270	378	1399	**1841**	**2995**
01-02 pm	836	627	325	650	223	223	388	1436	**1772**	**2936**
02-03 pm	723	542	354	708	243	243	360	1332	**1680**	**2825**
03-04 pm	636	477	331	662	210	210	341	1262	**1518**	**2611**
04-05 pm	688	516	354	708	240	240	362	1339	**1644**	**2803**
05-06 pm	789	592	372	744	265	265	375	1388	**1801**	**2988**
06-07 pm	852	36	312	624	248	248	412	1524	**1824**	**2432**
07-08 pm	812	609	263	526	189	189	371	1373	**1635**	**2697**
08-09pm	653	490	153	306	176	176	332	1228	**1314**	**2200**
09-10pm	412	309	142	284	177	177	292	1080	**1023**	**1850**
10-11pm	314	236	112	224	152	152	201	744	**779**	**1355**
The highest peak observed is 3473 PCU/hr during 10am to 11 am (worst case)										
Total width of the Road in meters (Arterial Road)										**20**
Carrying capacity of the road (the road is 4 lane Divided 2 way road) As per IRC:106-1990 (PCU's per hour)										**3600**
Existing V/C Ratio										**0.96**
LOS=Level of Service (Existing)										**"E"**
Indicators for LOS										

V/C	LOS	Performance	Description
<0.60	A	Excellent	Highest drive comfort, free flowing
0.60-0.70	B	Very good	Highest drive comfort, little delay
0.70-0.80	**C**	**Good**	Aceptable level of drive comfort, some delay
0.80-0.90	D	Fair/Average	Some driver frustration, moderate delay
0.90-1.00	E	Poor	High level of driver frustration, high levels of delay
>1.00	F	Very poor	High level of driver frustration, excessive delays

3.8.1 Volume count

The volume count surveys have been conducted at 2 locations at New Manali Express Road & Ernavur Village Road.The traffic volume counts were conducted for 17 hours (from 6: 00 AM to 23:00 PM on the day) in three shifts at these locations at specific point. Manual count method was adopted for vehicular counts. At every one hour interval, the number and category of vehicles passing through each arm of the intersection were recorded in the survey form. The vehicle count values are given in the **Table 3.13 & 3.14.**

From the above table it can be understood that the road corridors in the study area has a medium to heavy traffic flow. This traffic corridor is the main source of communication and transportation for its proximity to the major highway and commercial areas in this locality.

As per the IRC: 106 -1990 recommendations a 2 way, 2 lane road (sub arterial road) can accommodate 1200 PCUs per hour. On Ernavur village road as per our traffic survey the no. of PCUs expected during peak hour are 702 PCUs. The existing road is 7.0 m width road and the road capacity is within the IRC standards for Sub Arterial roads.

As per the IRC: 106 -1990(PCU's per hour) recommendations a 4 lane divided, 2 way road (Arterial road) can accommodate 3600 PCUs per hour. The New Manali Express Road as per our traffic survey the no. of PCUs expected during peak hour are 3473 PCUs.which shows the LOS "E" category. The existing road is 40.0 m width road and the road capacity is within the IRC standards for Arterial roads. However the roads which are designed are well the movement of the three wheelers, trucks and Heavy vehicles.

3.9 Soil quality

The present study on soil quality establishes the baseline characteristics in the study area surrounding the project site. The study has been addressed with the following objectives.

- To determine the base line characteristics
- To determine the soil characteristics of proposed project site.
- To determine the impact of industrialization/urbanization on soil characteristics
- To determine the impacts on soils from agricultural productivity point of view.

3.9.1 Criteria adopted for selection of sampling locations

For studying soil characteristics, 9 sampling locations were selected to assess the existing soil conditions representing various land use conditions and geological features.

The homogenized soil samples collected at different locations were packed in a polyethylene plastic bag and sealed. The sealed samples were sent to laboratory for analysis. The important physical, chemical parameter concentrations were determined from all samples.

3.9.2 Methodology and sampling

The homogenized soil samples collected at different locations were packed in a polyethylene plastic bag and sealed. The sealed samples were sent to laboratory for analysis. The important physical, chemical parameter concentrations were determined from all samples. The soil sampling locations and details of the monitoring locations are given in **Figure 3.5** & **Table 3.15** and soil results are given in **Table 3.16**.

Table 3.15: Soil sampling locations

Code	Name of the Locations	W.R.T.Site		Latitude (North)	Longitude (East)	Source	Address
		Distance (km)	Direction				
S1	Site	-	-	13^0 11’ 52.8”	80^0 18’ 34.9”	Barren Land	Inside the Site
S2	Ernavur	0.3	S	13^0 11’ 21.7”	80^0 18’ 34.1”	Barren Land	Near Ashok Leyland
S3	Shivakami Nagar	0.4	E	13^0 11’ 58.6”	80^0 18’ 55.1”	Barren Land	Near village ground
S4	Ennore	1.2	NE	13^0 12’ 57.5”	80^0 19’ 15.9”	Barren Land	Near village main road
S5	Wimco Nagar	1.3	S	13° 10' 47.8"	80° 18' 28.8"	Barren Land	Near bridge
S6	Near Ash Pond	2.1	W	13° 12' 33.0"	80° 17' 28.0"	Barren Land	Ash pond
S7	Manali Newtown	3.4	W	13° 11' 31.7"	80° 16' 20.7"	Barren Land	Near Junction
S8	Ponniamman Nagar	3.8	W	13° 12' 22.6"	80° 16' 18.7"	Barren Land	Near Village road
S9	Nappalaiyam	3.9	NW	13° 13' 27.4"	80° 16' 49.6"	Barren Land	Near Village road

Figure 3.5: Soil sampling locations in the study area

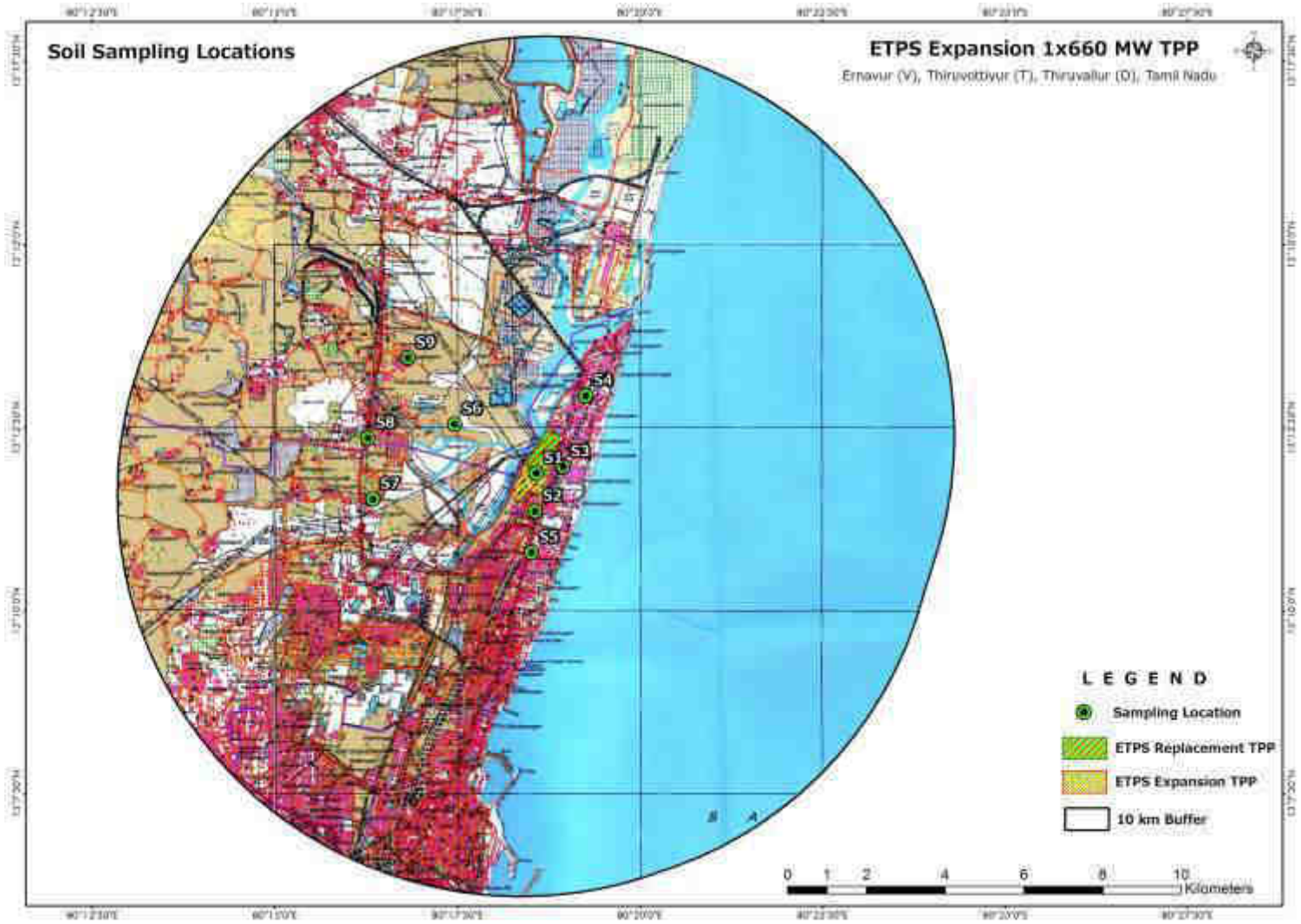


Table 3.16: Soil analysis results

Parameters	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9	Standard Soil Classification – (Indian Council of Agricultural Research, New Delhi
Texture	--	Clay loam									-
pH (1:5 Extraction)	--	8.1	7.6	7.4	8.4	6.9	7.7	7.6	7.1	7.2	Acidic<6.0, Normal to Saline 6.0-8.5, Tending to become Alkaline 8.6 to 9.0, Alkaline above 9.
EC (1:5 Extraction)	µS/cm	134	121	387	116	144	135	111	138	145	Normal<1000, Critical for germination 1000-2000, Critical for growing 2000 - 4000, Injurious to most crops>4000
Organic Carbon	%	0.42	0.52	0.48	0.52	0.28	0.18	0.42	0.54	0.45	Low < 0.5 , Medium 0.5 – 0.75, High > 0.75
Bulk density	gr/cc	1.55	1.28	1.58	1.26	1.84	1.54	1.17	1.22	1.54	-
Moisture content	%	4.5	3.8	2.9	3.2	4.1	3.8	3.7	2.9	5.2	
Available Nitrogen as N	kg/Ha	61.6	70.0	64.3	58.8	67.1	45.4	61.6	78.3	72.5	Low below 280, Medium 280-560, High above 560
Available Potassium as K	kg/Ha	106	223	280	179	72	65.5	230	256	125	Low below 110, Medium 110-280 High above 280
Available Phosphorus as P	kg/Ha	6.49	18.2	22.6	12.9	13.1	5.8	4.01	22.8	12.7	Low below 10, Medium 10-25,High above 25
Chloride as Cl	mg/kg	144	1586	480	96	192	384	822	1302	112	-
Sulphur	%	0.23	0.18	0.28	0.34	0.22	0.56	0.32	0.25	0.15	-
Iron as Fe	mg/kg	5610	3575	1480	5910	1289	2455	6208	4800	3113	-
Zinc as Zn	mg/kg	94.7	23.6	22.9	82.7	4.65	34.5	27.1	71.1	34.5	-

3.9.3 Regional scenario

The soil analysis results are shown in **Table 3.16.** The analytical results of the soil samples collected during the study period are summarized below.

- The pH of the soil is an important property, plants cannot grow in low and high pH value soils. The normal range of the soils in 6.0 to 8.5 is called as normal to saline soils. Most of the essential nutrients like N, P and K are available for plant at the neutral pH range. The pH in the study area is ranging from **6.9 to 8.4** indicating that soils falling under normal category.

- Based on the electrical conductivity, the soils are classified into 4 groups (Normal, Critical for germination, Critical for growth of the sensitive crops, Injurious to most crops). The electrical conductivity in the study area is ranging from **111 to 387 µs/cm** indicating that soils falling under normal category.

- The organic carbon influences the soil in respect to color, physical properties, supply of available nutrients and absorptive capacity. The main source of soil organic carbon is plant tissue while animals are the subsidiary source. Though organic carbon is a small part of mineral soils, it plays a vital role in the productivity and conditioning of soils. It serves as source of food for soil bacteria and fungi which are responsible for converting complex organic materials into simple substances readily used by the plants. In association with clay and calcium, it helps to form the aggregates of soil particles to produce the crumb structure.The organic carbon in the study area is ranging from **0.42 % to 0.54 %** which indicating that the 6 samples are in low range and 3 samples are in medium range.

- The other important parameters for characterization of soil for irrigation are N,P,K. Nitrogen, Phosphorus and Potassium are known as primary nutrients, Calcium, Magnesium and Sulphur as secondary nutrients. The primary and secondary nutrient elements are known as major elements. This classification is based on their relative abundance, and not on their relative importance.

- Available Nitrogen encourages the vegetative development of plants by imparting a healthy green colour to the leaves. It also controls, to some extent, the efficient utilization of phosphorus and potassium. Its deficiency retards growth and root development, turns the foliage yellowish or pale green, hastens maturity, causes the shriveling of grains and lowers crop yield. Excess nitrogen produces leathery and sometimes crinkled and dark green leaves with succulent growth. It also delays the maturation of plants, impairs the quality of crops like barley, potato, tobacco, sugarcane and fruits and increases susceptibility to diseases and causes”lodging” of cereal crops by inducing an undue lengthening of the stem internodes.The available Nitrogen as N in

the study area is ranging from **45.4 to 78.3 kg/ha** which indicates that all samples are in Low range.

- Available Phosphorus influences the vigor of plants and improves the quality of crops. It encourages the formation of new cells, promotes root growth (particularly the development of fibrous roots), and hastens leaf development, formation of grains, and the maturation of crops. It also increases resistance to disease and strengthens the stems of cereal plants, thus reducing their tendency to lodge. If phosphorus is deficient in the soil, plants fail to make a quick start, do not develop a satisfactory root-system, remain stunted and sometimes develop a tendency to show a reddish or purplish discoloration of the stem and foliage. In the study area available Phosphorus is ranging from **4.01 to 22.8 kg/ha** which indicates that the 3 samples are falling low range , 6 samples are in medium range.

- Available Potassium enhances the ability of the plants to resist diseases, insect attacks, and cold and other adverse conditions. It plays an essential part in the formation of starch and in the production and translocation of sugars, and is thus of special value to carbohydrate rich crops, e.g. sugarcane, potato and sugar beet. The increased production of starch and sugar in legumes fertilized with potash benefits the symbiotic bacteria and enhances the fixation of nitrogen. Vegetables and legumes are particularly heavy consumers of potassium. Deficiency of potassium produces the characteristic ringing of alfalfa leaves, reddish brown discoloration of cotton leaves, curbing of leaf margins of potato, and intraveinal chlorosis and flaring of maize leaves. The available potassium in the study area is ranging between **65.5 to 256 kg/ha** which indicates that the 3 samples are falling low range and remaining 6 are in medium range.

3.10 Biological environment

3.10.1 Introduction

An ecological survey of the study area was conducted particularly with reference to recording the existing biological resources in the study area. Ecological studies are one of the important aspects of environmental impact assessment with a view to conserve environmental quality and biodiversity. The present objective is to study an area 10 km radius from the proposed project site. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the abiotic components viz. physical and chemical components of the environment.

Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important in environmental impact assessment for

safety of natural flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

The animal and plant communities co-exist in a well-organized manner. Their natural settings can get disturbed by any externally induced anthropological activities or by naturally occurring calamities or disaster. So, once this setting is disturbed, it sometimes is either practically impossible or may take a longer time to come back to its original state. Hence, changes in the status of flora and fauna are an elementary requirement of Environmental Impact Assessment studies, in view of the need for conservation of environmental quality and biodiversity. Information on flora and fauna was collected within the study area. Relevant details on aquatic life within the study area were collected from related government offices.

3.10.2 Terrestrial ecology

3.10.2.1 Objectives of ecological study

The objectives of the present study are intended to:

- Generate baseline data from field observations from various terrestrial and aquatic ecosystems;
- Compare the data so generated with authentic past records to understand changes; and
- Characterize the environmental components like land, water, flora and fauna.

3.10.2.2 Methods adopted for the study

To accomplish the above objectives, a general ecological survey covering an area of 10 km radius from the proposed project boundary was done as follows:

- Reconnaissance survey for selection of sampling sites in and around the site on the basis of meteorological conditions;
- Generation of primary data to understand baseline ecological status, important floristic elements;
- Generation of primary data to understand baseline fauna structure; and
- Collection of secondary data from forest working plan and gazetteers.

3.10.2.3 Criteria adopted for selection of sampling locations

Reconnaissance survey was conducted to identify the phyto-sociological sampling locations on the basis of following citeria:

- Proximity to the proposed TPP;
- Downwind direction of the proposed TPP ; and
- Upwind direction of the proposed TPP.

3.10.3 Review of secondary data and environmental setting of the project site

With reference to the vegetation of the district, forests occupy 5.8% of the total area. The total extent of reserved forests and reserve lands are 19791 ha protected by this division. About 1800 ha of reserve lands, notified under section 26 of Tamil Nadu forest act is also under active consideration for declaration of reserve forest.

It has different types of forest vegetation's such as thron, dry green forests, dry deciduous forests, and scrub jungles. Dry deciduous & shrub type of forests is observed the study area. Natural factors include factors such as the altitude, the soil conditions, the quantity and regularity of the rainfall.

3.10.4 Terrestrial vegetation and flora of the core zone

It is an expansion project within the existing ETPS thermal power plant boundary and the construction work was under progress at site. There are no national parks / wildlife sanctuaries /reserve forests within 10 Km radius of the project site. It is away from the sea coast of Bay of Bengal by about 815m. When the existing thermal power plant was set up prior to 1994, development of typical industrial greenbelt on all sides in an area of at least 33% of the total plant area with a density of 1500 to 2000 trees per hectare was not mandatory. Though the ETPS has grown avenue trees along the internal roads and around the buildings and offices, typical industrial greenbelt does not exist except towards the sourthern side. The core area is under the usage of power plant and sparsely covered by few shrubs and some trees like Subabul (*Leucaena leucocephala*) and Neem (*Azadirachta indica*) there are large trees of Neem *(Azadirachta indica*, Peepal (*Ficus religiosa*) and Banyan *(Ficus benghalensis)* are grown in high density along the northern boundary & scattered all over but their density is not more about 50 trees per hectare. Along with the aforesaid trees, there are other plants as listed in **Table 3.17 and 3.18.**

A list of trees and ornamentals grown currently within the premises of the ETPS ccomplex is given in **Table 3.17.**

Table 3.17: List of trees, shrubs and perennial climbers grown / growing in the project site.

Botanical name	Common / local name	Family
Acaia auriculiformis	Australian wattle	Mimosaceae
Acalypha wilkesiana	Garden Acalypha	Euphorbaceae
Achras sapota	Sapodilla	Sapotaceae
Albizia lebbeck	Siris / Vagai	Mimosaceae
Allamanda cathartica	Golden Trumpet Wine	Apocynaceae
Alstonia scholaris	Indian Tree of Heaven	Apocynaceae
Araucaria columnaris	Christamas tree	Araucariaceae
Artocarpus heterophyllus	Jackfruit	Moraceae
Azadirachta indica	Neem	Meliaceae

Botanical name	Common / local name	Family
Bambusa vulgaris	Yellow Bamboo	Poaceae
Bauhinia racemosa	Atti / Tataki	Caesalpiniaceae
Bauhinia variegate	Kachnar	Caesalpiniaceae
Bombax malabaricum	Silk cotton tree	Bombacaceae
Borassus flabellifer	Palmyra palm	Arecaeae
Bougainvillea spectabilis	Bougainvillea	Nyctaginaceae
Caesalpinia pulcherrima	Peacock Flower	Caesalpiniaceae
Callistemon lanceolatus	Bottle brush tree	Myrtaceae
Calotropis gigantean	Erukku	Asclepiadaceae
Calotropis procera	Sodom Apple	Asclepiadaceae
Carica papaya	Papaya	Caricaceae
Caryota urens	Fishtail Palm	Arecaceae
Cascabela thevetia	Yellow Oleander	Apocynaceae
Cassia fistula	Golden Shower Cassia	Caesalpiniaceae
Cassia siamea	Siamese Cassia	Caesalpiniaceae
Chamaedorea sefritzii	Bamboo palm	Arecaceae
Chromolaena odorata	Siam weed	Asteraceae
Clerodendrum inerme	Glory tree	Verbenaceae
Cocos nucifera	Coconut	Arecaceae
Codiaeum variegatum	Croton	Euphorbiaceae
Cordia sebestena	Scarlet Cassia	Boraginaceae
Cycas revolute	Sago palm	Cycadaceae
Daemia extensa	Juttuve	Asclepiadaceae
Delonix elata	Gulmohar	Caesalpiniaceae
Dendrocalamus strictus	Bamboo	Poaceae
Duranta repens	Golden Duranta	Verbenaceae
Dypsis lutescens	Areca palm	Arecaceae
Erythrina suberosa	Corky coral tree	Fabaceae
Eucalyptus tereticornis	Red Gum	Myrtaceae
Ficus benghalensis	Banyan tree	Moraceae
Ficus benjamina	Weeping fig	Moraceae
Ficus elastic	Rubber plant	Moraceae
Ficus religiosa	Peepal	Moraceae
Hibiscus rosasinenis	China Rose	Malvaceae
Hyophorbe lagenicaulis	Bottle palm	Arecaceae
Ipomoea carnea	Pink Morning glory	Convolvulaceae
Jacaranda mimosaefolia	Jacaranda	Mimosaceae
Lagerstroemia parviflora	Common crape myrtle	Lythraceae
Lantana camara	Lantana	Verbenaceae
Leucaena leucocephala	Subabul	Mimosaceae
Mangifera indica	Mango	Anacardiaceae
Mimusops elengi	Spanish Cherry	Sapotaceae
Muntingia calabura	Singapore cherry	Muntingiaceae
Musa paradisiaca	Banana	Musaceae

Botanical name	Common / local name	Family
Nerium odorum	Nerium	Apocynaceae
Pedilanthus tithymaloides	Slipper surge	Euphorbiaceae
Peltophorum pterocarpum	Copper pod	Caesalpiniaceae
Phoenix sylvestris	Wild date	Aesthetic
Phyllanthus acidus	Star Gooseberry	Euphorbiaceae
Phyllanthus emblica	Indian Gooseberry	Euphorbiaceae
Pithecellobium dulce	Seema hunase	Mimosaceae
Plumeria alba	Kaadusampige	Apocynacae
Plumeria rubra	Kaadusampige	Apocynacae
Polyalthia longifolia	Ashok	Annonaceae
Polyalthia pendula	Ashok	Annonaceae
Pongamia pinnata	Punnai	Fabaceae
Prosopis juliflora	Mesquite	Mimosaceae
Psidium guajava	Guava	Myrtaceace
Quisqualis indica	Rangoon Creeper	Combretaceae
Roystonea regia	Royal palm	Arecaceae
Samanea saman	Rain Tree	Mimosaceae
Spathodea companulata	African tulip tree	Bignoniaceae
Sterculia foetida	Wild almond	Sterculiaceae
Syzygium cumini	Jamun /Naaval	Myrtaceae
Tamarindus indica	Tamarind	Caesalpiniaceae
Tectona grandis	Teak / Tekku	Verbenaceae
Terminalia arjuna	Arjun	Combretaceae
Terminalia catappa	Almond	Combretaceae
Thespesia populnea	Portia tree	Malvaceae
Vitex negundo	Nocchi	Verbenaceae
Wattakaka volubilis	Sneeze Wort	Asclepiadaceae
Wodyetia bifurcate	Fox tail palm	Arecaceae

A list of herbs and herbaceous species found in the core area & in buffer zone is given in **Table 3.18.**

Table 3.18: List of herbs and herbaceous species found in the core area & in buffer zone

Scientific name	Family
Abutilon indicum	Malvaceae
Acalypha indica	Euphorbiaceae
Acalypha lanceolata	Euphorbiaceae
Achyranthes aspera	Amaranthaceae
Aerva lanata	Amaranthaceae
Aerva tomentosa	Amaranthaceae
Ageratum conyzoides	Asteraceae
Alternanthera pungens	Amaranthaceae

Scientific name	Family
Alternanthera philoxeroides	Amaranthaceae
Alternanthera sessilis	Amaranthaceae
Alternanthera triandra	Amaranthaceae
Alysicarpus monilifer	Fabaceae
Ammania baccifera	Lythraceae
Andrographis echinoides	Acanthaceae
Apluda mutica	Poaceae
Argemone Mexicana	Papaveraceae
Asystasia gangetica	Acanthaceae
Blepharis maderaspatensis	Acanthaceae
Blepharis repens	Acanthaceae
Blumea lacera	Asteraceae
Boerhavia chinensis	Nycataginaceae
Boerhavia erecta	Nyctaginaceae
Cassia occidentalis	Caesalpiniaceae
Cassia tora	Caesalpiniaceae
Cenchrus ciliaris	Poaceae
Cenchrus setifgera	Poaceae
Chloris barbata	Poaceae
Chrozophora rottleri	Euphorbiaceae
Chrysopogon fulvus	Poaceae
Cleome gynandra	Cleomaceae
Cleome viscosa	Cleomaceae
Crotalaria medicaginea	Fabaceae
Crotalaria verrucosa	Fabaceae
Croton bonplandianum	Euphorbiaceae
Cuscuta reflexa	Cuscutaceae
Cyanodon dactylon	Poaceae
Cymbopogon caesius	Poaceae
Cymbopogon coloratus	Poaceae
Cynodon dactylon	Poaceae
Cyperus rotundus	Cyperaceae
Cyperus triceps	Cyperaceae
Dactyloctenium aegyptium	Poaceae
Datura alba	Solanaceae
Datura metel	Solanaceae
Desmodium triflorum	Fabaceae
Dichanthium annulatum	Poaceae

Scientific name	Family
Digera muricata	Amaranthaceae
Digitaria bicornis	Poaceae
Digitaria setacea	Poaceae
Echinops echinatus	Asteraceae
Eclipta alba	Asteraceae
Eclipta prostrate	Asteraceae
Eragrostis tenella	Poaceae
Eremopogon foveolatus	Poaceae
Euphorbia hirta	Euphorbiaceae
Euphorbia thymifolia	Euphorbiaceae
Evolvulus alsinoides	Convolvulaceae
Gomphrena globosa	Amaranthaceae
Hedyotis corymbosa	Rubiaceae
Hedyotis puberula	Rubiaceae
Heliotropium indicum	Boraginaceae
Hyptis suaveolens	Labiatae
Ischaemum rugosum	Poaceae
Justicia diffusa	Acanthaceae
Kyllinga triceps	Cyperaceae
Leucas aspera	Lamiaceae
Leucas indica	Lamiaceae
Leucas longifolia	Lamiaceae
Lippia nodiflora	Verbenaceae
Malvastrum coramandelianum	Malvaceae
Merremia emerginata	Convolvulaceae
Merremia gangetca	Convolvulaceae
Merremia tridentate	Convolvulacee
Mollugo hirta	Aizoaceae
Ocimum americanum	Lamiaceae
Ocimum basilicum	Lamiaceae
Ocimum canum	Lamiaceae
Ocimum sanctum	Lamiaceae
Oldenlandia herbacea	Rubiaceae
Oldenlandia umbellate	Convolvulaceae
Oldenlandiua corymbosa	Rubiaceae
Oxalis corniculata	Oxalidaceae
Panicum psilopodium	Poaceae

Scientific name	Family
Panicum repens	Poaceae
Parthenium hysterophorus	Asteraceae
Peristrophe bicalyculata	Acanthaceae
Phyllanthus niruri	Euphorbiaceae
Physalis minima	Solanaceae
Polygala arvensis	Polygalaceae
Polygala erioptera	Polygalaceae
Portulaca oleracea	Portulaccaceae
Saccharum munja	Poaceae
Saccharum officinarum	Poaceae
Scilla hyacinthine	Liliaceae
Senna uniflora	Caesalipiniaceae
Sida acuta	Malvaceae
Sida cordifolia	Malvaceae
Sida orientalis	Malvaceae
Sida rhombifolia	Malvaceae
Sida vernonicaefolia	Malvaceae
Solanum nigrum	Solanaceae
Solanum surattense	Solanaceae
Spermacoce hispida	Rubiaceae
Spermacoce articularis	Rubiaceae
Spermacoce stricta	Rubiaceae
Stachytarpeta indica	Verbenaceae
Themeda ciliate	Poaceae
Themeda quadrivalvis	Poaceae
Tragus biflorus	Poaceae
Trianthema decandra	Aizoaceae
Trianthema portulacastrum	Aizoaceae
Tribulus terrestris	Zygophyllaceae
Tridax procumbens	Asteraceae
Trigonella corniculata	Fabaceae
Vernonia cinerea	Asteraceae
Xanthium strumarium	Asteraceae
Zornia gobbosa	Asteraceae

3.10.5 Terrestrial flora of the buffer zone

The buffer zone includes Bay of Bengal, creeks, Industrial areas as well as a few residential areas. But there are no National Parks / Wildlife Sanctuaries /Reserve forests within 10 Km

radius of the project site. There a few saltpans along the creek but there are no Mangrove forests. *Avicennia alba* was found in some areas. Most of the areas are colonized by mesquite (*Prosopis juliflora).* Neem (*Azadirachta indica*) followed by Coconut (*Cocos nucifera)* are the most extensively cultivated trees in the entire buffer zone. Castor (*Ricinus communis*) was found widely scattered in all vacant places including road sides. All the common, widely grown Indian avenue and fruit trees and some exotic naturalized trees are found in the buffer zone. A list of trees, shrubs and ornamentals growing currently within the 10 Km buffer zone of the industry is given in **Table 3.19.**

Table 3.19: List of trees, shrubs, and perennial climbers found in the buffer zone of the project site.

Botanical name	Common / local name	Family
Acacia catechu	Khair	Mimosaceae
Acacia leucophloea	White babul	Mimosaceae
Acacia nilotica	Black babul	Mimosaceae
Acacia auriculiformis	Australian wattle	Mimosaceae
Adenanthera pavonia	Red bead tree	Mimosaceae
Aegle marmelos	Bilva	Rutaceae
Agave americana	Agave	Agavaceae
Ailanthus excels	Maha Neem	Simaroubaceae
Alangium salvifolium	Azhinji	Alangiaceae
Albizia lebbeck	Siris / Vagai	Mimosaceae
Allamanda cathartica	Golden Trumpet Wine	Apocynaceae
Alstonia scholaris	Indian Tree of Heaven	Apocynaceae
Anthocephalus cadamba	Kadamb	Rubiaceae
Araucaria columnaris	Christmas tree	Araucariaceae
Artabotrys odoratissimus	Champak	Annonaceae
Artocarpus heterophyllus	Jackfruit	Moraceae
Asclepias currasavica	Milk weed	Asclepiadaceae
Avicennia alba	White Avicennia	Acanthaceae
Azadirachta indica	Neem	Meliaceae
Bambusa vulgaris	Yellow Bamboo	Poaceae
Barringtonia acutangula	Barringtonia	Lecythidaceae
Bauhinia purpurea	Purple Orchid Tree	Caesalpiniaceae
Bauhinia variegata	Mandaarai	Caesalpiniaceae
Beaucarnea recurvata	Ponytail Palm	Arecaeae
Bixa orellana	Lipstick tree	Bixaceae
Bombax malabaricum	Silk Cotton Tree	Bombacaceae
Borassus flabellifer	Palmyra palm	Arecaeae
Bougainvillea glabra	Bougainvillea	Nyctaginaceae

Botanical name	Common / local name	Family
Bougainvillea spectabilis	Bougainvillea	Nyctaginaceae
Brassaia actinophylla	Octopus tree	Araliaceae
Brugmansia sp.	Tree Datura	Solanaceae
Butea monosperma	Palas	Fabaceae
Caesalpinia pulcherrima	Peacock Flower	Caesalpiniaceae
Callistemon lanceolatus	Bottle brush tree	Myrtaceae
Calophyllum inophyllum	Alexandrian laurel	Clusiaceae
Calotropis gigantea	Crown flower	Asclepiadaceae
Calotropis procera	Apple of Sodom	Asclepiadaceae
Cananga odorata	Kattu Chempakam	Annonaceae
Capparis zeylanica	Indian Caper	Capparaceae
Careya arborea	Wild Guava	Lecythidaceae
Carissa spinarum	Bush Plum	Apocynaceae
Caryota urens	Fishtail Palm	Arecaceae
Cassia fistula	Golden Shower Tree	Caesalpiniaceae
Cassia javanica	Java Cassia	Caesalpiniaceae
Cassia siamea	Siamese Cassia	Caesalpiniaceae
Cassia spectabilis	Golden Cassia	Caesalpiniaceae
Castanospermum australe	Black Bean	Fabaceae
Casuarina equisetifolia	Casuarina	Casuarinaceae
Chamaedorea sefritzii	Bamboo palm	Arecaceae
Chromolaena odorata	Siam weed	Asteraceae
Citrus aurantifolia	Orange	Rutaceae
Citrus limonum	Lemon	Rutaceae
Citrus sinensis	Sweet orange	Rutaceae
Clematis paniculata	Flower of the skies	Ranunculaceae
Clerodendrum splendens	Flaming glory	Verbenaceae
Cochlospermum gossypium	Butter cup tree	Bixaceae
Cocos nucifera	Coconut	Arecaceae
Colvillea racemosa	Colville's Glory	Caesalpiniaceae
Cordia sebestena	Scarlet *Cordia*	Boraginaceae
Couroupita guianensis	Cannon Ball tree	Lecythidaceae
Cryptostegia grandflora	Rubber Wine	Asclepiadaceae
Cycas revoluta	Sago palm	Cycadaceae
Cymbopogon citratus	Lemon grass	Poaceae
Daemia extensa	Uttamani	Asclepiadaceae
Dalbergia sissoo	Shisham	Fabaceae
Decalepis hamiltonii	Peru Nannari	Periplocaceae

Botanical name	Common / local name	Family
Delonix elata	Gulmohar	Caesalpiniaceae
Delonix regia	Gulmohar	Caesalpiniaceae
Dendrocalamus strictus	Bamboo	Poaceae
Dodonaea viscosa	Hop Bush	Sapindaceae
Dolichandrone platycalyx	Nile Tulip Tree	Bignoniaceae
Duranta plumieri	Golden dew drops	Shrub
Dypsis decaryi	Triangle Palm	Arecaceae
Dypsis lutescens	Areca palm	Arecaceae
Enterolobium cyclocarpum	Elephant Ear Pod Tree	Mimosaceae
Erythrina crista-galli	Cockspur Coral Tree.	Fabaceae
Erythrina indica	Indian Coral tree	Fabaceae
Erythrina suberosa	Corky coral tree	Fabaceae
Eucalyptus citriodora	Lemon Scented Gum	Myrtaceae
Eucalyptus globulus	Blue gum	Myrtaceae
Eucalyptus tereticornis	Red Gum	Myrtaceae
Euphorbia nivulia	Leafy Milk Hedge	Euphorbiaceae
Ficus benghalensis	Banyan Tree	Moraceae
Ficus benjamina	Weeping fig	Moraceae
Ficus elastic	Rubber plant	Moraceae
Fcus hispida	Hairy Fig	Moraceae
Ficus racemosa	Cluster fig	Moraceae
Ficus religiosa	Arali mara	Moraceae
Filicium decipiens	Fern tree	Sapindaceae
Firmiana colorata	Coloured Sterculia	Sterculiaceae
Furcraea foetida	Mauritius hemp	Agavaceae
Gardenia jasminoides	Cape Jasmine	Rubiaceae
Geranium sp.	Geranium	Geraniaceae
Gliricidia sepium	Mata Raton	Fabaceae
Golphimia gracilis	Rain of Gold	Malpighiaceae
Grevellia robusta	Silver oak	Proteaceae
Guazuma ulmifolia	West Indian Elm	Sterculiaceae
Heterophragma roxburghii	Bara Kalagoru	Bignonaceae
Hiptage benghalensis	Vasantakaala Malligai	Malpighiaceae
Holoptelea integrifolia	Kaladri	Ulmaceae
Hyophorbe lagenicaulis	Bottle palm	Arecaceae
Ipomoea biloba	Rubber wine	Convolvulaceae
Ipomoea carnea	Pink Morning glory	Convolvulaceae
Ipomoea palmata	Railway Creeper	Convolvulaceae

Botanical name	Common / local name	Family
Ixora singaporensis	Ixora	Rubiaceae
Jacaranda mimosaefolia	Jacaranda	Bignonaceae
Jacaranda mimosaefolia	Jacaranda	Mimosaceae
Jasminum grandiflorum	Jasmine	Oleaceae
Jasminum sambac	Jasmine	Oleaceae
Jatropha curcas	Wild Castor	Euphorbiaceae
Jatropha gossypifolia	Siria Amanakku	Euphorbiaceae
Kigelia pinnata	Sasega mara	Bignoniaceae
Lagerstroemia flos-reginae	Pride of India	Lythraceae
Lagerstroemia speciosa	*Pride of India*	Lythraceae
Lantana camara	Lantana	Verbenaceae
Lawsonia inermis	Mehendi	Lythraceae
Leucaena leucocephala	Subabul	Mimosaceae
Limonia acidissima	Wood apple / Vilam	Rutaceae
Mangifera indica	Mango	Anacardiaceae
Manilkara hexandra	Ceylon Iron wood	Sapotaceae
Manilkara zapota	Sapota	Sapotaceae
Markhamia lutea	Nile Tulip Tree	Bignoniaceae
Michelia champaka	Champak	Magnoliaceae
Millingtonia hortensis	Tree Jasmine	Bignoniaceae
Mimosa rubicaulis	Rasne / Urisige	Mimosaceae
Mimusops elengi	Maghizham	Sapotaceae
Morinda pubescens	Nuna / Ivory Wood	Rubiaceae
Muntingia calabura	Singapore cherry	Muntingiaceae
Murraya paniculata	Vengarai	Rutaceae
Mussanda frondosa	Paper chase tree	Rubiaceae
Nerium odorum	Oleander	Apocynaceae
Nyctanthes arbor-tristis	Paarijatham	Oleaceae
Ochna obtusata	Golden Champak	Ochnaceae
Parkia biglandulosa	Shivalinga	Mimosaceae
Pelargonium graveolens	Rose Geranium	Geraniaceae
Peltophorum pterocarpum	Copper Pod	Caesalpiniaceae
Pentas lanceolata	Pentas	Rubiaceae
Petrea volubilis	Purple wreath	Verbenaceae
Phoenix acaulis	Dwarf Date Palm	Arecaceae
Phoenix sylvestris	Wild date	Arecaceae
Phyllanthus acidus	Star Gooseberry	Euphorbiaceae
Phyllanthus emblica	Nelli	Euphorbiaceae

Botanical name	Common / local name	Family
Phyllanthus reticulatus	Karu Nelli	Euphorbiaceae
Pithecellobium dulce	Madras Thorn	Mimosaceae
Plumeria alba	Champa	Apocynacae
Plumeria pudica	White Frangipani	Apocynacae
Plumeria rubra	Champa	Apocynacae
Poinsettia pulcherrima	Poinsettia	Euphorbiaceae
Polyalthia longifolia	Ashoka	Annonaceae
Polyalthia pendula	Ashoka	Annonaceae
Pongamia pinnata	Honge	Fabaceae
Prosopis juliflora	Mesquite	Mimosaceae
Prosopis spicigera	Banni	Mimosaceae
Psidium guajava	Guava	Myrtaceace
Pterospermum acerifolium	Naradu	Sterculiaceae
Punica granatum	Pomeganate	Punicaceae
Putranjiva roxburghii (=Drypetes roxburghii)	Indian Amulet Tree / Karupala	Putranjivaceae
Pyrostegia purpurea	Flaming trumpet	Bignoniaceae
Pyrostegia venusta	Golden Shower	Bignoniaceae
Quisqualis indica	Rangoon Creeper	Combretaceae
Ricinus communis	Castor	Euphorbiaceae
Roystonea regia	Royal palm	Arecaceae
Russelia equisetiformis	Coral Plant	Srophulariaceae
Samanea saman	Rain Tree	Mimosaceae
Santalum album	Sandal wood	Santalinaceae
Saraca indica	Seetha Ashok	Caesalpiniaceae
Solanum trilobatum	Thoodhuvalai	Solanaceae
Spathodea companulata	Nirukai mara	Bignoniaceae
Sterculia foetida	Wild almond	Sterculiaceae
Syzygium cumini	Jamun /Naaval	Myrtaceae
Tabebuia argentea	Tree of Gold	Bignoniaceae
Tabebuia avellanedae	Pink Tabebuia	Bignoniaceae
Tabebuia rosea	Pink Trumpet Tree	Bignoniaceae
Tabernaemontana coronaria	Moon beam	Apocynaceae
Talipariti tiliaceum	Sea or Beach Hibiscus	Malvaceae
Tamarindus indica	Tamarind	Caesalpiniaceae
Tecoma stans	Yellow oleander	Bignonaceae
Tecomella undulate	Tecomella	Bignonaceae
Tectona grandis	Teak / Tekku	Verbenaceae

Botanical name	Common / local name	Family
Terminalia arjuna	Arjun / Neer Marudhu	Combretaceae
Terminalia catappa	Almond	Combretaceae
Thespesia populnea	Indian Tulip Tree	Malvaceae
Thevetia peruviana	Yellow oleander	Apocynaceae
Thunbergia grandiflora	Heavenly blue	Acanthaceae
Trachelospermum jasminoides	Star Jasmine	Apocynacae
Tylophora indica	Naippalai	Assclepiadacae
Vallaris solanacea	Bread Flower	Apocynaceae
Vernonia elaeagnifolia	Curtain creeper	Asteraceae
Vitex negundo	Nirgundi	Verbenaceae
Wattakaka volubilis	Sneeze Wort	Asclepiadaceae
Wisteria sinensis	Chinese Wisteria	Fabaceae
Wodyetia bifurcate	Fox tail palm	Arecaceae
Woodfordia fruticosa	Red bell bush	Lythraceae
Wrightia tinctoria	Sweet Indrajao	Apocynaceae
Zamia furfuracea	Cardboard Palm	Cycadaceae
Ziziphus mauritiana	Yalachi	Rhamnaceae

The list of Common Avifauna of Indigenous and migratory birds & list of fauna in Thiruvallure forest division are given in **Table 3.20 & 3.21.**

Table 3.20: List of avifauna of indigenous and migratory birds

S.No	Common Name	Scientific Name
1	*Grey Heron*	Ardca Sinerea
2	*Snake Darter*	Anbinga Rufa
3	*Spoon Bill*	Platalea Leucorodia
4	*Night Heron*	Nycticorax
5	*Cattle Egret*	Babulcusibis conomandus
6	*Common Teal*	Anas enecca erecca
7	*Water Hen*	Anaruornis phoenicirus

Table 3.21: List of fauna in Thiruvallur forest division

S.No	Common Name	Scientific Name
1	*Porcupine*	Hystrix Indica
2	*Mongoose*	Herpestes Edwardsi
3	*Wild Boar*	Sus Scrofa
4	*Common Monkeys*	Macaca Radiate
5	*Hare*	Lepus Rubicandelus
6	*Snakes*	Naja tripundians (Cobra)
7	*Jackal*	Canis aureus

8	*Jungle Cat*	Felis Ehaug

3.10.6 Aquatic flora and fauna of the study area

There are one perennial water body i.e: Kosasthaliya River at above 500mm(W) and several small village/irrigation tanks Peeriyathoppu lake 6.1km(SW), Kadapakkam lake 5.4km(SW) Buckingham Canal adjacent (W), Bay of Bengal 0.8km(E), like in the 10km study area. There is no reservoir either in the core or buffer zone. There are no protected wetlands or other ecologically sensitive wetlands within the 10 km radius of the study area. As such, the area is not important from the point of aquatic ecology. Aquatic flora like semi aquatic macrophytes and fauna observed in study area and secondary sources is given in the below **Table 3.22** respectively.

Table 3.22: List of semi aquatic macrophytes found in the surface water bodies of the study area

Latin name	Common name	Family
Alternanthera philoxeroides	Alligator weed	Solanaceae
Alternanthera sessilis	Dwarf Copperleaf	Solanaceae
Bacopa monnieri	waterhyssop	Plantaginaceae
Brachiaria mutica	Para grass	Poaceae
Carex cruciate	Carex	Cyperaceae
Chrysopogon aciculatus	Golden beard grass	Poaceae
Colocassia esculenta	Chema dumpa	Araceae
Cyperus exaltatus	Nut grass	Cyperaceae
Cyperus rotundus	Nut sedge	Cyperaceae
Echinochloa colona	Jungle rice	Poaceae
Eclipta alba	False daisy	Asteraceae
Eichhornia crassipes	Common water hyacinth	Pontederiaceae
Ipomoea aquatic	Tigabachhali	Convolvulaceae
Ipomoea carnea	Bush Morning Glory	Convolvulaceae
Limnophila indica	Indian Marsh weed	Scrophulariaceae
Ludwigia perennis	Water Primrose	Onagraceae
Marsilea quadrifolia	Four leaf clover	Marsiliaceae
Nymphoides hydrophylla	white water snowflake	Menyanthaceae

Fishes

Fishes/ aquatic fauna of the study area is reported based on field sampling, confirmation from the local people and secondary data provided by Thiruvallur district office. Fishes like Chirocentrus dorab(Dorab wolf-herring), Sardinella fimbriata (Lesser Sardines), Anchoviella, Flying Fish, Sciaenids, Caranx, Mackerel, Seer, Crabs are found in good numbers in the study area.

3.10.6.1 Rare or endangered or threatened flora and fauna

There are no rare or endangered or threatened plant species in the core area. All the plants found in the core area are of common and widespread occurrence.

They include Sandal wood (*Santalum album*), Seetha Ashok (*Saraca ndica),* Swallow root (*Decalepis hamiltonii),* ornamental palm (*Zamia furfuracea*) and some other cultivated ornamental shrubs. *Zamia furfuracea* is critically endangered ornamental palm of Veracruz State in Eastern Mexico. It is now widely grown as an ornamental in India and it is performing extremely well. It was noticed to produce fertile cones as well as suckers. Swallow root (*Decalepis hamiltonii)* was the only uncultivated RET species while the rest were cultivated and protected.

Wildlife sanctuaries/ national parks/ biosphere reserve/REET species

There are no National Parks, Wildlife Sanctuaries, Biosphere Reserves and Important Bird Areas (IBA) within the study area. There are no reports of occurrence of any rare or endangered or endemic or threatened (REET) fauna in the study area. None of the species reported or recorded from the study area placed in Schedule I of the Indian Wildlife (Protection) Act, 1972.
The sensitivity map of the project site within 15 km radius & beyond 15km is shown in **Figure 3.6 & Figure 3.7** respectively.

Figure 3.6: Sensitivity map of the project site with 15 km radius

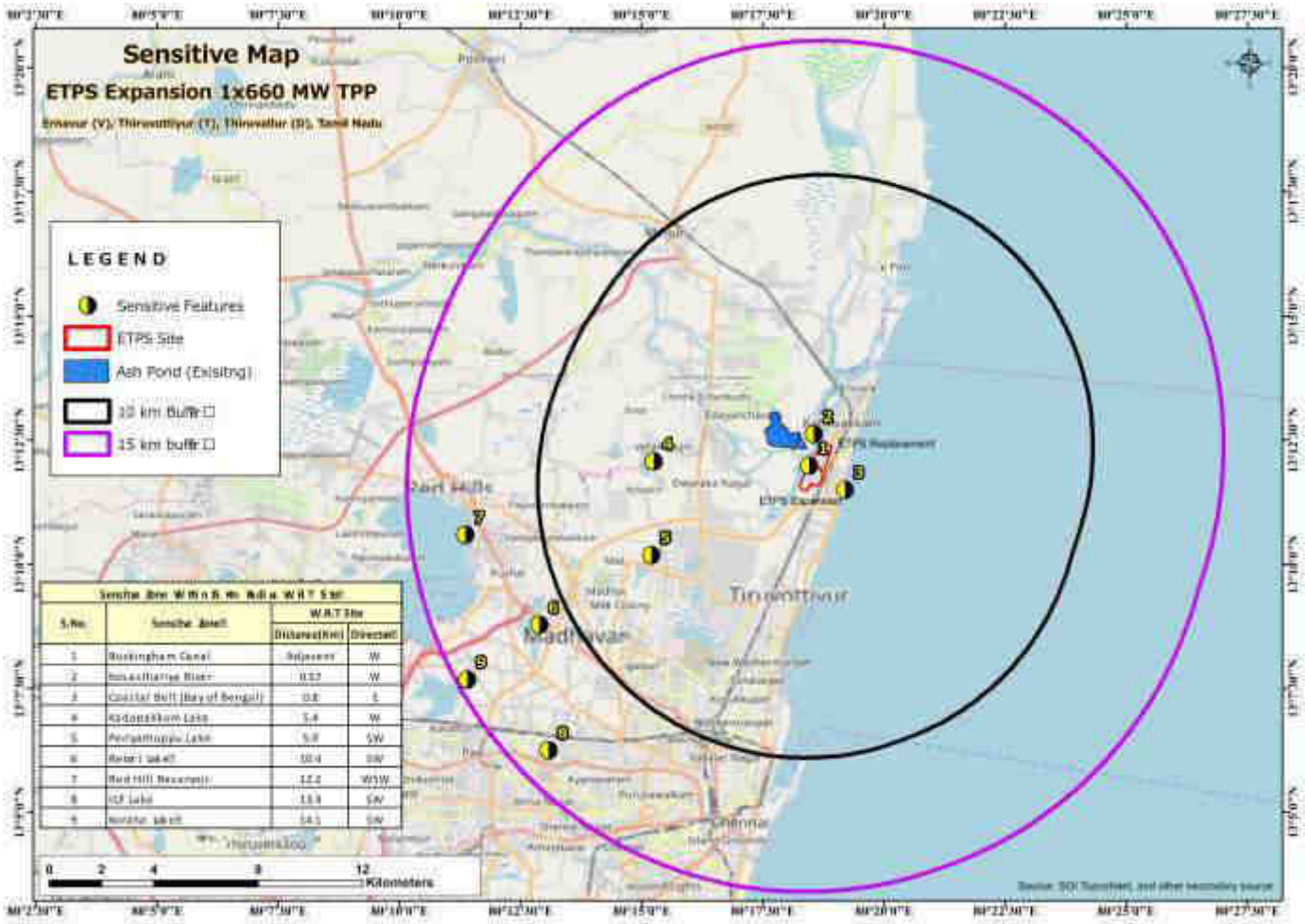
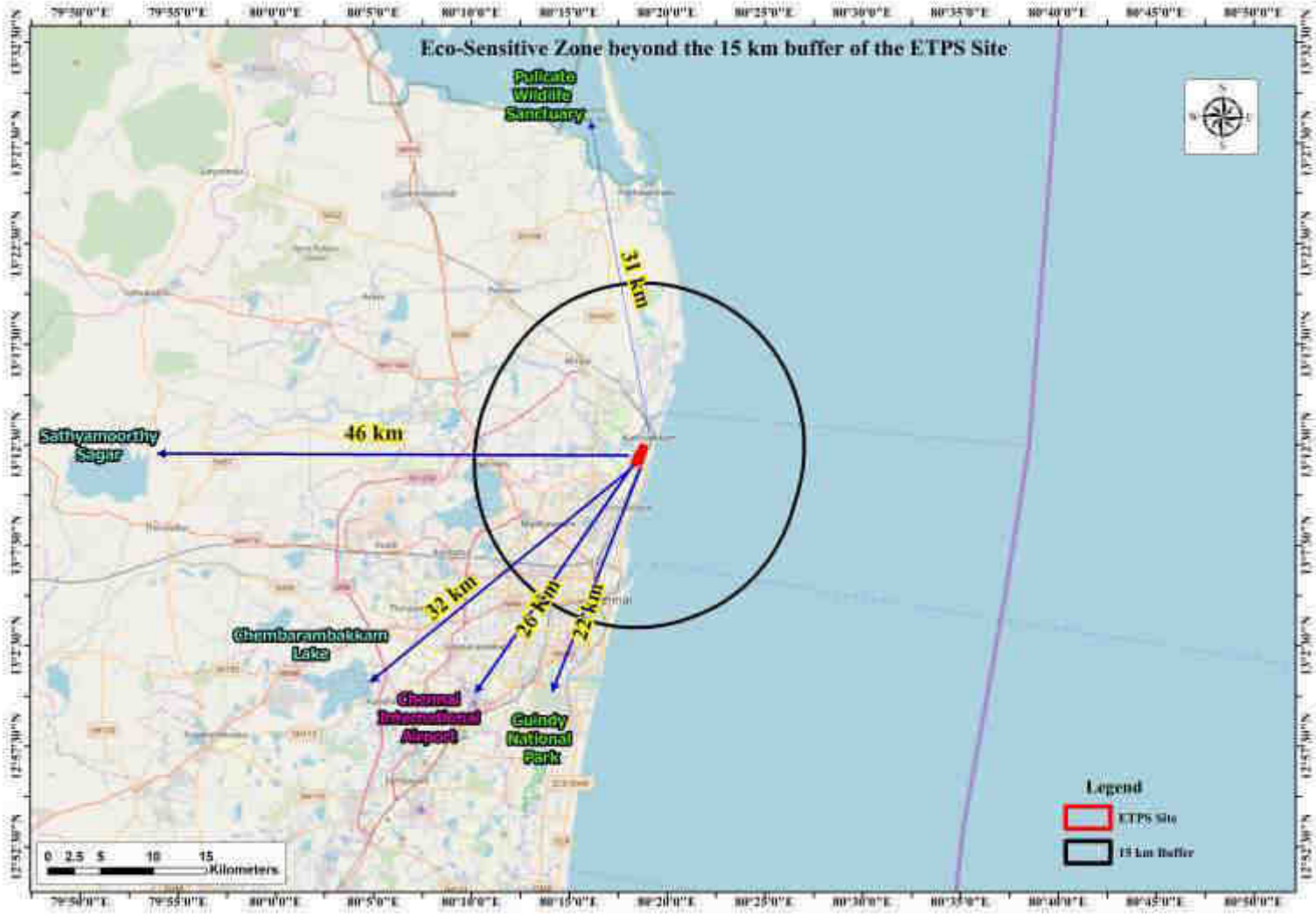


Figure 3.7: Ecosensitive zones map of the project site beyond 15 km radius



3.11 Land environment

The land use/land cover for the proposed study area of 10 km radius is prepared in the form of a map by using Satellite Imageries. The satellite data is processed using ERDAS Imagine software supported with Toposheets, Google Earth. Area and distance calculations have been carried out using ERDAS & Geographical Information System (GIS) software. The data Analysis and visual interpretation with the help of ground truth verification & Survey of India (SoI) Toposheets (scale 1:50,000).

Land cover data documents how much of a region is covered by forests, wetlands, impervious surfaces, agriculture, and other land and water types. Water types include wetlands or open water. Land use shows how people use the landscape – whether for development, conservation, or mixed uses.

Understanding both the land use and land cover of a track of land provides a comprehensive picture of a particular area. This data is a fundamental component of the planning and decision-making processes for many communities because it helps them to understand better where to plan for different types of growth and where to preserve; it also helps them to understand the connectivity or fragmentation of various features in their community.

3.11.1 Important of LULC in EIA

The growth of a society totally depends on its social and economic development. This is the basic reason why socio-economic surveys are carried out. This type of survey includes both spatial and non-spatial datasets. LULC maps play a significant and prime role in planning, management and monitoring programmes at local, regional and national levels. This type of information, on one hand, provides a better understanding of land utilization aspects and on the other hand, it plays an important role in the formation of policies and programme required for development planning. For ensuring sustainable development, it is necessary to monitor the on-going process on land use/land cover pattern over a period of time. In order to achieve sustainable urban development and to check the haphazard development of towns and cities, it is necessary that authorities associated with the urban development generate such planning models so that every bit of available land can be used in most rational and optimal way. This requires the present and past land use/land cover information of the area. LULC maps also help us to study the changes that are happening in our ecosystem and environment. If we have inch by inch information about Land Use/Land Cover of the study unit we can make policies and launch programmes to save our environment.

EIA is an important policy initiative to conserve natural resources and environment. Many human activities produce potential adverse environmental effects which include the construction and operation of highways, rail roads, pipelines, airports, radioactive waste disposal and more. Environmental impact statements are usually required to contain specific

information on the magnitude and characteristics of environmental impact. LULC is very much important to carry out the EIA study efficiently by the help of GIS tool, through integrating various GIS layers for assessing the performance of natural feature.

3.11.2 Materials and methods

Methodology of LULC: The technological advances in remote sensing products and Digital Image Processing software are surely blessing to analyse urban studies. The Indian Topographic Maps of 1:50,000 scales is used as the base line data for comparison. Indian Remote Sensing Satellite Multispectral Resourcesat -2A, LISS-IV imagery of 5.8 meter spatial resolution is obtained and Date of pass: 22-Feb-19

Data used: This study involved primary data collection and secondary data collection. Resourcesat – 2 Multispectral high resolution LISS-IV image were used for mapping land use feature classification up to level-2 standard to represent the map in 1:50000 scale along with SOI Top sheets were used as Secondary source for Geographic reference of the study area as well as satellite image to make one to one co-ordination between both data and furthermore for superimposing the project on exact location.

Details of satellite data used:

Launch Vehicle	Satellite	Sensor	Path - Row	Band (Micro-meter)	Date of Pass	Spatial Resolution (m)	Swath (km)
PSLV-C16	IRS-R2A	LISS-IV	102 - 064	Green:0.52-0.59 Red:0.62-0.68 NIR:0.77-0.86	22-Feb-2019	5.8	70

Data processing

Pre-processing: The satellite data acquired as per latest acquisition from National Remote Sensing Centre (NRSC) was initially downloaded from FTP server path after successful selection of satellite data grid based on study area boundary. It was corrected for radiometric and geometric errors. Indian Remote Sensing Satellite (IRS-P6), LISS-IV (5.8 m resolution) data of January 2019, geo-registered to UTM Zone 44 N projection and WGS 84 datum were used. UTM projection was chosen due to its easy application and widespread usage throughout the world. More importantly, UTM projections are best suited for small areas that lie within a single zone.

The 10 km radius of the study area Toposheet was obtained from The Survey of India (SOI). Toposheet No. D44O03, D44O04, D44O07 & D44O08 published in 2011 which is latest publication of OSM data, of a scale of 1:50.000 was digitally scanned and georeferenced using Ground Control Points (GCPs). The satellite data was then geometrically rectified following image-to-map registration with the aid of the georeferenced toposheets. This was done by superimposing geometrically corrected satellite data over the Topobase in the digital domain. This process ensured the creation of correctly georeferenced database. The co-registration of

spatial features and GCPs with that of Topobase has been verified using the Swipe tool available with the ERDAS Imagine Viewer.

A map depicting major land use / land cover classes comprising built up lands, crop land, Plantation, Forest land and water is developed. Based upon output, area statistics is calculated for different land use classes and given in the **Table 3.23** and Land use/land cover map (10 km radius) is shown as **Figure 3.8.** The satellite imagery of the study area is given in **Figure 3.9** & **Figure 3.10**

Table 3.23: Land use pattern of the project study area

S.No.	Level-1	Level-2			%
	Class	Class	Area (ha.)	Area (Acres)	
1	Built Up	Urban	4232.54	10458.82	12
		Rural	2178.79	5383.91	6
		Industrial area	3796.46	9381.24	11
2	Agriculture	Crop	1247.20	3081.90	4
		Fallow	1176.30	2906.70	3
		Plantation	483.00	1193.51	1
3	Waterbodies/ Wetlands	Sea	15053.70	37198.44	43
		River	671.54	1659.41	2
		Tank	411.88	1017.79	1
		Marshy	952.79	2354.40	3
		Coastal wetland	217.39	537.18	1
4	Wasteland	Land with Scrub	2923.79	7224.83	8
		Land without Scrub	1083.64	2677.72	3
		Coastal Sand	146.37	361.68	0.4
5	Other	Ash Pond	466.89	1153.71	1
		Grass Land	13.78	34.04	0.04
Total			**35056.06**	**86625.27**	**100**

Visual image interpretation technique of classification was applied in the study. It is a process of identifying what we see on the images and communicates the information obtained from these images to others for evaluating their significance. Below visual interpretation methodology was used in the present study.

This comprise of the following six major steps:

- Selection and acquisition of data
- Pre-field interpretation
- Ground data collection and verification
- Post field interpretation and modification
- Computation of area

- Final cartographic map preparation and reproduction.

Reconnaissance of the area under study is a prerequisite for any kind of attempt in mapping natural resources of the earth. The preliminary survey of the area assists in acquainting the worker with the various kinds of classes of LULC types present in the field and subsequently help in adopting a suitable classification scheme and interpretation key for the final map generation. Hence a general reconnaissance of the study area was carried out and different classes of LULC that could be demarcated on LISS IV satellite imagery were identified on the ground. A final interpretation key for the various classes was prepared using spectral characteristics of classes and field knowledge.

On screen digitization was done in Arc Map 9.1 software. A polygon map was generated where each polygon represented a distinct class. The classes were then assigned their respective attributes. Ground truth verification was done by using a handheld GPS during field visit. GPS readings which included river bank, road crossing, plantation, Mango, Coconut, Tamarind and Eucalyptus growing sites etc. and other important and identifiable land use/land cover types were recorded and brought into GIS platform. It was found that points were very accurate in the satellite image. Finally, the area statistics of different categories of LULC and colour coded classified map of 10 km radius of the project site was generated.

LULC analysis result: In present EIA study 10 km radius of the project site were identified as study area of this project and prepared LULC for the same area to get present LULC status around 10 km buffer of the TPP.

The visual interpretation of the satellite data with the ground truth was used to map different categories of land use/ land cover (LULC). 16 categories of LULC were classified which include majorly Five Water bodies , Three Built-Up classes (Urban, Rural and Industrial area), Three agriculture types (Plantation, Crop land and Fallow land) and other land use (water bodies, wasteland and etc.).

As per present LULC scenario surroundings area of the project site mostly dominated by Water bodies and built up area, both classes are covering 80% of the study area and majorly covered by Sea water around 50% area and followed by northern part of Chennai city as built up area which areas are significantly high after sea water around the study and it will increase day by due to rapid urbanization as it is adjacent to capital city Chennai of Tamil Nadu state.

Figure 3.8: Land use land cover (LULC) map of the project

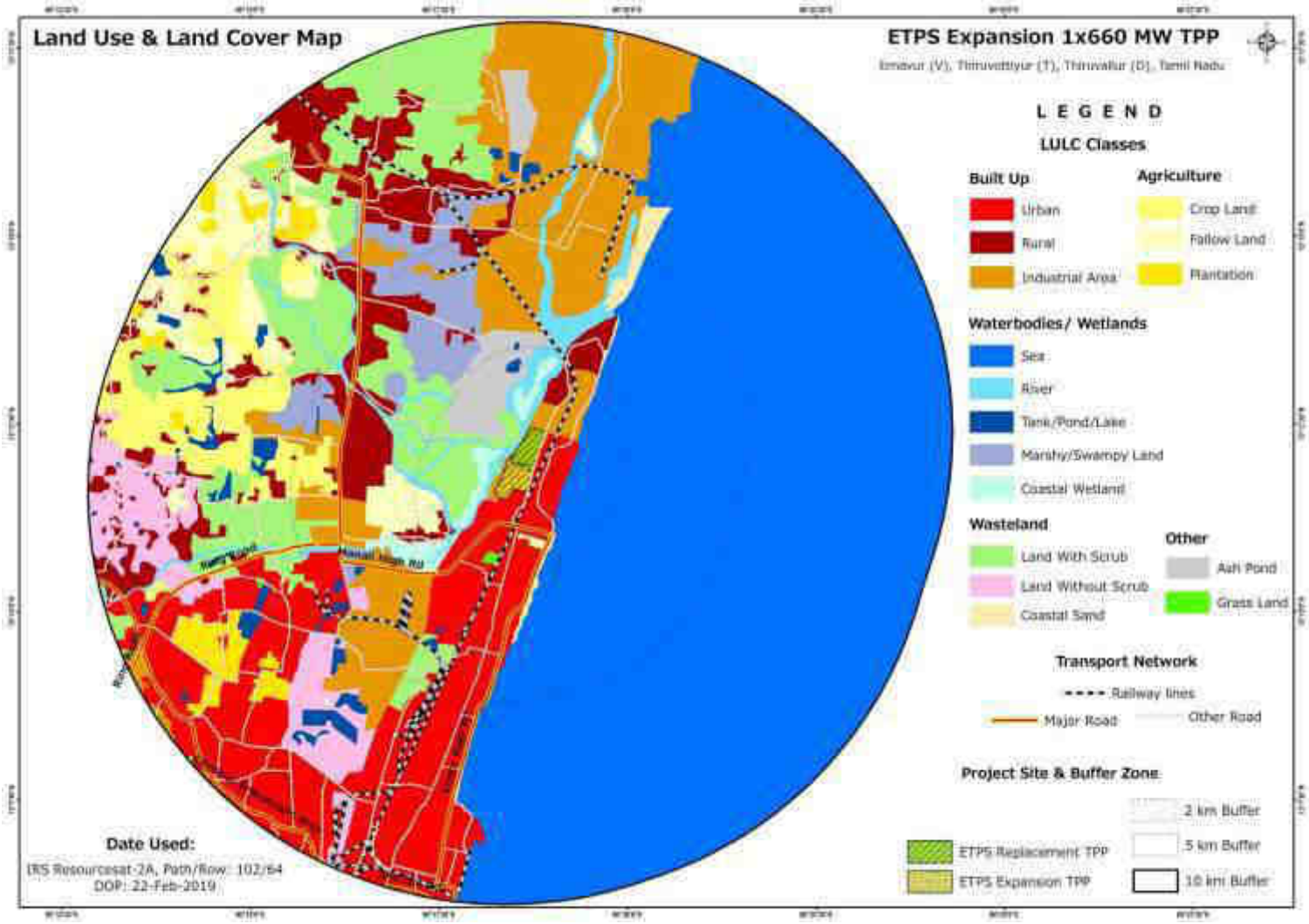


Figure 3.9: Satellite imagery of the study area

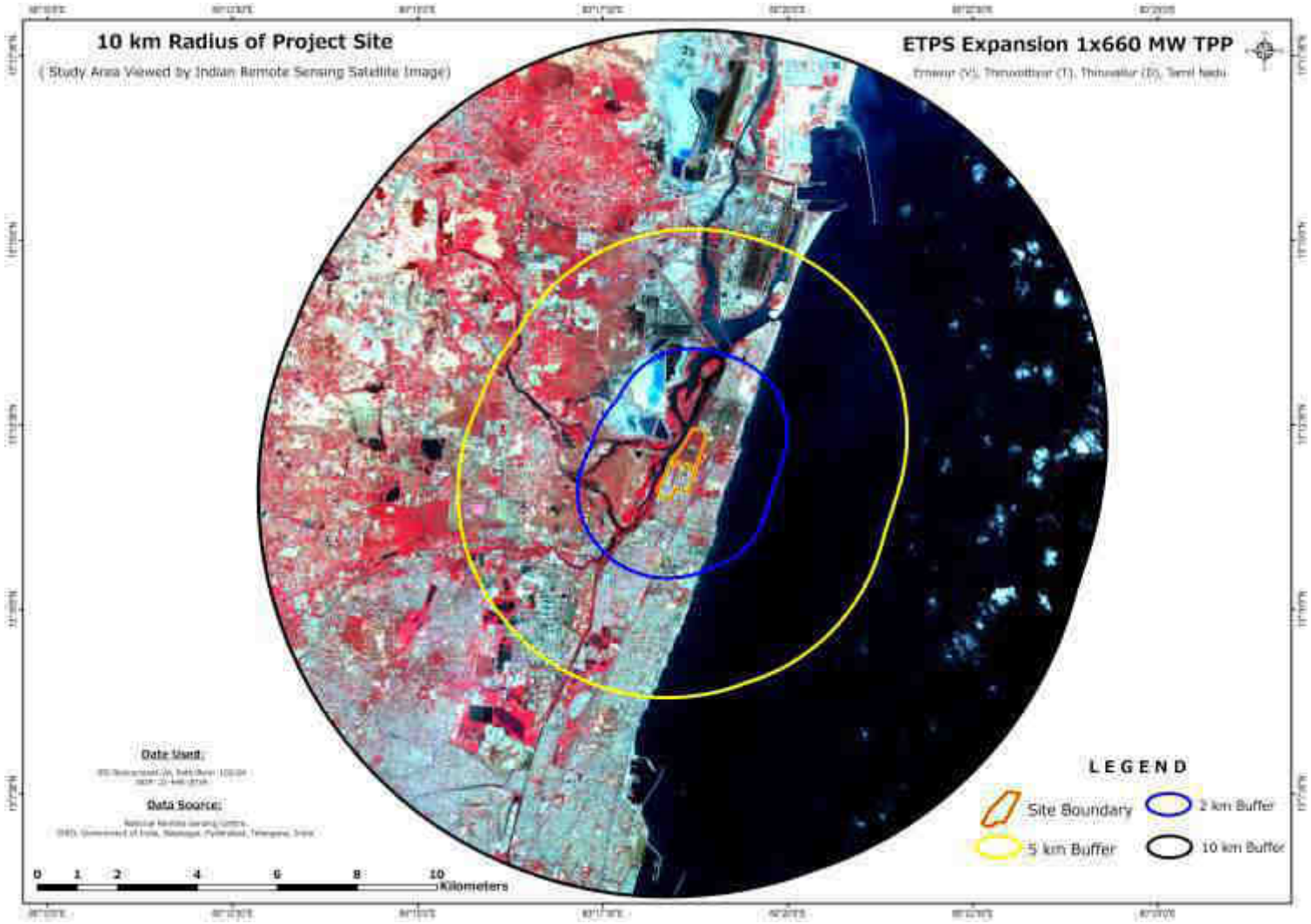


Figure 3.10: Satellite imagery of the project site

3.12 Demography and socio-economics

This section illustrates the prevailing socio-economic aspects of villages in the 10 km radius of proposed expansion of ETPS in Ernavur village, Chennai, Tamil Nadu. The following pages attempts to comprehend the social phenomenon so as to represent the demographic, occupational, gender and diversity among the project area villages, thereby postulate impactful developmental interventions. Baseline data for Occupational status and Health amenities existing in the study area has been collected by personal interaction with the villagers in the study area and also from secondary sources such as census/statistics, data etc. The Socio economic details of the study area from 2011 census data are given in **Table 3.25.**

3.12.1 Objective

Any developmental activity will have impact on the socio-economic conditions of the population in the region and on the quality of life. Socio-Economic Impact Assessment helps to get an idea of changes on social, economic and cultural status. Keeping in view the commitment of the organization towards social responsibility as well as to honor the sentiments and developmental needs of the local population, sample survey was done to collect qualitative information about the socio economic environment of the area.

3.12.2 Approach

In order to prepare a comprehensive report, few villages were visited for conducting sample village survey containing questions about all socio-economic aspects, including questions on the aspirations and requirements of the people for a better living. The village schedule was filled in order to capture the overall condition of the village with respect to community land, major crops produced, sources of irrigation, availability of potential earning opportunities in the vicinity, community institutions (schools, Anganwadi center, health sub-center, community center, places of worship, etc.), availability of electricity, provision of drainage and toilet facility etc.

3.12.3 Methodology adopted for the study

Afore mentioned, the Socio-Economic study covers villages in the 10 km radial distance from the periphery of the expansion project site at Ernavur, Chennai, Tamil Nadu. The study area covers Mathavaram and Ponneri Talukas of Thiruvallur district, Tamil Nadu. The field area is a mix of Semi-urban and urban society in composition, covering major villages and towns. The Socio-Economic study categorizes these villages/towns/wards in to 3 Zones, namely Core Zone (0 to 2 Km radius), Buffer Zone (2 km to 5 km) and other villages which are in 5 to 10 km distance from the proposed site.

The study also adopts a two-fold methodology for data collection, namely, review of published secondary data and analysis of primary data. Secondary data was collected from district census

statistics of 2011, which includes: demography, occupational structure, literacy profile and Social structure etc.

Similarly, the primary data was collected through a range of research techniques and tools like: transact walk, structured questionnaire, Focus group discussions, observations and key stakeholder interactions. The primary data was also collected through random survey covering a sample of 5% of households in the core project area villages.

The salient features of the demographic and socio-economic aspects in the Core and Buffer Zone (hereafter referred as Study area) has been described in the following sections. Similarly, village wise demographic data as per 2011 census is presented in subsequent annexure.

3.12.4 Demographic aspects

3.12.4.1 Distribution of population

As per 2011 census the study area consists of 433117 persons inhabited in the study area of 10-km radial distance from the periphery of the project. The distribution of population in the study area is given in **Table 3.24**.

Table 3.24: Distribution of population in the study area

S no.	Particulars	0-2 km	2-5 km	5-10 km	0-10 km
1	No. of Households	9354	7490	93918	110762
2	Male Population	18466	14835	184709	218010
3	Female Population	18151	14567	182389	215107
4	Total Population	36617	29402	367098	433117
5	Male Population (0-6 years)	2194	1551	20676	24421
6	Female Population (0-6 years)	2107	1525	19442	23074
7	Total Population (0-6 years)	4301	3076	40118	47495
8	Average Household Size	3.9	3.9	3.9	3.9
9	% of males to the total population	50.43	50.45	50.31	50.33
10	% of females to the total population	49.56	49.54	49.68	49.66
11	Sex Ratio (no of females per 1000 males)	982.94	981.93	987.43	986.68

Source: District Primary Census statistics of Thiruvallur district of Tamil-nadu -2011

The males and females constitute about 50.33% and 49.66% in the study area respectively.

3.12.4.2 Average household size

The study area had an average family size of 3.9 persons per household in 2011. This is moderate family size and is in comparison with the other parts of the district.

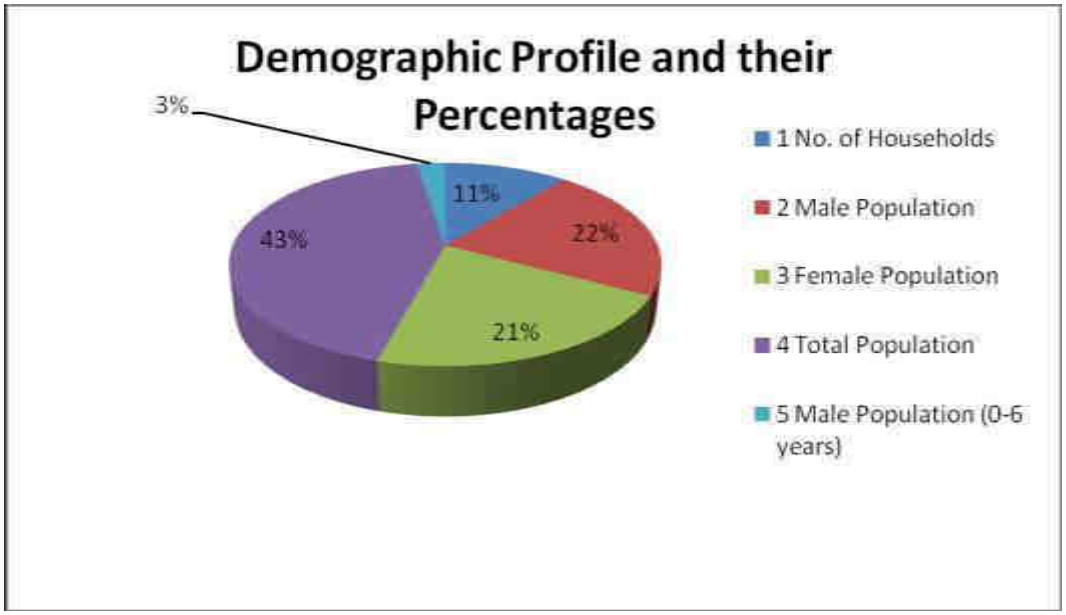
3.12.4.3 Population density

The density of population of the study area works out to about 1098 persons per $km^{2.}$ The following population projections (based on percentage decadal variation) have been worked out based on available census data.

Annual population projections in the project area				
Percentage Decadal Variation in Thiruvallur Dist (2001-11)	**Year**	**Total population**	**Male**	**Female**
Decadal Population Growth Rate	2011	433117	218010	215107
35.33	2012	448276	225422	222851
Total Annual Percentage Growth Rate	2013	463966	233087	230873
3.5	2014	480205	241012	239185
Male Annual Percentage Growth Rate	2015	497012	249206	247796
3.4	2016	514407	257679	256716
Female Annual Percentage Growth Rate	2017	532411	266440	265958
3.6	2018	551046	275499	275532
	2019	570333	284866	285451

3.12.4.4 Sex ratio

The configuration of male and female indicates that the males constitute to about 50.33% and 49.66% females to of the total population. The sex ratio i.e. the number of females per 1000 males indirectly reveals certain sociological aspects in relation with female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 986 females per 1000 males.



Source: District Primary Census statistics of Thiruvallur district of Tamil-nadu -2011

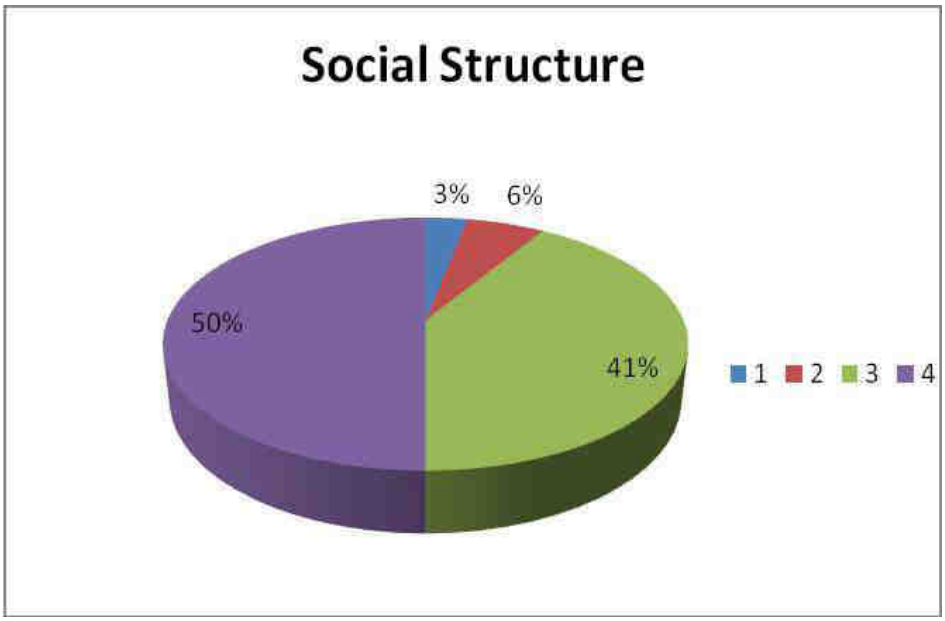
3.12.5 Social structure

In the study area about 0.45% population belong to Scheduled Tribes (ST) and 21.35% Scheduled Castes (SC) indicating that about 15.98% of the population in the study area belongs to socially weaker sections. The distribution of population in the study area by social structure is shown in **Table 3.25**.

Table 3.25: Distribution of population by social structure

Sr.no	Particulars	0-2 km	2-5 km	5-10 km	0-10 km
1	Schedule caste	5718	10611	76143	92472
2	% to the total population	15.61	36.08	20.74	21.35
3	Schedule Tribes	136	199	1635	1970
4	% to the total population	0.37	0.67	0.44	0.45
5	Total SC and ST population	5854	10810	77778	94442
6	% to total population	15.98	36.76	21.18	21.80
7	Total population	36617	29402	367098	433117

Source: District Primary Census statistics of Thiruvallur district of Tamilnadu -2011



Source: District Primary Census statistics of Thiruvallur district of Tamil-nadu -2011

3.12.6 Literacy levels

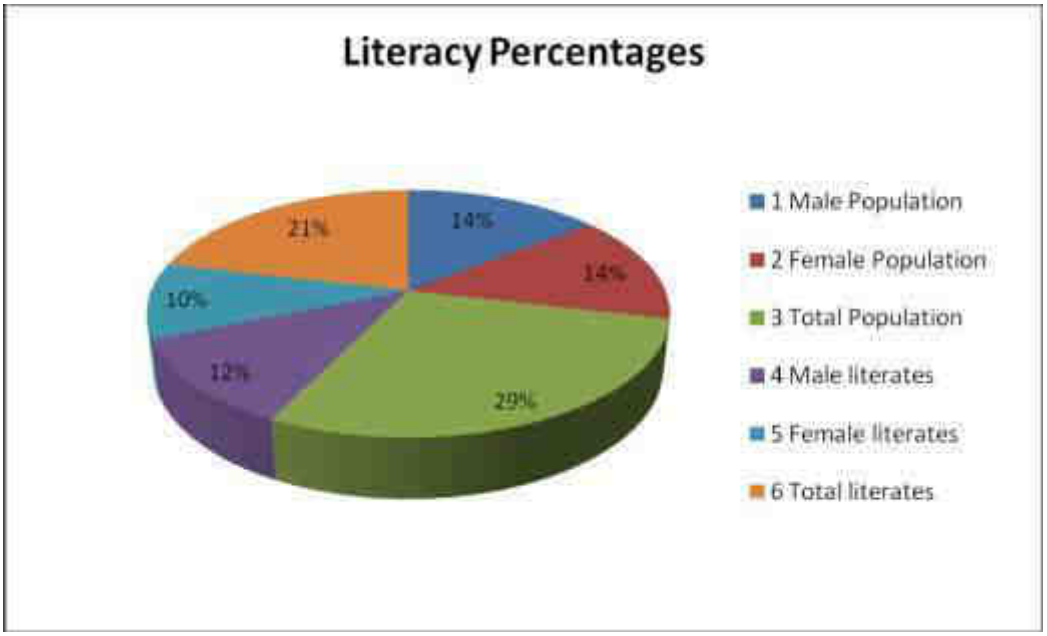
The analysis of the literacy levels in the study area reveals an average literacy rate of 77.40% as per 2011 census data. The distribution of literates and literacy rates in the study area is given in **Table 3.26.**

The male literacy i.e. the percentage of literate males to the total literates of the study area works out to be 52.90% The female literacy rate, which is an important indicator for social change, is observed to be 47.10% in the study area.

Table 3.26: Distribution of literate and literacy rates

S.no	Particulars	0-2 km	2-5 km	5-10 km	0-10 km
1	Male Population	18466.00	14835.00	184709.00	218010.00
2	Female Population	18151.00	14567.00	182389.00	215107.00
3	Total Population	36617.00	29402.00	367098.00	433117.00
4	Male literates	14692.00	12135.00	150502.00	177329.00
5	Female literates	12587.00	10327.00	134968.00	157882.00
6	Total literates	27279.00	22462.00	285470.00	335211.00
7	Male literacy rate (%)	53.86	54.02	52.72	52.90
8	Female literacy rate (%)	46.14	45.98	47.28	47.10
9	% of Male literates to the Male Population	79.56	81.80	81.48	81.34
10	% of Female literates to the Female Population	69.35	70.89	74.00	73.40
11	Total Literacy rate (%)	74.50	76.40	77.76	77.40

Source: District Primary Census statistics of Thiruvallur district of Tamilnadu-2011



Source: District Primary Census statistics of Thiruvallur district of Tamil-nadu -2011

3.12.7 Occupational structure

The occupational structure of residents in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 4 categories of workers defined by the Census Department consisting of cultivators, agricultural laborers, those engaged in manufacturing, processing and repairs in household industry; and others including

those engaged in household industry, construction, trade and commerce, transport and communication and all other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As per 2011 census records altogether the main workers works out to be 32% of the total population. The marginal workers and non-workers constitute to 6% and 62% of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The occupational structure of the study area is given in **Table 3.27.**

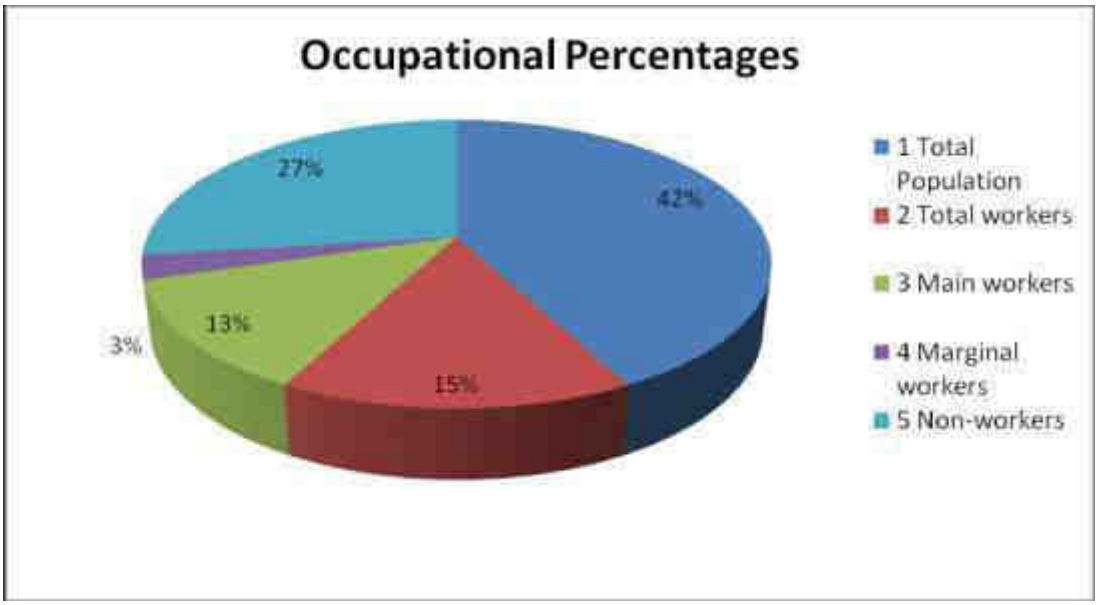
Table 3.27: Occupational structure

Sr.no	Particulars	0-2 km	2-5 km	5-10 km	0-10 km
1	Total Population	36617	29402	367098	433117
2	Total workers	13273	10778	139199	163250
3	Work participation rate (%) (Total Workers/Total population)*100	36.25	36.66	37.92	37.69
4	Main workers	10880	8865	117996	137741
5	% of main workers to total population	29.71	30.15	32.14	31.80
6	Marginal workers	2393	1913	21203	25509
7	% of marginal workers to total population	6.54	6.51	5.78	5.89
8	Non-workers	23344	18624	227899	269867
9	% of non-workers to total population	63.75	63.34	62.08	62.31
10	Dependency Ratio	1.76	1.73	1.64	1.65

Source: District Primary Census statistics of Thiruvallur district of Tamilnadu -2011

3.12.7.1 Dependency ratio

Based on the occupational structure of the study area the dependency rate of non-workers on the workers category has been estimated at 1.65. Hence some economic generating activities shoud be developed so that most of the pupils can engage in employment opportunities.



Source: District Primary Census statistics of Thiruvallur district of Tamil-nadu -2011

3.12.7.2 Primary observations in the core zone

The following paragraphs illustrates the current Infrastructural details in project area villages which includes, presence of educational institutions, working profile, housing typology and social composition. The data represented in the graph has been collected through interactions and Focus Group Discussions (FGDs) with primary stakeholders in the project area villages.

3.12.8 Infrastructure facilities

1. Social infrastructures

Post offices:

Among the villages only two villages consists of Post offices in their villages, rest of the villages people have to travel for 3-8 kms for obtaining the postal services. Hence there is a need of sanctioning the Post offices in these villages.

The primary data and village level focus group discussions also revealed that, 47% of villages have Sub-post offices. However, all the villages have power Supply both for Domestic and Agricultural purposes.

Primary schools:

It was observed during study that all villages/wards have Anganwadi, primary schools, middle schools and senior secondary schools. The villages in the buffer zone are also well connected to Taluks headquarters and urban umlands in the District thereby have an access to senior secondary, graduate & post-graduate courses.

Community health centers and banks:

Community health centers are the integral part of better society and better India as they provides health services to the needy .So provisions should be incorporated in making them implemented. While each and every village has to provided with bank services as they are necessary in economic transactions and economic viability in the villages

Community centers:

As there is very necessary of Conventional centres in the villages for periodical gatherings of Administrative and Political regardance, and hence need of actions to be taken towards them.

The primary data and village level focus group discussions also revealed that, only 35% of villages have community centers.

2. Physical infrastructure:

Water supply:

Regarding water facility in the studied villages the main source of drinking water public taps, village Wells, bore wells / tube wells, hand pumps, tank and ponds. Similarly, the study area presents a fair picture when it comes to sanitation. Many villages have individual toilets, community water treatment plants etc.

However, there is a need of the Plan of actions to be taken towards the sustainable water supply and sanitation, ensuring supply of minimum water supply per capita of 135 L/person.

Drainage networks:

Enhancing the proper drainage networks in the villages through periodical interventions.

Livelihood resources:

Ensuring Optimal usage of available resources in the local villages in the indigenous activities because as today we have been seeing the most of the villages are failing towards its best utilization of resources in meeting the demands of the pupils.

Transportation sectors: The villages in the core zone have good road connectivity. A large majority of the project villages have access to bus service with Pucca roads connecting to major towns and state highways. Almost all villages have all weather road connectivity. Transportation networks would enable to play a pivotal role in the following:

1. Proving better transit facilities to the villagers because transportation sectors play a crucial role in every region in its all round comprehensive development.
2. Transportation networks makes villages accessible to economic viabilities with nearby towns and cities in terms of attracting industries and new Livelihood patterns
3. It enhances a good rapport between the villages and towns

Housing:

Providing better housing for the poor through reforms and provisions. There has been several reforms in accordance with housing, so why can't use those provisions in making better villages and better India.

Inclusive development is highlight topic to work with to see that villages are viable for good living conditions.

There has been adopted lot of old and new policies and provisions towards rural development by Government of India. The question is whether those reforms have been implementing correctly or not? The transparency and accountability are the big issues towards the sustainable growth of the villages and towns as well to deal with.

So picking the right officials and right team for implementing those schemes and reforms. Regular monitoring mechanisms have to be adopted to see that they are implementing in a right manner.

The data collected from the field revealed that only all of the villages surveyed have access to Govt. hospitals. These villages have PHC, SHCs and village level dispensaries.

Awareness about government schemes and programmes:

Most of the villages surveyed are benefitted by government schemes such as MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act), swatchch bharat mission, and convergence programs through community participation etc. The study observed that villagers are aware of the developments so far as the welfare schemes and programs of the Government.

Other observations:

The socio-Economic study revealed that the youth in the project area are devoid of employment opportunities. They can be a potential source of workers with minimum handholding and vocational education. The youth have expressed their willingness to setting up of industries in the area as it provides them gainful employment opportunities.

Similarly, this would also trigger many direct and indirect benefits for economic advancement and social development of project area.

The study also noted an active presence of local committees, Self-Help-Groups in the project area villages. Many of these groups are acting as user groups, micro-finance entities, rotating small amount of loans among the group members.

The following pages illustrate the list of physical infrastructure facilities available in the project areas villages.

1. On nature of the living & housing conditions of pupils: It may causes sound and air pollution while exporting the materials during construction stage.

2. Livelihood patterns: If there is any land requirement for the expansion then R&R issues could be raised. So appropriate land acquisition act and other regulatory acts need to be adopted so that the Sustenance of livelihood ness of the local pupils.

3. Cattle population: it is imperative to handle the cattle population and take appropriate measures for prevention of bad impacts.

3.12.8.1 Likely impacts during the operational phase

Positive impacts:

Enhancing employment opportunities and livelihoodness:

Operational industry might create employment for the surrounding pupils resulting better standard of living.

Infrastructure and amenities

Current industry would enhance the better infrastructural facilities and amenities in the vicinity area and attracts the new settlements in and around the core area.

Urban agglomerations and outgrowth centers:

Gradual development of the vicinity area may causes urban agglomerations and can be acts as outgrowth centers for the nearby cities in future.

Likely negative impacts and measures:

- As the expansion would be on allotted land so there must be no R&R issues will be raised, and hence there might be no impacts on the agriculture or cattle gazing or Household.
- The only impact is likely to happen is due to coal ash which flows with the wind.

Appropriate measures for effluent emissions:

- Ensuring the cleansing and processing's of the effluents before releasing out.
- The disposal of the balanced effluent and coolant water will be disposed off in the deep sea after adopting mitigation measures adopting NDCT (Natural Draft Cooling Tower) System.

Table 3.28: Status of physical Infrastructures and their proximity

Village	PostOffice (In km Range)	Tap Water (Treated)	Covered Well	Uncover--ed Well	HandPump Functioning All round the year	Tube/BoreWells	Primary Health Centre (No's)	Cooperative Bank Status (In km Range)	Commercial Bank Status (In km Range)	Community Health Centre (No's)	Sports Club/ Recreation Centre	Govt Primary School (No's)	Private Primary School (No's)
Sadayankuppam	No(3 Km)	No	Yes	Yes	1	Yes	0	No(3 Km)	No(3 Km)	0	Yes	2	2
Ariyalur	No(7 Km)	Yes	Yes	Yes	1	Yes	0	No(7 Km)	No(7 km)	0	No(7 Km)	3	1
Andarmadam	No(15 Km)	Yes	No	No		Yes	0	No(8 km)	No(4 km)	0	No(15 Km)	0	0
Elandancheri	No(3 Km)	No	Yes	No		No	0	No(10 Km)	No(3 Km)	0	No(1 Km)	0	0
Kosapur	No(5 km)	Yes	Yes	Yes		Yes	0	No(5 Km)	No(5 km)	0	No(5 Km)	1	0
Elandancheri	No(3 Km)	No	Yes	No		No	0	No(10 Km)	No(3 Km)	0	No(1 km)	0	0
Neithavayal	No(3 Km)	Yes	Yes	Yes	1	No	1	No(3 Km)	No(3 Km)	0	No(3 Km)	2	0
Nandiambakkam	No(3 Km)	Yes	Yes	Yes	1	Yes	1	No(3 Km)	No(3 Km)	0	Yes	2	0
Seemapuram	No(3 Km)	Yes	Yes	No		No	0	No(10 Km)	No(3 Km)	0	No(10 Km)	1	0
Arumandai	No(3 Km)	Yes	Yes	Yes		Yes	0	Yes	No(2 km)	0	No(7 Km)	1	0
Vichoor	Yes	Yes	Yes	Yes		Yes	1	No(6 Km)	No(4 km)	0	No(10 Km)	1	1
Vellivoyal	No(4 Km)	Yes	Yes	Yes		Yes	0	No(4 km)	No(4 km)	0	No(12 Km)	2	0
Athipattu	No(10 Km)	No	No	No		No	0	No(15 km)	No(20 Km)	0	No(35 km)	2	0
Poongulam	Yes	Yes	No	No		Yes	0	No(14 km)	No(14 Km)	0	No(14 Km)	2	0

Source: *Village Directory, 2009*

Sustainable CSR works would carry out in future

ETPS project would involve in doing excellent Social Service in and around the villages and industry. It can be involve in developing health, education, skill development, environment and spiritual development of the society.

Suggestions for improvement of CSR activities & livelihood enhancement of local Community

The future CSR activities can be planned based on the need of the locals assessed during the survey. Some of the salient activities are listed below:

- Needs of village level tanks which give sustainable use of water to the villagers and to their live stock.
- Instead of regular health camps, among them, one in each quarter can be changed to health camp particularly for women alone, with particular focus on identification of reproductive track infections and identification of uterus cancer and others. This will help a lot for a family to identify the cancer or other infections in the earlier stage and avoid bigger health and economic risks at a later stage.
- Similarly health awareness meetings for women on the reproductive health and anemia will give lot of qualitative improvement in the health of women.
- The social investment on providing capacity building trainings and strengthening of CBO's activities**.**
- The health care and village camps which can conduct in the mornings, can be conduct in the evening then lot of people including school going children and working people and women will get benefitted.
- Distribution of vitamin and de worming tablets to Anganwadi and school going children, distribution of iron tablets to women will bring a tremendous change in the health of women and children.
- Fruit distribution to Anganwadi children on certain days in a week, construction of baby friendly toilet with water facility in the Anganwadi etc will have positive impact.
- Providing skill trainings in tailoring, greeting card making, Jam, squash, pickle, basket making for the rural women and then purchasing the products for company's canteen after quality checks will improve the skill and provide employment opportunity of the rural women & adolescent girls.
- Further improvements in the infrastructural and other amenities provided to the locals.

  A number of CSR activities can be initiated in the project area villages on convergence mode whilst partnering with exiting Government schemes and financial support from developmental institutions like NABARD.

3.13 Hydrogeology & geology

Hydrogeological and Geological aspects are studied at the project site and study area. physiographical and topographical conditions, natural drainage, soil types, geology and geomorphology of the project site and study area, groundwater conditions in and around the project site and study area have been studied in details.

3.13.1 Physiography and topography

The proposed project site area is a barren land within the boundary of ETPS. Contour of the project site varies from 1m to 9 m. General slope of the land is from east to west. Some portions of the land are being filled, graded and compacted for getting the required plant level of + 9.15 m above MSL. Excavated earth will be utilized for leveling the ground.

Recommendations

a. The project site has natural slope from east to west. Storm water drainage channels will follow the natural drainage slope and the out falls will be connected to SWD.
b. The proposed expansion project will not affect the natural drainage pattern.

Contour map of the project site is shown in **Figure 3.11** Contour map showing changes in surface elevations around 10 km radius study area is presented by **Figure.3.12** Maximum elevation of the study area is 20 m (AMSL) and minimum elevation is 0 m (AMSL). Contour interval is 5 m. Average elevation of the ETPS complex is about 8 m (AMSL).

Figure.3.11: Contour map of the project site

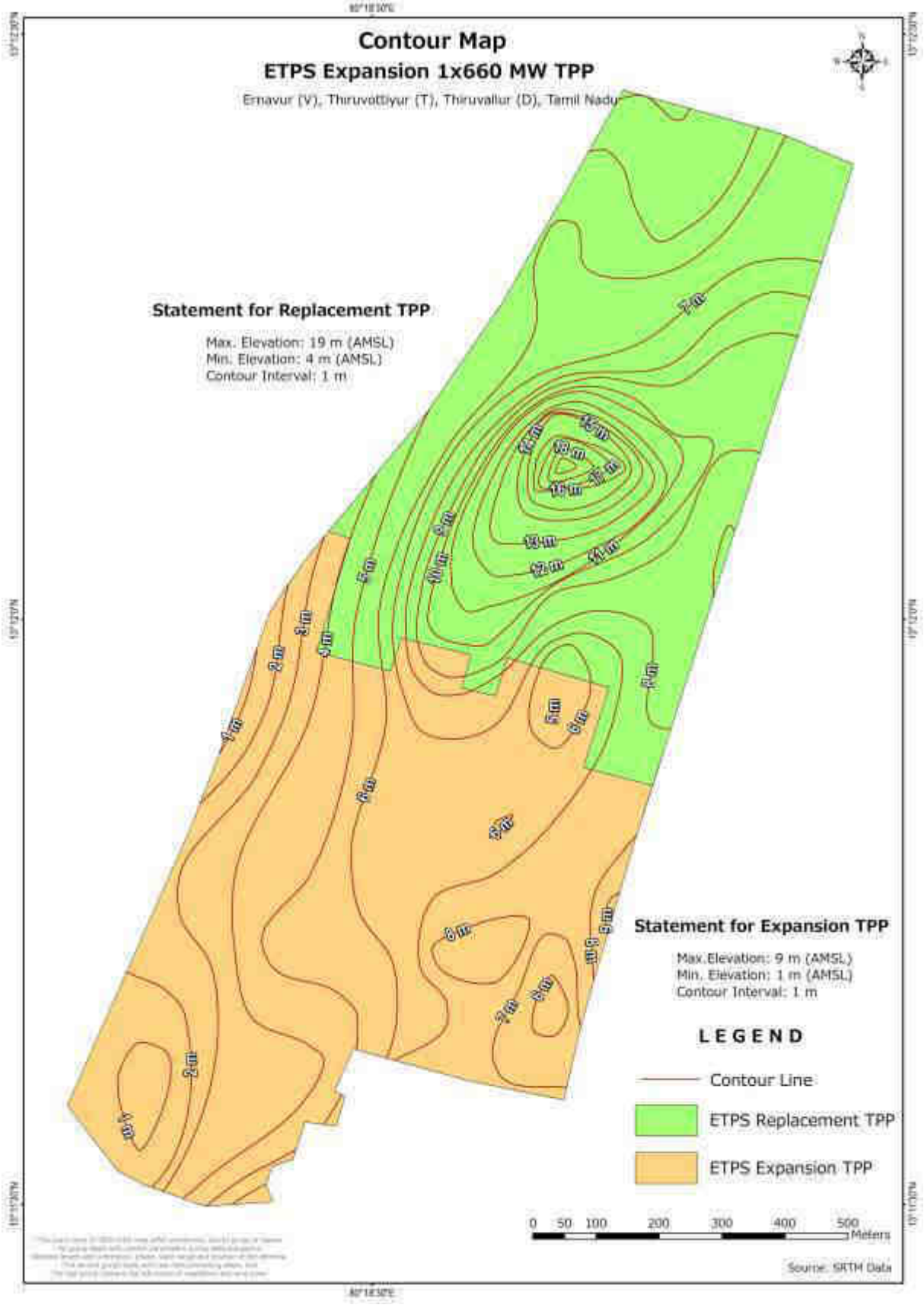
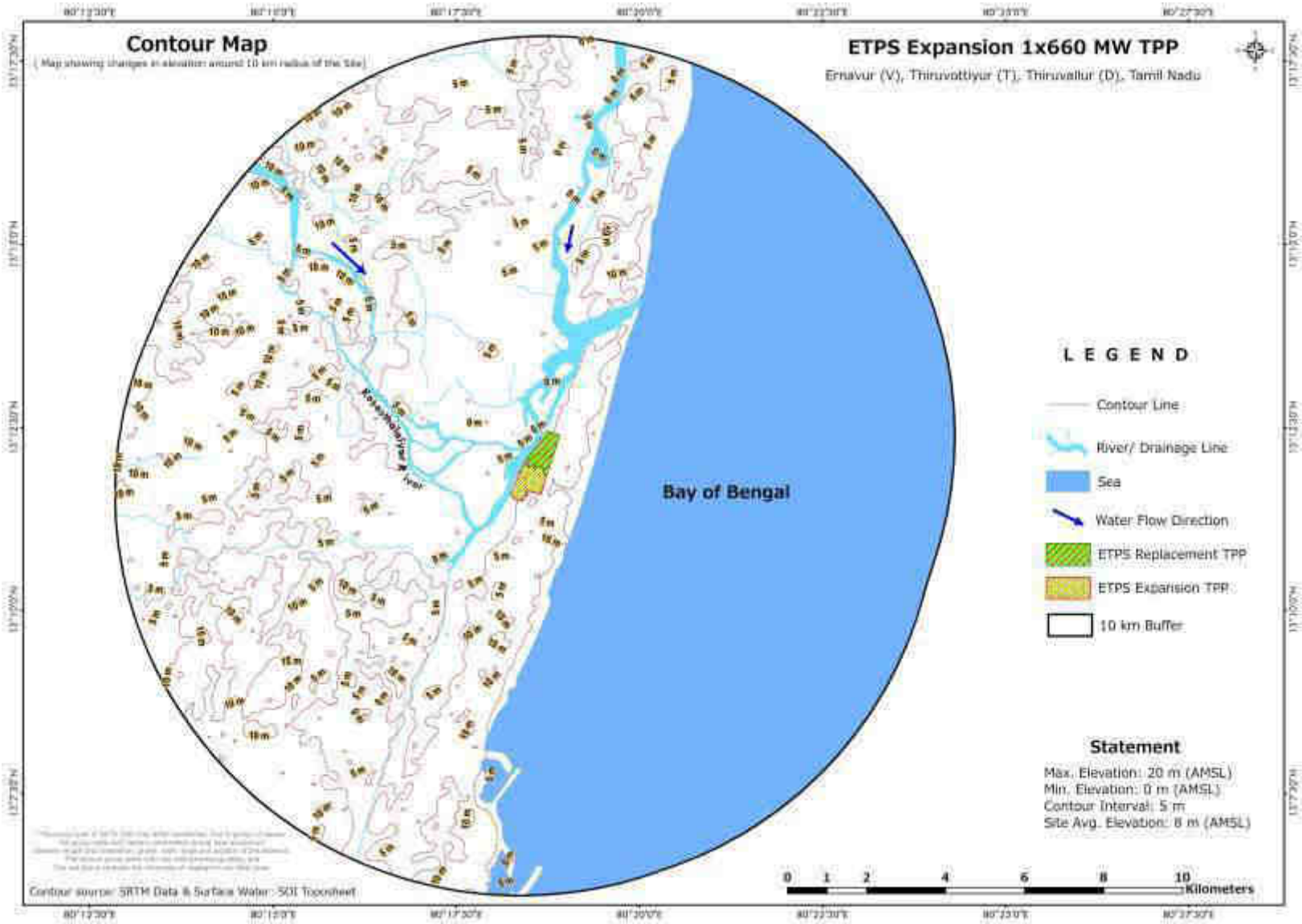


Figure.3.12: Contour map showing changes in surface elevations in 10 km radius study area



3.13.2 Drainage of the study area

The natural drainage of the study area is consisting of streams, drains, **Buckingham Canal**, **Kosasthaliyar River and Bay of Bengal.** Bay of Bengal is about 815 m away from the project site towards East. These streams, drains and canal are found throughout the study area. The drainage system is showing sub-dendritic drainage pattern. The streams are flowing through the study area finally flowing towards Kosasthaliyar river. The streams flowing in this area are mostly ephemeral in nature that is flowing during the rain-pours. The drainage map of the study area is presented by **Figure.3.13**

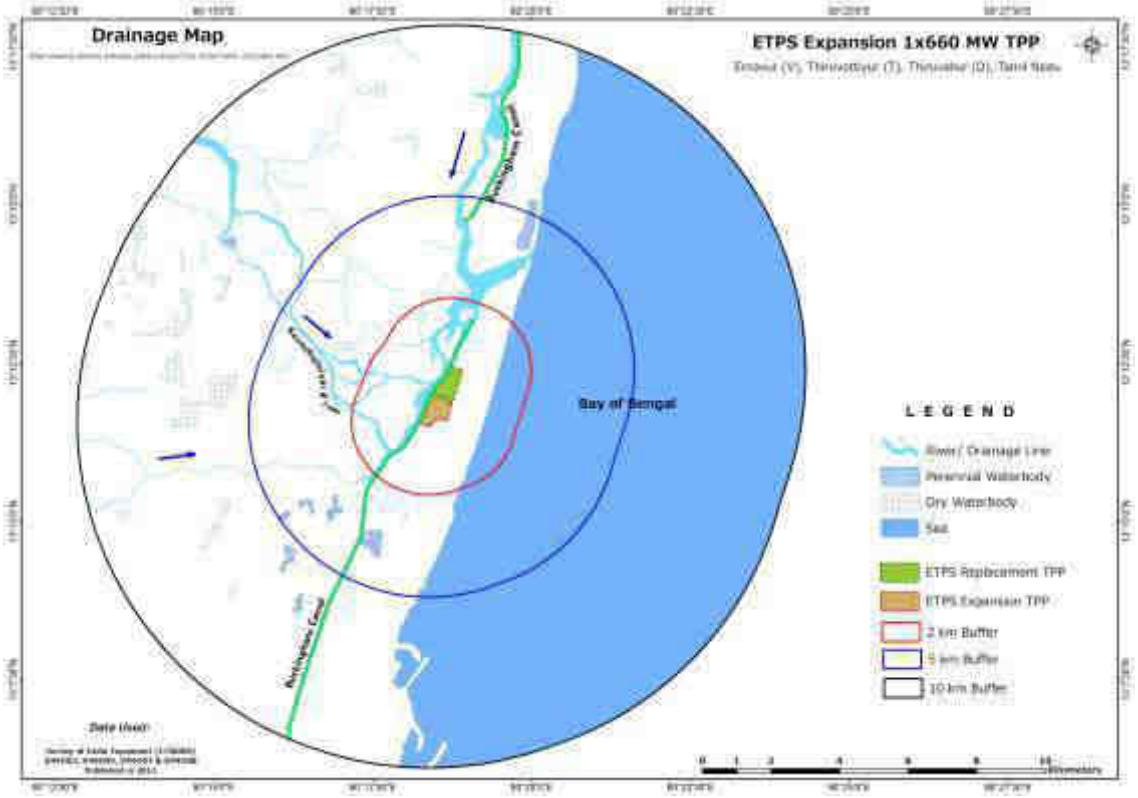
3.13.3 Drainage within the project site

The site is a low lying area. Contour of the project site varies from 1m to 9 m. General slope of the land is from east to west. Some portions of the land are being filled, graded and compacted for getting the required plant level of + 9.15 mtr above MSL.

Contour of the project site varies from 1mtr to 9 mtr. General slope of the land is from east to west. Storm water drainage channels will follow the natural drainage slope and the out falls will be connected to storm water drain (SWD).

3.13.4 Hydrogeology of the study area & project site

Figure.3.13: Drainage map of the study area



The area is underlain by porous and fissured formations. The important aquifer systems of the area are constituted by a) Unconsolidated formations, b) Semi-consolidated formations and c) weathered, fissured and fractured crystalline rocks.

The porous formations in the study area include sandstones and clays of Jurassic age (Upper Gondwana), marine sediments of Cretaceous age, Sandstones of Tertiary age and Recent alluvial formations. As the Gondwana formations are well-compacted and poorly jointed, the movement of ground water in these formations is mostly restricted to shallow levels. Ground water occurs under phreatic to semi-confined conditions in the inter-granular pore spaces in sands and sandstones and the bedding planes and thin fractures in shales. In the area underlain by Cretaceous sediments, ground water development is rather poor due to the rugged nature of the terrain and the poor quality of the formation water. Quaternary formations comprising mainly sands, clays and gravels are confined to major drainage courses in the district. The maximum thickness of alluvium is 30.0 m whereas the average thickness is about 15.0 m.

Ground water occurs under phreatic to semi-confined conditions in these formations and is being developed by means of dug wells, bore wells and filter points. Alluvium forms a good aquifer system along the Kosasthalaiyar river bed which is one of the major sources of water supply to urban areas of Chennai city and also to the Industrial units.

Ground water generally occurs under phreatic conditions in the weathered mantle and under semi-confined conditions in the fissured and fractured zones at deeper levels. The thickness of weathered zone in the area is in the range of 2 to 12 m. The depth of the wells ranged from 3.5 mtr below ground level (MBGL) to 25.0 MBGL.

The yield of large diameter wells tapping the weathered mantle of crystalline rocks ranges from 100 to 500 lpm and are able to sustain pumping for 2 to 6 hours per day. The yield of bore wells drilled down to a depth of 50 to 60 m ranges from 20 to 400 lpm.

Depth to Ground Water Level in the study area varies between 3.5 MBGL – 25.0 MBGL. The seasonal fluctuation shows a rise between 0.28 and 4.80 mbgl.

3.13.5 Depth to ground water level at the project site and study area

Total 10 Nos. of Ground Water samples have been collected during baseline study from the project site and study area. Depths of Ground Water Level have been measured at these 10 Nos. of Ground water monitoring locations by Ground Water Level Meter. Depths of Ground Water Level as per location have been presented in **Table. 3.29.**

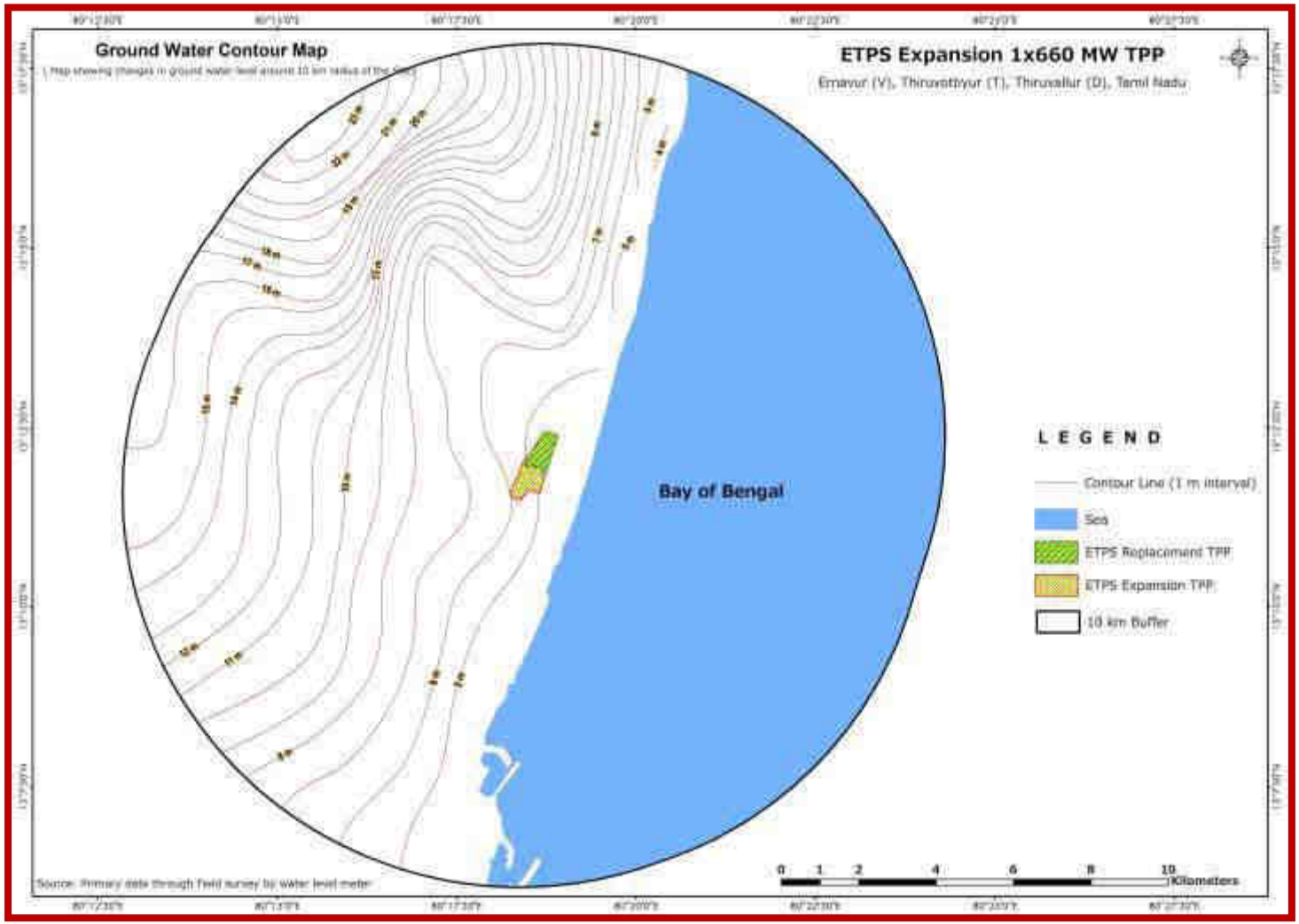
Table.3.29 Depths of ground water level as per locations

S. No	Name	Distance (km)	Direction	Latitude	Longitude	Depth of Ground Water Level
GW1	Site			13° 11' 49.8" N	80° 18' 40.8" E	3.5 MBGL
GW2	Ernavur	0.3	S	13° 11' 20.9" N	80° 18' 31.2" E	8.0 MBGL
GW3	Shivakami Nagar	0.3	S	13° 11' 59.3" N	80° 18' 56.7" E	4.5 MBGL
GW4	Kattivakkam	0.4	N	13° 12' 36.1" N	80° 18' 59.6" E	4.3 MBGL
GW5	Ennore	1.1	NNE	13° 12' 54.2" N	80° 19' 13.2" E	5.3 MBGL
GW6	Tiruvottiyur	2.6	S	13° 10' 6.10" N	80° 18' 17.3" E	3.8 MBGL
GW7	Manali New Town	3.4	W	13° 11' 32.20" N	80° 16' 20.10" E	8.5 MBGL
GW8	Ponniam Nagar	3.9	W	13° 12' 23.7" N	80° 16' 18.1" E	9.2 MBGL
GW9	Vallur	6.1	NW	13° 15' 15.1" N	80° 16' 55.5" E	21.3 MBGL
GW10	Minjur	8.9	NW	13° 16' 18.3" N	80° 15' 43.2" E	25.0 MBGL

3.13.6 Ground water status of the study area

The shallow alluvial aquifers along Kosasthalaiyar River serve as an important source of drinking water for Chennai Metropolitan area. Dug wells and Bore wells are the most common ground water abstraction structures in the study area. The yield of dug wells range from <50 to 200 m^3/day in weathered crystalline rocks, 20 to 100 m^3/day in Gondwana formations and upto 400 m^3/day in recent alluvial formations along major drainage courses. The dug wells in hard rock terrain tapping the entire weathered residuum are capable of yielding 6 – 7 lps, requiring the installation of 5 HP centrifugal pumps for extraction of ground water. Ground water contour map of 10 km radius study area is shown in **Figure 3.14**

Figure 3.14: Ground water contour map of 10 km radius study area



3.13.7 Geology

The study area can be geologically classified into hard rock and sedimentary (alluvial) formation. This area is principally made up of Archaean, upper Gondwana and the tertiary formations. These are over laid by laterites and alluvium. The oldest of the crystalline rocks of Archaean age are of Biotite and Hornblende Gneiss, Charnockite and granite. These are intruded by Amphibole dykes, and occasionally with veins of quartz and pegmatites. These crystalline rocks have under gone weathering to variable extent.

a. Upper gondwana

The Upper Gondwana consists of clay shales, sandstones and conglomerates. These formations are encountered in the study area.

b. Tertiary formation

These formations comprise of shales, clays and sandstones. Sandstones and clays are important members of tertiary group. These occurs interbedded with conglomerates and shales. They are normally coarse to medium grained, brown to yellow in colour and beds varying in thickness from few inches to massive beds.

c. Conglomerates

These are composed of boulders and small pebbles mostly quartzites.

d. Alluvium

The alluvial deposits own their occurrence chiefly to the Kosasthalaiyar river. The Kosasthalaiyar alluvium consists of unconsolidated coarse grained sands, gravels, pebbles, clay, sandstones and kankar. The thickness of this river alluvium is comparatively small.

Recommendations

1. Spread / raft foundations for plant building, supported on the bedrock, can be designed for a maximum net allowable bearing capacity of up to 100 t/m^2.
2. Hard rock founding strata can be identified as it offers complete refusal to the bucket excavators.
3. Excavation sides should be sloped at a maximum slope of 1:1 (horizontal: vertical) or flatter. Excavated soils can be used for backfilling.

Chapter-4

Anticipated Environmental Impacts & Mitigation Measurements

Chapter 4

Anticipated Environmental Impacts &Mitigation Measures

4.1 Introduction

In this chapter the environmental impacts associated with the expansion of thermal power project 1x660MW at Ernavur village, characterized, and evaluated systematically. The extent of impact on air, water, soil, flora, and fauna will be evaluated in relation to the environmental pollution. The impacts will be distinctly direct and indirect, positive and negative, reversible and irreversible. The prediction of impacts on various environmental parameters during demolition, constrction and operational activities assists in effective identification of mitigation measures to minimize the adverse impacts on environmental quality. The prediction of impacts on different sectors has been studied using scientific tools and the results are anticipated. Such predictions are superimposed over the baseline (pre-project) status of environmental quality to develop the ultimate (post-project) scenario of the environmental conditions. The successful environmental impact assessment process requires proper identification, prediction, assessment, and also communication of the significant environmental impacts to the public. The details on impact of the project activity on each of the disciplines mentioned above are discussed below.

The environmental impacts associated due to the expansion of thermal power plant at Ernavur village the area is classified into three phases and the possible impacts are assessed.

1. Impacts during demolition
2. Impacts during constructional phase
3. Impacts during operational phase

4.2 Impacts during demolition phase of existing ETPS plant

The proposed project is 1X660MW ETPS expansion of coal based thermal power plant with super critical thermal power plant technology. The plant proposed in the land available within the ETPS complex in an area of 84 acres. As project was already under construction (about 17% of physical progress was made based on earlier EC) hence no demolition activities are proposed. The existing plant in neighbouring area of this proposed expansion will be decommissioning the sheds and buildings will be removed during construction period of ETPS replacement project and construction & demolision rules 2016 will be followed.

4.3 Anticipated impacts during construction phase

Activities during constructional phase include site clearance, site formation, building works, infrastructure provision, and any other infrastructure activities.

4.3.1 Impact on air quality

Up gradation of existing roads and construction of new roads approaching the expansion of thermal power plant development at Ernavur village the area involves cutting and filling of the earth. Within the proposed plant layout, cutting and leveling activity would be required for providing roads, sewage network, storm water system, administrative buildings and for power plant erection.

The potential source of air quality impact arising from the establishment/construction of the proposed project is fugitive dust generation. The dust, measurable as Particulate matter (PM<2.5µm, PM<10µm), Sulphur dioxide (SO_2) oxides of nitrogen (NOx) and Ozone (O_3).Would be generated as a result of construction activities. During construction, the existing houses nearby neighboring areas etc may be subjected to the potential dust impacts.

The potential dust sources associated with the constructional activities are loading and unloading of the materials, top soil removal, vehicular movement over unpaved roads, and wind erosion, etc. The possible constructional activities that contribute to the environmental impacts broadly given below:

- Dust generation during leveling of earth
- Dust generation due to the movement of vehicles on unpaved roads
- Emission of pollutants from vehicular exhaust
- Unloading of raw materials and removal of unwanted waste material
- Accumulation of excavated earth material

Exhaust emissions from vehicles and equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO_2, NO_X, PM, CO and un-burnt hydrocarbons. The impact of such activities would be temporary and restricted to the construction phase. The impact is generally confined to the project area and is expected to be negligible outside the plant boundaries.

4.3.1.1 Proposed mitigation measures

The impact of the above mentioned activities would be temporary and will be restricted to the constructional phase. However, the impact is generally confined to the expansion of thermal

power plant area and is expected to be negligible outside the boundary. Nevertheless, the following mitigation measures will be adopted to limit the environmental impact during constructional phase.

- Regular water sprinkling will be done to avoid the dust materials entering into the atmosphere. Furthermore, during windy days, the frequency of the water sprinkling will be increased.
- The vehicular movement will be minimized, with a planned scheduling, to reduce the emission of pollutants.
- Temporary thin sheets of sufficient height (3m) will be erected around the site of dust generation or all around the project site as barrier for dust control.
- The excavated material shall be reused within the boundary.
- Plantation of trees around the project boundary will be initiated at the early stages by plantation of 2 to 3 years old saplings using drip irrigation so that the area will be moist for most part of the day.
- All the vehicles carrying raw materials will be covered with tarpaulin/plastic sheet; unloading and loading activity will be stopped during windy period.

The implementation of proper control measures for dust suppression, no adverse impacts are expected and compliance with the ambient air quality is achieved at ASR's (Air Pollution Sensitive Receivers) at all time.

4.3.2 Impact on water quality

The expansion of thermal power project will involves various infrastructure developmental construction activities and the impact on water quality associated with each of these construction activities are described below:

Site formation

The preparation of land required for the subsequent development activities generates a significant amount of construction waste. The site formation may produce large quantities of run-off with high suspended solids in the absence of appropriate mitigation measures. This potential problem will be intensified during rainy season.

Construction of buildings

During rainy season, due to the construction of various civil structures, the site runoff results in significant pollution in the receiving water bodies and washing various construction equipment's will also result in water pollution.

Site workshop

The storage of used engine oil and lubricants as waste materials has a potential to create impacts if spillage occurs. Waste oil may infiltrate into the surface soil layers or in the form of runoff into local watercourses which increases the hydrocarbon levels.

Presence of workers

Wastewater will be generated from eating areas and the sewage will be generated from temporary sanitary facilities. Sewage is characterized by high levels of BOD, ammonia and E.Coli. Significant impact on water quality is envisaged if the sewage is discharged directly into the receiving waters without any prior treatment.

4.3.2.1 Mitigation measures-water quality

During site development necessary precautions will be taken, so that the runoff water from the site gets collected in a working pit. If any over flow occurs, the excess water will be diverted to nearby greenbelt/plantation area.

The domestic wastewater, generated from cleaning of equipment and from eating areas, will be collected and diverted to the working pit in which the suspended solids, if any, will be separated. The settled water will be reused for constructional purposes and for sprinkling on roads to control the dust emissions.

The domestic wastewater generated from temporary toilets used by the work force will be diverted to septic tank followed by soak pit. If the wastewater generation is high a mobile STP will be hired from the local suppliers.

The waste generated from the site work shop will be segregated like used oil, lubricants, etc., and disposed to authorized recyclers. The waste like soiled cotton and paper etc. will be disposed to municipal dust bins. Therefore, impact on water quality due to the project would be insignificant.

4.3.3 Impact on noise levels

Heavy construction traffic for loading and unloading, fabrication and handling of equipment are likely to cause an increase in the ambient noise levels. The areas affected are those close to the site. However, the noise generation during construction phase of the project will be temporary and will be restricted mostly to daytime.

The major activities, which produce periodic noise, during construction phase, are as follows:

- Foundation works

- Fabrication of structures
- Plant erection
- Operation of construction equipment
- Movement of vehicles

4.3.3.1 Mitigation measures-noise quality

The impact on noise environment can be made insignificant by adopting the following mitigation measures:

- Noise generating equipment will be used during day time for a brief period as per requirements.
- Where ever possible the noise generating equipment will be kept away from the human habituation and proper enclosures will be used for reduction in noise levels.
- Temporary thin sheets of sufficient height (3m) will be erected around the project area as barrier for minimizing the noise travel to surrounding area.
- All the vehicles entering into the project will be informed to maintain speed limits, and not to blow horns unless it is required.
- The workers involved in operating major noise generating equipment's will be provided with ear plugs/ear muffs.

4.3.4 Impact on soil

The construction activities will result in loss of vegetation cover and topsoil to some extent in the plant area. Apart from localized impacts due to construction at the plant site, no other adverse impacts on soil are anticipated in the surrounding areas. Construction activities involving leveling, excavation and removal of existing vegetation would invariably disturb the soil of the area. The impacts on soil during construction phase shall be mainly due to loss of top soil in the construction areas and contamination of the soils of surrounding area due to construction materials such as cement, sand etc. The disturbances would be more pronounced during the summer and monsoon seasons with strong winds and rains. However, it shall be temporary and shall be confined to the areas of construction only.

4.3.4.1 Soil erosion/ pollution mitigation measures

Appropriate soil conservation measures associated with improved construction techniques would be implemented in order to minimize such impacts. Some of the measures followed to mitigate these impacts on soil include:

- Wetting of soil by sprinkling of water near construction site would be done to avoid erosion of soil due to winds.

- Green belt with short and fast growing plants near construction site would be done to conserve soil.
- It is proposed to construct line drains for storm water to minimize the soil erosion and run off through rain.

Apart from localized construction impacts at the plant site, no adverse impacts on soil in the surrounding area are anticipated.

4.3.5 Impacts due to solid waste generation

During the constructional stage, the solid waste generated is required to be disposed in an appropriate and environmentally acceptable manner. The waste generated from different activities of constructional phase include following:

- Vegetation and demolition waste from site clearance
- Excavated materials from earthworks like cuttings, grading, & foundation works
- General construction waste like wood, scrap metal, & concrete debris etc.
- Domestic waste generated by site workers
- Bricks, tiles
- Cement plaster
- Steel (from RCC, door/ window frames, roofing support, railings of staircase etc.)
- Rubble, sand
- Stone (Marble, granite, sand stone)
- Timber/wood
- Paints/varnishes

Besides above there are some major and minor components namely conduits, pipes, electrical fixtures, panels, etc. in all the proposed projects. In addition the packing material used for packing of various items used in creation of sports infrastructure and others also constitutes the solid waste.

4.3.5.1 Mitigation measures- solid waste

The solid waste generated during this period being predominantly inert in nature, construction and demolition waste does not create chemical or biochemical pollution. Hence maximum effort would be made to reuse and recycle them. The most of the solid waste material can be used for filing/ leveling of low-laying areas. All attempts should be made to stick to the following measures.

- All construction waste shall be stored within the plant site for development of thermal power plant area itself. A proper screen will be provided so that the waste does not get scattered.
- Attempts will be made to keep the waste segregated into different heaps as far as possible so that their further gradation and reuse is facilitated.
- Materials, which can be reused for purpose of construction, leveling, making roads/ pavement will also be kept in separate heaps from those which are to be sold or land filled.
- The local body or a private company may be arranged to provide appropriate number of skip containers/ trolleys on hire.

The use of the construction material basically depends on their separation and conditions of the separated material. A majority of these materials are durable and therefore, have a high potential for reuse. It would, however, be desirable to have quality standards for the recycled materials. Construction waste can be used in the following manner.

- Reuse of bricks, tiles, stone slabs, timber, piping railings etc. to the extent possible and depending upon their conditions.
- Sale/ auction of materials which cannot be used at the site due to design constraint
- Plastics, broken glass, scrap metal etc. can be sent for recycling in the industries.
- Rubble/ brick bats can be used for building activity such as leveling under coat of lanes where the traffic does not constitute heavy moving loads.
- Larger unusable pieces can be sent for filing up low laying areas.
- Fine material such as sand, dust, etc. can be used as cover material
- The unearthed soil can be used for leveling as well as for lawn development
- The broken pieces of the flooring material can be used for leveling in the building or can be disposed off
- The unused or remaining paints/varnishes/wood can either be reused or can be disposed off

4.3.6 Impact on land use

The proposed Expansion project is located within the existing ETPS complex area, the project site is situated towards south of the proposed ETPS replacement project in the ETPS complex. As the project construction work was initiated after removal of major old buildings during the construction phase. Remaining is an open land covered with trees and shrubs. There will not be any adverse impact on the land use as the allotted land falls under industrial area approved by govt. of Tamil Nadu state. Furthermore, the impact on surrounding land use, during the

constructional activity, is negligible as all the raw materials required will be stored in the designated area within the boundary of the development of thermal power plant.

Impact on terrestrial environment

There will be minor impact on the terrestrial environment of the proposed site as the site is covered with trees and shrubs as the project will be commencing on the existing plant area only. During the construction phase the some trees will be demolished at the built up area. During completion of the project they will simultaneously develop the green belt area around the project site as per MoEFCC guidelines. The impact of construction activities on terrestrial environment will be insignificant.

Further, adoption of control measures such as paving and surface treatment, water sprinkling and plantation schemes would still minimize the impacts and would restrict them to the plant boundary. Thus impacts of construction activities will be marginal.

The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. The option of transplantation of trees will also be studied to save the existing matured trees and replant them in the area earmarked for greenbelt development.

4.3.7 Impact on demography and socio-economics

The impact due to the proposed expansion of thermal power plant unit on demography and socio economic conditions of the study area would be as follows:

- Increase of floating population
- Additional strain on civic amenities like road, transport, communication, drinking water, sanitation, and other facilities to meet the work force requirement
- Increase in demand for services like hotels, lodges, public transport, etc.
- Employment opportunities for construction laborers, skilled and unskilled workers, etc.
- Economic uplift of the area and region
- Raising of home rents and land prices and increase in labour rates
- Rapid growth of service sector will result in increase of incomes in the area
- More work to civil construction and transportation companies
- Expanding of services like retail shops, banks, automobile workshop, schools, hospitals etc.
- Increase in literacy rates

4.4 Impacts during operation

The major areas identified to assess the environmental impact due to the expansion of thermal power plant at Ernavur village area are given below:

- Topography & climate
- Ambient air quality
- Water quality
- Soil quality
- Noise quality
- Solid waste generation
- Ecology
- Demography and socio-economics
- Impact on health

4.4.1 Impact on topography and climate

The major topographical changes envisaged would be the manmade structures like erection of plant sheds, raw material storage space, ash pond, civil structures, water storage reservoirs, etc. However, it will also invite some positive benefits in the form of up gradation of existing roads, land leveling, tree plantations, greenbelt development, etc., in the proposed plant vicinity.

Being a thermal power project the impact on the climate due to the exhaust gas temperature will be envisaged. The maximum temperatures of the exit gas from the stack will be restricted to 135^0C during normal conditions. Normally, this will not cause any thermal imbalance. Impact on the climatic conditions from the expansion power plant will be marginal which can be nullified /reduced by developing green belt and by adopting pollution prevention equipment's like bag filters.

4.4.2 Impact on air quality

The major source of pollution from expansion of thermal power plant is emission from the chimney. The basic fuel for thermal power plant is considered as 100% imported coal the other options are as (a) 70 % (Imported):30 %(Domestic), (b) 50% (Domestic):50% (Imported) given in **Table 4.1.**

Table 4.1 Coal options

S.No	Coal Option	GCV of coal (Kcal/kg)	Qty. Required (MTPA)	Ash Content (TPD)
1	100% (Foreign coal)	5805	1.96	419
2	70% (Imported coal) 30% (Domestic coal)	5203	2.19	1279

3	50% (Imported coal) 50% (Domestic coal)	4802	2.37	1972

The important air pollutants generated from thermal plant are Particulate matter PM_{10}, $PM_{2.5}$, Sulphur dioxide (SO_2) and Oxides of nitrogen (NO_x) etc.

4.4.2.1 Emission details

(a) Particulate mater

Particulate matter is the complex mixture of small particles and they are made up of number of components, like organic chemicals, metals and dust etc. The sizes of the particles potentially cause health problems are PM_{10}, $PM_{2.5}$.These fine particulates are found in smoke burnt from coal, oil and etc.

For this project both domestic & imported coal is used as raw material in different combinations depends on availability. The ash content in the domestic coal to be used for thermal power plant is 45%. The imported coal ash content is about 6.62%.

Out of this ash content, about 20% is bottom ash and about 80% is fly ash. Electro static precipitators (ESPs) with an efficiency of 99.98% will be installed to limit the particulate matter below 30mg/Nm^3. Particulate matter emission is estimated to be 18.8gm/sec (worst case). In order to control the fly ash emissions, ESP's with efficiency of 99.98% will be installed to collect fly ash from the flue gas. Different type of coal consumptions options are given in **Table 4.4.**

(b) Sulphur dioxide

For this project 100% imported coal is used as raw material, the sulphur content in the coal to be used for thermal power plant 0.53%. Emission rate of SO_2 is estimated as 776gm/sec.

Sulphur dioxide emission from the boiler is due to burning of coal. Coal is utilising from both the options of Indian & Imported coal. 0.52% of sulphur content from 50% (Domestic):50% (Imported) & 70:30% of Domestic and Imported coal. The emission from chimney will be limited to 100mg/Nm^3.

(c) Oxides of nitrogen

Oxides of nitrogen are one of the major pollutants in the thermal power plants and to reduce the NOx emissions, steam generator would be provided with advanced low NOx burners. The emission from chimney will be limited to 100mg/Nm^3.

4.4.2.2 Stimulation model for prediction – (USEPA AERMOD)

Air dispersion modeling is done using emission and meteorological data. The predicted ground level concentration of the proposed project will indicate the impact within the 20 km x 20 km modeling area with the help of AERMOD ver. 7.0.3 software.

AERMOD model version: 7.0.3 which is a steady-state dispersion model designed for short-range (up to 50 kilometers) dispersion of air pollutant emissions from stationary industrial sources. It is used to predict the ground level concentrations (GLCs) of PM, NOx and SO2 due to the proposed project. The GLCs of PM, SO2 and NOx were predicted on 24 hourly average basis and the concentrations are shown in the form of isopleths.

The pollutants released into the atmosphere will disperse in the down wind direction and finally reach the ground at further distance from the source. The GLC mainly depend upon the strength of the emission source and meteorology of the study area.

In order to estimate the GLC due to the emission from the stack at the project, EPA approved AERMOD Air Dispersion Model has been used. Air Dispersion Model provides option to model emissions from a wide range of sources that are present at a typical industrial source complex. The model considers the sources and receptors in plain terrain as seen in the map. The basis of the model is the straight line steady state Gaussian Plume Equation. AERMOD model with the following options has been used to predict the ground level concentrations (GLCs) due to the proposed project emissions.

- Area being rural, rural dispersion parameters are considered
- Predictions have been carried out to estimate concentration values over radial distance of 10 km around the sources
- A uniform Cartesian receptor network has been considered
- Emission rates from the source was considered as constant during the entire period
- Land use type is considered in all directions of the project site
- The ground level concentrations were computed as is basis without any consideration of decay coefficient
- Calm winds recorded during the study period were also taken into consideration
- 24 hour mean meteorological data extracted from the meteorological data collected during the study period as per the guidelines of IMD/CPCB has been used to compute the mean ground level concentrations to study the impact on study area.
- The ground level concentrations contours are plotted on the topo map

The predicted maximum GLCs of PM, SO_2 and NOx are combined with baseline values and compared with the stipulated standards.

4.4.2.3 Model inputs and results

The inputs used to run the model are stack details, emission details, and twenty-four hours mean meteorological data. The meteorological data the season is shown in **Table 4.2** Stack details of proposed plant is given in **Table 4.3.** The stack emission (1x660MW) details given in **Table 4.4** and cumulative stacks emission details are shown in the **Table 4.5.**

Post project scenario of proposed expansion plant is given in **Table 4.6** & cumulative stacks overall post project scenario for season are shown in **Table 4.7.** The values are compared with the national ambient air quality standards and stack standards.

The predicted maximum ground level concentration of 24 hour average of PM, SO_2 and NO_X concentrations considering 24 hour mean meteorological data of study season are superimposed on the maximum baseline concentrations obtained during the study period **July to September 2018** to estimate the post project scenario, which would prevail at the post operational phase.

Table 4.2: 24 hours mean meteorological data for July to September 2018

Hour	Temperature (°C)	Relative Humidity (%)	Wind Direction (Degree)	Wind Speed (m/s)	Stability Class
1	28.6	85	240	2.37	6
2	27.6	87	225	2.46	6
3	26.6	89	225	2.15	6
4	25.6	92	225	2.32	6
5	24.9	96	240	2.19	6
6	24.3	98	270	1.25	6
7	25.4	95	225	1.27	5
8	27.8	92	225	1.35	4
9	29.7	84	240	3.31	4
10	30.5	75	225	2.74	3
11	34.6	68	225	3.51	2
12	36.5	57	225	3.49	2
13	39.6	48	225	3.45	1
14	40.2	31	240	3.39	1
15	39.2	49	240	2.71	1
16	38.1	57	225	2.83	1
17	37.4	67	200	2.62	2
18	36.3	76	200	2.53	3

19	34.5	78	225	2.56	4
20	33.2	79	225	2.71	5
21	32.1	80	225	2.54	6
22	30.2	82	225	2.72	6
23	30.1	83	225	2.01	6
24	29.6	84	270	2.53	6

Table 4.3: Stack details of proposed plant (Capacity - 660MW)

Details	Units	Description
Type of Fuel	-	Coal
Internal Diameter of Stack	m	7
Temperature of Flue Gas	°C	130
Height of the Stack	m	275
Ambient Temperature	°C	38
Velocity of Flue Gas	m/s	22
Flow	m^3/s	847
Efficiency of ESP	%	99.98
Efficiency of FGD	%	95.0

Table 4.4: Stack emissions details of proposed plant (Different coal proportions)

Details	units	Imported 100%	Imported 70%&30 % Domestic	Imported 50%& 50% Domestic
Coal consumption	TPA	1.96	2.19	2.37
Coal consumption	TPH	263.43	293.91	318.42
Ash content	%	6.62	18.13	25.81
Ash content	TPH	17.44	53.30	82.18
Ash content	TPD	419	1279	1972
Sulphur content	%	0.53	0.52	0.52
Sulphur dioxide	TPH	2.79	3.06	3.28
Particulate matter (without control measure	g/s	3875	11841	18263
Particulate matter (with control measure)	g/s	0.78	2.37	3.65
Particulate matter (outlet std)	g/s	18.8	18.8	18.8
Sulphur dioxide	g/s	776	851	911
Sulphur dioxide (with FGD)	g/s	39	43	45.6
Sulphur dioxide (outlet std)	g/s	62.6	62.6	62.6

Nitrogen dioxide (outlet std)	g/s	62.6	62.6	62.6
NOx-260 g/Gj	g/s	172	172	172

Note: Model run for 50:50 in worst case

Table 4.5: Cumulative stacks emission and details for proposed coal based power plants

Details	NCTPS Stage III (Proposed)	Ennore SEZ TPP (proposed)	ETPS Replacement (Proposed)	ETPS Expansion (Proposed)
	Imported	Imported	Indian (100%)	Imported(100%)
	NE & 3.5 km, w r t ETPS	NNE & 6.5 km, w r t ETPS	-	-
Plant capacity (MW)	1x800	2x800	1x660	1x660
Raw material consumption (TPD)	6720	13,828	9677	6322
Height of the stack (m)	275	275	275	275
Temp of flue gas (K)	407	407	403	403
Velocity of flue gas (m/s)	22	22	22	22
Flue gas flow rate (m^3/s)	751	751	847	847
Ash content (%)	12	12	34	6.62
Sulphur content (%)	0.8	0.8	0.55	0.53
PM emissions (g/s)	7.3	15.0	29.7	0.78
SO_2 emissions (g/s)	1244	2561	1232	776
SO_2, FGD (g/s)	62.2	128	61.6	39.0
NO_x emissions(outlet 100mg/Nm^3)	55.0 (g/s)	110 (g/s)	62.6 (g/s)	62.6 (g/s)
TPP (Units) to be Installed from 1 st January 2017				
PM (mg/Nm^3)	30			
Sulphur dioxide (mg/Nm^3)	100			
Oxides of nitrogen (mg/Nm^3)	100			

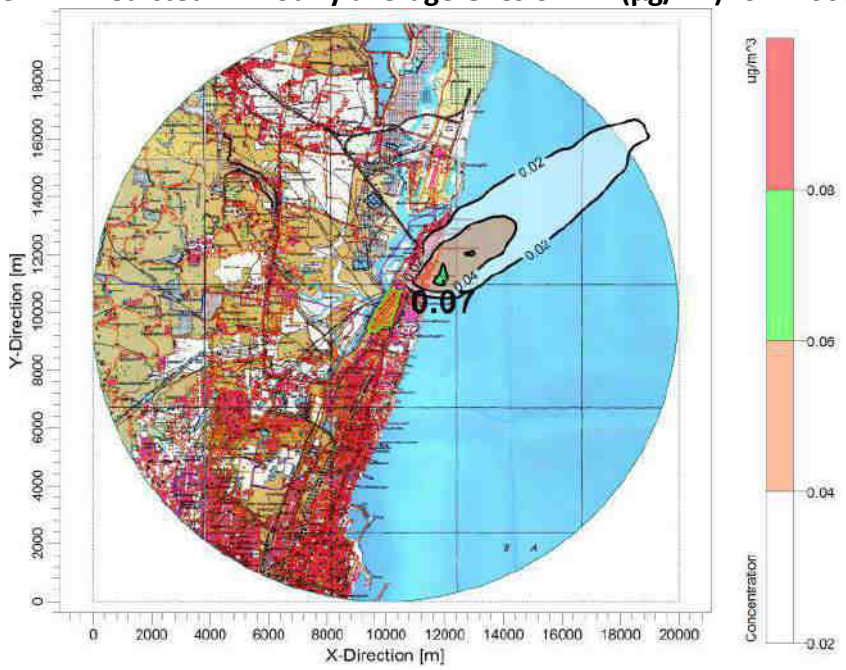
Table 4.6: Post project scenario of proposed expansion plant

Particulars	Concentrations (µg/m^3)								
	Imported 100%			Imported 70%&30% Domestic			Imported 50%& 50% domestic		
	PM	SO_2	NO_X	PM	SO_2	NO_X	PM	SO_2	NO_X
Based on outlet std	**0.36**	1.2	1.2	**0.36**	1.2	1.2	**0.36**	1.2	1.2
Based on control measure	0.02	0.75		0.05	0.83		0.07	0.85	
Without control measure	776	**14.1**		2383	**16.3**		3671	**17.0**	
NOx (based on 260 g/Gj)			**3.2**			**3.2**			**3.2**
ESP efficiency for PM 99.98%, FGD SO2 efficiency 95%,									
Baseline Scenario (Max)	98.5	26.5	38.5	98.5	26.5	38.5	98.5	26.5	38.5
Predicted GLC **(Worst Case)**	0.36	14.1	3.2	0.36	16.3	3.2	0.36	17.0	3.2
Future predicted baseline (Worst Case)	**98.86**	**40.6**	**41.7**	**98.86**	**42.8**	**41.7**	**98.86**	**43.5**	**41.7**
NAAQ Standards	**100**	**80**	**80**	**100**	**80**	**80**	**100**	**80**	**80**
Baseline Scenario (Max)	98.5	26.5	38.5	98.5	26.5	38.5	98.5	26.5	38.5
Predicted GLC (outlet std)	0.36	1.2	1.2	0.36	1.2	1.2	0.36	1.2	1.2
Future predicted baseline (Worst Case)	**98.86**	**27.7**	**41.7**	**98.86**	**27.7**	**41.7**	**98.86**	**27.7**	**41.7**
NAAQ Standards	**100**	**80**	**80**	**100**	**80**	**80**	**100**	**80**	**80**

Table 4.7: Post project scenario of cumulative stacks (July-Sep 2018)

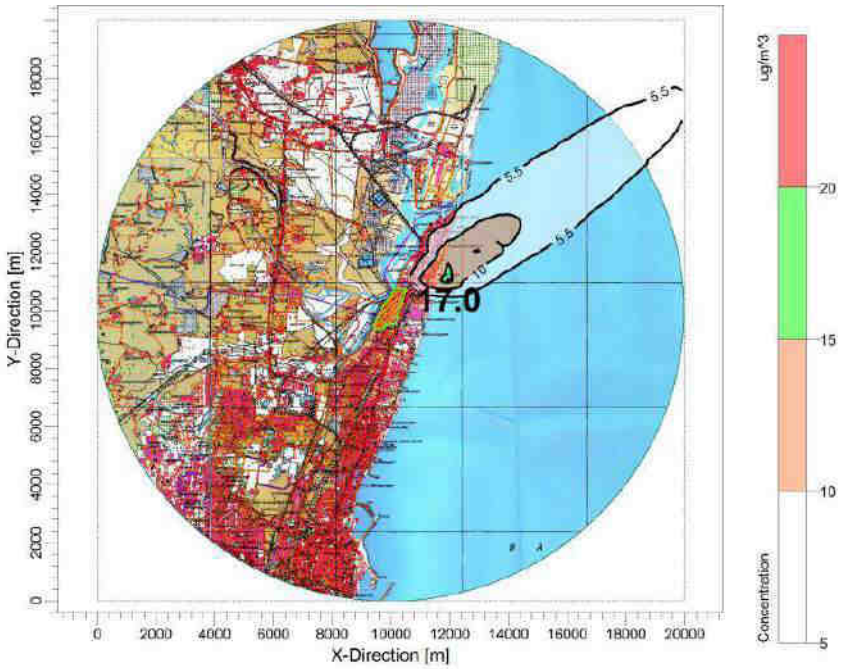
Particulars	Cumulative coal based (µg/m^3)		
	PM_{10}	SO_2	NO_X
Baseline Scenario (Max)	98.5	26.5	38.5
Predicted GLC	0.64	54.2	2.9
Future predicted baseline (Worst Case)	**99.14**	**80.7**	**41.4**
Predicted GLC with FGD	**-**	**2.7**	**-**
Future predicted baseline (With FGD)		**29.2**	
NAAQ Standards '*'	**100**	**80**	**80**

Figure 4.1: Predicted 24-hourly average GLCs of PM (µg/m^3) for 1x660MW



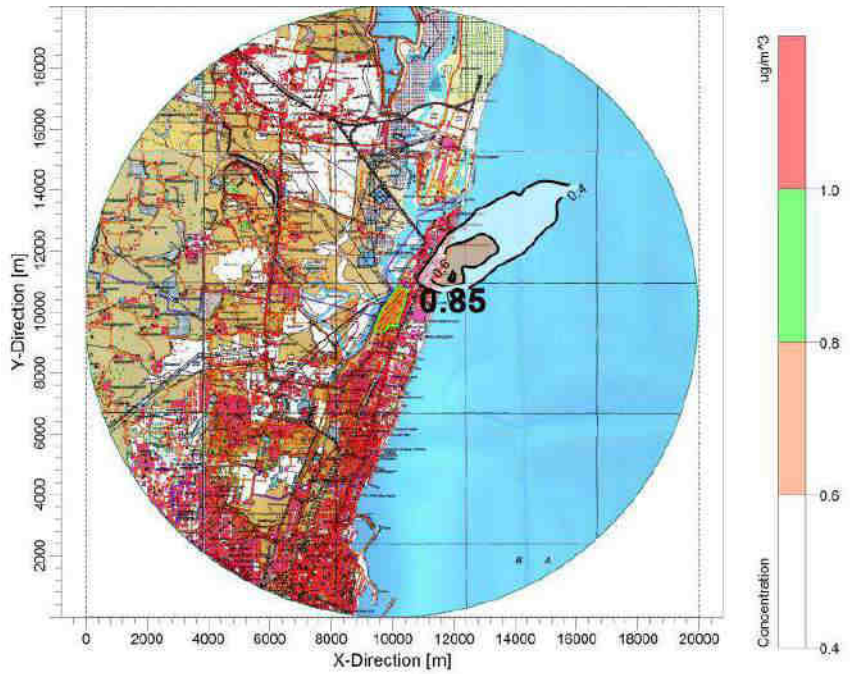
Maximum PM Concentration 0.07 ug.m^3 @ at 1.8 km in NE direction

Figure 4.2: Predicted 24-hourly average GLCs of SO_2 (µg/m^3) for 1x660MW (without FGD)



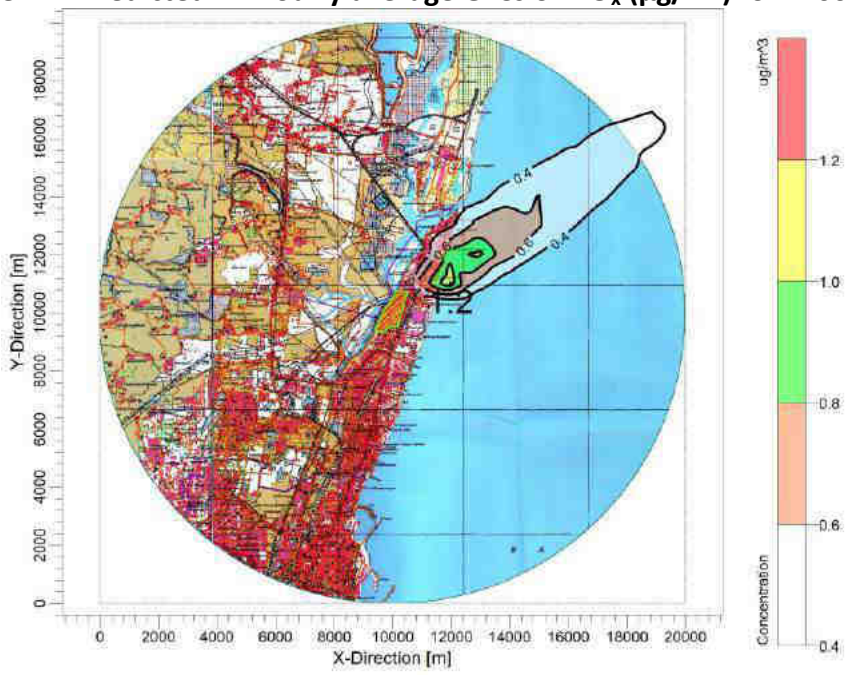
Maximum SO_2 Concentration 17.0 ug/m^3 @ at 1.8 km in NE direction

Figure 4.3: Predicted 24-hourly average GLCs of SO_2 (µg/m^3) for 1x660MW (with FGD)



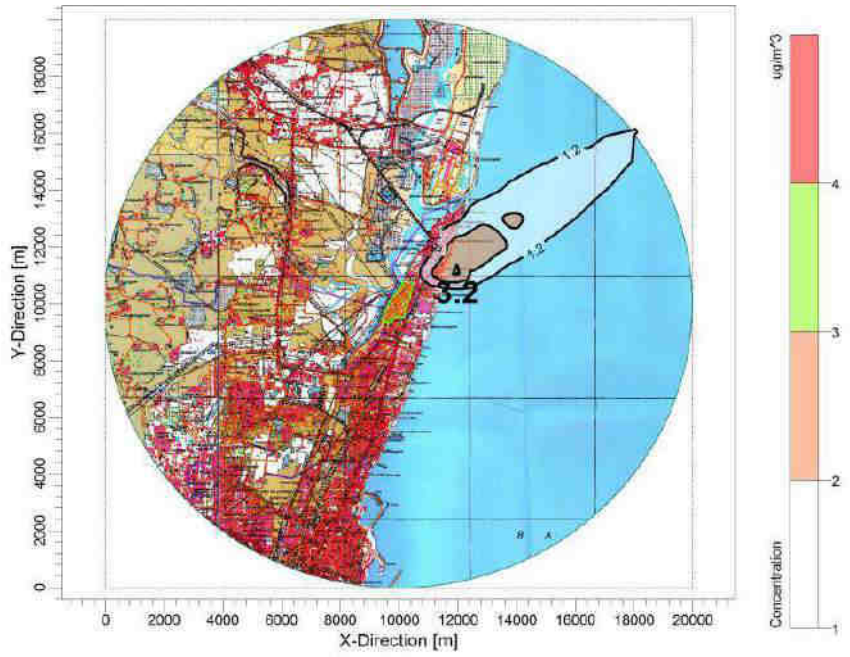
Maximum SO_2 Concentration 0.85 ug/m^3 @ at 1.8 km in NE direction

Figure 4.4: Predicted 24-hourly average GLCs of NO_x (µg/m^3) for 1x660MW



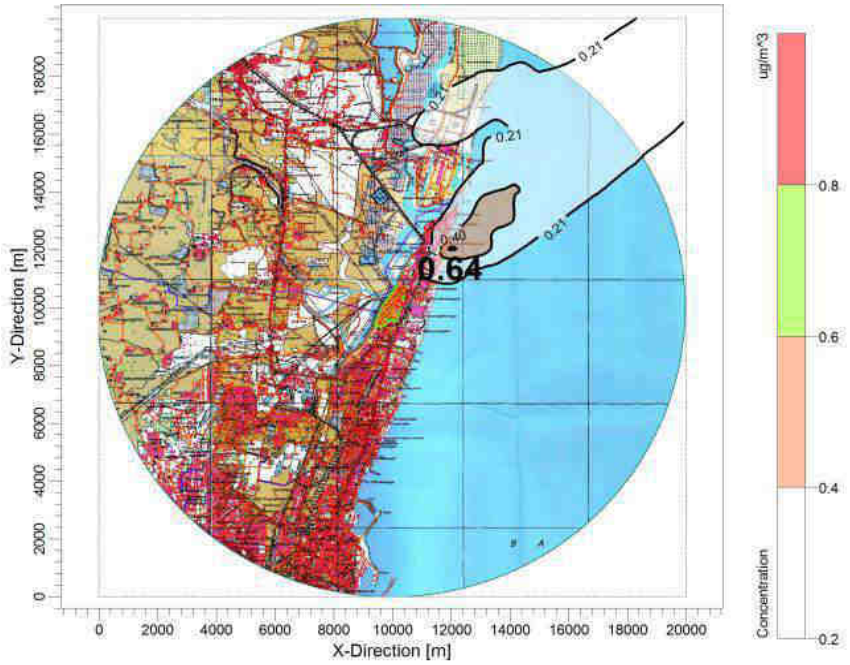
Maximum NOx Concentration 1.2 ug/m^3 @ at 1.8 km in NE direction

Figure 4.5: Predicted 24-hourly average GLCs of NO_x (µg/m^3) for 1x660MW (260 g/Gj)



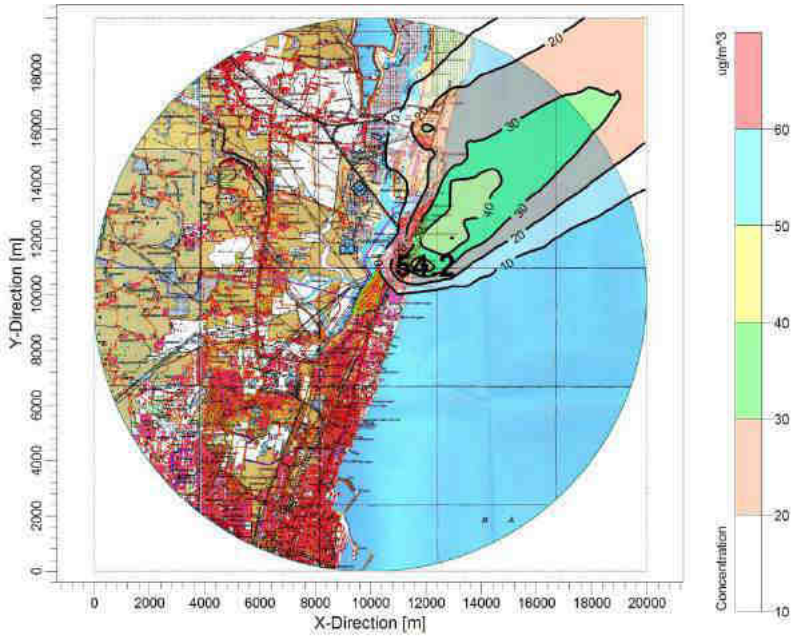
Maximum NO_X Concentration 3.2 ug/m^3 @ at 1.8 km in NE direction

Figure 4.6: Cumulative predicted 24-hourly average GLCs of PM (µg/m^3)



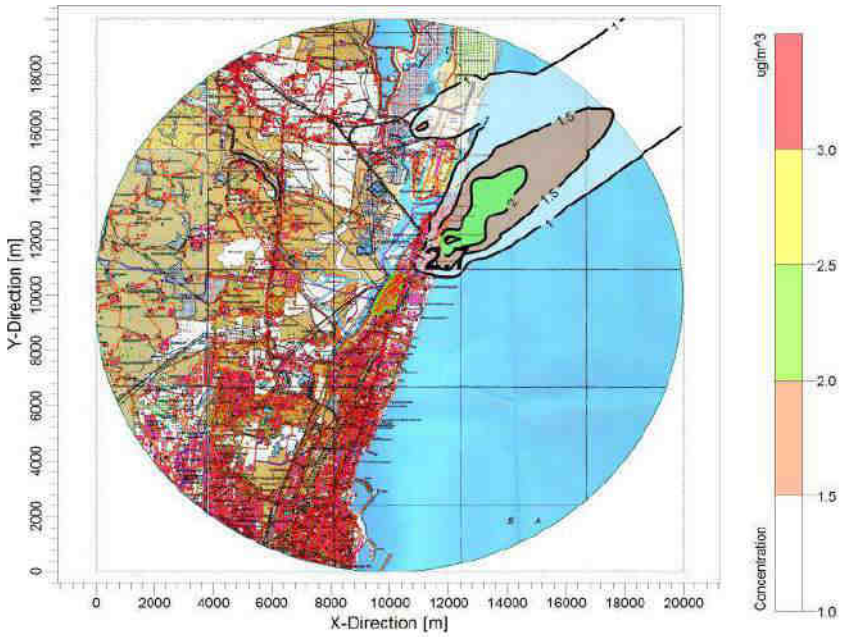
Maximum PM Concentration 0.64 ug.m^3 @ at 2.2 km in NE direction

Figure 4.7: Cumulative predicted 24-hourly average GLCs of SO_2 (µg/m^3) for 1x660MW (without FGD)



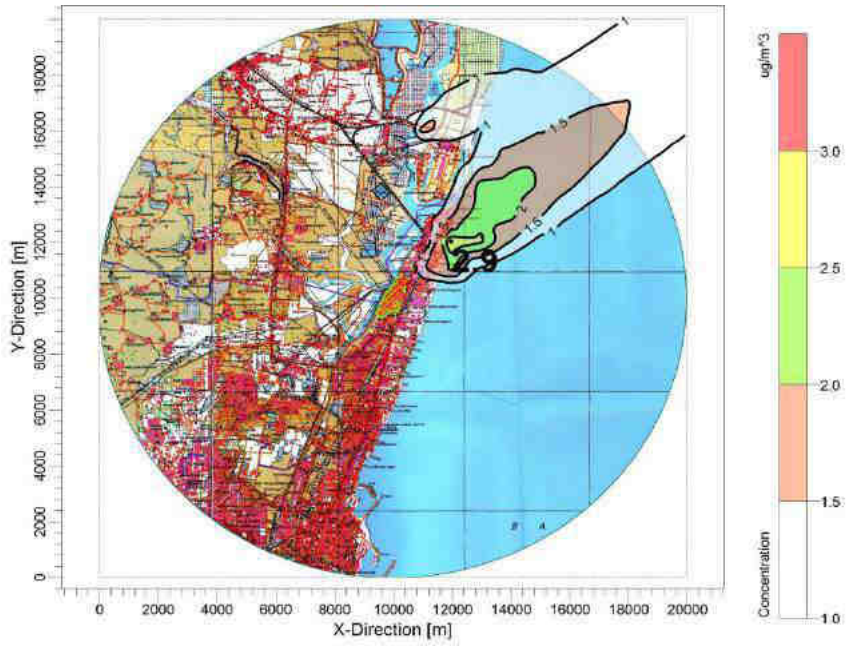
Maximum SO_2 Concentration 54.2 ug.m^3 @ at 2.2 km in NE direction

Figure 4.8: Cumulative predicted 24-hourly average GLCs of SO_2 (µg/m^3) for 1x660MW (with FGD)



Maximum SO_2 Concentration 2.7 ug.m^3 @ at 2.2 km in NE direction

Figure 4.9: Cumulative predicted 24-hourly average GLCs of NO_x (µg/m^3) for 1x660MW



Maximum NOx Concentration 2.9 ug/m^3 @ at 2.2 km in NE direction

Results & discussion

The emission rates in stack estimated for PM, SO_2 and NOx **without** control measures are 3875 g/s, 776 g/s and 172 g/s respectively. Whereas emission rates in stack for PM, SO2 and NOx with ESP (99.98% efficiency), FGD (95% efficiency) and Advanced combustion technology with low NOx burners are 0.78 g/s, 39 g/s and 62.6 g/s respectively.

Without control measures result of dispersion modeling shows increase in maximum GLC for PM is 745 µg/m^3, SO2 is 14.1 µg/m^3 and NOx is 3.2µg/m^3. With control measures result of dispersion modeling reveals a likely increase in maximum GLC for PM is 0.02 µg/m^3, for SO_2 is 0.75 µg/m^3 and for NOx is 1.2 µg/m^3. From the above value we can see that installation of control equipment will help in considerably reducing GLC values. Future predicted concentration (with control equipment) including existing baseline status for PM is 98.52 µg/m^3, SO_2 is 27.25 µg/m^3 and NOx is 39.7 µg/m^3. These values are within NAAQ standards 2009.

The cumulative study of the stacks showing all the values of PM, NO_x are within limit as per NAAQ standards except SO_2 emissions which exceeds the NAAQ standards in case FGD (Flue-gas desulfurization) is not in use. And it can be controlled by the effective utilization of FGD in respective TPPS's.

4.4.2.4 Mitigation measures

a) Coal handling area

- Dust suppression/extraction facilities will be provided to mitigate the dust generated at coal conveying area, transfer points and coal stockyard.
- Enclosed galleries will be provided to arrest the coal dust generated at all the conveyor points.
- Dust collection system will be provided in coal bunkers to evacuate dust and hazardous gases like methane from the coal bunkers.
- Collected dust would be returned to either the associated belt conveyors or to the coal bunkers. The coal dust from coal transfer points would be restricted to 5mg/Nm^3.

b) Ash handling area

In order to restrict the fly ash dust particles in the ash handling areas, vent filters will be installed on top of intermediate silos & main fly ash silos to restrict the escape of fly ash into the atmosphere during its unloading from ESP hoppers to silos.

The following pollution control measures would be installed for ash disposal:

- 100% dry fly ash extraction, storage and disposal facilities are proposed for utilization of 100% fly ash in dry form. Closed trucks & containers would be used for this purpose.

- To reduce the dust nuisance while loading the ash into the open trucks from fly ash silos, the fly ash would be conditioned with water spray.

It is proposed to cover the ash in the open trucks with tarpaulin to prevent flying of fine ash during transportation.

c) Particulate matter

To control the particulate matter in the flue gas, an electrostatic precipitator with an efficiency of 99.98% is proposed. Electrostatic precipitator is proposed to limit the particulate emissions to 30mg/Nm^3. The emission standards of particulate matter for thermal power plant are presented in **Table 4.8.**

Table 4.8: Thermal power plant emission standards {Environment (Protection) 1986, Amendment Rules, 2015}

Industry	Parameter	Standards
Thermal Power Plant	**TPPs (units) installed before 31st December, 2003***	
	Particulate matter	100mg/Nm^3
	Sulphur dioxide (SO_2)	600mg/Nm^3(Units Smaller than 500MWcapacity units) 200mg/Nm^3 (for units having capacity of500MW and above)
	Oxides of nitrogen (NOx)	600mg/Nm^3
	Mercury (Hg)	0.03mg/Nm^3 (for units having capacity of500MW and above)
	TPPs (units) installed after 1st January,2003, upto 31st December,2016*	
	Particulate matter	50mg/Nm^3
	Sulphur dioxide (SO_2)	600mg/Nm^3 (Units Smaller than 500MWcapacity units)
	Oxides of nitrogen (NOx)	300mg/Nm^3
	Mercury (Hg)	0.03mg/Nm^3
	TPPs (units) to be installed from 1st January, 2017**	
	Particulate matter	30mg/Nm^3
	Sulphur dioxide (SO_2)	100mg/Nm^3
	Oxides of nitrogen(NOx)	100mg/Nm^3
	Mercury (Hg)	0.03mg/Nm^3

Source: MOEFCC notification Dated 7th December, 2015(Published in the Gazette of India on 8th December, 2015)

* TPPs (units) shall meet the limits within two years from date of publication of this notification.

** Includes all the TPPs (units) which have been accorded environmental clearance and

d) Sulfur dioxide

For proper dispersion of the flue gases into the atmosphere MoEFCC has suggested stack heights of 275 m for thermal power plants 500MW and above generation capacity. The stacks are recommended for thermal power plants of different power generation capacities to control SO_2 through dispersion are given in **Table 4.9**. In proposed project to minimize the SO_2 emissions FGD is proposed with an efficiency of over 95%. The revised emissions norms of MoEFCC will be followed for Sulphur dioxide (SO_2) & Oxides of nitrogen (NO_x) i.e. 100mg/Nm^3.

Flue-gas desulfurization (FGD) is a set of technologies used to remove sulfur dioxide (SO_2) from exhaust flue gases of fossil-fuel power plants, and from the emissions of other sulfur oxide emitting processes.

Wet limestone FGD system shall be installed to limit the SO2 emission up to 100 mg/Nm3 (at 12% CO2 on dry gas basis). It will take suction from flue gas duct after ESP and feed the de-sulphurised flue gases back to the chimney. The FGD system shall be necessarily based on Wet Lime Stone Forced Oxidation process technology to reduce the emissions of Sulphur Dioxide in flue gas produced by coal being fired in boiler to the limits specified. The FGD system shall have an independent absorber limestone milling systems and gypsum dewatering system. An auxiliary absorbent tank, for storage of absorber slurry shall be installed. The absorbers, limestone grinding system and gypsum dewatering system shall be installed. All ducting, dampers, pumps, valves, supports, etc. as required for completeness of system of absorbers, limestone grinding system and gypsum dewatering system shall also installed. Clean gas from the absorber shall be taken to the GGH through two stage mist eliminators. Treated and reheated flue gas from the absorber shall be discharged through a 275/100 m high stack. Necessary lining in duct and chimney shall be provided for protection of duct and chimney from low temperature acidic corrosion.

Provision shall be made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation. Limestone to the absorbers shall be supplied by a wet limestone grinding in slurry form. Each wet limestone mill shall be fed from an independent bunker through a gravimetric feeder. The classified limestone slurry from the mills shall be stored in two (2 no) limestone slurry storage tank, from where the slurry shall be pumped to the individual absorbers by dedicated limestone slurry pumps. The gypsum from the two (2 no) absorbers shall be pumped by dedicated gypsum bleed pumps to Gypsum Dewatering system consisting of multiple streams of primary and secondary dewatering equipments. The water removed from the absorber shall be recycled to the absorbers. The waste water from the system shall be collected and neutralized using lime and neutralized effluent shall be pumped to Ash slurry sump. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor.

Gypsum dewatering system shall be installed. The dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of dewatering equipments. The filtrate water from belt filter dewatering and washing system and the over flow from the secondary hydro-cyclone shall be taken to a filtrate water tank and further to absorber tank

e) Oxides of nitrogen

The NOx emissions would be checked for ground level concentrations as per Indian emission standards i.e. 100mg/Nm^3. In order to reduce the NO_X emissions, steam generators are provided with advanced low NO_X burners by installing flue gas selective catalytic reduction (SCR) $DeNo_X$ system.

Flue gas Selective Catalytic Reduction (SCR) DeNOx system and its auxiliaries for steam generators shall be installed. For NOx emission limit will be below to 100 mg/Nm3 (norm) dry as per new environmental norms. The SCR System shall be planned, designed to perform and demonstrate to meet the environmental norms of MoEF&CC. The SCR reactor shall be flown through from top to the bottom and arranged in the flue gas pass of the steam generator between economizer and air heater. The reagent will be ammonia/air mixture. The overall design of the SCR shall be done under consideration of all operating conditions (e.g. higher and lower temperature), minimization of ammonia consumption and slip, prevention of formation of ammonium hydrogen Sulphate and other ammonia components, which deactivate or plug up the catalysts, minimization of SO3-conversion, prevention of disturbances in downstream equipment, prevention of plugging by ash particles, especially “popcorn ash”. The catalyst layers shall be installed in maximum two layers on horizontally arranged support frames. Furthermore one reserve layer (without catalysts) shall be designed.

The SCR reactor considerably consisting of Reactor housing, Inlet and outlet hood with guiding vanes, connecting nozzles for media (e.g. flue gas, steam, pressurized air, etc.), grid measurement with adapters, fixture for soot blower connection per catalyst layer and bearing beams for catalyst. Soot blowers shall be installed for three catalyst layers for removal of ash deposits on the catalyst. Initially only 2 catalyst levels are filled with catalyst. A 3rd catalyst layer serves as spare for future filling (already equipped with the soot blowing system). The entire SCR plant e.g. reactor, ammonia injection shall be equipped with a sufficient number and size of platforms for inspection, maintenance and sampling. Storage and supply of ammonia shall be delivered by truck tanks as liquid-pressurized form to the Power Plant.

Table 4.9: Thermal power plants– stack heights

Generation Capacity	Stack Height (meters)
500 MW and above	275
200 MW/210 MW & above to less than 500 MW	220
Less than 200 MW/210 MW	$H = 14 (Q)^{0.3}$
Source: EPA Notification {G.S.R. 742 (E), Dt 30th Aug, 1990} Stack height recommended for Gas/Naphtha based Thermal power plants as per EPA Notification (GSR 7, Dt Dec. 22nd, 1998) is as per the formula given in table	

Power Generation Capacity	Stack Height (meters) with wet flue gas desulphurization (FGD)
100MW and above	$H=6.902(QX0.277)^{0.555}$ or 100 m minimum
Less than 100MW	$H=6.902(QX0.277)^{0.555}$ or 30 m whichever is more
Q=Emission rate of So_2 in Kg/hr*,H=Physical stack height in meter *total of all connected to stack Source: MOEF Notification: GSR 593(E) date 28-06-2018	

f) Control measures – coal handling area

The coal dust is generated generally at the conveyor transfer points, coal unloading area and coal stockpile area. To mitigate the dust generation, coal transfer points and coal stockyard would be provided with dust suppression/ dust extraction facilities. In order to arrest the coal dust generation, all conveyors would be provided with enclosed galleries. The bottom portion of all the conveyor galleries would be provided with seal plates within the power plant area and at road crossings.

Dust collection system is also provided in coal bunkers to evacuate dust and hazardous gases like methane from the coal bunkers. Collected dust would be returned to either the associated belt conveyor or to the coal bunker. The dust collector outlet emission would be restricted to 5mg/Nm^3.

g) Control measures – ash handling area

To control fly ash generation at ash handling areas, fly ash evacuation from the ESP collecting hoppers would be done in closed pipelines by pneumatic means. At the time of unloading fly ash to the silos, some ash laden air would get vented out. In order to restrict the fly ash dust particles to the limits of 100mg/Nm^3, a vent filter would be installed on top of each of the fly ash silos at the vents. The following pollution control measures would be installed for ash disposal.

100% utilization of fly ash in dry form is envisaged. Closed trucks & containers would be used for this purpose, as far as possible to reduce the dust nuisance while loading the ash into the open trucks from fly ash silos, the fly ash would be conditioned with water spray.

It is proposed to cover the ash in the open trucks with tarpaulin to prevent flying of fine ash during transportation.

Ash utilization plan

Fly ash and bottom ash would be collected and stored in the silos and given to end users for manufacturing cement and bricks. TANGEDCO would put maximum efforts and ensure bottom ash utilization. 100% ash utilization will be achieved as per MoEFCC new notification dated 03-11-2009 in the phased manner as follows.

S.No	Fly ash utilization level	Target date
1.	At least 50% of fly ash generation	One year from the date of commissioning
2.	At least 70% of fly ash generation	Two years from the date of commissioning
3.	90% of fly ash generation	Three years from the date of commissioning
4.	100% of fly ash generation	Four years from the date of commissioning

4.4.3 Impact on water quality

The main source of water for the proposed power plant is Bay of Bengal through the proposed intake pipeline of ETPS expansion (1x660MW) already under construction. For arranging sweet water RO based desalination plant is recommended.

Bay of Bengal is above 815 m away from the site towards eastern direction. The sea water will be used for cooling water make-up to cooling tower, plant cycle make-up, potable water, service water, etc. The maximum requirement of construction water is estimated to be about 200 Cu.m/hr. The construction water will be sourced out from CMWSSB Authorities taking necessary permission / approval from concerned authorities. The Water required for construction will be stored in an underground water tank. From underground tank water will be pumped into overhead tank for further distribution by gravity to various points. The fresh water requirement of the project will be meet by desalinating the sea water using RO process. The detailed water Balance is given in **Table 4.10**.

Table 4.10: Water requirement (ETPS- 1x660MW)

S. No.	Description	Estimated Quantity		Remarks
		m^3/h	m^3	
1	Natural draft cooling tower system		79000	Source of water is Bay of Bengal; The intake point is 600 m from shore line.
2	Ash water system requirement		22490	
	One Time Requirement – Total		**101490**	
			m^3/day	
3	Cooling water make up requirement	5700	136800	
4	Sea water requirement for RO	1413	33912	
	Daily Requirement - Total	**7113**	**170712**	
Concentration Ratio 1:1.3 COC				

4.4.3.1 Wastewater generation

The wastewater in the project is generated from below mentioned sources and its associated facilities.

a) CT (Cooling Tower) System blow down
b) Filtration plant & DM plant
c) Clarifier & RO-I reject
d) Domestic wastewater
e) Miscellaneous wastes like Coal Handling Plant waste, Service Wastewater from plant etc.

The waste water generation details are given in **Table 4.11.**

Table 4.11: Details of waste water generation-(m^3/d)

Details	Wastewater		Remarks
	m3/h	m3/d	
Cooling tower blow down	4114	98736	• Wastewater from CPU and DM generation will be neutralised and sent to Guard pond. • Clarifier & RO I reject sent to guard pond • CW blow down and guard pond water meeting sea discharge standards, sent to sea through dedicated marine pipeline
Clarifier reject	88	2112	
RO I condensate	928	22272	
Condensate polishing unit regeneration	7	168	
DM regeneration	3	72	
Total	**5140**	**123360**	
Domestic / potable	9	216	Domestic wastewater will be treated in STP and treated water used for greenbelt.
Total	**9**	**216**	

The wastewater characteristics before treatment are given in **Table 4.12** and final discharge characteristics after treatment are given in **Table 4.13.**

Table 4.12: Wastewater characteristics before treatment

Parameter	Units	CT Blow	Clarifier reject	RO I condensate	Condensate polishing unit regeneration	DM regeneration	Domestic /potable
Quantity	**m^3/d**	**98736**	**2112**	**22272**	**168**	**72**	**216**
pH	-	8.0 – 8.5	8.0 -8.3	6.5 – 10.5	3.0 – 10.0	3.0 – 10.0	6.5 – 8.0
il & Grease	mg/l	Nil	-	Nil	<12	<12	<12
TSS	mg/l	100	200	10	10	10	150 – 200
TDS	mg/l	50700	40000	56000	500	500	400 - 450
COD	mg/l	<5	<5	<5	<5	<5	300 – 400
BOD	mg/l	<2	<2	<2	<2	<2	200 - 275
Temp	-	<5°c above raw water	-	-	-	-	-
Free available chlorine	-	<0.5	-				
Phosphates	-	<5.0					

Table: 4.13: Final discharge characteristics after treatment

S.No	Parameter	Value	*Discharge Standards for TPP
1	pH	6.5 – 8.5	6.5 – 8.5
2	Oil & Grease (mg/l)	<10	20
3	TSS (mg/l)	<100	100
4	Temperature (°C)	Not exceeding 5°C above the receiving water temperature	Not >5 °C than the intake
5	Free available chlorine	<0.5	0.5
6	Phosphates	<5.0	5.0

* Source: EPA Notification S.O.844 (E), dt 19th Nov 1996 & GSR 7, Dec 22, 1998

4.4.3.2 Wastewater treatment scheme

There are three major types of wastewaters generated from the proposed plant.

The first type of wastewater coming as cooling tower blow down and as sea water RO reject contains high total dissolved solids and hence they are diverted to outfall sump, part of this water is reused for ash handling system and rest is led back to the sea. The second type of wastewater is coming as DM plant reject, services from plant. The DM plant reject which may be acidic/ alkaline will be neutralized and sent to guard pond, The third type of waste is domestic waste from various buildings in the plant area will be collected through separate drains and treated in Sewage treatment plant and the treated water from TP and reused for greenbelt, dust suppression etc.

The schematic flow diagram of the STP is given as **Figure 4.10.** And design details of STP are given in **Table 4.14.**The treated wastewater will be reused and recycled within plant.

The Schematic diagram of waste water/effluent treatment plant is given in **Figure 4.11.**

4.4.4 Sea water treatment plant:

The cooling tower blow down from the proposed plant along with rejects from desalination plant will be discharged in to sea through the proposed outfall pipeline of ETPS expansion TPP. The schematic diagram of desalination plant is given in **Figure 4.12**.

Figure 4.10: Schematic flow diagram of sewage treatment plant-– 0.25 MLD Capacity

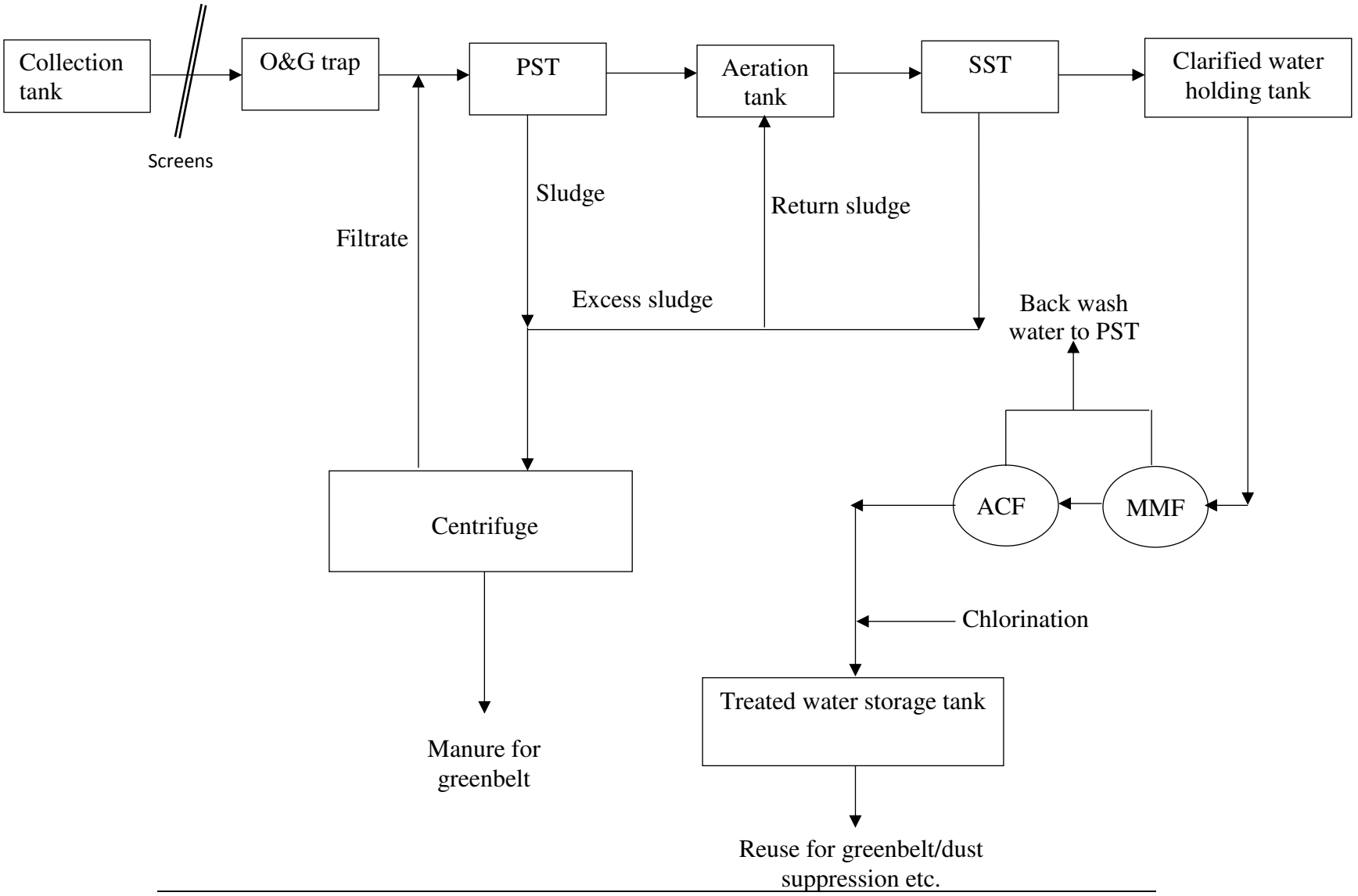


Table 4.14 Design details of - 0.25 MLD STP

S. No.	Name of the unit	Purpose	Dimensions/Capacity
1.	Collection tank	To collect the sewage from the facility	2.6 m x 2.6 m x 1.5 m SWD + 0.5 FB
2.	Bar screen chamber	Include fine screening, usually manually operated to intercept floating & suspended debris with a rake to remove the screenings & residue for the disposal offsite.	0.5 m x 0.5 m x 1.0 m SWD + 0.5 m FB
3.	O & G trap	To remove oil and grease floating on sewage surface	1.0 m x 1.0 m x 1.0 m SWD + 0.5 m FB
4.	Primary settling tank	To remove the suspended solids	4.5 m dia x 2 m SWD + 0.5 m FB
5.	Aeration tank	To remove the organic material present in the waste water	5.2 m x 5.2 m x 2.5 m SWD + 0.5 FB
6.	Secondary clarifier	To remove the solids after the biological treatment	4.5 m dia x 2.5 m SWD + 0.5 m FB
7.	Clarified water holding tank	To hold the waste water from secondary clarifier and acts as a feed for MMF	3.2 m x 3.2 m x 2.0 m SWD + 0.5 FB
8.	Mixed Media Filter (MMF)	To remove suspended solids in clarified water from secondary clarifier	Capacity: 12 kl/hr
9.	Activated Carbon Filter (ACF)	To remove suspended solids and odour in clarified water from secondary clarifier	Capacity: 12 kl/hr
10.	Treated water tank	To store the final treated water	4.6 m x 4.6 m x 2.5 m SWD + 0.5 m FB
11.	Sludge sump	To collect and store sludge from primary and secondary clarifiers	1.5 m x 1.5 m x 1.2 m SWD + 0.3 m FB
12.	Centrifuge	To separate liquids from sludge	Capacity: 1.5 kl/hr

Figure 4.11: Waste water/effluent treatment plant

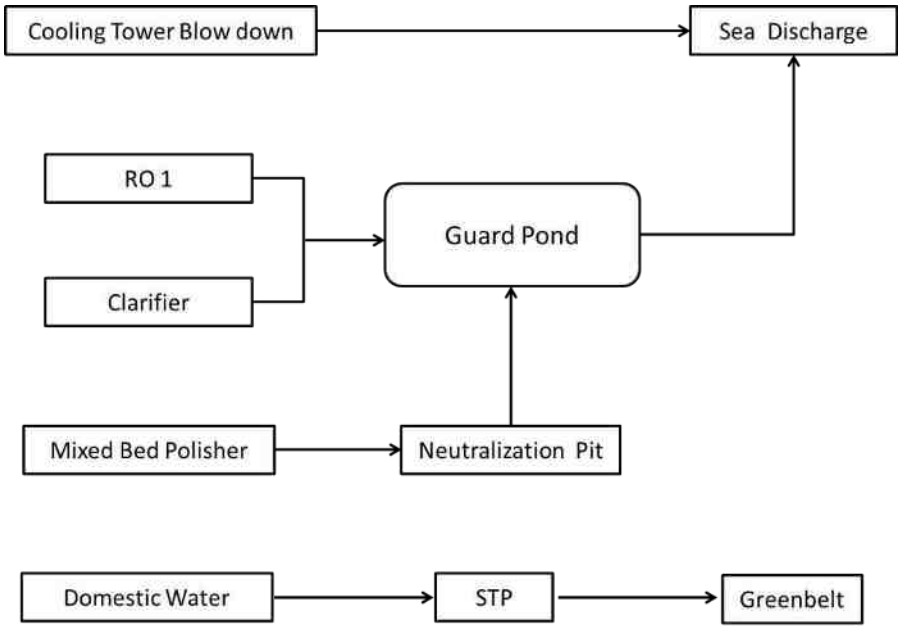
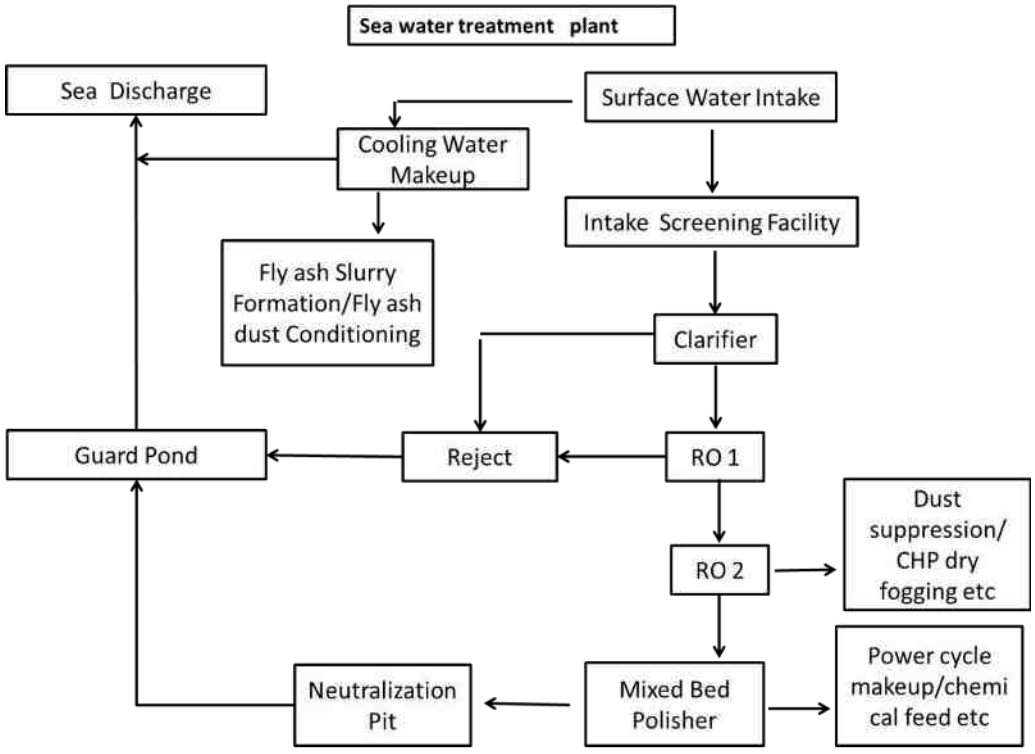


Figure 4.12: Schematic diagram of desalination plant



4.4.5 Thermal pollution

The major sources of thermal pollution in TPP are:

a) Heat loss through stack and
b) Heat loss through cooling tower.

Heat loss through stack is only about 8 to 10% of the total heat input to the furnace. This is nominal when compared with the capacity of ambient as the heat sink and this would be adequately dispersed with the plume from the high stack. The majority of the heat in cooling tower is rejected in the form of evaporation loss. This does not cause any appreciable thermal pollution to the surrounding areas.

4.4.6 Impact on noise levels

Industry in general consists of several sources of noise in clusters or single. In order to predict ambient noise levels at various sensitive areas from the proposed power plant, sound wave propagative modeling has been done.

The sound pressure level is generated by noise sources decreases with increasing distance from the source due to wave divergence. For hemispherical sound wave propagation through homogenous loss free medium, noise levels can be estimated at various locations due to different sources of proposed plant as per the following equation:

$$Lp2 = Lp1 - 20Log (r2/r1) \quad (1)$$

Where Lp2 and Lp1 are sound pressure levels (SPLs) at points located at distances r2 and r1 from the source. The combined effect of all the sources then can be determined at various locations by the following equation.

$$Lp (Total) = 10Log (10(Lp1/10) + 10(Lp2/10) + 10(Lp3/10) + \ldots\ldots) \quad (2)$$

Where, Lp1, Lp2, Lp3 are noise pressure levels at a point due to different sources.

Any industrial complex, in general, consists of several sources of noise pollution. The different sources of noise pollution are mentioned below:

- Crusher unit
- Induced draft & forced draft fans
- Boilers feed pump
- Turbine
- Generator

- Cooling tower
- Frequent vehicular movement

4.4.7 Noise generation sources

For studying impacts on the ambient noise due to the proposed industrial activities were studied using custic version 3.2 (Noise pollution modeling software). The custic software estimates the dispersion of noise in air. The numeric algorithms that custic gives the possibility to study the noise pollution that we find in our environment. The numerical method uses an equation that estimates the dispersion of the noise in air. The software admits meteorological data to establish the form of the noise pollution and calculates the sound emission that is produced by each one of the sources and it considers the estates of the sources and state of atmosphere.

The main sources of the noise generating equipment in the project and there noise levels are given in **Table 4.15,** the figure showing Isoplets generated is given as **Figure 4.13** and the noise Isoplets values observed near the boundary of the plant and future predicted noise is given in **Table 4.16**.

Table 4.15: Input noise levels for different sources

S.No	Equipmnet	Nos.	Noise	Remarks
1	ID & FD fans	2	100	Used to extract the air
2	Crusher unit	2	85	Used for industrial process
3	Boilers feed pump	2	100	Used to pump feedwater
4	Turbine generator	2	92	Used for generate electricity
5	Generator	2	90	Used during power failure
6	Cooling tower	2	81	Used to extract waste heat to the atmosphere

Table 4.16: Noise values observed at boundary of the project – dB(A)

S.No	Boundary of the project	Noise Predicted	Ambient Noise	Noise Future Predicted	Remarks
1	North	27	65	65	The noise values are within the industrial zone standards
2	East	40	64	64	
3	South	27	55	55	
4	West	34	67	67	

Figure 4.13: Noise Isoplets

Note: Contour interval is 6.73dB(A), Grid distance 450 m

According to noise modeling study output results, noise maximum levels are 67 dB (A). The noise values are within the industrial zone standards. There is no effect noise level from the Plant to the nearest villages.

4.4.7.1. Mitigation measures

The noise due to the operation of the proposed project will have only marginal impact on the baseline noise levels by adopting the following noise control measures:

- Properly designed plant and machinery (i.e. by providing inbuilt mechanisms like silencers, mufflers, and enclosures for noise generating parts) and shock absorbing pads at the foundation of vibrating equipment will be provided.
- In the high noise intensity working areas/zones ear muffs or ear plugs or any other suitable personal protective equipment would be provided to the workmen.
- Provision of isolation for major noise generating equipment's.
- Distribution of working hours among more personals working with major noise generating equipment's.
- Regular noise level monitoring would be carried out for taking corrective action, wherever required.
- Vehicular movement will be restricted and the drivers will be informed to blow horns only when required.
- The steam turbine generator would be housed in closed buildings, which would considerably reduce the transmission of noise from the generators to outside environment. The inlet air and exhaust gas streams would be provided with silencers for noise reduction.
- Necessary plantation all along the boundary and with total area not less than 33% would be developed as the greenbelt, so that the noise emissions at the plant boundary to be within the stipulated standards of CPCB as given in **Table 4.17** and the OSHA standards are given in **Table 4.18**.

Table 4.17: Ambient noise standards

Area Code	Category of Area	Limits in dB(A) Leq	
		Day Time	Night Time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Note :

1. Day time is recorded in between 6 a.m. and 10 p.m.
2. Night time is recorded in between 10 p.m. to 6 a.m.
3. Silence zone is defined as areas up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
4. Mixed categories of areas should be declared as one of the four above mentioned categories by the competent authority and the corresponding standards shall apply.

Source: EPA Notification [G.S.R. 1063 (E) dt. 26.12.1989 published in the Gazette No. 643 dt. 26.12.1989].

Table 4.18: Noise standards for occupational exposure

Total Time of Exposure per day in hours (continuous or short term Exposure)	Sound Pressure level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
¾	107
For any period of exposure falling in between any figure and the next higher or lower figure as indicated in Column (1), the permissible level is to be determined by extrapolation on a proportionate scale	
Source: Occupational Safety and Health Assessment standards (OSHA),USA	

4.4.8 Solid waste generation, impact & management

Fly ash and bottom ash will be main solid waste being generated from the plant. Fly ash would be collected in dry form and stored in the silos, the bottom ash will be collected in the ash hopper and passed through clinker grinders and the slurry would be pumped to disposal area using jet pumps. The fly ash generated from the proposed project will be disposed through e-auction.

The details of ash generation from the proposed plant are given in **Table 4.19.** The details of the fly ash utilization, MoEFCC notification is given as **Table 4.20.**

Table 4.19 Ash generation from the proposed plant

S.No	Description	100% Imported coal		30% Indian: 70% Imported: coal		50% Indian: 50% Imported: coal	
		TPD	TPH	TPD	TPH	TPD	TPH
1	Fly ash@ 80%	335	14	1023	42.6	1578	65.7
2	Bottom ash@20%	84	3.5	255.8	10.7	394.5	16.4
Total ash		**419**	**17.5**	**1279**	**53.3**	**1972**	**82.1**

Table 4.20 Fly ash utilization – new coal & lignite based TPPs

S.No	Fly ash utilization level	Target date
1	At least 50% of fly ash generation	One year from the date of commissioning
2	At least 70% of fly ash generation	Two years from the date of commissioning
3	90% of fly ash generation	Three years from the date of commissioning
4	100% of fly ash generation	Four years from the date of commissioning
Source: MoEFCC Notification S.O.2804, dated 3.11.2009, as per notification fly ash means all ash generated such as ESP ash, dry fly ash, bottom ash, pond ash, and mound ash		

4.5 Impact on ecology

The proposed expansion project is located towards south of the existing ETPS complex area and on north the proposed ETPS Replacement project is proposed within the ETPS complex. The Proposed expansion project is under execution of construction stage. Most of the land was covered with construction activities. Remaining is an open land covered with trees like Prosopis and shrubs etc. so no major impacts are envisaged on the vegetation with in boundary and surroundings as well. There is only one existing building which will be used as administrative block. During operation of plant the wastewater generated is from cooling water will be discharged to sea through outlet, and rest of the treated wastewater coming from domestic and plant services are treated and reused within plant premises for greenbelt development, make up for fire, dust suppression, etc. The discharge into the sea will be as per the marine studies report; hence the impact on marine ecology will be minimum due to the proposed project.

4.6 Greenbelt development plan

When the industry was established, development of greenbelt in 33% of the total area was not mandatory. They have grown avenue trees as evidenced by the presence of large Neem, Peepal, Banyan, Copper Pod and other trees. High density plantations of Neem and Subabul are found mainly towards the southeastern side. In the other areas, there are a few large cultivated as well as wild trees with invasive species such as *Lantana camara, Hyptissuaveolens*, *Parthenium hysterophorus* and many other weeds at the ground level. It is not possible to go for a typical 50 m wide industrial greenbelt of tall and evergreen trees of 2000 to 2500 per Ha all along the boundary on all sides of the industry for the following reasons:

1 The total area of the of the thermal power plan is 84 acres out of which 28 acres (14 acres within site & 14 acres outside boundary) will be ear marked for greenbelt for 33% of total area).

2 There are a few large trees along the boundary. They have large canopy which does not permit the light to reach the ground level. Hence, they are capable of preventing the growth of any sapling by light exclusion and competition.

3 These trees do not allow new saplings to grow properly. Mortality of the saplings grown under big trees is higher and growth will be poor. Unless they are removed, it is not possible to grow any tree under their shade.

4 It is not advisable to go for clear felling of the existing trees and to go for fresh plantations since the purpose of the greenbelt gets defeated.

5 Hence only gap filling with minimum pruning of the crown of the existing trees shall be undertaken. It is not possible to develop a greenbelt of uniform width on all sides because of the presence of some permanent structures near the boundary in some areas.

6 But it is proposed to satisfy the requirement of 33% of the total area under tree cover. This green cover of 33% (28 acres) includes plantations along the boundary, avenue plantations and block plantations.

7 Tall and less branched Malabar Neem, Casuarina and Subabul will be grown at a density of 2000 (2m x 2.5m spacing) all along the boundary. At the ground level, Hamata or Stylo grass (*Stylosanthes hamata*) and forage grasses will be grown to enrich the soil with nitrogen and to provide perennial fodder. It also helps in soil conservation and ground water recharge.

8 Large plants with wider canopy are grown as avenue plants.

4.6.1 Action plan for greenbelt development, block avenue plantations, and gardens

It is proposed to strengthen and reinforce the existing greenbelt with gap filling and addition of one to three rows subject to feasibility during the first year. It is expected to cover an area of 28 acres. A list of plants suggested for greenbelt, avenue and block plantations are given in **Table 4.21**.

Table 4.21: List of trees and shrubs identified for greenbelt, avenue, and block plantations within the project site.

Botanical name	Common / local name	Main consideration
Acacia auriculiformis	Australian wattle	Already growing
Achrassapota	Sapodilla	Fruit tree
Adenantherapavonia	Red bead tree	Ornamental tree
Aeglemarmelos	Bilva	Medical plant
Albizialebbeck	Siris / Vagai	Multipurpose
Alstoniascholaris	Indian tree of heaven	Ornamental tree

Botanical name	Common / local name	Main consideration
Anthocephalusindica	Kadmbam	Ornamental tree
Arachisduranensis	Wild arachis	Legume for ground cover.
Araucaria columnaris	Christamas tree	Ornamental tree
Artocarpusheterophyllus	Jackfruit	Fruit tree
*Azadirachtaindica **	Neem	Growing well
*Bambusa vulgaris **	Yellow bamboo	Suitable for boundary
Bauhinia variegate	Kachnar	Ornamental tree
Beaucarnearecurvate	Ponytail palm	Ornamental palm
Bombaxmalabaricum	Silk cotton tree	Ornamental tree
Borassusflabellifer	Palmyra palm	Ornamental palm
Bougainvillea spectabilis	Bougainvillea	Ornamental tree
Brassaiaactinophylla	Octopus tree	Ornamental tree
Caesalpiniapulcherrima	Peacock flower	Ornamental shrub
Callistemon lanceolatus	Bottle brush tree	Ornamental tree
Calophylluminophyllum	Alexandrian laurel	Ornamental tree
*Caryotaurens **	Fishtail palm	Ornamental palm
Cascabelathevetia	Yellow Oleander	Ornamental shrub
Cassia fistula	Golden Shower Cassia	Ornamental tree
Cassia siamea	Siamese Cassia	Ornamental tree
Castanospermum austral	Black Bean Tree	Ornamental tree
*Chamaedoreasefritzii**	Bamboo palm	Ornamental palm
Cocosnucifera	Coconut	Economically important
Cordiasebestena	Scarlet Cassia	Ornamental tree
Couroupitaguianensis	Naagalingam	Ornamental tree
Cycasrevoluta	Sago palm	Cycadaceae
*Dalbergiasissoo**	Shisham	Timber tree
Delonixelata	Gulmohar	Ornamental tree
*Dendrocalamusstrictus **	Bamboo	Suitable for boundary
Dypsisdecaryi	Triangle Palm	Ornamental palm
Dypsislutescens	Areca palm	Ornamental palm
Erythrinasuberosa	Corky coral tree	Ornamental tree
Ficusbenjamina	Weeping fig	Ornamental tree
Ficus elastic	Rubber plant	Ornamental tree
Ficusreligiosa	Peepal	Religious importance
Filiciumdecipiens	Fern tree	Beautiful foliage

Botanical name	Common / local name	Main consideration
Furcraeafoetida	Mauritius hemp	Ornamental
Hibiscus rosasinenis	China rose	Ornamental
Hyophorbelagenicaulis	Bottle palm	Ornamental Palm
Jacaranda mimosaefolia	Jacaranda	Ornamental tree
Kigeliapinnata	Sausage tree	Timber tree
Lagerstroemia parviflora	*Common crape myrtle*	Ornamental tree
*Leucaenaleucocephala**	Subabul	Pulp wood
Mangiferaindica	Mango	Fruit
*Meliadubia **	Malabar neem	Timber tree
Micheliachampaka	Champak	Ornamental tree
Mimusopselengi	Spanish cherry	Multipurpose
Muntingiacalabura	Singapore cherry	Multipurpose
Neriumodorum	Nerium	Ornamental shrub
Peltophorumpterocarpum	Copper pod	Fast growth
Phoenix acaulis	Dwarf date Palm	Aesthetic
*Phoenix sylvestris**	Wild date	Aesthetic
Phyllanthusacidus	Star gooseberry	Fruit edible
Phyllanthusemblica	Indian gooseberry	Fruit edible
Pithecellobiumdulce	Seemahunase	Fruit edible
Plumeria alba	Kaadusampige	Ornamental tree
Plumeriarubra	Kaadusampige	Ornamental tree
*Polyalthialongifolia**	Ashok	Ornamental tree
Polyalthiapendula	Ashok	Ornamental tree
Pongamiapinnata	Punnai	Biodiesel
Psidiumguajava	Guava	Fruit tree
Pterospermumacerifolium	Dinner plate tree	Ornamental tree
Punicagranatum	Pomegranate	Fruit tree
Putranjivaroxburghii	Lucky bean tree	Ornamental tree
Quisqualisindica	Rangoon creeper	Ornamental climber
Roystonearegia	Royal palm	Ornamental Palm
*Samaneasaman**	Rain tree	Multipurpose
*Spathodeacompanulata**	African tulip tree	Ornamental tree
*Sterculiafoetida**	Wild almond	Ornamental tree
Stylosanthes hamate	Hamata grass	As ground cover and nitrogen fixation.

Botanical name	Common / local name	Main consideration
*Swieteniamacrophylla**	Large-leaved mahogany	Timber tree
*Syzygiumcumini**	Jamun /Naaval	Multipurpose
*Taliparititiliaceum**	Sea or beach hibiscus	Highly suitable
Tamarindusindica	Tamarind	Tamarind fruit
Tectonagrandis	Teak / Tekku	Timber
*Terminaliaarjuna**	Arjun / NeerMarudhu	Timber
Terminaliacatappa	Almond	Multipurpose
Thespesiapopulnea	Indian tulip tree	Highly suitable
Wodyetia bifurcate	Fox tail palm	Ornamental Palm
The species chosen are capable of growing in the area under consideration. Species indicated by ** shall be grown in large numbers in Greenbelt*.		

4.7 Impact on occupational health & mitigation measures

The damage risk criteria as enforced by Occupational Safety and Health Administration (OSHA) to reduce hearing loss, stipulates that the noise levels up to 90 dB (A) are acceptable for 8-hour working per shift per day.

Adequate air, water and noise pollution control measures will be provided in the proposed power plant to meet the regulatory standards. The environmental management and emergency preparedness plans are proposed to ensure that the probability of undesired events and consequences are greatly reduced and adequate mitigation are proposed in case of an emergency. The overall impact on human health would be negligible during operation of power plant.

There are a few noise generating equipment's in the proposed power plant, such as ID fans, turbines, boilers, etc. However, impacts on the working personnel are not expected to be significant on account of the high level of automation of the plant, which means that workers will be exposed for short duration only that too intermittently. Equipment's will be provided with silencers or kept in closed room conditions. Workers will be provided with necessary protection devices like: Ear plugs, ear muffs etc.

4.8 Positive and negative socio economic impacts in the study area

The impacts of the expansion of thermal power plant during operation on demography and socio economic conditions would be both positive and negative some of them are as follows.

4.8.1 Positive impacts

- Increase in employment opportunities and reduction in migrants to outside for employment.
- Increase growth in service sector
- Increase power so that power failure system is reduced.
- Increase in consumer prices of indigenous produce and services, land prices, house rent rates and Labour prices.
- Improvement in socio cultural environment of the study area.
- Improvement in transport, communication, health and educational services.
- Increase in employment due to increased business, trade and commerce and service sector.

4.8.2 Negative impacts

- The negative impacts would be minimized by allocating the funds for EMP & CER.
- CSR Funds will be allotted for the social activities as per the companies act.

The overall impact on the socio economic environment will be beneficial.

4.9 Impacts on drainage within the project site and mitigation measures

During constructional phase

The natural drainage i.e. streams, drains, canals etc. are not found within the project site. Therefore during constructional phase there will be no diversion of natural drainage that means this project will not affect the drainage system within the project site during constructional phase.

During operational phase

At the very beginning site assessment and planning have been done. Storm water drain (SWD) will be constructed within the plot and storm water will flow by this storm water drain towards west because slope of the plot is from east to west. The slope will be maintained throughout the SWD in such a way that the velocity of the flowing water will be more than 0.3m/sec but for drainage design velocity of the flowing water has been considered as 0.6m/sec.

4.10 Impacts on ground water and surface water regimes and mitigation measures

Water is required for different purposes in any thermal power plant. The main uses are cooling tower and auxiliary cooling water systems, boiler makeup, potable water for plant, services water for plant, firefighting, ash handling, etc.

Water requirement will be fulfilled by sea water. Source of water will be Bay of Bengal. The intake point will be 3 Km from the project site. Total requirement of water will be drawn from Bay of Bengal at 5 m depth at a distance of 650 m from the shoreline.

Sea water will be made available at the fore bay through a channel connected to intake well through underground pipeline. Stop log gate and coarse screen shall be provided at inlet and coarse screen at outlet of channel respectively. Intake pipeline is being laid for drawl of water from intake well to draw the quantity of 25,000m3/h for both ETPS expansion TTP and ETPS replacement TTP. The entire pipeline is proposed to be buried in the sea bed.

Total requirement of water will be fulfilled by sea water from Bay of Bengal. No ground water will be withdrawn and no surface water will be taken from any other surface water source. Therefore this expansion project of Ennore thermal power station will have no adverse impact on ground water as well as surface water regime.

4.11 Rooftop rain water harvesting and water conservation

Rooftop rain water harvesting will be carried out in this proposed 1x660MW supercritical Ennore thermal power station expansion project. The good thing about rainwater is that it falls on our own roof, and is almost always of excellent quality. Water from well-maintained and covered rooftop rain water harvesting tanks generally meets drinking water quality standards.

4.11.1 Rooftop rain water harvesting and water conservation within the project premises

The average annual rainfall in Tiruvallur district of Tamil Nadu is about 1383 mm and average number of rainy days per year is about 59 days **(as per Government of India, Ministry of Earth Sciences, India Meteorological Department, Climatological Tables - 1981-2010 - Station: Nungambakkam, Chennai).** Rooftop rain water harvesting and water conservation are mainly based on the rainfall intensity at the project area. Rainwater will be captured by using the rainwater harvesting system. It will be done by direct collection from the rooftop and utilization of this rooftop rainwater as Makeup water in this power plant during the rainy days. Harvested rooftop rain water will be used in following purposes. Potable water (sweet water) will be required in the following heads

The **Table 4.22** provides information about harvested roof top rainwater can be utilized, the **Table 4.23** and **4.24** provides information of quantity of rain water can be harvested based on average and maximum rainfall per day.

Table 4.22: Utilization of harvested rooftop rainwater

Purposes	Requirement of Water	
	m^3/h	m^3/d
Makeup water power cycle	33	792
Chemical feed	2	48
Hydrogen generator	2	48
DM water cooling makeup	3	72
Condensate polishing unit regeneration	7	168
DM regeneration	3	72
Total	**50**	**1200**

Table 4.23: Rooftop rain water harvesting calculation(Average rainfall per day)

Particulars	Area in (m2)	Runoff Co-efficient	Rainfall intensity in m / day	Roof top rain water in m^3 / day
Roof top area	22348	0.9	0.0235	473

Table 4.24 Rooftop rain water harvesting calculation (on the basis of the highest rainfall)

Particulars	Area in (m2)	Runoff Co-efficient	Rainfall intensity in m / day	Roof top rain water in m^3 / day
Roof top area	22348	0.9	0.0326	656

About 473 m3/day of water can be harvested through rooftop rainwater and which can be utilized as makeup water in different uses. If we calculate the quantity of harvestable rooftop rainwater on the basis of the highest rainfall (i.e. peak flow) then we have to take the average highest rainfall in in Tiruvallur district of Tamil Nadu which was about 374.4 mm during the month of November and average number of rainy days during this month was about 11.5 (as per Government of India, Ministry of Earth Sciences, India Meteorological Department, Climatological Tables - 1981-2010 - Station: Nungambakkam, Chennai). About 656 m3/day of water can be harvested through rooftop rainwater and which can be utilized as makeup water in different purposes.

4.12 Storm water drainage

At the very beginning site assessment and planning have been done.The plant area is divided into a number of sub zones. Storm water generated from these sub zones will be conveyed by a network of storm water drainage system consisting of one main channel, four branch channels

and four distributary channels. The length of proposed channels have been presented below **Table 4.25**

Table 4.25: Storm water drain details

S. No.	Channel Type	Channel ID	Length (m)	Width & Height of Drains (m)	Remarks
1.	Main Channel	M-1	1301	Width: 3 Height: 2	Main Channel will pour storm water into Main SWD outside the project premises.
2.	Branch Channel	B-1	341	Width: 2 Height: 1.5	Branch Channel will pour storm water into Main Channel.
		B-2	125		
		B-3	124		
		B-4	161		
3.	Distributary Channel	D-1	321	Width: 1.5 Height: 1.0	Distributary Channel will pour storm water into Branch Channel.
		D-2	527		
		D-3	91		
		D-4	75		

The slope will be maintained throughout the SWD in such a way that the velocity of the flowing water will be more than 0.3m/sec.

4.13 Flood protection

4.13.1 Estimation of peak floods

The maximum flood discharge in a river can be determined by various methods. One such method is using the physical indications of past floods. By noting the flood marks, depths, affluxes and other items actually at an existing bridge or weirs in the vicinity, the maximum flood discharge can be estimated. The flood marks are connected with H.F.L marked on it and the cross sectional area is determined. Roughness coefficient value is determined as per the nature of the river bed and sides of the river. The velocity can be determined and the flood discharge is estimated.

4.13.2 Design of safe grade elevation of the proposed plant

The safe grade elevation of the plant is defined as the minimum elevation to be maintained throughout the plant in such a way that there will not be any inundation or other harmful effects to the plant even in the severe combinations of climate. This safe grade elevation has been calculated with respect to MSL by considering the high flood level (HFL) in the nearby river. The existing ground level and other water levels near to the plant are presented below **Table 4.26**.

Table4.26: Existing ground level and other water levels near to the plant

Sr. No.	Particulars	Details
1.	Sea level	MSL + 6.095m
2.	High tide level	MSL + 6.720m
3.	Low tide level	MSL + 5.580m
4.	High flood level in Kosasthalaiyar river	MSL + 8.550m
5.	Depth of maximum rainfall excess	86mm.

Providing a free board of 0.5 m level with the high flood level and depth of rainfall excess will provide a complete safety to the plant from the flood occurrences. The safe level for the plant will be **MSL + 9.136m.** Existing Ennore thermal power plant is already situated at an elevation of **MSL + 9.150m.** The same level can be adopted for this proposed 1 X 660MW supercritical Ennore thermal power station expansion project.

Chapter-5

Analysis of Alternatives

Chapter-5
Analysis of Alternatives (Technology & Site)

5.1 Introduction

In view of acute shortage of power in the State and to bridge the demand-availability gap, Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) a subsidiary of the Tamil Nadu Electricity Board (TNEB), Chennai -2, has proposed for a huge capacity addition of 3300MW of coal based thermal power projects during the 12th plan in the state sector.

The existing ETPS was established during 1970-75 in an area of about 237 acres having an installed station capacity of 450MW (3x110MW + 2x60MW) and were operating at capacity de rated to 340MW. These units have served for more than 40 years and reached the last leg of their life span and decommissioned on 31.03.2017. In place of this aged units TANGEDCO has proposed to replace with higher capacity and efficient units adopting modern technology. TANGEDCO has proposed to install "1x660MW supercritical ETPS expansion project" in the vacant land of about 84 acres inside the existing ETPS complex.

5.2 Technology selection

Higher capacity units came into operation in many countries and towards the end of last century unit capacities have increased to 1300MW. However in India, except for a few units, the vast majority of the units were of 30 to 60MW size till the seventies. Starting with around 60/110/210MW size in the seventies, India has quite a few 500MW units in successful operation from eighties onwards. Still higher size unit like 660MW are in the pipe line and are yet to be commissioned. Now entrepreneurs have proposed to manufacture large unit size of 800MW to 1000MW as the next size in the country with super critical technology to increase the pace of capacity addition.

The coal fired thermal power plants in India generally adopt subcritical technology for generation of power. The overall thermal efficiency of a conventional/subcritical (operating steam pressure temp at 130kg/sq.cm, 540°C) coal fired thermal power plants depends on the combustion technology, operating conditions and coal properties.

Subcritical Boilers (500MW sets) involves steam pressure of 170 bar and super heat/ reheat temperature 540°C/540°C and supercritical boilers would be designed with pressure of 246kg/cm^2 and super heat/ reheat temperature of 565°C/592°C. Main focus about supercritical boiler is on minimizing CO_2 emission originating from the fossil fired plants. CO_2 increase is linked to global warming. Hence it offers advantage of "Burn less fuel for the same output" thus economical use of energy resources and low emission.

Above an operating pressure of 225kg/sq.cm (temp. 560°C), the cycle is supercritical wherein the medium is a single phase fluid with homogeneous properties and there is no need to separate steam from water in a drum once through boilers are therefore used in supercritical cycles. Adoption of once through boiler technology has advantage of operational flexibility to respond quickly to load changes and grid fluctuations, siding pressure operation and shorter start-up times.

5.2.1 Comparison of subcritical & supercritical – TPP

The relative comparison of subcritical unit & supercritical unit in terms of capital cost, performance, plant operation, availability etc. are as given in **Table 5.1**

Table 5.1: Comparison of subcritical & supercritical

Particulars	Subcritical unit	Supercritical units
Capital cost	Base	Higher by 10 to 15%
Heat rate	Base	Lower by 5%
Boiler efficiency	Base	No significant variation
Auxiliary consumption	Base	No significant variation
O & M operations	Base	Higher by 2%
Plant efficiency	Base	Higher by 2% points, leads to reduction in coal consumption
Ash production	Base	Lower due to lower coal consumption
Process make-up water requirement	Base	Lower due to supercritical boiler
Part load operation	Base	Higher efficiency at part loads
Predicted availability	No significant variation	No significant variation
Start-up times	Longer duration	Lower duration
Indian experience	Extensive	Very limited
Availability of equipment	Indigenous as well as imported	Indigenous technology not yet operated, imported technology available
Sizes	All sizes of equipment up to around 600 MW are available	At present mostly large size units of size 660MW and 800MW area available and are getting established, 1000MW also available
Project schedule (Months)	38 to 40	24 to 36

The proposed project is of 1 x 660MW based on supercritical technology enables Rankine cycle to be operated at higher operating pressures thereby increasing the cycle efficiency. Higher efficiency means a reduction in fuel consumption and thereby a reduction in emissions per unit of electricity generated. The supercritical technology will enhance operational efficiency over subcritical technology, which is the most prevalent and commonly used for thermal power generation in India.

Hence adopting supercritical technology for higher size of coal based unit leads to enhanced plant efficiency, less fuel consumption and reduced greenhouse emissions.

Adopting supercritical technology has the following advantages:

- ✓ Superior technology
- ✓ Reduced greenhouse emissions
- ✓ Environmental friendly/ CDM benefits
- ✓ Operational flexibility to grid fluctuations
- ✓ Shorter start-up times
- ✓ Reduced coal consumption
- ✓ Savings in coal cost
- ✓ Reduced O&M cost
- ✓ Improved ash management

5.3 Compliance of the site with site selection criteria

In order to help the concerned authorities and the entrepreneurs, MoEFCC, GOI has framed certain broad guidelines for siting an industry. The broad environmental guidelines recommended for siting of industries to ensure optimum use of natural and man-made resources in sustainable manner with minimal depletion, degradation and or destruction of environment are given in **Table 5.2**

Table 5.2: Site selection criteria – areas to be avoided

Land procurement	Sufficient land to meet the demand of greenbelt development, reuse of treated water, storing of solid waste before final disposal
Coastal areas	At least 500 m from high tide line
Estuaries	At least 200 m away from the estuary boundaries
Flood plains of the riverine system	At least 500 m from flood plain or modified flood plain, or by flood control systems
Transport/ communications system	At least 500 m from highway and railway
Major settlements	At least 25 km from the project growth boundary of the settlement (3 lakh population)
Ecologically and or otherwise sensitive area	At least 25 km (Archaeological monuments, National parks & Sanctuaries, Biosphere reserves, Hill resorts, Scenic areas, etc.
Ecologically and / or otherwise sensitive areas include: 1) Religious & historic places, 2) Archaeological monuments, 3) scenic areas, 4) Hills resorts, 5) Beach resorts 6) Health resorts 7) Coastal areas rich in coral, mangroves, breeding grounds of specific species, 8) Estuaries rich in mangroves, breeding ground of specific species, 9) Gulf areas, 10) Biosphere reserves, 11) National parks and sanctuaries, 12)Natural lakes, swamps, 13) seismic zones, 14) Tribal settlements, 15) Areas of scientific and geological interest, 16) Defence installations, specifically those of security importance and sensitive to pollution 17) Border areas (International), 18) Airports, 19) Tiger reserves/ elephant reserves/ turtle nestling grounds 20) Habitat for migratory birds 21) Lakes/ reservoirs/ dams.	

In siting power plant, care should be taken to minimise the adverse impact of the power plant on the immediate neighbourhood as well as distant places. Some of the natural life sustaining systems and some specific land uses are sensitive to power plant impacts because of the nature and extent of fragility. With a view to protecting such an industrial site shall maintain the above mentioned distances.

No alternative sites are proposed as it is the expansion of the existing plant. The proposed power plant site is located in the portion of the existing ETPS complex at Ernavur Village, Tiruvottiyur Taluk, Thiruvallur District, Tamil Nadu. This land is TANGEDCO's own land. About 84 acres of barren land available in the southern side of the existing plant within the ETPS complex is developed for building & infrastructure related to the thermal power project. It is already a declared industrial area.

5.4 Selected site

The following factors have influenced the idea of setting up of the power plant site selection.

1 Availability of adequate vacant land owned by TANGEDCO for establishment of 1 x 660MW power plant free from R&R issues.
2 Availability of adequate seawater for makeup, corridor for cooling water Intake & outlet pipelinesis used from the common facility which is to be located in adjacent ETPS expansion project area.
3 Raw water requirement for the project is envisaged to be met from metro water or desalination of sea water.
4 The proposed site is away from CRZ regulations.(>500m (Away from CRZ Regulations 1991)
5 Koratliyar River, West - 575 m from the project site, Bay of Bengal, East 815m Ennore backwaters: 70 m from the project site.
6 Facility to utilize existing Ennore port for coal movement through pipe conveyors.
7 Proximity of Ports for transport of fuel.
8 Availability of transmission system for power evacuation.
9 Possibility to arrange required coal conveyor system.
10 Suitability on environmental considerations.
11 Availability of developed infrastructures nearby.
12 Intake and outfall for sea water of ETPS expansion project will be used.

Chapter-6

Environmental Monitoring Program

Chapter-6
Environmental Monitoring Program

6.1 Environmental monitoring program

The main objective of environmental monitoring program is to check the efficacy of the EMP (Environmental Management Plan) and mitigation measures implementation and take corrective action needed. A well-defined environmental monitoring program would be followed for the proposed project. It would be ensured that trained and qualified staff supervises the monitoring of ambient air, stack gases, effluents, noise etc. to see that prescribed standards laid down are obtained.

The monitoring Plan will have two components:

- Construction phase
- Operational phase

6.1.1 Construction phase

The proposed project envisages setting up of 1x660MW coal based super critical thermal power project. Major components for setting up the above projects are boiler, turbine, generator, condenser, cooling water system, coal handling system, ash handling system, coal plant, ESPs, switchyard and other civil, mechanical and electrical plant and equipment.

The construction activities require clearing of vegetation, mobilisation of construction material and equipment. The construction activities are expected to last for over three years. The generic environmental measures that need to be undertaken during project construction stage are given in **Table: 6.1.**

Table 6.1: Environmental monitoring during project construction stage

S. No.	Potential Impact	Detailed actions to be followed as per EMP	Parameters for Monitoring	Frequency of Monitoring
1.	Air emissions	All equipment's are operated within specified design parameters.	Random checks of equipment logs/ manuals	Periodic
		Vehicle trips to be minimized to the extent possible	Vehicle logs	Periodic during site clearance & construction activities
		Any dry, dusty materials stored in sealed containers or prevented from blowing.	Stockpiles or open containers of dusty materials.	Periodic during construction activities
		Compaction of soil during various construction activities	Construction logs	Periodic during construction activities

S. No.	Potential Impact	Detailed actions to be followed as per EMP	Parameters for Monitoring	Frequency of Monitoring
		Maintenance of construction DG set emissions to meet stipulated standards	Gaseous emissions (SO_2, HC, CO, NO_x)	Periodic emission monitoring
		Ambient air quality within the premises of the proposed unit to be monitored.	The ambient air quality will confirm to the standards for PM (<10 & <2.5), SO_2, NO_x, and CO	As per CPCB/ SPCB requirement
2.	Noise	List of all noise generating machinery onsite along with age to be prepared.	Equipment logs, noise reading	Regular during construction activities
		Night working is to be minimized.	Working hour records	Periodic
		Generation of vehicular noise	Maintenance of records of vehicles	Periodic
		Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances and enclosures).	Site working practices records, noise reading	Periodic during construction activities
		Stopping machinery running when not required.		
		Acoustic mufflers/ enclosures to be provided in large engines.	Mufflers/ enclosures shall be in place.	Prior to use of equipment.
		Noise to be monitored in ambient air within the plant premises.	Instant Noise recording	As per CPCB/ SPCB requirement
		The Noise level will not exceed the permissible limit both during day and night times.		
		All equipment's operated within specified design parameters.	Random checks of equipment logs/ manuals	Periodic during construction activities
		Vehicle trips to be minimized to the extent possible.	Vehicle logs	Periodic during construction activities
3.	Waste water discharge	No untreated discharge to be made to surface water, groundwater or soil.	No discharge hoses shall be in vicinity of watercourses.	Periodic during construction activities

S. No.	Potential Impact	Detailed actions to be followed as per EMP	Parameters for Monitoring	Frequency of Monitoring
		The discharge point should be selected properly and sampling and analysis should be undertaken prior to discharge.	Discharge norms for effluents as given in Permits	Periodic during construction activities
		Take care in disposal of wastewater generated such that soil and groundwater resources are protected.	Discharge norms for effluents as given in permits	
4.	Soil erosion	Minimize area extent of site clearance, by staying within the defined boundaries	Site boundaries not extended/ breached as per plan document.	Periodic during construction activities
		Protect topsoil stockpile	Effective cover in place.	Periodic during construction activities
5.	Drainage and effluent management	Ensure drainage system and specific design measures are working effectively. The design to incorporate existing drainage pattern and avoid disturbing the same.	Visual inspection of drainage and records thereof	Periodic during construction activities
6.	Waste management	Implement waste management plan that identifies and characterizes every waste arising associated with proposed activities and which identifies the procedures for collection, handling & disposal of each waste arising.	Comprehensive Waste Management Plan should be in place and available for inspection on-site.	Periodic check during construction activities
7.	Non-routine events and accidental releases	Plan to be drawn up, considering likely emergencies and steps required to prevent/ limit consequences.	Mock drills and records of the same	Periodic during construction activities
8.	Health	Employees and migrant labour health check ups	All relevant parameters including HIV	Regular checkups as per Factories Act.

6.1.2 Operational phase

During operational stage, continuous air emissions from boilers, wastewater and ash generation are expected.

The following attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:

- Source emissions and ambient air quality;
- Groundwater levels and ground water quality;
- Water and wastewater quality (water quality, effluent & sewage quality etc.);
- Solid waste characterisation (Ash, ETP & STP sludge); Soil quality;
- Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels); and
- Ecological preservation and afforestation.

Table: 6.2: Environmental monitoring during operational phase

S. No	Potential Impact	Action to be Followed	Parameters for Monitoring	Frequency of Monitoring
1.	Air emissions	Stack emissions from Power Plants	Gaseous emissions (PM, SO_2 & NO_x)	Continuous monitoring using on-line equipment during operation phase
		AAQ within the project premises and nearby habitations to be monitored. All vehicles to be PUC certificate.	PM (<10 & <2.5), SO_2 & NO_x Vehicle logs to be maintained.	As per CPCB/ SPCB requirement
		Meteorological data	Wind speed, direction, temp., relative humidity and rainfall.	Continuous monitoring using automatic weather station.
2.	Noise	Noise generated from operation of Compressor power plant, cooling towers to be monitored.	Spot Noise Level recording;	Periodic during operation phase
3.	Wastewater discharge	Compliance to wastewater discharge standards.	pH, TSS, TDS, BOD, COD & Oil & grease	Periodic or As per CPCB/ SPCB requirement
4.	Solid waste/ hazardous waste	Check compliance to HWMF rules	Quality & quantity monitoring	Periodically

S. No	Potential Impact	Action to be Followed	Parameters for Monitoring	Frequency of Monitoring
5.	Ground water quality and water levels	Monitoring ground water quality, around plant site and levels	Comprehensive monitoring as per IS 10500 Groundwater level BGL	Periodically
6.	Flora and fauna	Vegetation, greenbelt/ green cover development	No. of plants, species	Once a year
7.	Soil quality	Checking & Maintenance of good soil quality around	Physico-chemical parameters and metals.	Once a year
8.	Health	Employees and migrant labour health check ups	All relevant parameters including HIV.	Regular checkups as per factories act.

6.1.3 Water quality monitoring

Detailed action plan for monitoring ground water quality in and around the project area is given below.

- A detailed plan for conducting monitoring of water quality regularly with proper maintenance of records will be formulated and maintained, the same will be shared too concerned authorities as per the requirement.
- Three locations will be identified around the project site with due consideration of flow of water in the area. Four locations around the ash pond covering all directions will be identified for providing piezometers.
- The water samples will be collected as per BIS/CPCB procedures and important major and minor ions including heavy metals will be analyzed once in a month.
- The ground water table in the study area including piezometers will be monitored at regular intervals covering all seasons.

6.2 Environmental laboratory equipment

The plant shall have an in-house environmental laboratory for the routine monitoring of air, water, soil, meteorology, and noise. For all non-routine analysis, the plant may utilize the services of external laboratories and facilities. The laboratory equipment's required for monitoring and analysis are listed in **Table 6.3.**

Table 6.3: List of equipment proposed for environmental laboratory

Name of the Equipment	No. of Instruments
Automatic Weather Station (wind speed, wind direction Temp., Relative Humidity, rainfall, solar radiation & sunshine)	1
a).Online Automatic gaseous stack monitoring kit for SO_2, NO_x, O_2, Flue gas volume, Temperature and b).conventional monitoring kit for particulates	1
High volume air samplers with RPM provision	5
Portable Flue Gas Combustion Analyser	1
Atomic Absorption Spectrophotomètre	1
Mercury analyser	1
Portable Noise level meter (Dosimeter)	2
Portable Wastewater Analysis Kit	1
BOD Incubator	1
COD Digester with colorimeter	2
Different micron sieves(set)	1 set
Dissolved oxygen Mater-Brief case size	2
Electronic Balance	1
Spectrophotometer	1
Hot Air Oven	2
Laboratory Water Distillation and demineralization unit	2

6.3 Pollution monitoring facilities

Process stacks shall have online monitoring instrument for SO_2 and NO_x. Similarly automatic/ manual AAQ and meteorological monitoring stations shall be installed in the Plant. Environmental laboratory shall have above equipment/ instruments to analyze air and wastewater parameters.

6.3.1 Reporting schedules of the monitoring data

It is proposed that voluntary reporting of environmental performance with reference to the EMP should be undertaken. The environmental monitoring cell shall co-ordinate all monitoring programs at site and data thus generated shall be regularly furnished to the State regulatory agencies. The frequency of reporting shall be on six monthly bases to the local state PCB officials and to regional office of MoEFCC. The Environmental audit reports shall be prepared for the entire year of operations and shall be regularly submitted to regulatory authorities.

6.3.2 Environmental management organizational setup

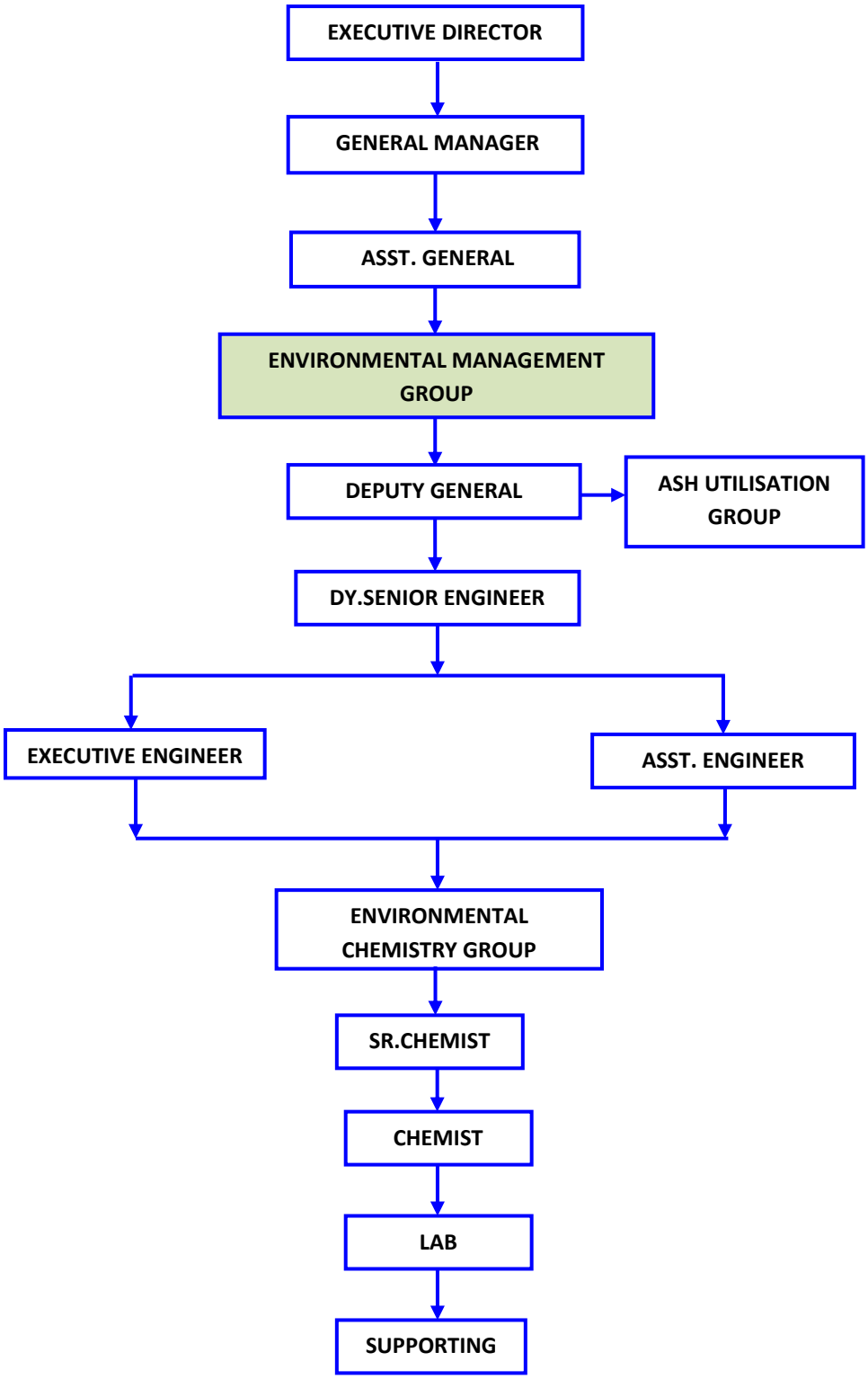
For the implementation of EMP and periodic monitoring, a well-organized environmental management group (EMG) consisting of competent workforce headed by AGM level has

been established by the proponent to deal with various environmental and ash utilization aspects. The activities of EMP include- follow up with SPCB, regional office of MoEF&CC and CPCB as well as to interact with inter-disciplinary groups responsible for maintenance and operation of pollution control equipment. The EMG reports to the head of the station. The same group will continue as the nodal agency for the proposed ETPS expansion project when in operation with the following functions:

- Obtaining consent order from SPCBs;
- Environmental monitoring;
- Analysis of environmental data, reports, preparations and transmission of report to statutory authorities, corporate centre etc.;
- Compliance with guidelines and statutory requirements;
- Coordination with statutory bodies, functional groups of the plant, corporate EMG / engineering etc.;
- Interaction for evolving and implementation of modification programs to improve the availability/efficiency of pollution control devices / systems;
- Environmental appraisal (Internal) and environmental audit; and
- Formulating strategy at for ash utilization and compliance to MoEF&CC guidelines.

Further EMG at regional level and corporate level will monitor the environmental performance of the project and provide regular guidance in consultation with MoEF&CC and CPCB. Organizational structure of EMG for the existing and proposed plant is shown in **Figure 6.1** which will be suitably augmented by employing relevant subject/discipline experts at an appropriate time.

Figure 6.1 Organizational structure of environmental management group (EMG)



6.3.3 Budgetary provision for EMP

In order to comply with the environmental protection measures as suggested in the above sections, management has set aside budgetary provision for environmental protection and safety measures. Cost towards environmental mitigation measures is given in **Table 6.4**

Table 6.4: Cost towards environmental mitigation measures

S. No	Particulars	Capital Cost (Rs. In Crores)	Recurring Cost (Rs. in Crores)
1	Dust control system i) ESP ii) Dust suppression system for coal handling	192.00 3.50	48.00
2	Chimney	88.90	
3	Water treatment plant including clarifier, UF, RO, DM, electrical and Instrumentation	42.24	
4	Effluent treatment plant	3.50	
5	Dense phase, pneumatic ash handling plant including bottom ash & fly ash silos, conveying compressors and other equipment's	106.56	
6	Development of greenbelt	0.68	
7	Sewage system	1.44	
8	Chemical dosing and chlorination plant	9.70	
9	Pollution monitoring instruments/ equipment	14.16	
10	Other unforeseen items	14.16	
11	FGD and SCR	500.00	50.00
	Total	**977.00**	**98.00**

- TANGEDCO proposed to incur Rs. 500 Crores towards installation of FGD (Flue Gas Desulfurization) and SCR (Selective Catalytic Reduction) to comply the latest emission norms.
- Additional Greenbelt endowment fund of Rs. 1.0 Crore

Chapter-7
Additional Studies

Chapter 7

Additional Studies

7.0 Introduction

Following additional studies have been completed as a part of EIA studies.

- Risk assessment
- Disaster management plan
- Hydro-geological studies
- Need based assessment studies and preparation of CSR plan.
- Public consultation

7.1 Risk assessment

The safety aspects of the manufacturing activity were generally covered under the factories Act of 1948. However, consequent to the Bhopal gas tragedy, the Government of India has made major amendments to the Factories Act. In the year 1987 and under the exercise of powers conferred by the Environment (protection) Act of 1986, the Central government promulgated 'The Manufacture, Storage and Import of Hazardous Chemicals Rules - 1989' and amended the rules in 1994. Under these rules, industries handling Hazardous Chemicals listed in Schedule 1, 2 and 3 of the Act have to obtain clearance from the government after submitting a safety report giving systematic hazard analysis and risk assessment of the project and made it as a general responsibility of the occupier of the said Industrial activity.

Objectives:

Hazard Identification and Risk Assessment is aimed at identifying hazardous chemicals quantifying the consequences of plant operations. The specific objectives of the study are:

- Identification and assessment of major accident hazard potential in the plant operations.
- Identification of major failure scenarios
- Consequence Analysis of the scenarios with respect to dispersion of released gases, areas affected by fire or explosion etc.
- The report includes a description of the hazards arising out of the activity together with an account of the controls that are in operation.

A hazard is a danger, peril, source of harm, or an adverse impact on people or property. Risk is an expression of chance, a function of likelihood of an adverse and the magnitude of its consequences.

Risk is associated with frequency of failure and consequence effect. Predicting such situations and evaluation of risk is essential to take appropriate preventive measures. The major concern of assessment is to identify the activities falling in matrix of high and low frequencies at which the failures occur and the degree of its impact. The high frequency, low impact activities can be managed by regular maintenance i.e., Leak Detection and Repair (LDAR) programs. Whereas, the low frequency, high impact accidents are of major concern in terms of risk assessment. As the frequency is low, often the required precautions are not taken. However, the risk assessment identifies the major concerns which require additional preventive measures, likely consequence distances considering domino effects, which will give possible causalities and ecological loss in case of accidents. These magnitudes demand the attention for preventive and Disaster Management Plans (DMPs).
Risk assessment can be carried out in 5 sequential steps:

1. Hazard Identification- sources of adverse impacts;
2. Hazard accounting- Scoping and setting the boundaries;
3. Scenarios of exposure- how the hazard might be encountered;
4. Risk characterization- likelihood and severity of impact damage;
5. Risk management- mitigation or reduction of unacceptable risk.

7.1.1 Hazard identification

Identification of causes and types of hazards is the primary task for planning for risk assessment. Hazard can happen because of the nature of the chemicals handled and also the nature of process involved.

The methods employed for hazard identification in this study are:

- Identification of major hazards based on **Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of GoI (as amended in 2000)** and
- Identification of hazardous units and segments of plants and units based on relative ranking technique. Example: Fire- Explosion and Toxicity Index (FE&TI).

7.1.1.1 Identification of major hazards (based on manufacture, storage and import of hazardous chemicals rules, 1989 of GoI as amended in 2000).

A systematic analysis of the fuels/chemicals and their quantities of storages have been carried out, to determine threshold quantities as notified by GoI Rules, 1989 (as amended in 2000) and the applicable rules are identified.

The proposed TPP involves storage of various hazardous bulk chemicals (Toxic and Flammable) which will be used as fuel and auxiliaries. The major hazardous Chemicals/Fuels

that are stored and involved with process are Light Diesel Oil (LDO), Heavy Fuel Oil (HFO), Chlorine, and Hydrogen. The threshold quantities of storage of these substances as notified by GoI Rules, 1989 (as amended in 2000) are provided in **Table 7.2.**

Table 7.1: Details of flammable, explosive and hazardous materials

S.No	Product	Codes/Label	Type of Storage	Storage Capacity
1	Coal	Flammable	Open yard	50000 Tons
2	Heavy Fuel Oil (HFO)/ Light Diesel Oil (LDO)	Flammable	Tanks	2000 KL (1No.) 1000 KL(1No.)
3	Hydrogen	Flammable	Cylinders	-----
4	Chlorine	Toxic	Cylinders	-----

Table 7.2: Applicability of GoI rules to fuel/chemical storage for proposed TPP

S. No.	Chemical/Fuel	Listed in Schedule	Threshold Quantity for Application of Rules (MT)	
			5,7-9,13-15	10-12
1	Light Diesel Oil (LDO)	1 (part I)	5000	50000
2	Heavy Fuel Oil (HFO)	1 (part I)	5000	50000
3	Chlorine (Cl_2)	3 (part I)	10	25

7.1.2 Fire explosion and toxicity index (FETI) approach

The most widely used relative ranking hazard index is Dow's Fire Explosion Index (F&EI) and Mond's Toxicity Index (TI) together is called as Fire Explosion and Toxicity Index (FETI). It involves objective evaluation of the realistic fire, explosion, toxicity and reactivity potential of process or storage units. The quantitative methodology relies on the analysis based on historic loss data, the energy potential of the chemical under study and the extent to which loss prevention measures are already applied.

7.1.2.1 FETI objectives and methodology

The basic objectives that characterize FETI are:

- Identification of equipment within the plant that would contribute to the initiation or escalation of an incident.
- Quantification and classification of the expected damage potential due to fire, explosion and toxicity incidents in realistic terms.
- Determination of "area of exposure" surrounding the process or storage unit.

F&EI is a product of Material Factor (MF) and Hazard Factor (F3). While MF represents the flammability and reactivity of the substances, hazard factor (F3) is itself a product of General

Process Hazard (GPH) and Special Process Hazard (SPH). An accurate plot plan of the plant, a process flow sheet and Fire and Explosion Index and Hazard classification Guide published by Dow Chemical Company are required to estimate F&EI of any plant or storage units.

The toxicity index is primarily based on the index figures for health hazards established by NFPA in codes NFPA 704, NFPA 49 and NFPA 325m.

7.1.2.2 Computations and evaluation of F&EI and toxicity index (TI):

The F&EI is calculated from,

F&EI= MF x F3

Where ***F3= GPH x SPH***

The degree of hazard potential is identified based on numerical value of F&EI as per the criteria given in **Table 7.3.**

Table 7.3: Degree of hazard based on F&EI

F&EI Range	Degree of Hazard
< 60	Light
61-96	Moderate
97-127	Intermediate
128-158	Heavy
> 159	Severe

The TI is calculated as follows:

$$TI = \left(\frac{Th + Ts}{100}\right)(1 + GPH + SPH)$$

Where, *Th* is the health factor.

By comparing the indices of F&EI and TI, the unit under analysis is classified into one of the following categories established for this purpose.

Table 7.4: Categories of substances based on F&EI and TI

Category	Fire and Explosion Index (F&EI)	Toxicity Index (TI)
I	< 65	< 6
II	65 ≤ F&EI < 95	6 ≤ TI < 10
III	≥ 95	≥ 10

Certain basic minimum preventive and protective measures are required for the three hazard categories.

Detailed computations of FETI for various storage tanks at proposed TPP are given in the **Table 7.5.** The flammability, reactivity, health, MF for all the materials under consideration was derived from NFPA codes. The GPH and SPH were calculated accordingly. Based on F&EI and TI, LDO and HFO were found to fall under Category I and light degree of hazard and nil toxicity, while Chlorine was under category II with light degree of hazard and severe toxicity. Hydrogen falls under category III with intermediate degree of hazard and low toxicity.

Thus further assessment are carried out to further asses the hazard likely to occur due to fire from LDO and HFO tanks while chlorine storage tank is assessed for toxic hazard by carrying out Maximum Credible Accident analysis for the same.

Table 7.5: F&EI and TI of chemical/fuels used in proposed TPP

Chemical/Fuel	NFPA Classification				GPH	SPH	F&EI	F&E category	TI	Toxicity category
	N_h	N_f	N_r	MF						
Light Diesel Oil (LDO)	1	2	0	10	1.80	2.83	50.9	Light	2.8	Light
Heavy Fuel Oil (HFO)	1	2	0	10	1.80	2.83	50.9	Light	2.8	Light
Hydrogen	0	4	0	21	1	2.63	99.3	Moderate	-	Light
Chlorine	3	0	0	1	1	2.7	2.7	Light	17.7	Severe

7.1.3 Hazard assessment and evaluation

A preliminary hazard analysis is carried out to identify the major hazards associated with storages in plant. This is followed by consequence analysis to quantify these hazards. Finally the vulnerable zones are plotted for which risk reducing measures are deduced and implemented.

Physical and health occupational hazards in any process plant can be broadly classified as:

- Mechanical risks
- Electrical risks
- Fire/Explosion risks
- High/Low temperature exposure risks
- Toxic /Carcinogenic chemical exposure risks
- Corrosive/Reactive/Radioactive chemical exposure risks

The first 2 types of risks are universal in nature, not specific to any particular industry. Mechanical risks which are generally encountered are injuries to head, limbs, eyes, etc. usually as a result of negligence on part of operating/maintenance personnel in the use of tools, bypassing prescribed safety procedures neglect of personal protective wear and risks associated with high energy release from compressed gases. Electrical risks which result in shock and/or burns are most often consequence of poor maintenance, ingress of dust or moisture, handling by unauthorized personnel and use of improper or substandard hardware.

7.1.4 Preliminary hazard analysis (PHA)

The purpose of Preliminary Hazard Analysis (PHA) is to identify potential hazards associated with or inherent in a process design, thus eliminating costly and time consuming delays caused by design changes later.

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities and safeguards.
In the proposed major hazard is fire due to storage of chemicals in the tanks. The process related hazards are very rare as the process is carried out in closed systems and does not involve exothermic reactions. Other hazardous installation is the boiler where the steam is generated and used at various stages.

The hazards associated with the propose TPP are

- Electrical Hazards
- Fire Hazards
- Cable Galleries
- Toxic release

7.1.4.1 Electrical hazards

Electrical hazards leading to fire and explosion in switchgear and other equipment mainly due to failure of circuit breakers, insulators, fuses, busbars and poor maintenance. Accidents may also occur in transformer due to open arcing; flash over above oil level, insulator failure, failure of air cooling systems, lightening…etc. Nevertheless, all these hazards lead to localized accidents only.

7.1.4.2 Fire hazards

There could be other areas in the plant that have potential for fire hazard and require adequate firefighting equipment for example, the raw material storage area. These are

considered here since uncontrolled fire may trigger the above emergencies due to domino effect. However for the proposed plant, safety guidelines will be as per rules.

7.1.4.3 Cable galleries

For containment of fire and preventing it from spreading in the cable galleries, unit wise fire barriers are planned. The ventilation system provided will be interlocked with fire alarm system so that, in the event of a fire, the ventilation system is automatically switched off.
Also to avoid spreading of fire, all cable entries/openings in the cable galleries, tunnels, channels, floors, barriers…etc, will be sealed with nonflammable/fire resistant sealing material.

7.1.4.4 Toxic release

The major toxic chemical to be used in proposed plant is Chlorine. If not handled properly, it will lead to toxicity. Self-contained breathing apparatus will be available in the plant premises in the event of leakage. Since the quantity of toxic release will be lower, off site implications of release are not envisaged.

The **Table 7.6** gives a list of various process equipments and associated hazards identified as per PHA.

Table 7.6: Preliminary hazard analysis for process/storage areas

Equipment	Process/Storage	Potential Hazard	Provision
Turbine	Converts pressure in steam to mechanical energy	Mechanical and Fire hazards	Layout of equipment/machinery is done in accordance to plant and electrical inspectorate.
Generator	Converts mechanical energy into electrical energy	Mechanical hazards and fire hazards in • Lube oil system • Cable galleries • Short circuits	As above
Power transformers	-	Fire and explosion	All electrical fittings and cables are provided as per the specified standards. Foam/CO_2/ DCP type fire extinguishers are to be provided

Equipment	Process/Storage	Potential Hazard	Provision
Switch yard	Switch yard	Fire	As above
Switch yard control room	-	Fire in cable galleries and switches	As above
Boilers	-	Fire, steam; Explosion	As above
DG set		Fires in cable galleries, short circuits in control rooms and switch gears	As above
HFO Storage	-	Combustion at elevated temperature	Leak detection and neutralization system will be provided
LDO Storage	-	Fire	
Hydrogen Plant	-	Explosion	
Coal Storage yard	Storage of coal	Coal dust fire and dust explosion	Water sprinklers for continuous dust suppression

7.1.5 MCA analysis

A Maximum Credible Accident (MCA) can be characterized, as an accident with maximum damage potential, which is still believed to be probable. MCA analysis does not include quantification of the probability of occurrence of accident. Moreover, since it is not possible to indicate exactly a level of probability that is still believed to be credible, the selection of MCA is somewhat arbitrary. In practice the selection of accident scenarios representative for an MCA analysis is done on the basis of engineering judgment and expertise in the field of risk analysis studies, especially accident analysis.

As an initial step in this study, a selection has been made of the storage units and activities which are believed to represent the highest level of risk to the surroundings. For this selection following factors have been taken into consideration:

- Type of compound viz. flammable or toxic
- Quantity of material present in a unit or involved in an activity
- Storage conditions such as temperature, pressure, flow, mixing and presence of incompatible mixtures.

In addition to the above factors the location of the unit or activity with respect to adjacent activities is taken into consideration to account for the potential escalation of the accident also called as Domino Effect.

Following steps are employed for visualization of MCA scenarios:

i. Chemical inventory analysis
ii. Identification of hazardous processes in individual storage units
iii. Identification of chemical release and accident scenarios
iv. Visualization of release scenarios with recourse to consequence analysis
v. Damage distance computations for the credible accident cases.

7.1.5.1 Chemical inventory analysis

The major inventories of fuels in storage vessels have been identified from the proposed unit. The minimum quantities have been screened as per GOI rules, 1989, amended in 2000. The chemical potential has been shortlisted and prioritized on the basis of hazard potential assessed by FETI. The detailed results have been discussed in earlier sections.

7.1.5.2 Identification of chemical release and accident scenarios

Following the accidental release of chemical, the effects thus caused depends on large number of factors like type and quantity of released material, meteorological conditions, location and presence or otherwise of an ignition source. The accident scenarios can be divided into the following categories according to mode of release, physical effects and the resulting damages:

- Liquefied gas and boiling liquid release under pressure
- Flammable gas release
- Toxic gas release
- Non boiling liquid release or pool fire
- Spontaneous Combustion of Coal Dust

Of the above scenarios toxic gas release from chlorine storage and pool fire in HFO/LDO storage vessels is assumed to occur.

7.1.5.3 Visualization of release scenarios with recourse to consequence analysis damage criteria

The storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to accidental release of any fuel will arise from fire and explosion. Tank

fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal pressure of the tank. Pool fire would occur when the flammable liquid in the tank gets ignited after leakage. The major contributors to damage in any TPP are

- Damage due to fire
- Damage due to toxic gas release
- Coal dust explosion

Damage due to fire

The flammable liquid in a pool will burn with large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of heat is radiated while the rest is convected away by rising hot air and combustion products. The radiations can heat nearby storage or process units to above their ignition temperatures and thus result in spread of fire.

The radiation can also cause severe burns or fatalities to workers or firefighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of flammable liquid pool likely to be crated due to leakage or catastrophic failure of storage or process vessel. This will help decide the location of other storage/process vessels, decide the protective clothing the workers/firefighters need, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for nearby storage vessels.

The **Table 7.7** tabulates the damage effect on equipment and people due to thermal radiation intensity.

Table 7.7: Effect of thermal radiation on equipment and people

S. No.	Incident Radiation (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	Damage to people
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without flame	50% lethality in 1 min. Significant injury in 10 sec.
3	12.5	Minimum energy to ignite with a flame	1% lethality in 1 min
4	4.5	------	Causes pain if duration is longer than 20 Sec, however blistering is unlikely (Ist degree burns)
5	1.6	------	Causes no discomfort on long exposure

Damage due to toxic gas release

Chlorine is greenish-yellow, highly reactive halogen gas that has a pungent, suffocating odor. The vapor is heavier than air and will form a cloud in the vicinity of a spill. Like other halogens, chlorine exists in diatomic state in nature. Chlorine is extremely reactive and rapidly combines with both inorganic and organic substances. Chlorine is an eye and respiratory tract irritant and, at high doses, has direct toxic effect on lungs. The critical values of chlorine concentrations in air are given in **Table 7.8**

Table 7.8: Critical concentrations of chlorine

Criteria	Concentration (ppm)
LC_{50}	293ppm/1Hour (rats)
Immediate damage to life and health (IDLH)	10
Short Term Exposure Limit (STEL)	1
Timed Weighted Average (TWA)	0.5

Consequences of over pressure

The effects of the shock wave vary depending on the characteristics of the material, the quantity involved and the degree of confinement of the vapor cloud. The peak pressures in an explosion therefore vary between a slight over-pressure and a few hundred kilopascals (kPa). Direct injury to people occurs at pressures of 5-10 (5E-5 to E-4) kPa (with loss of life generally occurring at a greater over-pressure), whereas dwellings are demolished and windows and doors broken at pressures of as low as 3-10 kPa. The pressure of the shock wave decreases rapidly with the increase in distance from the source of the explosion. Details are given in **Table 7.9**.

Table 7.9: Over pressure damage

Over Pressure (Bar)	Damage
0.3	Heavy damage
0.1	Moderate damage
0.03	Significant damage

Coal dust explosion

Coal dust when dispersed in air and ignited would explode. Crusher Houses and conveyor systems are most susceptible to this hazard. To be explosive, the dust mixture should have:

- Particles dispersed in the air with minimum size
- Dust concentrations must be reasonably uniform
- Minimum explosive concentration for coal dust (33% volatile) is 50 grams/m^3

Failure of dust extraction and suppression systems may lead to abnormal conditions and increasing the concentration of coal dust to the explosive limits. Sources of ignition present are incandescent bulbs with the glasses of bulkhead fittings missing, electric equipment and cables, friction, spontaneous combustion in accumulated dust.

Dust explosions may occur without any warning with maximum explosion pressure up to 7.4 bars. Another dangerous characteristic of dust explosions is that it sets off secondary explosions after the occurrence of the initial dust explosion. Many a time, the secondary explosions are more damaging than primary ones.

The dust explosions are powerful enough to destroy structures, kill or injure people and set dangerous fires likely to damage a large portion of the Coal Handling Plant including collapse of its steel structure, which may cripple the lifeline of the power plant.

The following assumptions have been made while judging representative set of incidents:

- There are no automatic isolation valves within the system and therefore an instantaneous failure of one of the components will lead to rapid release of entire contents of the unit.
- The pipe diameter is assumed to be 2
- Worst case environmental conditions are assumed for modeling as per past metrological data i.e., partially cloudy sky, B or C class stability, temperature of 32^0C.
- A hole in the pipeline is the most credible scenario.
- It is not continuous exposure
- No detection and mitigation measures are initiated
- There is no enough time available for warning public and initiating emergency action
- Secondary fire at public road and building is unlikely
- The effect of smoke on reduction of source radiation has not been considered; therefore hazard distances tend to be conservative
- Shielding effect of intervening trees or other structures has not been considered.

Based on the aforementioned assumptions the following incidents are considered for analysis:

- Pool fire in LDO/HFO storage vessels with thermal radiation
- Toxic gas release from catastrophic failure of chlorine storage tank
- Toxic gas release from full bore rupture of pipeline
- Toxic gas release from hole of various diameters in chlorine storage tank.

7.1.5.4 Damage distance computations for the credible accident cases

The major hazards scenarios identified for the possibility of occurrence are mainly concerned with thermal radiation for LDO/HFO tanks and Toxic gas release from Chlorine storage tank.

Pool fire of HFO/LDO storage

One tank of HFO of capacity 500 KL and tank of LDO of capacity 200 KL is considered for the proposed project. Tank fire would occur if the radiation intensity is high on the peripheral surface of tanks leading to increase in internal tank pressure. Pool fire would occur when fuel oil collected in the dyke due to leakage gets ignited. As the tanks are provided within the dyke the fire will be confined within the dyke wall.

For all bulk storage of HFO, LDO and other flammable liquids, it is assumed that the complete liquid leaks due to tank failure or ruptures and develops into a pool and gets ignited. In the second scenario it is assumed that the dense vapors from the storage are released due to failure or increase in internal pressure of storage tanks or operator negligence and vapors could meet an ignition source and develops into a fireball and exists as a vapor cloud explosion.

For the above storage liquids, hazards distances have been arrived due to effect of pool fires. For MCA analysis full tank storage capacity has been considered for all the materials and radiation intensities at different distances are estimated as follows.

Either HFO/LDO tank is on fire:

Source strength:

Burning Puddle / Pool Fire

Puddle Diameter: 4 meters; Puddle Volume: 6000 liters

Initial Puddle Temperature: Air temperature

Flame Length: 11 meters

Burn Duration: ALOHA limited the duration to 1 hour

Burn Rate: 65.2 kilograms/min

Total Amount Burned: 3,913 kilograms

Threat zone:

Threat Modeled: Thermal radiation from pool fire

Red : less than 10 meters (10.9 yards) --- (37.5 kW/(sq m))

Orange: less than 10 meters (10.9 yards) --- (25 kW/(sq m))

Orange: 10 meters --- (12.5 kW/(sq m))

Yellow: 17 meters --- (4.5 kW/ (sq m))

Yellow: 27 meters --- (1.6 kW/ (sq m))

Figure 7.1: Threat zone when either HFO/LDO tank is on fire

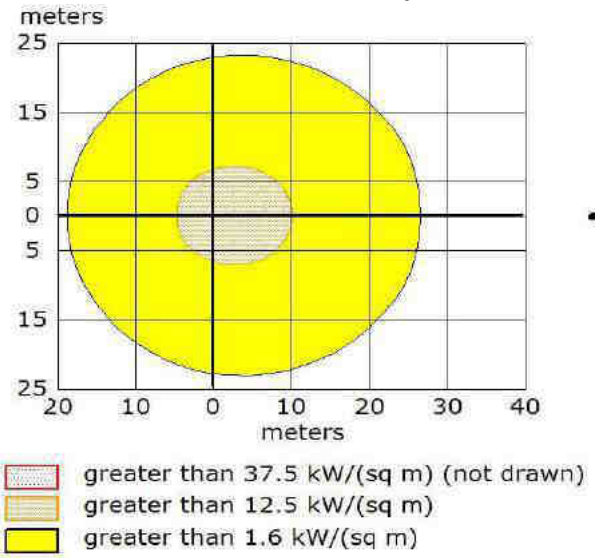


Figure 7.2: Aloha risk plotting on the layout for HFO/LDO

Hydrogen gas cylinders

Release of Hydrogen Gas from a cylinder through a partially opened valve will disperse in the atmosphere along with the prevailing wind is considered as the accident scenario for the study. The dispersed gas cloud in the air if ignited in contact with a source of ignition will cause explosion. The blast wave resulting from the explosion has the potential to cause property damage in the surroundings.

Scenario:

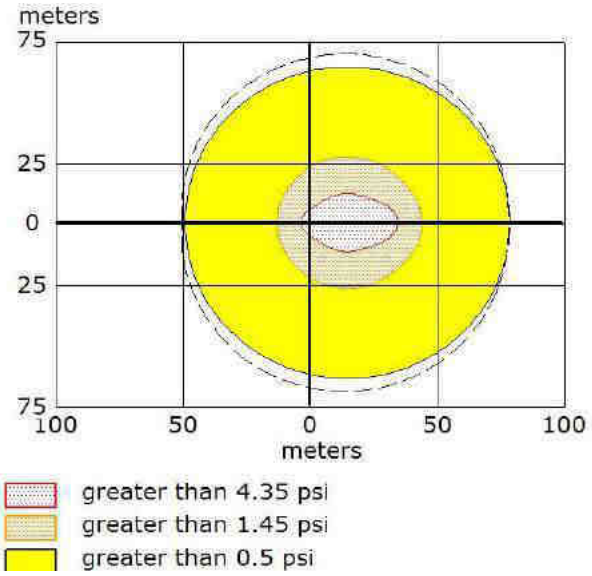
Source strength:

Direct Source: 50 grams/sec
Release Duration: 30 minutes
Release Rate: 3 kilograms/min
Total Amount Released: 90.0 kilograms

Threat zone:

Threat Modeled: Overpressure (blast force) from vapor cloud explosion
Type of Ignition: ignited by spark or flame
Level of Congestion: congested
Model Run: Gaussian
Red : 35 meters --- (4.35 psi) (0.3 BAR)
Orange: 44 meters --- (1.45 psi) (0.1 BAR)
Yellow: 79 meters --- (0.5 psi) (0.01 BAR)

Figure 7.3: Threat zone due to leak of Hydrogen gas



Chlorine storage

To prevent growth of organic matter and microorganisms, which tend to foul condenser tubes etc, chlorine is the most common biocide used. Chlorine is highly toxic (IDLH – 10ppm). One tank of 1 Ton capacity is proposed to be located in the plant. Any leakage in the system will cause toxic release which will spread in down wind direction. The system is based on conventional gas chlorination using evaporator – chlorinators proposed to be housed in a building close to the cooling tower and CW pumps. Chlorine cylinders of adequate requirement would be housed in a separate semi-open shed. Worst Rupture in Chlorine Cylinder is considered for modeling.

Scenario:

Direct Source: 10 grams/sec
Source Height: 5 meters
Release Duration: 5 minutes
Release Rate: 600 grams/min
Total Amount Released: 3.00 kilograms
Note: This chemical may flash boil and/or result in two phase flow.

Threat zone:

Model Run: Heavy Gas
Red : 168 meters --- (10 ppm = IDLH)
Orange: 565 meters --- (1 ppm = STEL)
Yellow: 812 meters --- (0.5 ppm = TWA)

Figure 7.4: Threat zone due to leak of Chlorine gas

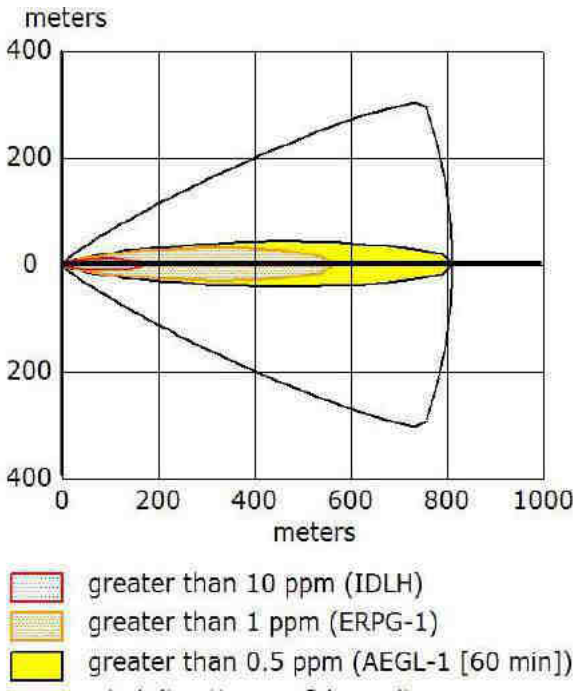
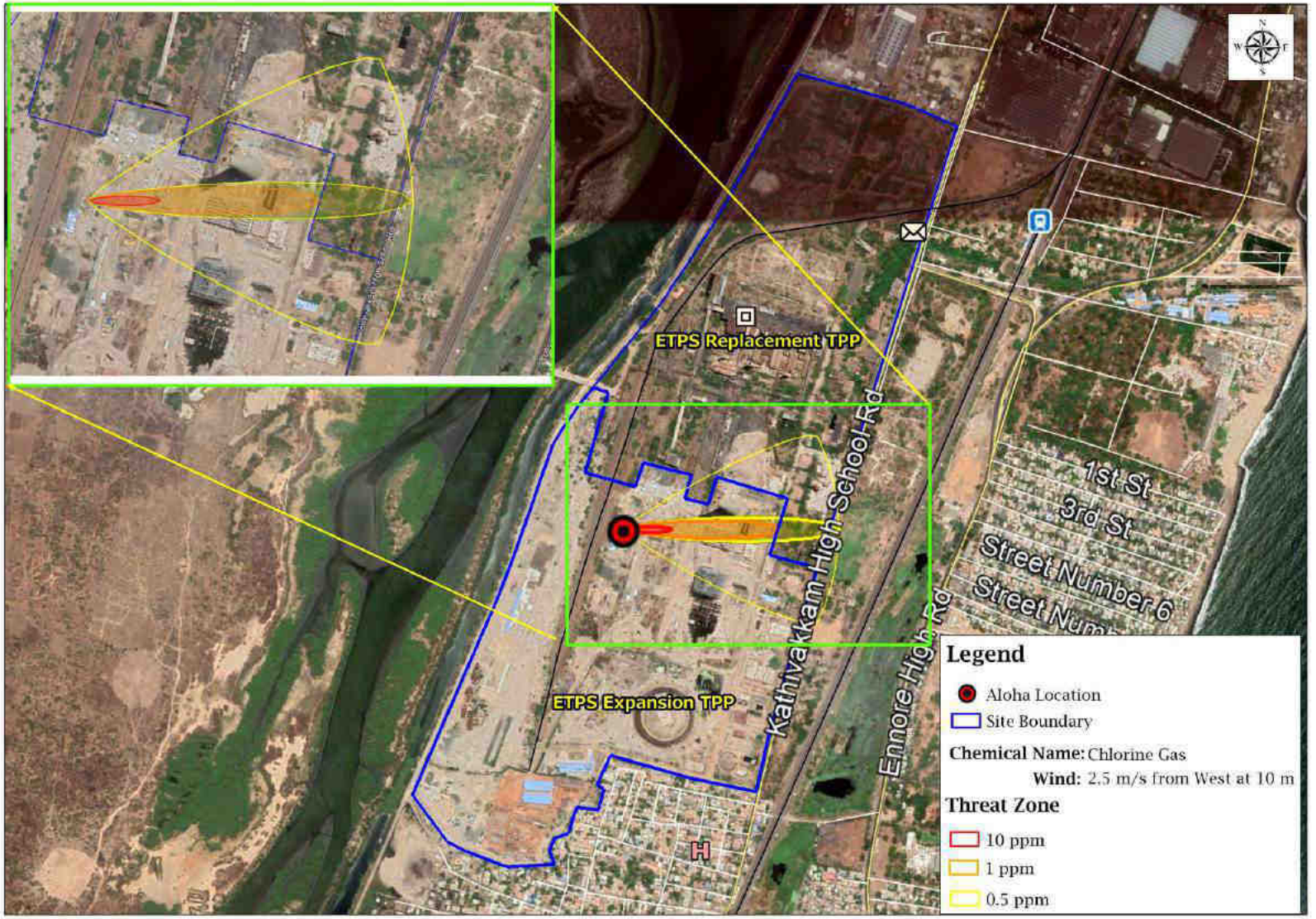


Figure 7.5: ALOHA risk plotting for chlorine gas



Consequence analysis

From the modeling studies on radiation intensity due to pool fire in fuel storage vessels, it can be inferred that the safe operating zone (radiation intensity < 1.6kW/m^2) for operators/firefighters is about 27 m when either of fuel storage tank i.e. either of HFO or LDO tank is on fire. The distance at which equipment damage can occur is within 10m from the tank location, therefore the chances of domino effect occurring from this situation is nil, as no equipments are envisaged to be located within that distance from storage tanks. While distance at which 1% lethality can occur after an exposure for about 1min to radiation intensity of 12.5kW/m^2 is 10m from the tanks.

The modeling results of hydrogen leak, the shock wave vary depending on the characteristics of the material, the quantity involved and the degree of confinement of the vapor cloud. The peak pressure 0.3 bar cause heavy explosion at a distance of 35m. Direct injuery and moderate damage occurs at a pressure of 0.1 bar around 44 m. Significant damage occurs at 79m with 0.01 bar pressure. The pressure of the shock wave decreases rapidly with the increase in distance from the source of the explosion.

From the modeling studies of Chlorine release from storage tank, during worst case situation, it was observed that the distance up to which 90% lethality (866ppm concentration) can occur after a continuous exposure for 10 min is 168 m, 565 m for 10% lethality after 10 min exposure, 812 m is for IDLH to occur.

All these distances fall well within plant boundary and adequate safety measures have been planned in case an emergency situation does occur.

7.1.6 Safety measures

Adequate number of fire detectors and toxic gas detectors will be put in place for early warning at all potential locations where accidents can occur, with the provision for alarms.
For protection against fire, all yard equipment and plant equipment will be protected by a combination of hydrant system; automatic sprinkler spray system (emulsifier system); fixed foam system for oil handling areas; automatic high velocity and medium velocity sprinkler spray system; auto-modular inert gas based system for control rooms apart from portable and mobile fire extinguishers located at strategic areas of plant buildings and adequate Passive Fire Protection measures. The systems will be designed as per the recommendations of NFPA or approved equals in accordance with the Tariff Advisory Committee of the Insurance Association of India stipulations.

For scenarios involving toxic gas release adequate numbers of face masks and isolation chambers with oxygen supply will be provided at strategic locations within the plant premises.

Emergency Management plan will be out in place along with the provision for carrying out regular safety exercises and work permit system.

7.2 Disaster management plan

The objective of any industry should be engage in safe operation / Production: All efforts, right from the design stage, therefore should emphasize safety and elimination of accidents in the industry. However due to human errors or system malfunctions, accidents could happen. The suffering and damage as a result of an accident is determined by the potential of loss, surrounding the event. But by taking effective action at the time of occurrence of the incident, severity and full potential loss can be largely contained/ avoided. Effective action will be possible for handling major emergencies, only if preplanned procedures are practiced by utilizing the combined resources of the factory and out-side emergency services.

The obligation of occupier of the plant, handing hazardous chemicals is to prepare an emergency plan as stipulated in Rule-13 of the manufacture, storage and import of hazardous chemicals rules, 1989 (amended in 1984).

Apart from the provision of the hazardous chemicals rules, section 41B(4) of the factories act, 1948 (as amended) also require every occupier to draw up an On-site Emergency Plan with detailed disaster control measures for the industry and to educate the workers employed in the factory premises. The general public living in the vicinity is also to be informed and educated about safety measures and actions required to be taken in the event of an accident.

Accordingly "**Disaster Management Plan**" is prepared and will be circulated to all concerned widely.

This plan deals with probable hazards, their consequences, protections, preventive measures and action Plan to deal with the emergencies. It also clearly assessed its strengths and weakness, supports available within and from neighboring industries/ organization etc. This Plan also identifies the authority / responsibilities and actions of the people to act at the time of emergency. All emergency numbers (fire station, police station, nearby hospitals, ambulance services, doctors, plant heads, inspector of factories, pollution control board, etc) will be displayed at strategic locations and at security gate.

7.2.1 On –site emergency plan

Emergencies may occur due to many reasons. It may occur due to natural causes like earth quake, cyclone, flood etc. It may occur due to terrorist activity or it may be due to malfunction of standard working systems or practices.

In the industry handling hazardous materials, large-scale emergencies will be essentially those of a major release of flammable or toxic material and of events, which have significant environmental impact.

This On-site Emergency plan is made considering the nature and scale of the events and based upon all relevant information including, most importantly, practical operating experience.

The Emergency plan is aimed at enduring safety of people, protection of environment, protection of installation, restoration of production and salvage operations in the same order of priorities. For effective implementation of the Emergency plan, it will be widely circulated and personnel are trained through mock drills.

The Emergency plan should reflect the probable consequential severities of the undesired event due to deteriorating conditions or through 'Knock on 'effects. Further the Emergency Plan should be able to demonstrate that the correctness of assessment of the consequences, use of supporting evidences currently available and reliable information and incident data and if necessary the reports of outside consultancies.

To tackle the consequences of a major emergency inside the factory (Power Plant) a major emergency plan has been formulated and this document is called "DISASTER MANAGEMENT PLAN".

The objective of the major emergency plan is to make use of the combined resources of the plant and the outside services to achieve the following.

1. Effect the rescue and Medical treatment of casualties.
2. Safeguard other people.
3. Minimize damage to property and the environment.
4. Initially contain and ultimately bring the incident under control.
5. Identify any dead.
6. Provide authoritative information to the news media.
7. Provide for the needs of relatives.
8. Secure the safe rehabilitation of affected area.
9. Preserve relevant records and equipment for the subsequent enquiry into the Cause and circumstances of the emergency.

Identification of major hazard potentials – major plant sections

Considering the process and the material to be used at Thermal Power Station, the following can be considered as major plant sections.

(a) Coal Handling plant.
(b) Main plant (Boiler, Turbo Generator, Lube Oil Tanks)

(c) Water treatment plant.
(d) Hydrogen filling area.
(e) Switchyard including sub-stations and transformers.
(f) Fuel oil handling plant.
(g) Cable Galleries.
(h) Stores where hazardous, flammable and explosive materials are stored.

7.2.2 Major hazard potential assessment

The major disasters or emergencies usually take birth from one or any combination of the following:

(a) Slow isolated fires.
(b) Fast spreading fires.
(c) Explosions.
(d) Bursting of pipes Lines/vessels.
(e) Uncontrolled release of toxic/corrosive/flammable liquids.
(f) Uncontrolled release of toxic/flammable gases/ducts depending upon the nature, scale, speed and impact on environment.
(g) Breach of dam/ash dyke.

7.2.3 Release of gases / dust – areas

(a) Chlorine in Water treatment Plant.
(b) Hydrogen in Turbo Generator area of Main Plant.
(c) Pulverized coal dust from mills associated piping and flue gases.
(d) Coal dust in transfer points of CHP, Crushers, Wagon tippers and Mill areas.
(e) Flue gases from the ducts.

7.2.4 Release of chemicals areas

(a) Chemical tanks and Chlorine in Water treatment plant.
(b) Acid & Alkali storage tanks in Water Treatment Plant.
(c) Fuel oil tanks in Fuel oil handling section.
(d) Control Fluid in turbine system.

7.2.5 Major causes of on-site emergency

7.2.5.1 Chlorine leakage

Liquid Chlorine filled containers are brought by the suppliers through their own transport. The toner containers are placed on its seat, specially fabricated for this purpose.
The toner containers are connected to the manifold system and then to the evaporation line for use. The possible emergencies in this process are mentioned below.

7.2.5.2 Explosion of cylinders due to terrorist / sabotage activities

In case of any terrorist activity and blasting of manifold system or Chlorine toners with the use of explosives, heavy quantum of Chlorine may leak, which in no case can be sealed. In that case, only action is evacuation of victims and others.

However, such probabilities are reduced to almost zero, by providing fool proof security measures and restricting entry into chlorine handling / storage area.

7.2.5.3 Explosion due to fire

Such an explosion may occur due to fire also. But again to prevent such event, no flammable material is allowed to be kept in the vicinity of Chlorine. Even uncontrolled growth of grass is not allowed there.

7.2.5.4 Release of chlorine due to leakage

Due to corrosion or mishandling leakage of chlorine from chlorination system has happened in different parts of the country. Most of the leakages are occured from the toner valves and joints. On few occasions, leakage at the shell has also come to the light.

To control such leakage, emergency sealing kits have been provided close to the chlorine container stores.

The staff been fully trained to seal any leakage with the help of such emergency kit in shortest possible time and neutralize the leaking Chlorine. A specially designed chlorine neutralization pit is available at Chlorination plant. This can be used if there if there is any uncontrollable chlorine leakage from any toner. Breathing equipment is also provided, to use in such operation.

7.2.5.5 Explosion

Explosion in the plant is possible in Hydrogen filling area, oil storage tanks, or where Hydrogen Cylinders are stored. To prevent such possibility Hydrogen is purged with inert gas like Nitrogen or Carbon Di-Oxide and always purity above 98% is maintained.

1. In oil storage tanks appropriate fire fighting system is provided.
2. Explosion of Boiler Furnace due to internal pressurization.

7.2.5.6 Coal dust explosion

Coal dust can explode when they are suspended in air. A coal dust explosion may occur if the coal dust is present in the concentration between Upper Explosive Limit & Lower Explosive Limits i.e., 30-2000 grams/m^3 of air and also a source of ignition like sparks caused by friction or static electricity. However measures are adopted to prevent the chances of explosion in the design state itself. To prevent the accumulation of dust, dust suppression and dust extraction systems are propose at strategic locations.

7.2.5.7 Boiler explosion

Whenever Boiler gets pressurized due to non-evacuation of steam, there are chances of Boiler explosion. However, various interlocks and protections will be provided for Boiler during design stage to avoid Boiler explosion.

7.2.5.8 Turbine generator explosion

Hydrogen gas explosion is a possible hazard in generator. However, the Generator is designed to withstand explosion. Seal oil system is also provided for the Generator to prevent the leakage of H_2 gas. And also the H_2 purity is continuously monitored and maintained always above 98%. All the H_2 cylinders are checked for high purity.

7.2.5.9 Fire in cable galleries

The main hazard in cable galleries is fires. To contain fires, heat sensors and smoke detectors are provided in the cable galleries to detect the fires at the inception stage itself. Automatic sprinkler systems will be provided at important places to extinguish the fires. Also fires resistance barriers will be provided at the cable entries/ intersections, intermittent places on cable trays, cable raisers and cable entry points.

7.2.5.10 Transformer hazards

Possible hazards in transformers are:

1. Failure of terminal bushings and flashover.
2. Sudden gas pressure formation due to transformer internal failure and subsequent failure of explosion vents and pressure release devices may cause explosion of transformer and fires.
3. Accumulated leakage oil from different parts of transformers can catch fire due to spurious sparking.
4. To take care above possible hazards, adequate protection systems are proposed as per engineering and in case of failure emulsifier system is provided to quench fires.

7.2.5.11 Sub-station hazards

Where indoor switchgears are provided, fires and explosions may occur due to:

- Short Circuit either at bus bars, breaker high voltage parts or cable termination chambers may occur due to reptile's ingress or falling of internal accessories on to live parts.
- Failure of supporting insulators of bus bars, breakers, termination and subsequent earthling of supply may cause flash over.
- Failure of measurement equipments like CTs & PTs may cause flashover in the concerned chambers.

To take care of the above problems, the following precautions are taken.

- Plugging of cable gland plates and breaker inspection plates against reptile entry.
- Periodical inspection. / testing of switchgear equipment.
- Providing proper nomenclature of switchgear equipment with regards to voltage level, feeder description and panel numbering to avoid wrong identification.

7.2.5.12 Water treatment plant hazards

There are chances of spill-over from storage tank. There are chances of chemical burns due to contact with acids/alkalies. However, dyke walls are provided to contain any over flow / leakage of acids from tanks. Also all these spill-overs are collected in neutralization pits and disposed off.

7.2.5.13 Fuel oil handling system hazards

The main hazard in fuel oil section in fires and storage tanks explosion. However, to contain the chances of fires/explosions due to spillover dyke walls are provided all around the fuel oil storage tanks. Apart from this, foam pores and MV water spray systems are provided on all Fuel Oil tanks. The level gauges and temperature monitors are also provided on the fuel oil tanks.

7.2.5.14 Storage /godown-hazards

The main hazards in stores / godowns are fire and explosion due to stored gas cylinders. However to prevent the chances of fires and explosions, gas cylinders and flammable materials are stored safely with utmost care and precautions. Fire hydrant/Portable fire extinguishers systems will be provided in nearby storage area.

7.2.6 Facilities proposed to control hazards

7.2.6.1 Fire fighting

For protection against fire, all yard equipment and plant equipment will be protected by a combination of hydrant system, automatic sprinkler spray system (emulsifier system), fixed foam system for oil handling areas, automatic high velocity and medium velocity sprinkler spray system, auto-modular inert gas based system for control rooms apart from portable

and mobile fire extinguishers located at strategic areas of plant buildings and adequate Passive Fire Protection measures. The systems will be designed as per the recommendations of NFPA or approved equivalents in accordance with the Tariff Advisory Committee/Loss prevention Association of India stipulations.

- In view of vulnerability to fire and its importance in the running of the power station, effective measures will be taken to tackle fire in the susceptible areas such as cable galleries, fuel oil handling areas, coal handling plant areas including transfer points, crusher houses and tunnels, etc.
- For containment of fire and preventing it from spreading in cable galleries, unit wise fire barriers with self-closing fire doors will be provided. In addition, all cable entries / openings in the cable galleries, tunnels and floors will be sealed with non-inflammable / fire resistant sealing materials to prevent fire propagation for at least three (3) hour. Fire protection cable coating compound over cables at switchgear entry points, power station building entry points and trays shall be provided to prevent damage from fire for at least thirty (30) minutes.

Adequate separating distances will be maintained between different process blocks and hazardous equipment. To prevent fire from spreading through ventilation & air conditioning ducts, dampers with auto closing arrangements will be provided at appropriate locations. FRLS power and control cables will be used.

Fire water pumps are installed in the filtered water pump house. In the filtered water storage tank water will be stored as dedicated dead storage for meeting firewater requirement in exigencies.

In addition to the above facilities, adequate number of manual call points, as well as portable and mobile (wheel mounted) fire extinguishers of soda acid type, foam type, chemical type, and carbon-dioxide type will be provided at suitable locations throughout the plant area to meet NFPA code as well as Tariff Advisory Committee/ Loss prevention Association of India stipulations. These extinguishers may be used during the early stages of fire to prevent from spreading.

Fire wing

A full fledged fire station operated by fire officer & sufficient staff. The fire control room is manned in 3 shifts round the clock. The minimum strength in each shift available shall be as follows.

1 no - Leading Fire Man
1 no – Driver
3 nos - Fire Man

The fire station will be equipped with the following facilities to handle the fire promptly and actively.

Hydrant landing valves / yard hydrant

Fire hydrant mains will be laid covering all major risk areas. The layouts of hydrant mains are kept at all the shift officers. The details of the fire hydrants and sprinkler systems proposed and fire detection systems are given in **Table 7.10 & 7.11**

Table 7.10: Fire hydrant & sprinkler systems

S. No.	System capacity (Lts/sec)	Equipment	Head (mts)	Discharge Lts/Sec
1.	Hydrant	Diesel Engine Driven Pump	92	75
2.	Hydrant	AC Motor driven Pump	92.5	75.8
3.	Hydrant	AC Motor driven Pump	92.5	75.8
4.	Spray/ Sprinkler	AC Motor driven Pump	92.6	113
5.	Spray/ Sprinkler	Diesel driven Pump	92.8	113
6.	Pressurization	AC Motor driven Jockey pump	99	8.3
7.	Pressurization	AC Motor driven Jockey Pump	99	8.3
8.	Pressurization	Air compressor	29.67 m^3/hr	-
9.	Pressurization	HPT TANK	220 m^3/hr	-

Table: 7.11: Fixed fire detection and protection system

S. No.	Type & Nomenclature of fire protection / fire detection system	Data on qty/capacity	Data on premises installed
1.	a) Water sprinkler system and Emulsifier	8 Kgs working pressure	On all Transformers
	b) Water spray system	8 Kgs working pressure	On all conveyor system
2.	Medium Velocity Water spray system	8 Kgs working pressure	On all oil tanks
3.	Smoke Detectors	-	At all control rooms, switch gear rooms, cable galleries etc.,

a) Fixed foam system

HFO & LDO Tanks would be provided with fixed foam system. The foam station would be situated near Heavy Fuel Oil Tanks where foam concentrate has to be kept in tanks. The mixer of water and foam concentrate goes to the HFO, LDO tanks, thrown on to the top surface of the oil tanks and converts into foam to extinguish the fire.

b) Medium velocity system

In addition to the foam system, the LDO tank would be provided with Medium Velocity Spray system to cool down the oil vapors which develop due to heating of the oil in case of fire incident.

c) Sprinkler system

All coal conveyors would be provided with the sprinkler system against fire hazard. Quartz old bulb and Fusible plug heat detectors would be provided at the tips of each pipe covered. Under the network of pipe meant for sprinkling system, the bulbs break at 79^0C of heat and through the tips the water automatically spray out on the Conveyor, Transformers and LDO tank areas to arrest the fire.

d) Emulsifier system

The Emulsifier system is proposed on transformer areas GT, UATs, Station Transformers. In the emulsifier system Quartz old bulb fuses at 79 ^{0}C and release air from the line due to pressure drop of air deluge valve opens and water sprinkles through separate nozzles provided on the transformers.

e) Portable fire extinguishers:

In addition to above fire fighting equipments, portable and mobile fire extinguishers would be installed at all locations of the plant including Main Plant, control rooms, Switch Gear rooms, Laboratories, Off site Administration building etc. Details are in **Table 7.12.**

Table 7.12: Details of portable fire extinguishers

S.No	Type of Extinguishers	Capacity	No. of Extinguishers.	
1	CO_2 Type	22.5 Kgs 9.0 Kgs 6.5 Kgs 3.0 Kgs.	2 10 20 28	 Total 60
2	Foam Type	9 Its mech foam	10	Total 10
3	DCP type	75 kgs. 25 kgs. 10 kgs. 5 kg.	5 5 10 20	 Total 40

7.2.6.2 First aid centre

A First Aid center and dispensary will be provided inside the plant premises and manned round the clock. Ambulance facility would be available round the clock within the plant premises and tie up will be made with nearest hospitals. The minimum medical staff will be as follows.

No. of Doctor	1
No. of Nursing Staff	4
Ambulances (with oxygen administration facility)	1
Lab Technicians	2
Pharmacist	2

7.2.6.3 Communication facilities

Public address system would be provided in the plant, Telephone and Internal Communication facilities would be available at all required desk or with officials in control room. P & T (STD) telephones, Fax & Carrier Communication facilities would be provided in Chief Engineer/ O&M office and in unit control board to contact nearby industries to ask for assistance. The facility is also used to contact district authorities for information and help. The plant would be connected to corporate office through VSAT (Very Small Aperture Terminals).

7.2.6.4 Emergency power supply

Emergency lights would be provided at all vulnerable areas for lighting arrangements as well as to operate minimum equipment for operating the plant safely. Both the units would be provided with DG Sets as well as DC battery Systems which comes on automatically in case of power failure. More than one supply through different transmission systems would also be provided to ensure electric supply without fail.

7.2.6.5 Emergency safety equipment

The following emergency safety equipments would be made available in Unit Control Board, Fire Station, Water Treatment Plant, Fuel Oil Pump House, Shift in charge engineer's office and Safety Office.

- Self contained breathing apparatus.
- Gas masks.
- Chlorine leak arresting kits.
- Emergency suits.
- Gum boots.
- Hand gloves.
- Aprons etc.

7.2.7 Emergency control centre (ECC)

The Emergency Control Centre is proposed which would be fully equipped with all communication facilities to contact. Emergency control centre will be centrally located and

will see that it is nearer to Unit Control Board, Switch Yard Control Room & Chemical wing to give instructions to the Officers.

The Emergency Control room will be manned by the Chief Incident Controller, the Officials nominated as key personnel and Sr. Officers of outside services called in for assistance. No other personnel shall have access to the Control Centre.

ECC will also contain the following data:

a) Safety data pertaining to all hazardous materials likely to cause emergency.
b) Procedure of major and special fire fighting, rescue operations, first aid etc.,
c) Procedures for tackling Chlorine gas and other chemical leakages.
d) Emergency call out list of persons drafted for emergency control, key personnel, Fire, Safety, First aid, Medical, Personnel, Welfare & Industrial Relations, Security, Police and District Administration Authorities.

7.2.7.1 Evacuation & assembly points

In an emergency, it would certainly be necessary to evacuate personnel from affected areas and as per precautionary measure to further evacuate non-essential workers, in the first instance from areas likely to be affected where the emergency escalate. The evacuation will be effected on getting necessary instructions from Superintending Engineer / O&M/. On evacuation, employees shall assemble at assembly points.

The following areas are identified as assembly points and employees shall assemble at the assembly points depending on the area of emergency.

1. Switch yard control room (MCR)
2. Main plant security gate.
3. Service building.

7.2.7.2 Emergency alarms

The Emergency siren will be sounded by the Security Personnel with the instructions of Divisional Engineer/Shift Engineer from the Security control room and it is proposed to install the sirens at the following places.

1) Fire Station Control Room
2) Housing Colony Security Gate

The above locations are manned round the clock. The emergency alarm shall consist of represent long short blast for continuous period of 2 minutes. The purpose is to advise all persons on the major emergency occurred in the plant. The alarm is sounded such that the nature of emergency can be distinguished as a Chlorine release or a major fire.

Emergency siren

1.	In case of Fire	-	5 Seconds ON 2 Seconds OFF 3 Times.
2.	Emergency Siren for Heavy Chlorine leak		20 Seconds ON 10 Seconds OFF 3 Times
3.	All clear Signal	-	continuous siren for 3 minutes

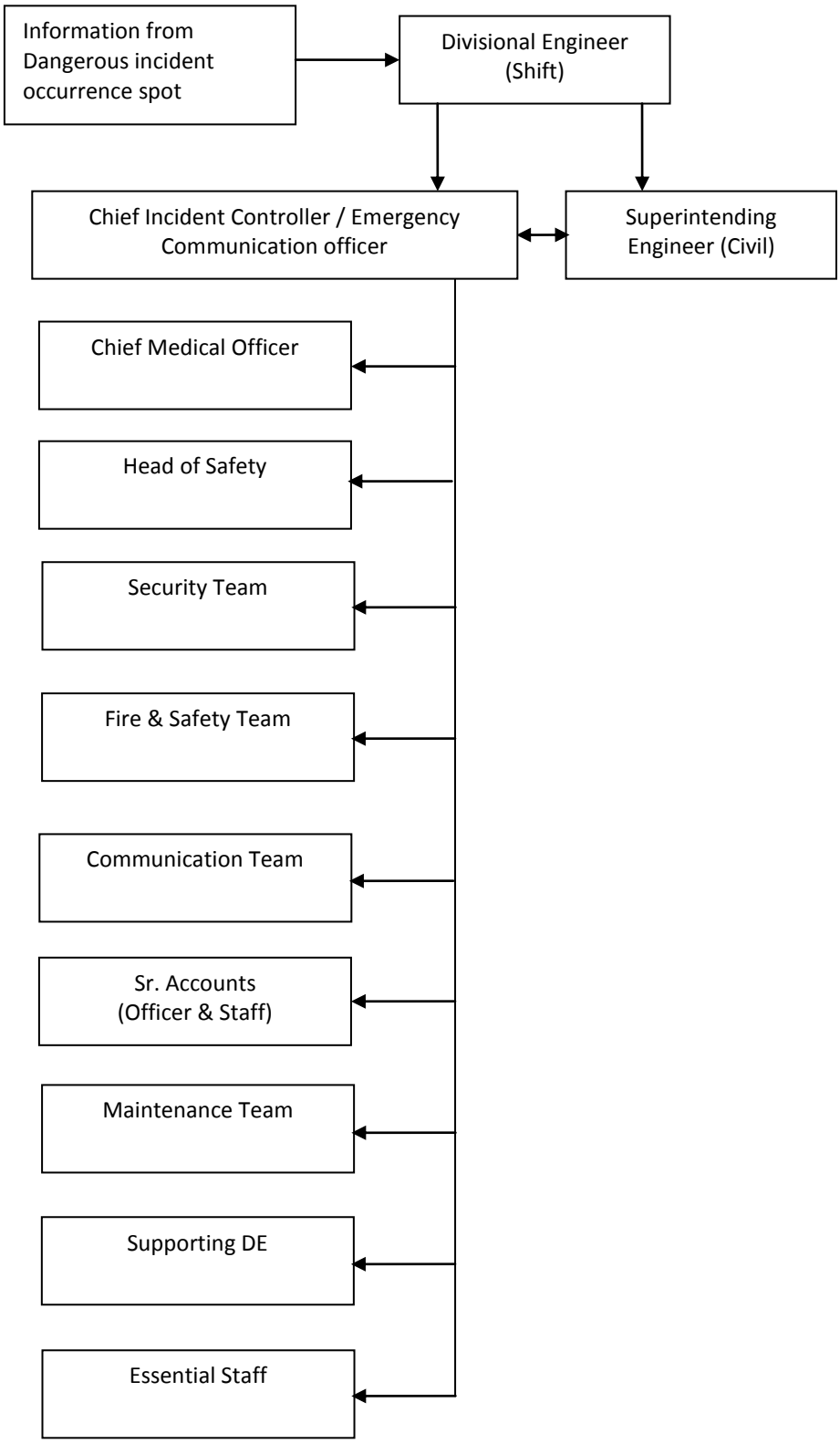
7.2.7.3 Action plan

For effective control and management of an Emergency, an action plan and organization chart is prepared along with responsibilities.

The Action Plan Consists of

1. First Information from the site.
2. Responsibility of Superintending Engineer / O&M concerned.
3. Responsibility of Divisional Engineer / O&M.
4. Responsibility of declaration of Emergency.
5. Responsibility of Emergency communication officer.
6. Responsibility of Key personnel.
7. Responsibility and action to be taken by essential staff and various teams.
8. Responsibility for all clear signal.

Figure: 7.6: Emergency management organization chart



First information from the site

The first person who observes / identifies the hazardous incident shall inform by announcing through public addressing system and by telephoning to the Shift Divisional Engineer in Unit Control Board about the hazard. The observer shall also telephones to Fire station in case of Fire hazard. The Divisional Engineer / Shift will inform to concerned Superintending Engineer (According to the area of hazard) and also to the Chief Engineer / O&M and Asst. Divisional Engineer / Peshi to Chief Engineer / O&M and communicate it to all key personnel about the incident.

Responsibilities of superintending engineer

The Superintending Engineer on knowing about hazardous incident, immediately will rush to the incident site and take overall charge and inform the same to Chief Engineer / O&M. On arrival, he will assess the extent of emergency and decide if major emergency exists and inform the Emergency Communication Office accordingly. His responsibilities will be:

1. To direct all operations within the affected area taking into consideration priorities for safety of personnel, minimum damage to the plant, property, environment and minimum loss of materials.
2. To provide advice and information to the Fire & Security Officers and the local Fire Services.
3. To ensure that all non-essential workers/staff on the areas affected are evacuated to the appropriate assembly points and the areas are searched for casualties.
4. To set up communication points and establish contact with Emergency Control Centre in the event of failure of electric supply and thereby Public Address System (PAS) and internal telephones failure.
5. To report on all significant developments to the Chief Engineer / O&M.
6. To have regard to the need to preserve the evidence so as to facilitate any enquiry into the cause and circumstances, which caused or escalated the emergency

Responsibilities of chief incident controller (Chief engineer / O & M)

The Chief Engineer / O&M, who is also the Chief Incident Controller, will assume overall responsibilities for the Factory and its personnel in case of any emergency. His responsibilities are:

1) To assess the magnitude of the emergency situation and decide if staff needs to be evacuated from their assembly points to identified safer places.
2) To undertake continuous review of possible developments and assess in consultation with key personnel as to whether shutdown of the plant or any section of the plant and evacuation of personnel are required.

3) To Co-Ordinate with senior officials of Police, Fire brigade, Medical, Factories Inspectorate and provide advice on possible effects on areas outside the factory premises.
4) To look after rehabilitation of affected persons and discontinuation of emergency.
5) To issue authorized statements to news media, and ensure that evidence is preserved
6) For enquiries to be conducted by the Statutory Authorities.

Responsibilities for declaration of major emergency

The Superintending Engineer on hearing the hazardous incident shall go to the scene of the incident make an informal assessment of the situation and decide whether a major emergency exists or is likely develop. On his decision he will inform the Chief Engineer / O&M and activate the major emergency procedure Superintending Engineer /O&M who has knowledge and experience to recognize the fact of major emergency potential for it, in consultation with Chief Engineer /O&M, declare a Major Emergency.

Once the Emergency alarm is raised the Emergency Procedures will be activated.

Making the emergency known inside the plant

The major emergency will be made known to everyone inside the plant by resounding the alarm. Separate alarms are sounded to warn different types of major emergencies such as Fire and Explosion or Toxic gas escape same alarm can be used with different number of times as given and Public Address System will also be available throughout the Plant.

A) Sample emergency message:

On getting the message that emergency has been declared, Chief Engineer / O&M/ Superintending Engineer / O&M will rush to the affected / likely to be affected areas and announce through fixed / mobile P.A. system the following message.

"Heavy Chlorine Leak Has Taken Place in Power Project and as a result of which Chlorine content in the atmosphere may become high"

B) "Step to control the situation is in progress".

In the mean time you are advised to:

1) Not to get panic.
2) Keep the doors and windows tightly closed.
3) Don't try to come out from closed doors if you find irritating smell.
4) If found necessary we may evacuate you to the nearest evacuation centre be prepared it.

Announcement would be made by the concerned official in Local Language and English. Similarly announcement termination of the emergency also would be made.

Responsibilities of emergency communication officer

On hearing the emergency alarm he will proceed to emergency control centre. He will:-

a) Report to Chief Engineer / O&M and Superintending Engineer /O&M and maintain contact with them.
b) On the information received from the Superintending Engineer/ O&M of the situation recommending evacuation, if necessary, evacuate the staff from assembly points.
c) Identify suitable staffs to act as runners or a messenger, who is listed in the Essential Staff, between him and the Superintending Engineer /O&M if the telephone and other system of communication fail due to any reason.
d) Maintain inventory of items in the Emergency Control Centre.
e) Contact local meteorological office to receive early notification of changes in weather condition in case of gas leak and prolonged action.
f) Maintain a log of incidents.
g) Keep in constant touch with happenings at the emergency site and with Superintending Engineer /O&M.
h) Liaise with neighborhood fire brigades, hospitals, civil and Police authorities on advice from Chief Engineer /O&M.

Key personnel

a) All divisional heads.
b) Superintending Engineer /O&M.
c) Chief Medical Officer.
d) Head of Safety
e) Security Officer.
f) Fire Officer.
g) Essential Staff.

A list of key personnel and their phone numbers shall be informed to all concerned suitably. If necessary, they will decide the actions needed to shut down plant, evacuate personnel, carryout emergency engineering works, arrange for supplies of equipment, personnel etc., carryout atmosphere test, provide catering facilities, liaison with local bodies, state government authorities, inform relatives of the victims, media etc.,

Responsibilities of key personnel

A) Departmental heads

The departmental heads will provide assistance as required by Chief Incident Controller. They will decide which member of their departments is required at the incident site.

B) Superintending engineer / O&M

He will:

a) Report to Chief Engineer/O&M.
b) Ensure that all non-essential workers in the affected areas are evacuated to assembly points in consultation with the Chief Engineer/O&M.
c) Receive reports from nominated persons from assembly points and pass on the information.
d) Keep liaison with other co-coordinators to meet the requirements of services such as materials, security management, transportation, medical, canteen facilities etc., as required during emergency.
e) Be in constant touch with Chief Engineer /O&M and feed him correct information of the situation.
f) Give information to press, public and authorities concerned on instruction from Chief Engineer /O&M.
g) Ensure that causalities received adequate attention at medical centre and arrange required additional help and inform relatives of the injured.
h) Arrange to inform public on Radio and TV about evacuation etc.,
i) Arrange TV coverage on handling emergency.

C) Chief medical officer

Chief Medical Officer will render medical treatment to the injured and if necessary will shift the injured to nearby Hospitals. He will mobilize extra medical help from outside if necessary. He will keep a list of qualified first aid workers.

D) Head of safety

On hearing the emergency alarm, he will proceed to the site. He will:-

a) Make sure that all safety equipments are made available to the emergency teams.
b) Participate in rescue operations.
c) Co-ordinate to transfer the injured persons to medical centre and arrange for first aid.
d) Keep in contact with the Chief Engineer /O&M and the Superintending Engineer/O&M and advise them on the condition of injured persons.

E) Security officer

On hearing the Emergency alarm, he will proceed to main entrance / main gate.

He will:

- Arrange to control the traffic at the gate and the incident area.
- Direct the security staff to the incident site to take part in the emergency Operations under his guidance and supervision.

- Evacuate the people in the plant or in the nearby areas as advised by Superintending Engineer / O&M after arranging the transport through Transport-In-charge.
- Allow only those people who are associated with handling emergency.
- Maintain law and order in the areas; if necessary seek the help of Police.
- Maintain communication with Chief Engineer/O&M & Superintending Engineer/O&M.

F) Fire officer

On hearing the emergency, he will reach the fire station and arrange to sound the alarm as per the type of emergency in consultation with Superintending Engineer/O&M. He will:

a) Guide the fire fighting crew i.e., firemen and trained plant personnel and shift the fire fighting facilities to the emergency site. Adequate facilities will be made available.
b) Take guidance of the Superintending Engineer/O&M for fighting as well assessing the requirement of lighting and providing temporary by pass of the work.
c) Maintain communication with Superintending Engineer/O&M & Chief Engineer/O&M.

G) Essential staff

1 Attendants.
2 First Aiders.
3 Personnel for emergency engineering work such as for providing extra lighting or replacement of lighting, providing temporary by pass of the work.
4 Personnel for transporting equipment to the incident site from other parts of the works.
5 Personnel for moving tankers or vessels from area of risk
6 Personnel for acting as runners in case of communication difficulties
7 Personnel for manning plant entrance, in liaison with the police to Direct emergency vehicles entering the plant, to control traffic leaving the plant and to turn away or make alternate arrangement for visitors and other traffic arriving at the gate.

It is the responsibility of the Superintending Engineer O&M to identify the above essential staff and form a Task Force which report at defined plant control centers so that they can be readily contacted. It is the responsibility of the Superintending Engineer/O&M to remove all non-essential staff to assembly points.

Responsibilities of teams

A. Task force

- To identify source of hazard and try to neutralize / contain it.
- To isolate remaining plant and keep that in safe condition.
- To organize safe shut down of plant, if necessary.
- To organize all support services like operation of fire pumps, sprinkler systems etc.

B. Maintenance team

- Attend to all emergency maintenance jobs on top priority.
- To take steps to contain or reduce the level of hazard created due to disaster.
- To organize additional facilities as desired.

C. Fire fighting team

In case fire erupts and emergency is due to fire the Fire Fighting team is responsible for.

- To rush to fire spot and extinguish the fire.
- To seek help from outside fire fighting agencies through knowledge of plant officials.
- To evacuate persons affected due to whatever reasons.

D. Communication team

- To maintain the Communication network in working condition.
- To attend urgent repairs in the communication system, if required.
- To arrange messengers for conveying urgent messages when needed so.
- To help plant authorities to communicate with external or internal authorities /officials.

E. Security team

- To man all gates.
- To bar entry of unauthorized persons.
- To permit, with minimum delay, the entry of authorized personnel and outside agencies, vehicles etc., who have come to help
- To allow the ambulance / evacuation vehicles etc., to go through the gates with security escort.

F. Administration team

- To rescue the casualties on priority basis.
- To transport casualties to first aid post, safe places, or medical centers.
- To account the personnel.
- To pass information to the kith and kin of fatal or seriously injured persons.

G. Safety team

- To arrange required safety equipment.
- To measure gas concentrations, in case of gas leakage at various places.
- To guide authorities on all safety related issues.
- To record accident details.
- To collect and preserve evidences in connection with accident inquiry.
- To report the accident to statutory authorities and Chief Engineer/O&M

H. Medical Team

- To arrange first aid materials / stretchers immediately and reach the site of incident.
- To arrange for immediate medical attention.
- To arrange for sending the casualties to various hospitals and nursing homes etc.,
- To ask specific medical assistance from outside including specialists in consultation with Chief Engineer / O&M and Superintending Engineer /O&M.

Support teams

In addition to the teams already mentioned, there will be two additional teams known as support teams.

A. Support team to chief engineer / O&M

This team assists Chief Engineer / O&M during the emergency to execute his functioning in consultation with him. The members of the team and their responsibilities are given below.

a) Head of personnel (Divisional Engineer /Admn.)

- Contacting statutory authorities.
- Arranging for relievers and catering facilities.
- Giving information to News Media.
- Arranging shelters for affected persons.
- Contacting medical centers and nursing homes.
- Providing all over support, as necessary.

b) Head of materials (Divisional Engineer/Stores)

- Arranging for urgently required materials through cash purchase or whatever means.

c) Head of finance (Sr. Accounts Officer)

- Arranging funds for various relief measures as well as emergency purchase of materials and sending his representative for emergency purchases.

B. Supporting team to superintending engineer / O&M.

The support team to Superintending Engineer/O&M will consists of

- Asst. Divisional Engineer/Technical.
- Divisional Engineer/General.

- Divisional Engineer /Electrical, Maintenance.

The team may call any more persons depending upon the need.

The team will assist the Superintending Engineer/O&M in manning communication and passing instruction the team.

One Asst. Engineer / Technical shall always be available with Superintending Engineer/O&M for recording all information coming in and instructions going out.

Responsibility for all clear signal

After cessation of emergency, Superintending Engineer/O&M will communicate to Chief Engineer/ O&M about it. After verification of Status, Chief Engineer /O&M will communicate to announce the "All clear" by instructions to sound the "All Clear Signal".

7.2.8 Off-site emergency plan

The task of preparing the Off-Site Emergency Plan lies with the district collector; however the off-site plan will be prepared with the help of the local district authorities. The proposed plan will be based on the following guidelines. Off-site emergency plan follows the on-site emergency plan. When the consequences of an emergency situation go beyond the plant boundaries, it becomes an off- site emergency. Off-site emergency is essentially the responsibility of the public administration. However, the factory management will provide the public administration with the technical information relating to the nature, quantum and probable consequences on the neighboring population.

The off-site plan in detail will be based on those events which are most likely to occur, but other less likely events which have severe consequence will also be considered. Incidents which have very severe consequences yet have a small probability of occurrence will also be considered during the preparation of the plan. However, the key feature of a good off- site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who will be involved in the implementation of an off- site plan are described below. Depending on local arrangements, the responsibility for the off-site plan will be either rest with the works management or, with the local authority. Either way, the plan will identify an emergency co-ordinating officer, who would take the overall command of the off-site activities. As with the on-site plan, an emergency control center will be setup within which the emergency co-ordinating office can operate. An early decision will be required in many cases on the advice to be given to people living "within range" of the accident - in particular whether they should be evacuated or told to go indoors. In the latter

case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors.

- In the case of a major fire but without explosion risk (e.g an oil storage tank), only houses close to the fire are likely to need evacuation, although a severe smoke hazard may require this to be reviewed periodically;
- If a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people should be advised to stay indoors and shield themselves from the fire.

7.2.8.1 Aspects proposed to be considered in the off-site emergency plan

The main aspects, which will be included in the emergency plan, are:

Organization

Details of command structure, warning systems, implementation procedures, emergency control centers maintained. Names and appointments of incident controller, site main controller, their deputies and other key personnel.

Communications

Identification of personnel involved, communication center, call signs, network, lists of telephone numbers.

Specialized knowledge

Details of specialist bodies, firms and people upon whom it may be necessary to call i.e. those with specialized chemical knowledge, laboratories.

Voluntary organizations

Details of organizers, telephone numbers, resources etc

Chemical information

Details of the hazardous substances stored or procedure on each site and a summary of the risk associated with them.

Meteorological information

Arrangements for obtaining details of weather conditions prevailing at the time and weather forecasts.

Humanitarian arrangements

Transport, evacuation centers, emergency feeding treatment of injured, first aid, ambulances, temporary mortuaries.

Public information

Arrangements for dealing with the media press office, informing relatives, etc.

Assessment

Arrangements for: (a) collecting information on the causes of the emergency; (b) reviewing the efficiency and effectiveness of all aspects of the emergency plan.

7.2.8.2 Role of the emergency co-ordinating officer

The various emergency services will be co-ordinated by an Emergency Coordinating Officer (ECO), who will be designated by the District Collector. The ECO will liase closely with the site main controller. Again depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control will be passed to a senior local authority administrator or even an administrator appointed by the central or state government.

7.2.8.3 Role of the local authority

The duty to prepare the off-site plan lies with the local authorities. The Emergency Planning Officer (EPO) appointed will carry out his duty in preparing for a whole range of different emergencies within the local authority area. The EPO will liase with the works, to obtain the information to provide the basis for the plan. This liaison will ensure that the plan is continually kept up-to-date.

It will be the responsibility of the EPO to ensure that all those organizations which will be involved off site in handling the emergency, know of their role and are able to accept it by having for example, sufficient staff and appropriate equipment to cover their particular responsibilities. Rehearsals for off-site plans will be organized by the EPO.

7.2.8.4 Role of police

Formal duties of the police during an emergency include protecting life and property and controlling traffic movements. Their functions will include controlling bystanders evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death or injury.

7.2.8.5 Role of fire authorities

The control of a fire will be normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer will also have a similar responsibility for other events, such as explosions. Fire authorities in the region will be apprised about the location of all

stores of flammable materials, water and foam supply points, and fire-fighting equipment. They will be involved in on-site emergency rehearsals both as participants and on occasions, as observes of exercises involving only site personnel.

7.2.8.6 Role of Health Authorities

Health authorities, including doctors, surgeons, hospitals, ambulances, and so on, will have a vital part to play following a major accident, and they will form an integral part of the emergency plan. For major fires, injuries will be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this in all but extreme cases may be generally available in most hospitals. Major off-site incidents are likely to require medical equipment and facilities additional to those available locally, and a medical "mutual aid "scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

7.2.8.7 Role of government safety authority

This will be the factory inspectorate available in the region. Inspectors are likely to want to satisfy themselves that the organization responsible for producing the off-site plan has made adequate arrangements for handling emergencies of all types including major emergencies. They may wish to see well documented producers and evidence of exercise undertaken to test the plan. In the event of an accident, local arrangements regarding the role of the factory inspector will apply. These may vary from keeping a watching brief to a close involvement in advising on operations.

7.2.9 Disaster management & emergency preparedness for natural disasters

7.2.9.1 Introduction

The Natural disasters include cyclones, floods, earthquakes, volcanic eruptions, famines, drought, landslides etc. Amongst all the ones mentioned floods and earthquakes are the most common in India. India is no exception as it has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions.

Natural disasters can neither be predicted nor prevented. The problem before us is how to cope with them, minimizing their impact. Increase in urban population coupled with the construction of man-made structures often poorly built and maintained subject cities to greater levels of risk to life and property in the event of earthquakes and other natural hazards. One of the main objectives is to reduce the risk of loss of human life and property and to reduce costs to the society. We have to recognize that in such cases of natural disasters, we deal with phenomena of enormous magnitude that cannot be controlled by any direct means of human intervention. But what we try to do is to reduce the impact on human beings and property.

Tamil Nadu has witnessed havoc caused by cyclones and storm surge in the coastal regions, earthquakes, monsoon floods, landslides, and recently the Tsunami. Increase in urban population coupled with the construction of man-made structures often poorly built and maintained subject cities to greater levels of risk to life and property in the event of earthquakes and other natural hazards.

Tamil Nadu covers an area of 130, 0582 kms and has a coastline of about 1,076 kms which is about 15% of the coastline of India. More than 40% of the fisher population lives within 1km of coast and 50% of them live within 2 km of the coast. The geographical setting of Tamil Nadu makes the state vulnerable to natural disasters such as cyclones, floods and earthquake-induced tsunami. About 8% of the state is affected by five to six cyclones every year, of which two to three are severe. Cyclonic activities on the east coast are more severe than on the west coast, and occur mainly between April-May and October-November.

7.2.9.2 Floods & cyclones

Floods are high stream flow that overflows the natural banks of the rivers and most of the times become calamitous. The main causes of floods are excessive rains in river catchments, poor natural drainage, Change of river course, Landslide restricting river flow, cyclone and very intense rainfall.

From the flood hazard map of India (shown as **Figure 7.5**), it is seen that no area in Tamil Nadu falls in the risk zone.

Figure 7.7: Flood hazard map of india

But within a local body area, particularly with reference to an area's proximity to a major drainage system like rivers, canals, and also water bodies like lakes, and further with reference to contour levels/low-lying areas, flood prone area mapping has to be done.

Tamil Nadu is also subjected to annual flooding, including flash floods, cloudburst floods, monsoon floods of single and multiple events, cyclonic floods, and those due to dam bursts or failure. Every year, on average thousands of people are affected, a few hundred lives are lost, thousands are rendered homeless and several hectares of crops are damaged. The cause of flood is mainly the peculiarities of rainfall in North east monsoon period in the state. Out of the total annual rainfall in the state, 90% is concentrated over short monsoon season of three months. As a result, heavy discharges from the rivers during this period causing widespread floods in the delta regions. Floods occur mainly in the coastal districts basin that carries 100% of the state total river flows.

Cyclones

Cyclone refers to a whirl in the atmosphere with very strong winds circulating around it in anti-clockwise direction in the Northern Hemisphere and clockwise in the Southern Hemisphere. Cyclones are intense low pressure areas with pressure increasing outwards. Cyclones can be hazardous as Cyclones are normally associated with strong winds. A storm surge is an abnormal rise of sea level near the coast caused by a severe tropical cyclone; as a

result, sea water inundates low lying areas of coastal regions drowning human beings and lives-stock, eroding beaches and embankments, destroying vegetation and reducing soil fertility. Apart from strong winds, cyclones can result in heavy rains causing floods. However, the most destructive factor associated with the cyclones is the storm surge.

For cyclone forecast and advance warning, the Government has strengthened the Meteorological Department, by providing Cyclone Surveillance Radars at Calcutta, Paradeep, Visakhapatnam, Machilipatnam, Madras and Karaikal in the east coast and at Cochin, Goa, Bombay and Bhuj in the west coast. Bay of Bengal is one of the five cyclone prone areas of the world. The coastal regions surrounding this bay are frequently affected by flooding from the sea as well as from the rivers due to tropical cyclones and related storm surges and heavy rainfall. In Tamil Nadu during the years 1990 to 1995, and 2006 the damages caused to property were worth 5800 million rupees and the loss of human lives were more than 500.

Tamil Nadu lies in the southern part of Indian peninsula and has a long east coast. The east coast is more vulnerable to cyclones and floods. Tamil Nadu has a very long coastline of about 1076 km with 591 coastal villages, which is exposed to tropical cyclone arising in the Bay of Bengal and has seasonal character to Tamil Nadu. The coast line starts from Pulicat along the east coast and extends up to Erayamanthurai in Kanniyakumari District and consists of Estuaries of ecological importance, Major and Minor ports, Fishing harbours, Monuments of international heritage, Tourist locations, Pilgrimage centers, etc.

Disaster management should aim at reducing the impact of the three main characteristics and effects of a cyclone, which are- High speed winds, Storm Surge and Floods caused by Heavy and wide-spread rainfall. The focus therefore has to be on the following: -

a. Understanding the mechanism of formation, development, structure and movement of cyclones,
b. The capability of detecting cyclones while out at sea,
c. The capability to predict their movement and behaviour,
d. Capacity to warn vulnerable people in time,
e. Measures for cyclone preparedness both in advance and during a cyclone,
f. Relief and rehabilitation after the cyclone.
g. An integrated hazard mitigation policy dove-tailed into the development plan.

The first four are essentially based on meteorology and the rest are in the field of planning, organising, and implementation. For the sake of clarity a separate chapter on tropical cyclones is included to cover the aspects from (a) to (d) above. It will be found that most measures (e) and (f) above have been included in the state contingency plan for cyclones. The aspects covering (g) are now formulated by Disaster Management Unit (DMU) under the Revenue Department.

7.2.9.3 Earth quake-prone areas:

Earthquakes are powerful manifestations of sudden releases of strain energy accumulated within the crust and propagated as seismic waves. The need to understand and study the phenomenon of earthquake is for a simple reason, that it is the most disastrous natural calamity for mankind. The first Seismological observatory in India was established in the year 1898 in the city of Calcutta. Over the years the department has been exponentially expanded by the Meteorological Department of India.

Tamil Nadu is not as seismically active as states in the northern and western parts of the country, small to moderate earthquakes have occurred in the state of Tamil Nadu. The frequency of earthquakes is low i.e. the gap between moderate sized events is fairly long (**Figure 7.8**). The seismic hazard map of India was updated in 2000 by the Bureau of Indian Standards (BIS). According to the new map more areas of Tamil Nadu are susceptible to damage from earthquakes than previously thought (**Figure 7.9**).

Figure 7.8: Seismic zone map of India

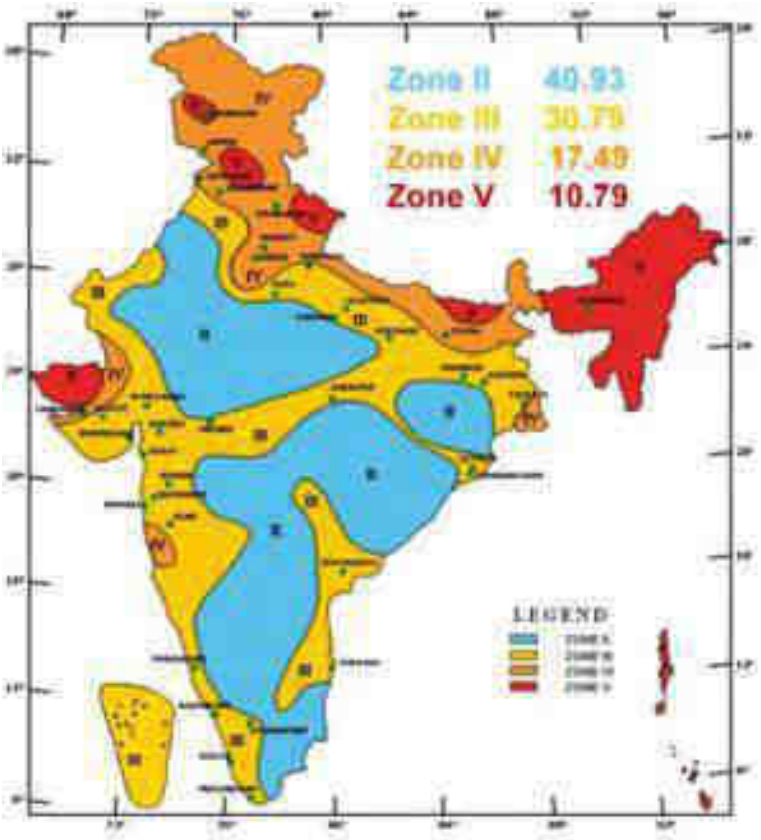
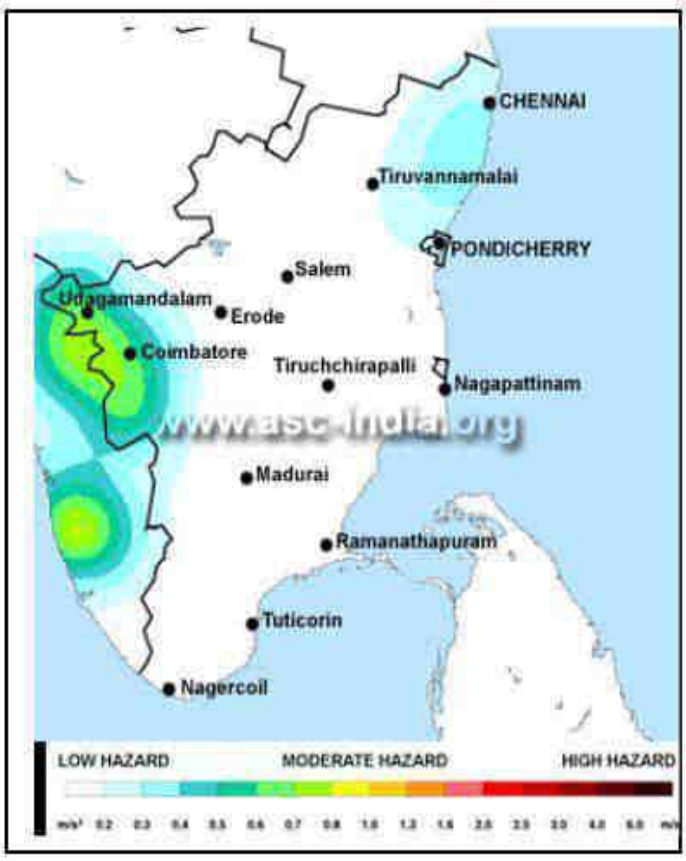


Figure 7.9: Seismic zone map of Tamil Nadu



The city of Chennai, formerly in Zone II now lies in Zone III. Districts in the western part of the state, that lie along the border with Kerala also lie in Zone III, along with districts along the border of Andhra Pradesh and a section of the border with Karnataka. The maximum intensity expected in these areas would be around MSK VII. The rest of the state lies in Zone II.

Since the earthquake database in India is still incomplete, especially with regards to earthquakes prior to the historical period (before 1800 A.D.), these zones offer a rough guide of the earthquake hazard in any particular region and need to be regularly updated.
According to GSHAP (Global Seismic Hazard Assessment Program) data, the state of Tamil Nadu falls mostly in a region of low seismic hazard with the exception of western border areas that lie in a low to moderate hazard zone. Puducherry lies in a low hazard region. As per the 2002 Bureau of Indian Standards (BIS) map, Tamil Nadu and Puducherry fall in Zones II and III. Historically, parts of this region have experienced seismic activity in the M5.0 range. Tamil Nadu is also prone to very severe damaging earthquakes. Its people feel much more vulnerable to earthquake-induced tsunamis since the 2004 Indian Ocean tsunami, which affected the coast of Tamil Nadu destroying much of the marine biology and severely damaging the ecosystem.

Largest Instrumented Earthquake occurred in Tamil Nadu and Puducherry on 26th September 2001(11.984 N, 80.225 E, D=010.0 kms, OT=14:56:55 UTC). A moderate earthquake occurred in the Bay of Bengal, off the coast of the union territory of Puducherry, on 25 September 2001 at 20:26 PM local time resulting in three deaths and minor damage to property in Puducherry and coastal Tamil Nadu. It had a magnitude of Mw=5.5.

Earthquake disaster mitigation program consists of three components which are Preparedness, Rescue and Rehabilitation as described below. Earthquake mitigation program and preventive action program in India are outlined.

a. Preparedness:

The preparedness phase involves the following aspects:

I. Hazard zoning.
II. Earthquake prediction and warning.
III. Implementation of earthquake engineering codes.
IV. Strengthening of existing structures.
V. Education & training.
VI. Seismic instrumentation-new & upgradation.
VII. Insurance.
VIII. Emergency preparedness
IX. Training for handling damaged buildings.

Preparation of contingency plan and creation of administrative structure for effective and coordinated action during the emergency. This would include arrangements of digging & clearing equipment (bulldozers, cranes, chain saw, drills & crowbars etc.) for rescue of people trapped in collapsed houses, materials for shelters, emergency bridges, fire wood, medical facilities including mobile hospitals & medicines, immunisation, water tankers & water purifiers.

b. Rescue:

Rescue at the time of emergency involves the following operations:

I. Maintenance of law and order; prevention of trespassing, looting, Keeping roads clear from sight seeing persons so that free movement of rescue vehicles is assured, etc.
II. Evacuation of people.
III. Recovery of dead bodies and their disposal.
IV. Medical care for the injured.
V. Supply of food and water and restoration of water supply lines.
VI. Temporary shelters like tents, metal sheds.
VII. Restoring lines of communications & information.
VIII. Restoring transport routes
IX. Quick assessment of damage and demarcation of damaged areas according to grade of damage.
X. Cordoning off of severely damaged structures that are liable to collapse during after shocks.
XI. Temporary shoring of certain precariously standing buildings to avoid collapse and damage to other adjoining buildings.

c. Rehabilitation:

After the emergency, rehabilitation involves the following aspects:

I. Repair, restoration, strengthening or demolition of damaged buildings.
II. Selection of sites for new settlements, if necessary.
III. Adoption of strategies for new constructions like construction through contractors or by self-help; construction of core houses only or supply of construction material only.
IV. Execution of the construction program.
V. Preview/review of seismic codes & construction norms.
VI. Training of personnel, engineers, builders and artisans.
VII. Rehabilitation of destitute persons, orphans, widows, the aged and the handicapped.

7.2.10 Responsibility for all clear signal

After cessation of emergency, Superintending Engineer/ O&M will communicate to Chief Engineer/ O&M about it. After verification of Status, Chief Engineer/ O&M will communicate to announce the “All clear” by instructions to sound the “All Clear Signal”.

7.2.11 Evaluation & functioning of disaster plan

7.2.11.1 Full mock drill monitoring committee

The mock drills will be conducted at regular intervals; the full mock drill monitoring committee consists of the following committee members.

CE/O&M	-	Chairman of the committee
SE/O&M	-	Vice Chairman
SE/CHP	-	(Alternate to Chairman in his absence)
Fire Officer	-	Organizer
DE/E&P	-	Member
Medical Officer	-	Member
Welfare Officer	-	Member
Security Officer	-	Member
DE/TMD/	-	Member
Safety Officer	-	Member

The committee may invite any other official/expert, if considered necessary.

The committee shall supervise the following activities:

- Functioning of emergency Control centre, specifically availability of all facilities as mentioned in the plan and its functional healthiness.
- To evaluate communication of the Disaster Management Plan to all segments of employee's to familiarize them about their responsibilities in case of any disaster including evaluation of behavior of employees and others.
- To ensure that all facilities as required under the plan from within the plant or from nearby industries/aid centers under mutual assistance scheme or otherwise are available.
- To ensure that the necessities under material assistance scheme is properly documented and the concerned employees are fully aware of this.
- To ensure that employees are fully aware of the steps to fight any emergency like sealing of chlorine leakage, fire fighting or other such causes.
- All employees are trained about their responsibilities /duties. They are all aware of evacuation routes, direction of evacuation and the equipment to be used during evacuation or the method of evacuation.
- All employees are fully trained to rescue their colleagues who are affected due to cause of disaster. In case they are unable to rescue their colleagues, they should know to whom they are to inform about such persons.
- All employees will be fully trained in first aid, use of desired equipment including breathing apparatus, first aid box etc., and will be available at the desired location.

- All Warning alarms will be functional. Public address system will be in healthy condition.
- All telephone lines / communication systems will be provided in control rooms and there will no removal of the facilities (as prescribed) for the control rooms.
- It is very clear amongst the concerned officers who shall call for assistance under Mutual Aid Scheme or the facilities (as prescribed) from the control room.
- It is very clear amongst the concerned officers who shall call for assistance under Mutual Aid scheme or the facilities from within.
- It is clear at the plant who shall declare emergency.
- It is clear at the Plant, who shall inform the District Authorities, State Authorities and Corporate Centre.

7.2.11.2 Steps of mock drills

The Mock Drills should be carried out step by step as stated below.

First Step	:	Test the effectiveness of communication system.
Second Step	:	Test the speed of mobilization of the plant emergency teams.
Third Step	:	Test the effectiveness of search, rescue and treatment of Casualties.
Fourth Step	:	Test Emergency isolation and shut down and remedial measures taken on the system.
Fifth Step	:	Conduct a full rehearsal of the actions to be taken during an emergency.

The Disaster Management Plan should be periodically revised based on experience gained from the Mock Drill.

Chapter-8
Project Benefits

Chapter- 8

Project Benefits

8.1 Introduction

Development of power sector projects plays a key role in the economic growth of the state and the country. The proposed project with a massive investment of Rs. 5421.28Crores will improve the physical and social infrastructure of the area.

Lack of availability of sufficient electric power has always been one of the greatest deterrents to the economic growth of the State. To mitigate the gap between demand and supply, TANGEDCO has proposed to establish of 1x660MW supercritical coal based ETPS expansion thermal power plant, inside ETPS premises, Ernavur village, Tiruvottiyur Taluk, Thiruvallur District. The southern region is predominantly of hydel power generating stations. The potential from hydel plants is already exploited to the maximum. Further, the hydel generation which is being restricted only to the monsoon period, could not cater to the overall power requirement of the region and hence the capacity addition in thermal power sector has become necessary. In such a situation implementation of base load power plants using thermal power generation is the preferred alternative. The actual growth in industrial, agricultural and domestic demand will establish that there is an appreciable shortfall in the installed capacity, demand and energy availability as on date. This shortfall will continue even after the commissioning of the proposed power plants in various parts of the state and in the southern region. As Tamil Nadu state is the most preferred state for industrialization, the industrial demand for power will be ever increasing. Added to the industrial demand the agriculture need as well as domestic consumption coupled with the improved standard of living of the population will be on the rise. Further, the grid is large enough to accommodate this proposed 1x660MW coal fired power plant.

Taking all these into consideration, establishment of the proposed ETPS expansion thermal power plant of 1x660MW is justified in all aspects, since this will only meet a part of the projected power demand.

As the proposed project being adopted supercritical technology the unit leads to enhanced plant efficiency, less fuel consumption and reduced greenhouse emissions.

8.2 Improvements in the physical infrastructure

In addition to the direct and indirect employment from the proposed project, due to the proposed project there will be other ancillary industries coming up to cater the needs of the proposed project. This development activity will increase the employment potential of the local

persons. The business activities will also improve due to movement of employees of the proposed project and visitors coming to the project works.

8.3 Improvement in the social infrastructure

A key issue related to the sustainable development, a minimum quality and standard of living pertains to the availability of and accessibility to basic infrastructure facilities viz. water, power, sewerage, drainage and solid waste management. The rapid and almost uncontrolled growth of population has put these facilities under severe pressure, and there are significant deficiencies. Even a cursory analysis of the present state of affairs, infrastructure problems could become a cause of crisis. Critical need of advance action and arrangement is required for the adequate provision of physical infrastructure.

The proposed project will keep certain matching amount for development of physical infrastructure of nearby villages, especially adjacent villages under corporate social responsibility. Some of development activities proposed is as follows, which will be taken up with discussion with local villagers depending upon their requirement.

- Development and strengthening of the nearby village connecting roads
- Improvement of drinking water facilities
- Improvement of storm water drainage facilities
- Improvement of sewerage system available in the nearby villages

Due to the proposed project even the social infrastructure like educational institutions, hospitals, housing, railways, etc will improve to cater the needs of the employees and visitors of the proposed project.

8.4 Employment potential

The lack of adequate employment generation is one of the most pressing economic and social problems in Tamil Nadu at the moment, much as in the rest of India. But the problem seems to be even more acute in this state than elsewhere, given the sharper declines in employment expansion that have been noted.

The proposed project will be providing number of direct employment opportunities to the locals as skilled and unskilled primarily once it is commissioned. During construction period it will have direct employment for construction workers for period of two to three years. The employment opportunities for skilled will also be available based on skill set.

Additionally it will also generate indirect employment opportunities at local/ regional level due to contractual, marketing and associated jobs directly with the project. The other related employment due to transportation requirement, supply of essential items and services to the project site and other community services will be plenty. The possibility of development of trades and occupations linked with the project beneficiated personnel like dairy, poultry, commercial shops etc is also expected to boost the local employment levels.

Employment in these sectors will be permanent based on own initiatives and interest of the individual. Involvement of unskilled labour requirement will be continuous basis depending on the requirement of contractor at site. A major part of this labor force will be hired from local villages.

8.5 Other benefits

8.5.1 Development around the project

The proposed supercritical power project will be center for development of small scale ancillary industrial units around the project area, they generally have input and output linkages with the plant and its employees and their families. The Demand for various spare parts, equipments, goods, eatables etc. will meet through the supply chain of small scale units located nearby as they will be able to supply at competitive prices.

8.5.2 Education & entrepreneurship

The interest of the locals towards education and entrepreneurship will increase due to the expectation of getting jobs and job works in the proposed project and other ancillary industries units which come in nearby areas.

The demand for day to day needs of the employees and their families on grocery, milk, vegetables etc. will provide ample business opportunities for local people around the project site. The following changes in socio-economic status are expected to take place with this project.

I. Due to increased income levels and raising consumption levels through multiplier effect there will be positive impact on economics of the region.
II. TANGEDCO will train people for increasing their employability in the plant
III. There will be increased revenue to the state in the form of taxes & duties which will find its way to support and development of the region over all.
IV. Project will also help in the development of social infrastructures/such as.

- Education facilities
- Banking facilities
- Post offices and Communication facilities
- Medical facilities
- Recreation facilities
- Business establishments
- Plantation and parks
- Community facilities

8.6. CSR funding

The CSR budget will be mandatorily as per the guidelines created through a board resolution as a percentage of net profit as per the rule prescribed by the government of India. However, during primary data collection in the study area it has been noticed that there are good number of unemployed local youth in the surrounding villages, an action plan will be proposed to train the local employable youth, so that after relevant training they will be employed in the proposed project based on the requirement of different stages of the project.

TANGEDCO will be allocated budget for meeting corporate social responsibility (CSR) activities as per the existing guidelines of state & central government. The detailed need based assessment study (socio economic study) of the surrounding villages was carried out by the madras school of social works, Chennai and based on the recommendation of the report the budgetary for CSR activities will be allotted.

The CSR budget will be mandatorily as per the guidelines created through a Board Resolution as a percentage of net profit as per the rule prescribed by the government of India/ Companies Act 2013. The CSR Budget will be fixed for each financial year. This funding will not lapse.

Criteria for Applicability of CSR Under Section 135 (I) of Companies Act 2013		
Either of the Following 3 Criteria		
Turnover Criteria Turnover during financial Year is INR 1000 Crores or More	Net Profit Criteria Net profit during financial year is INR 5 Crores or more	Net worth Criteria Net worth is INR 500 Crores or More
As per the act the management board shall ensure that at least 2% of average net profits of the company made during three immediately preceding financial years shall be spent on CSR activities in every financial year.		

8.7 CER funding

Corporate Environmental Responsibility has become an integral, self-regulating mechanism through which business monitors and safeguards its active compliance with the Law and ethical standards. CER aims to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, employees, consumers, stakeholders, communities and the larger public.

The project would further promote public interest through provision of basic amenities such as roads, transportation, electricity, education, and sanitation and healthcare facilities. This would also encourage community growth and development and improved socio-economic conditions, and quality of life of the people living in the project area. The company shall also continue to have among its objectives the promotion and growth of the national economy through increased productivity, effective utilization of material, manpower resources and continued application of modern scientific and managerial techniques, in keeping with the national aspiration; and the company shall continue to be mindful of its social and moral responsibilities to consumers, employees, shareholders, society and the local community. The company shall earmark funds for CER in the surrounding villages towards development of education, healthcare, skill development, drinking water supply, avenue plantation, strengthening of infrastructure facilities and capacity building of local communities. These funds shall be utilized over a period of 3 years initially. The proposed CER activities are given in **Table 8.1** below.

The CER activities have been proposed based on the community need assessment and analysis the existing infrastructure facilities in project area villages. These activities will be implemented through credible partners and monitored periodically by the company. The implementation agencies would submit a monthly progress report, MIS, quarterly report and other relevant documents for information and mandatory compliance.

8.8 Corporate environmental responsibility (CER) funding

The CER fund shall be allotted as per the MoEFCC office memorandum F.no.22-65/2017-IA.III dated, 1st May, 2018, is given in **Table 8.1.** "The fund allocation for CER shall be deliberated in the EAC or SEAC or DEAC as the many case may be with a due diligence subject to maximum percentage as prescribed below for the different cases"

Table 8.1: CER fund as per MoEFCC OM F.No.22-65/2017-IA.III dated 1st May 2018

Capital investment/additional capital investment (in Rs.)	Greenfield project	Brownfield project
≤ 100crores	2.0%	1.0%
> 100crores ≤ 500crores	1.5%	0.75%
> 500crores ≤ 1000crores	1.0%	0.50%
> from 1000crores to ≤ 10000crores	**0.5%**	**0.25%**
> 10000crores	0.25%	0.125%

Table 8.2: Proposed CER activities and budget allocation

S. No	Activities	Details	Frequency/timelines	Yearly Budget allocation (in Crores)			Total Amount (in Crores)
				1st Year	2nd Year	3rd Year	
1	Health checkups	Health checkup for communities in the nearby villages and distribution of medicines to the needy	Once in every month in every village in the core zone and needy villages in the other zones	0.5	0.5	0.75	1.75
2	Installation of hand pumps	Hand pump & Community Water Filter Units in the nearby villages	Need based	0.5	0.5	1	2
3	Installation of solar lights	Solar street lights will be installed in the project area villages	Need based	0.5	0.5	0.5	1.5

4	Infrastructure development of schools	Modernization of class rooms, donation of computers, note books, other need based education materials, provision of potable drinking water and improving sanitation in local schools	Need based	0.5	0.5	1.2	2.2
5	Plantation drives	Identified blocks of degraded forests, Schools and community building in the project area	Once in six months in the project area	0.5	0.5	0.5	1.5
6	Construction of community toilets	A total of 5 toilets will be constructed for the community use in the needy villages.	5 villages will be targeted in the project area. The SBM-Rural funding of Rs. 65,000/- for each community toilets will be also mobilized. O&M will be provided for first 3 years.	0.5	0.5	0.5	1.5
7	Vocational education training program	identified Youth in all Project affected villages will be trained in job oriented courses	Half yearly one batch	0.5	0.5	0.5	1.5
8	Strengthening agriculture and fisheries	Through Formation of FPOs, fisheries and agriculture market extension services and enhancement of infrastructure in local Mandis/markets	Once in a quarter/Need based	0.5	0.5	0.7	1.7
Grand Total				**4**	**4**	**5.65**	**13.65**

Note: The Company shall earmark the fund of Rs. 13.65 Crores for CER. This fund shall be utilized over a period of 3 years.

Chapter-9

Environmental Management Plan

Chapter-9
Environmental Management Plan (EMP)

9.1 Introduction

The industrial development needs to be intertwined with utilization of natural resources within the limits of permissible assimilative capacity. The environmental management plan (EMP) is required to ensure sustainable development in the area of the proposed power plant site. Hence, it needs proper EMP to meet these objectives.

The management action plan aims at controlling pollution at the source level to maximum possible extent with the available and affordable technology followed by treatment measures before they are discharged. It encompasses the mitigation measures that are proposed in order to synchronize the economic development of the study area with the environmental protection of the region.

The following mitigation measures are proposed in order to synchronize the economic development of the study area with the environmental protection of the region.

9.2 Environmental management during construction

The impacts during the construction phase on the environment would be basically of temporary nature and are expected to reduce gradually on completion of the construction activities.

9.2.1 Air quality mitigation measures

For the proposed project site levelling and grading will be carried out wherever possible to maintain the natural elevations so that they are not disturbed. Only levelling activity will be carried out for providing roads, sewage network, storm water system, places required for providing buildings for administrative and power plant erection. According to the engineering assessment; most of the excavated material shall be reused within the project boundary.

Most of the construction dust will be generated from the movement of construction vehicles on unpaved roads. Unloading and removal of soil material shall also act as a potential source for dust nuisance. The control measures proposed to be taken up are given below.

Regular water sprinkling on main haul roads in the project area will be carried out at least twice a day, if need arises frequency will be increased on windy days. In this way around 50% reduction on the dust contribution from the exposed surface will be achieved.

1. The duration of stockpiling will be as short as possible as most of the material will be used as backfill material for the open cut trenches for road development.
2. Temporary tin sheets of sufficient height (3m) will be erected around the site of dust generation or all around the project site as barrier for dust.
3. Tree plantations around the project boundary will be initiated at the early stages by plantation of 2 to 3 years old saplings using drip irrigation so that the area will be moist for most part of the day.
4. All the vehicles carrying raw materials will be covered with tarpaulin / plastic sheet, unloading and loading activity will be stopped during windy period.
5. To reduce the dust movement from civil construction site to the neighbourhood the external part of the building will be covered by plastic sheets

Given the implementation of proper control measures for dust suppression, no adverse impacts are expected and compliance with the ambient air quality is achieved at ASR's (Air pollution Sensitive Receivers) at all time.

9.2.2 Water quality mitigation measures

During site development necessary precautions will be taken, so that the runoff water from the site gets collected to working pit and if any over flow is, will be diverted to nearby greenbelt/ plantation area.

During construction activity all the wash water from equipments will be diverted through oil and grease trap into working pit to arrest the suspended solids if any and the settled water will be reused for construction purposes, and for sprinkling on roads to control the dust emission etc.

The waste generated from the site work shop will be segregated into used oil, lubricants etc., are disposed to authorized recyclers and the waste like soiled cotton, paper, etc., will be disposed to municipal bins.

The domestic wastewater generated from temporary toilets used by the work force will be diverted to septic tank followed by soak pit. If the wastewater generation is high a mobile STP will be hired from the local suppliers. So that impact on water quality due to proposed unit would be minimum.

9.2.3 Noise mitigation measures

All noise generating equipment will be used during day time for brief period of its requirement. Proper enclosures will be used for reduction in noise levels. Temporary tin sheets of sufficient height (3m) will be erected around the noise generating activity or all around the project site as barrier for minimizing the noise travel to surrounding areas. Therefore, impact on noise environment due to proposed project would be insignificant.

All vehicles entering into the project will be informed to maintain speed limits, and not blow horns unless it is required.

Personal protective equipment like earmuffs, helmets covering ears would be provided to the workers working near noise generating equipment and would see that workers use the protective gadgets regularly.

9.2.4 Solid waste mitigation measures

The organic waste generated from canteens, lavatories and temporary residential shed will be aesthetically composted to produce manure, which will be used for green belt development. The inorganic and inert solid waste generated will be disposed of by adopting suitable means as described below.

Construction and demolition waste does not create chemical or biochemical pollution. Hence maximum effort would be made to reuse and recycle them. The most of the solid waste material can be used for filling/ levelling of low-lying areas. All attempts should be made to stick to the following measures.

1. All construction waste shall be stored within the site itself. A proper screen will be provided so that the waste does not get scattered.
2. Attempts will be made to keep the waste segregated into different heaps as far as possible so that their further gradation and reuse is facilitated.
3. Materials, which can be reused for purpose of construction, levelling, making roads/ pavement will also be kept in separate heaps from those which are to be sold or land filled.
4. The local body or a private company will be arranged to provide appropriate number of skip containers/ trolleys on hire.

The use of the construction material basically depends on their separation and conditions of the separated material. A majority of these materials are durable and therefore, have a high potential for reuse. It would, however, be desirable to have quality standards for the

recycled materials. Construction waste can be used in the following manner.

1. Reuse of bricks, tiles, stone slabs, timber, piping railings etc., to the extent possible and depending upon their conditions.
2. Sale/ auction of materials which cannot be used at the site due to design constraint.
3. Plastics, broken glass, scrap metal etc., can be sent for recycling in the industries.
4. Rubble/ brick bats can be used for building activity, such as levelling, under coat of lanes where the traffic does not constitute heavy moving loads.
5. Larger unusable pieces can be sent for filing up low laying areas.
6. Fine material such as sand, dust, etc., can be used as cover material.
7. The unearthed soil can be used for levelling as well as for lawn development
8. The broken pieces of the flooring material can be used for levelling in the building or can be disposed off.
9. The unused or remaining paints/ varnishes/ wood can either be reused or can be disposed off.

9.2.5 Ecological aspects

During construction period, there could be clearing of some vegetation in order to prepare the site for construction. However, this will be minimized by proper landscaping and also going for extensive plantation along the boundary during construction activity. A comprehensive green belt programme will improve the ecological condition of the region.

9.2.6 Site security

Adequate security arrangement would be made to ensure that the local inhabitants and the stray cattle are not exposed to the potential hazards of construction activities. It is proposed to erect temporary tin sheets of sufficient height (3m) during construction and later permanent fencing will be erected along the plant boundary.

9.3 Management during operational stage

Necessary control measures will be undertaken at the design stage to meet the statutory requirements and towards minimizing environmental impacts.

The design basis for all process units will lay special emphasis on measures to minimize effluent generation and emission control at source. The specific control measures related to gaseous emissions, liquid effluent discharges, noise generation, solid waste disposal etc. are described below:

9.3.1 Air quality management

a) Reduction of emissions at source

The main elements which are generated from the proposed power plant which cause air pollution are as follows:

- Dust particulates in flue gas from chimney
- Nitrogen oxide in flue gas
- Sulphur-di-oxide in the flue gas
- Coal dust particles due to handling of coal
- Fly ash dust particles from ash silos and ash disposal area

The following methods of abatement will be employed for the air pollution control:

- To control & limit Particulate matter to 30mg/Nm^3 in the flue gas, highly efficient (99.98%) ESPs are proposed.
- Chimney of 275m height will be provided for proper dispersion of sulfur dioxide and oxides of nitrogen. FGD technology will be adopted to control So_2 emissions.
- To reduce NO_x emission, steam generators will use coal burners of proven, advance design and would also be provided with SCR. The NO_x emissions would be checked for Ground Level Concentrations (GLC's) as per Indian Emission Regulations i.e:100mg/Nm^3.
- Coal dust would be generated generally at the conveyor transfer points, coal unloading area and coal stock pile area. Hence, coal transfer points and coal stock yard would be provided with dust suppression/dust extraction facilities. Further, in order to arrest the coal dust generation, all conveyors would be provided with enclosed galleries. The bottom portion of all the conveyor galleries would be provided with seal plates within the power plant area and at road crossings.
- Dust collection system would also be provided in coal bunkers to evacuate dust and hazardous gases like methane from the coal bunkers. Collected dust would be returned to either the associated belt conveyor or to the coal bunker. The dust collector outlet emission would be restricted to 30mg/Nm^3.
- Regular water sprinkling will be carried in coal storage yard to suppress the coal dust.
- Internal roads will be concreted/ asphalted to reduce fugitive emissions
- 100% fly ash utilization will be carried as MoEFCC guidelines
- 100% dry fly ash will be collected in dry form in silos and will be disposed through e-auction.
- Bottom ash will be disposed in slurry form to ash pond.

b) Pollution monitoring and surveillance systems

The emission and gas monitoring systems proposed for this project consist of the following:

i) Flue gas O_2 and CO monitoring

These would be measured at the economizer outlet. In addition, O_2 would be monitored at the air pre heater outlet. For this purpose CO and O_2 monitor probes and analyzers would be installed separately.

ii) Stack emissions

Flue gas exiting into the atmosphere would be monitored for CO_2, NO_x, SO_2 and opacity. Stack emission readings would be sent to the DCS for monitoring. For this purpose, probes, associated gas analyzers and support equipment, sample lines and opacity sensor/ transmitters would be installed. The opacity sensors would be equipped with a blower to protect the optics from coating by flue gas particles.

The system operation would be continuous. Stack gas analysis for SO_2, CO_2, and NO_x would be performed by extracting a gas sample from the following stream in the stack, filtering to remove particulate droplets, diluting with scrubbed instrument air and conveying the sample to the analyzers. One sampling system per unit would be provided.

The laboratory attached to the power plant will be equipped with the necessary instruments for carrying out air quality monitoring. It is also proposed to monitor the particulate emission at the stack to keep a continuous check on the performance of the ESP. Adequate sampling openings will be provided in the stack.

Air monitoring stations (AMS) would be set up to monitor the air quality in the neighboring villages. The parameters to be monitored are) particulate matter ($RPM_{<2.5}$& $RPM_{<10}$), Sulphur dioxide (SO_2), Nitrogen oxide (NO_x), Carbon monoxide (CO) and Hydro carbons (HC). The air quality monitoring would be carried out continuously.

iii) Meteorological observations

The dry bulb temperature, wet bulb temperature, wind speed, wind direction, cloud cover, rainfall and solar radiation will be recorded daily.

9.3.2 Water and wastewater quality management

i) Water management

The source of water for the proposed power plants is sea water from Bay of Bengal. Major Part of this water will be used for cooling purpose, and minor part of this water will be treated in sea Water RO. The treated RO water will be used for potable water, AC &

ventilation, HRSG (Heat Recovery Steam Generators) make up, service water, etc.

ii) Wastewater management

The wastewater generation from the proposed power plant includes Cooling tower blow down which will be discharged into sea shore, RO plant reject, effluent from ash handling system, effluent from coal pile run off area, air pre-heater wash water effluent, plant wash down water, floor and equipment drainage effluent, rain water drainage, sewage from various buildings in the plant etc.

a) Cooling tower blow down

The cooling tower blow down water is let back to sea. All the plant drains, miscellaneous effluents of the plant would be treated and reused for different services such as coal dust separation, ash handling system, horticulture, washing etc. All the effluent after suitable treatment would be reused. At present COC of 1:1.3 is considered, as sea water is used for condenser cooling. Complete analysis of the system would be carried out during detailed engineering stage. Thus the plant would maintain zero effluent discharge except for cooling water blow down outfall to sea.

b) Water treatment plant effluent

The effluent from the regeneration of the cation resin units in the water treatment plant (DM Plant) is generally acidic in nature and from the anion resin units are alkaline in nature. The combined wastewater from the DM plant would be neutralised in a neutralising pit.

c) Coal pile area run off

The coal pile area runoff water during monsoon season would be led to a separate pond. Coal particles would settle down in the pond and clear water would be led to the ash water tank.

d) Effluent from bottom ash handling system

The drain and overflow water from the bottom ash handling system would be collected at the bottom ash sump. From sump same would be pumped to the ash slurry sump for further disposal to ash disposal area.

e) Plant wash down water

The plant drain would be led to the central monitoring basin after oil separation.

f) Floor and equipment drainage system effluent

The function of this system is to provide a means for collecting and draining water from floors in process areas of the plant and collecting and disposing of water and other liquids from process equipment, discharged fire protection water and oil storage tanks.

In the turbine building, the ground floor slabs would be sloped to drain out floor drains. The equipment drains are piped directly to the drain system. Drains are collected and directed to sumps outside the buildings from where it would be pumped to the central monitoring basin.

g) Rain (storm) water drainage

The rain (storm) water collected from the yard area grade level surfaces would be directed through the open drains. All drains would be of RCC and located along the roads. Grade level would be contoured such that storm water run-off is directed on the ground to well defined paths leading to the drains. It is planned to provide a properly designed rainwater harvesting scheme.

The surface water from the coal handling plant would be led to a sump for settling and the overflow would be discharged into a guard pond located suitably within the plant boundary for treatment and recycling.

h) Sewage from various buildings in the plant

Sewage from various buildings in the power plant area would be conveyed through separate drains to sewage treatment plant followed by tertiary treatment to meet the requirement of BIS/ CPHEEO standards and state government pollution norms. The tertiary treated water is proposed to be utilized for gardening and other miscellaneous use.

9.3.3 Rain water harvesting

Based on the rainfall intensity of the proposed area, storm water drainage system will be designed. Storm water drainage system consists of well-designed network of open surface drains and rainwater harvesting pits along the drains so that all the storm water is efficiently drained off without any water logging.

9.4 Noise level management

The specifications for procuring major noise generating machines/equipment would include built in design requirements of 85 dB (A) to have minimum noise levels meeting occupational safety and health assessment (OSHA) requirement.

The major sources of noise pollution are as follows:

- Steam turbine generator
- Other rotating equipment
- Combustion induced noises

- Flow induced noises
- Steam safety valves.

9.4.1 Measures proposed

The rotating equipment in the proposed power plant will be designed to operate with a total noise level of not exceeding 85 to 90 dB (A) as per the requirement of occupational safety and health administration (OSHA) standards. The rotating equipments are provided with silencers wherever required to meet the noise pollution. Appropriate noise barriers/shields, silencers etc. would be provided in the equipment, wherever feasible. As far as possible noise emanating from noisy equipment would be adequately attenuated by keeping them in enclosures, using insulation material etc.

In order to mitigate the impacts on health of workers due to long term exposure to high noise, ear plugs will be provided for workers working near high noise generating machinery. Separate cabins will be provided for workers/operators working near boilers, compressors etc. Also thick green belt will be provided along the plant boundary and in between various facilities to isolate the noise to the working area.

9.5 Solid waste management

9.5.1 Fly ash dust particles from ash silos and ash disposal area

Fly ash evacuated from the ESP collecting hoppers would be transported in closed pipelines by pneumatic means. At the time of unloading fly ash to the silos, some ash laden air would get vented out. In order to restrict the fly ash dust particles a vent filter would be installed on top of each of the fly ash silos at the vents. The following pollution control measures would be installed for ash disposal:

a) 100% utilization of fly ash in dry form is envisaged through e- auction using closed trucks
b) To reduce the dust nuisance while loading the ash into the open trucks from fly ash silos, the fly ash would be conditioned with water spray.
c) It is proposed to cover the ash in the open trucks with tarpaulin to prevent flying of fine ash during transportation.

TANGEDCO would put maximum efforts and ensure bottom ash utilization. 100% ash utilization will be achieved as per MoEFCC new notification dated 03-11-2009 in the phased manner.

9.5.2 Commercial utilization of ash

Bottom ash which has a relatively large size, finds a ready use in construction of roads, embankments in rural areas, land filling etc. Considerable research and development work under taken during the past decades throughout the world, resulted in opening various avenues of commercial utilization of fly ash.

Fly ash is an amorphous Ferro-alumina silicate compound of spherical crystalline shape with particle sizes ranging between 2 to 50 microns. Fly ash has good pozzolonic property, good flow ability and low permeability, which facilitate myriad utilization of fly ash. Ash generated from the station would have sizable quantum of inert oxides and carbonates of silica, alumina, magnesium, etc. Some of the commercially viable uses of such fly ash are as follows:-

a) Fill material in cement
b) Mine fill
c) Building blocks
d) Light weight aggregates
e) Partial cement replacement
f) Road sub base
g) Grouting material
h) Filler in asphalt mix for roads
i) Partial replacement of lime aggregate in concrete work
j) Road embankment
k) Land filling material
l) Recovery of minerals namely aluminum and iron

Review of the various application areas of fly ash reveals that some usage of ash generated in the proposed station can be explored as mentioned below:

a) As fill materials in cement plant
b) For construction of village roads
c) As land fill in lower lying areas and for dyke/ bund construction. Ash would also be utilized in filling of ditches.

Necessary ash management plan would be adopted in an environment friendly manner to contain the fugitive ash emission in the nearby areas to minimum. An extensive green belt development plan around the ash dump area would be undertaken to contain ash dust induced pollution to the neighboring areas.

9.6 Occupational safety & health

Occupational safety and health is very closely related to productivity and good employer-employee relationship. The main factors that affect the occupational health in the project site are flue gas emissions and noise. To avoid any effects on the health of workers due to emissions and noise, sufficient measures have been proposed which include:

- Effective de-dusting system at loading, unloading, and transportation
- Provision of personal protection devices to the workers
- Availability of first-aid facilities
- Awareness on safety and ensure using personal protective equipments
- Imparting basic and refresher training to new and old employees respectively.

9.6.1 Measures to prevent occupational diseases

Occupational Health Survey of the employees shall be carried out at regular intervals. The concerned authorities adopts following measures to prevent occupational diseases and health hazard:

- Periodical medical examination of employees
- Regular monitoring of working environment and implementation of safety and control measures to prevent hazard.
- Use of protective equipments, clothing, helmets, dust mask, shoes, etc.

9.7 Socio-economic conditions of the region

Social welfare activities shall be taken up on a large scale. The social welfare activities can be planned in the following areas:

- Medical assistance
- Primary education
- Animal husbandry
- Rural water supply
- Agricultural improvement
- Vocational training

9.7.1 Medical assistance

- Providing better medical care to local people by extending them the hospital facilities
- Weekly clinics in surrounding villages on a regular basis

- Regular immunization programs
- Medical assistance and periodic specialist camps

9.8 Green belt development

In order reduce carbon foot print of proposed plant as well as improve environmental quality, thick green belt of tall and evergreen plants will be grown in an area equivalent to at least 33% of the plant area in and around the plant site.

Greenbelt development is one of the most effective environmental pollution control measure. Trees play vital role in the environment in preventing the horizontal dispersion of the pollutants to the surrounding areas. They are very effective in trapping the pollution causing agents viz. dust and gaseous pollutants. They are also considered to be excellent indicators of excessive ground level concentrations. The green belt is being proposed for the following objectives.

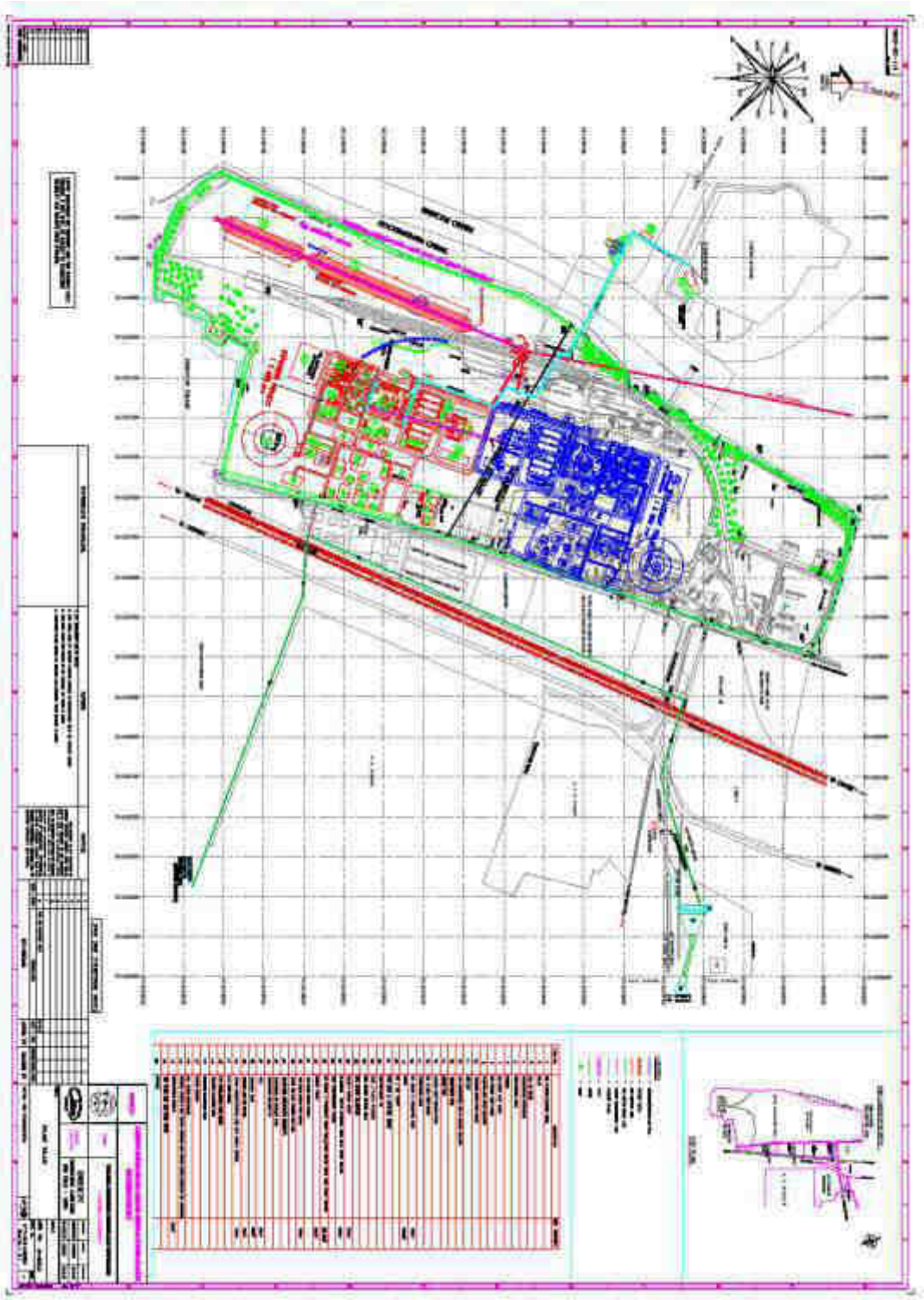
- Mitigation of fugitive dust emissions
- Noise pollution control
- Prevention of soil erosion
- Balancing eco environment
- Aesthetics

9.8.1 Action plan for greenbelt development in 33% of area

Block plantations with a density of 2000 plants per Ha shall be undertaken during the third year in an area of about 2 Ha. Avenue plantations shall be grown at a distance of 5 m between the plants at the rate of 400 plants (200 on each side at a distance of 5 m) per each Kilometer of roads. Existing ornamental garden shall be improved with addition of rare ornamental plants. The total area under greenbelt, block plantations and avenue plantations including the existing plantations shall not be less than 28 acres (14 acres within site & 14 acres outside boundary) (about 33% of total area).

Planting stocks are readily available from the social forest department as well as from the local private nurseries. All plants are locally adopted and the present site can support their growth with suitable horticultural practices. Sufficient space, resources and man power for development and maintenance are provided in the plan. The greenbelt layout plant is given in **Figure 9.1**

Figure: 9.1: The greenbelt layout plan



The project developer has chosen to spend about Rs.68, 00,000 for greenbelt, avenue and block plantations in a phased manner as indicated in **Table 9.1.**

Table 9.1: Year wise targets for development of greenbelt

Year	Activity	Area (28 Ac)	Financial outlay (Rs)	Achievement (Plants)
First year	Plantations along the boundary	6	12,00,000	4800
Second year	Plantations along the boundary and maintenance of 6 Ac fist year plantation	6	12,00,000	4800
Third year	Plantations at outside boundary and maintenance	6	12,00,000	4800
Third year	Avenue plantations	2000m	1,00,000	800
Fourth year	Plantations at outside boundary and maintenance	8	16,00,000	6400
Fourth year	Gardens & lawns & maintenance	2	10,00,000	300
Fifth year	Gap filling / thinning / pruning	28	5,00,000	200
			68,00,000	
After fifth year	**Regular maintenance**	**28 Ac**	**5,00,000 PA**	**20 PA**
(PA =Per Annum). ***Note:*** In addition to 14 acres greenbelt proposed, additional 14 acres of land in the purview of CRZ area will be developed as greenbelt to meet 33% of the total land area as greenbelt.				

The project proponent undertakes to financially support afforestation and reforestation; development of social and community forests undertaken by the state forest department. Proposals shall be invited from the forest department and financial assistance shall be given in accordance the guidelines of the forest development agency (FDA) and the Ministry of Environment, Forests and Climate Change (MOEFCC), G.o.I.

9.9 Roof – top solar energy

Solar power plant is being proposed, the solar panels will be installed on the rooftop of all administrative buildings in the power plant.

Technical requirements for rooftop solar power plant

- Shadow free flat roof top area having proper drainage building, service building, admin building, switchyard building etc.
- Total distributed load of the roof top PV due to panels, supporting structures, equipments and concrete blocks etc., and imposed load will not be more than 100kg/m^2.

- Proper approach to the roof top through lift / staircase.
- Availability of water for panel washing.

9.9.1 Proposed scheme

The actual solar radiation available in the project area will be measured to access the potential of power generation.

- Approx. 15 m^2 areas per kW are required for roof top solar power plant. Effective area for utilization for roof top solar PV on rooftop building will be estimated after detailed study.
- Solar PV panels shall be mounted on the roof through non-corrosive module mounting structure. The support structure shall not disturb the water proofing of the roof.
- Panel should be inclined at the angle equal to the latitude, facing towards south
- The total generation is estimated to be approx. 1300-1400 units per year from 1000 W solar PV roof top plant.
- The DC power generated by PV modules shall be converted to AC voltage through string inverters or central inverter and shall be injected to nearest available LT/HT switchgear assigned through isolation or step-up transformer. Accordingly provision of spare LT/HT module in the switchgear shall be made.
- Solar PV plant on roof top of thermal power project to be developed as an EPC package which includes design, supply, erection and commissioning etc. including one year operation and maintenance after commissioning.
- Metering for the purpose of monitoring of generation & internal accounting shall be done at the injection point in compliance to provisions of Central Electricity Authority (Installation and Operation of Meters) Amendment Regulations, 2013.
- The O&M of the solar PV plant after completion of one year of operation shall be ensured by site O&M department.

The calculation for installed capacity and cost is based on following assumptions:

- 100 sq.m area is required for the installing of 10 kWp capacity.
- Capital cost including batteries and other accessories is Rs. 1 lakh/kWp.

Table 9.2: The detailed area breakup considered for roof top calculations

S.NO	UNITS	AREA in sqm
1	TG building	4872
2	ESP control room	877
	Pump house	987
5	Trasnpoer air compressor house	336
6	Gis/gis control room	1304
7	Cw&ACW pump house, control room	1244
8	Electro chlorination plant	625
9	WTP mcc & control room	600
10	Hydrozen generation plant	480
11	Service building	1000
12	Administrative building	1158
13	Canteen/dormitories	240
16	Area for batching plant	2500
17	Fire station	403
18	Site office	2800
19	CCR building	1722
21	Car parking	500
22	Bike parking	700
	Total	**22348**

Table 9.3: The installed capacity and approximate cost details

Total roof toparea (m2)	Actual area (considering 1/3 of total area)(m2)	Installation capacity (considering 100 m2 for 10 kWp)kWp	Installation capacity in MW	Cost for installation (considering 3.5 cr MW/ crores
22348	7375	737.5	0.735	2.5
Note: Seven years ago, the fixed cost attached solar power plant was Rs. 15 crores/MW, which brought down to Rs. 7 crores /MW. GERMI's R&D efforts have successfully brought down the cost further to Rs. 2.5 crores /MW by using graphite and silicon in solar cells.				

The above mentioned roof top areas are approximate and can be firmed up after the design and engineering of the project. Based on various technology options considered, it is recommended that the solar PV cells shall be installed in the available area of roof tops within the premises for the purpose of harnessing solar power by means of utilizing the available roof top area. Once the final designs are available, an implementing agency will be hired for the execution of the project at proper time.

9.9.2 Implementation schedule and methodology

Implementation schedule for "Roof Top Solar PV Plant" will be ranging from 4-6 months from the issuance of notice of approval (NOA), depending upon the size of the plant and will be commissioned before commercial operation of the unit.

9.10 Reduction in carbon footprint

Sustainable power generation has been one of the prime objectives of ETPS. Towards achieving this objective, various measures shall be introduced to ensure minimize degradation of the environment due to the operation of power station. There is growing concern all over the world over and ETPS is no exception towards contribution of greenhouse gases released due to fossil fuel firing towards global warming.

As a part of the agreement under Kyoto Protocol, the CDM has been introduced to enable trading of certified emission reduction (CER) between the developed countries and the developing countries. Although, this issue is being exhaustively deliberated to establish long ranging solutions, accordingly, it is proposed to have super-critical boilers at the proposed power project. In view of the increased efficiency (2.4%) of super - critical boiler as compared to sub-critical boiler, the coal consumption per unit of electricity generation would be lowered with consequent reduction in CO_2 emissions. The reduction in CO_2 emissions would be of the order of 0.26 million tons per year. For the entire life of the plant (i.e. 25 years), it would be of the order of about 6.5 million tons. Since the super-critical technology is still under implementation stage in India, operation of super-critical boilers using the low grade Indian coal is challenging and technology barriers will have to be overcome. Investment costs for plant with super critical boilers is higher as compared to the plant with sub-critical boilers.

9.10.1 Intent of project proponent for benefits under clean development mechanism (CDM)

CDM allows emission reduction process that assists developing countries in achieving sustainable development and then generated certified emission reductions can be used by the industrialized countries.

The purpose of the proposed project is to set up 1 X600 MW supercritical TPP. The fuel used in the power station is imported coal for generating electricity with super critical technology which leads to lower greenhouse gas emissions. In the absence of supercritical project activity the same power would have been generated by fossil fuel fired sub critical plants located in the region. Since the project will use cleaner fuel like imported coal the project is eligible for carbon credits under CDM of Kyoto Protocol.

The proposed project needs to be developed under CDM cycle to monetize carbon credits envisaged from the project. Project will be developed as by lateral CDM project by CER buyer. CER buyer will take the responsibility to develop and finance the subject project in CDM cycle.

The project fulfills the following objectives:

- Reduction in fossil fuel (Coal) consumption through higher generation efficiency;
- Reduction in GHG emissions associated with power generation; and
- Bridging the demand-supply gap of electricity in India by enhancing installed capacity base of the regional and/or national grid.

Chapter-10
Summary & Conclusion

Chapter 10

Summary & Conclusions

10.1. Introduction

Tamil Nadu Generation and Distribution Corporation (TANGEDCO), proposes to set up a 1x660 MW coal based Supercritical Ennore Thermal Power Station (ETPS) Expansion Project within the existing ETPS complex located near Ernavur village, Tiruvottiyur taluk, Thiruvallur district of Tamil Nadu state.

The proposed plant consists of Coal Fired Boiler, Steam Turbine Generator Units and Balanced of Plant (BOP) Units. Based on proposed capacity, project is supposed to fall under category A of Project Activity 1(d), Thermal Power Plants (≥ 500 MW coal/ lignite/ naptha & gas based) under the schedule as per EIA notification issued on 14th September, 2006. In order to assess the likely impacts from proposed project on the surrounding environment and evaluating means of alleviating the likely negative impacts, if any, from the proposed project, TANGEDCO has retained Ramky Enviro Services Private limited (RESPL) as their environmental consultant.

Environment clearance for ETPS expansion project was accorded by MoEF&CC 03/06/2009 and extended for a period of 5 years on 08/09/2014(till 02/06/2019). CRZ clearance for coal conveyor intake and treated effluent outfall waterlines accorded on 23/12/2008 and validity extended up to 22/12/2018 on 31/3/2014. However, project could not be constructed within the validity period. Accordingly present proposal is submitted for obtaining fresh environmental clearance. The proposal was considered by Re- constituted Expert Appraisal Committee (Thermal Power) in its 23rd meeting held on 30th November, 2018 for determination of the Terms of Reference (ToR) for undertaking detailed EIA Study in accordance with the provisions of the EIA notification. The EAC has issued ToR vide its Letter No. F. No. J-13012/15/2018- IA. I (T) dated: 21st January 2019. Report has been prepared as per the recommendations of ToR.

Proposed expansion project is located adjacent to the proposed replacement project (capacity 1 X660 MW) within the existing ETPS complex. The project site is located near Ernavur village, Tiruvottiyur taluk, Thiruvallur district of Tamil Nadu state. The site is located at latitude of 13° 11' 30" to 13° 12' 04" N and longitude of 80° 18' 14"E to 80° 18' 30"E.

Project boundary is at a distance of about 70 m, 575 m and 815 m from Ennore back waters, Korattaliyar river and Bay of Bengal respectively. Project site is about 600 m, 1.2 km, 5 km & 20 km from Manali Highway, Ernavur village, Ennore port and Chennai city respectively.

10.2 Project requirements

10.2.1 Land requirement

The proposed plant will be constructed in 90 acres of land which includes vacant land of 84 acres within the existing ETPS complex (plant boundary) and 6 acres for corridor of pipeline and conveyor system (outside the plant boundary). In comparison to CEA guidelines the land required for similar capacity power plant (Coastal station based on imported coal with conveyor and Natural Draft Cooling Towers (NDCT) cooling towers) is about 135 acers which are well within the limits in terms of area utilization. There is no additional land acquisition and no rehabilitation or resettlement issues involved for the project.

10.2.1 Fuel requirement

Project is based on 100% imported coal supplied by M/s. MMTC limited. Coal is brought to Ennore Port by ship and further transported to project site by pipe conveyor. Boiler fuel (coal) consumption is 263 TPH and quantity of coal required is 2.0 Million tons /annum. Calorific value of imported coal is around 5805 Kcal/kg, ash & Sulphur content is 6.62% & 0.53% respectively. Support fuel used is Heavy Furnace Oil (HFO)/ Light Diesel Oil (LDO) supplied by nearby refinery at Chennai. Quantity of support fuel required is 5782 KL/ annum.

10.2.2 Water Requirement

Total water required for project is about 7113 m^3/hr. Source of water is Bay of Bengal with intake point about 650 m from shore line. Major water requirement is for cooling water make-up 5700 m^3/hr and Reverse Osmosis Plant (RO) 1413 m^3/hr. Water required during construction phase is 200 m^3/day, which is supplied by CMWSSB and stored in underground water tank. No groundwater will be used during construction or operation phases of project.

10.2.3 Process Description

Proposed plant will use supercritical plant (SCP) technology with boilers designed to take imported coal. Coal received is crushed in the crusher house to bring down the size to -20mm, which is subsequently pulverized in the coal mill. The powdered coal is burnt in the furnace to generate steam in the boiler. The steam generated will be semi outdoor, once through, radiant reheat, dry bottom and balanced draft unit of super-critical parameters, designed for firing pulverized coal as primary fuel. Stream generated will be sized for 2100 TPH at 256 kg/cm2 (a), super-heated outlet pressure, 568 ^oC stream SH temperature and 593^oC reheat temperature. The generators will be directly coupled, horizontal shaft cylindrical rotor continuously rated at rated power factor of 0.85 lagging, 3 phase 50 Hz.

Steam after expansion in turbine is condensed in condenser (Cooling tower type: NDCT) and condensed steam is circulated back to the boiler. Hot gasses from furnace after losing heat in different areas go through Electrostatic Precipitators (ESPs) with efficiency of 99.98%, where ash is collected. The clean gas goes through 275 m chimney. Flue gas desulphurization

(FGD) with efficiency of 95% is used for controlling sulphur dioxide emission and Advanced combustion technology with low NOx burners.

10.3 Baseline environmental status

Field investigations were undertaken for collecting existing baseline data for Land Use Land Cover (LULC) Air, Water, Noise, Soil, Ecological and Socio-economic conditions. A study area of 10 Km radius from project site is identified to establish present environmental conditions for above environmental components. The main aim of the EIA study is to identify critical environmental attributes affected and their adverse impacts on surrounding environment due to the proposed. The field data generation was undertaken as detailed below

- Ambient air quality (AAQ) monitoring is carried out during July to September 2018.
- LULC, Water, Noise, Soil, Ecological and Socio-economic conditions were carried out during April- May 2019.

10.3.1 Land Use Land Cover (LULC)

LULC features of the study area was collected by analyzing Survey of India topo sheets, Satellite imageries supplied by NRSC and Ground validation for interpretation of False Color Composite (FCC) imageries through site visits. The land use pattern of study area mainly falls under following categories Sea: 43%; Built-up: 29%; Agriculture 8%; In-land water bodies: 7%; Waste land 12%; Others 1% and Forest: 0 %.

10.3.2 Meteorology (Climate)

Metrological data is collected from nearest IMD station at Chennai and also at project site with the help of weather station. The pre dominant wind direction recorded is from South West (SW) closely followed by West South West (WSW). Calm conditions prevailed for 2.38% of the total time. Average wind speed observed for the season is around 2.85 m/s.

10.3.3 Ambient Air Quality

AAQ was monitored at 9 locations within study area. Monitoring locations were identified in downwind, cross & up wind directions. Air pollutants monitored are Particulate Matter ($PM_{2.5}$ & PM_{10}), Sulphur dioxide(SO_2), Oxides of nitrogen (NO_x), Ozone, Carbon Monoxide as per standard MoEF&CC guidelines and results compared with NAAQ 2009 CPCB Standards.

The minimum and maximum 24hr concentration of $PM_{2.5}$ recorded is in the range of 35.6 to 58.4 µg/m^3 against a standard of 60 µg/m^3 whereas the PM_{10} values are in the range of 74.8 to 98.5 µg/m3 against a standard of 100 µg/m^3. The maximum Particulate Matter values are just within the Standards. The SO_2 and NO_x 24 hr concentrations observed are in the range of 12.1 to 26.5 µg/m^3 and 20.8 to 38.5 µg/m3 respectively against a standard of 80 µg/m^3. Maximum SO_2 & NO_X values are found to be well within the NAAQ 2009 CPCB Standards. Ozone 1 hr concentration values are in range of 7.6 to 22.4µg/m^3 against a standard of 180 µg/m^3, whereas CO levels are found to be below detectable limits.

10.3.4 Water Quality Monitoring

Ground water 10 samples and surface water 3 samples were collected from different sources and analyzed for all important physico-chemical and biological parameters to establish quality of water prevailing in the study area. Ground water samples were collated from open well, hand pumps & bore wells. Surface water collected from Kosasthalaiyar river near bridge at Vichoor village, Buckinghum channel and sea water near Ennor beach.

10.3.5 Ground water samples: The pH values are in the range of 7.0 to 7.8; TDS levels between 462 to 2545 mg/l (samples from Ennore & Vallur village are above permissible limit); Chloride concentrations between 120 to 762 mg/l; hardness observed is 295 to 983 mg/l (samples from Site, Ponniamman nagar and Vallur village are above permissible limit); Fluoride concentrations between 0.5 to 1.5 mg/l. Except for samples from Project site, Ennore, Ponniamman nagar and Vallur village other samples values are within permissible limits of 10500: 2102 Dirking water-specifications and fit for drinking use purpose.

10.3.6 Surface water sample (Kosasthalaiyar river near bridge at Vichoor village): The pH values is 6.9; TDS is 1850 mg/l; Chloride concentrations is 604 mg/l; hardness observed is 413 mg/l: Fluoride concentrations is 1.5 mg/l; DO: 3.4 mg/l and BOD: 18 mg/l. Sample analysis indicates water is suitable for Irrigation, Industrial cooling, Controlled Waste disposal based as per "CPCB Water Quality Criteria Designated-Best-Use updated 11th Sep 2017". The other 2 surface water samples collected are sea water.

10.3.7 Noise Monitoring

Noise was monitored at 10 locations within the study area of the project site. The locations were identified for assessment of existing noise level status(keeping in view of the land use pattern, residential areas in villages, schools, bus stands, etc (Industrial: 2 no; Commercial: 2 no; Residential: 4 no; Silent: 2 no). Day equivalent noise levels (dB (A)) are in the range for Industrial area 57.6 to 62.4; Commercial area is 55.7 to 62.2; Residential area is 53.8 to 54.8; Silence zone is 49.8 to 49.9 whereas in night noise levels are in the range for Industrial area 44.1 to 45.3; Commercial area is 43.8 to 44.7; Residential area is 42.8 to 43.5; Silence zone is 39.8 to 39.9. Noise values in the study area are within the Noise Pollution Rules 2000.

10.3.8 Traffic Survey

Traffic survey was carried out at 2 locations (Ernavur village road & New Manali Express Road). Ernavur village road is a 2 lane 2 way road with 7 m width. Traffic volume recoded was between 406 to 702 PCU/H. As per IRC guidelines Level of Service of this road falls under category "C" (Acceptable level of driving comfort, some delays). New Manali Express Road is a 4 lane divided 2 way road. Traffic volume recoded was between 1355 to 3473 PCU / H. As per IRC guidelines Level of service of this road falls under category "E" (High level of driving frustration, high levels of delays).

10.3.9 Soil Quality

Soil Quality was monitored at 9 locations within the study area. The locations were selected to assess the existing soil conditions representing various land use conditions and geological features. The important physical, chemical parameter concentrations were determined and compared with Standards of Indian Council of Agriculture Research, New Delhi.

The pH values of samples in the study area are varying from 6.9 to 8.4 falling under normal to saline, the electrical conductivity is varying from 111 to 387 µmhos/cm , the organic carbon is varying from 0.18 to 0.54% falling under low & medium category, the available nitrogen is varying from 45.4 to 78.3 kg/ha falling under low category, the available phophorus is varying from 4.01 to 22.8 kg/ha falling under low(3) & medium category(6), and the available pottasium is varying between 65.5 to 256 kg/ha falling under low(3) & medium(6) category. NPK values of soil samples colleted are in low to medium category indicating need for fertilisars with high NPK vaules for agriculture and horticulture activities

10.3.10 Ecological Environment

A detailed analysis was done in the study area which includes compilation of secondary data from published literature of Forest Division and Primary data generation through systematic studies. Primary data was collected through visual observation of species in the study area.
There are no National Parks, Wildlife Sanctuaries, Biosphere Reserves and Important Bird Areas (IBA) within study area. There are no reports of occurrence of any rare or endangered or endemic or threatened (REET) fauna in study area. None of species reported or recorded from the study area are placed in Schedule I of the Indian Wildlife (Protection) Act, 1972.

10.3.11 Socio-Economic Environment

Total population in study area is 433177 people with sex ratio of 986. In study area 0.45%, 21.35% and 15.98% belong to ST, SC & socially weaker section respectively. Main workers, marginal workers constitute 32 & 6% respectively. Most of villager surveyed are benefited by government schemes and are aware of welfare schemes and programs of government. Youth in area are devoid of employment opportunities and are potential source of workers.

10.4 Anticipated environmental impacts and mitigation measures

The impact on environment during construction & operation phases of project are detailed

10.4.1 Impacts during construction phase

The possible construction activities that contribute to the environmental impacts are:

- Dust generation during leveling of earth, movement of vehicles on unpaved roads, unloading of raw materials and removal of unwanted waste material from site
- Emission of pollutants from vehicular exhaust
- Accumulation of excavated earth material

Impacts due to above activities would be temporary and confined within project boundary

10.4.2 Impacts during operation phase

10.4.2.1 Impact on air quality

Proposed plant utilizes 100% imported coal. Major source of pollution are flue gas emissions from the stack (Dust particulates, SO_2 and NO_X) and fugitive dust emissions from coal handling & material transfer points, fly ash dust particles from ash silos, ash disposal area and fly ash vented out during the unloading of fly ash from ESP hoppers to silos.

GLC of air pollutants released from 275 m height stake were estimated using study state dispersion model based on Gaussian Plume (AERMOD Version 7.0.3) software.

The emission rates in stack estimated for PM, SO2 and NOx without control measures are 3875 g/s, 776 g/s and 172 g/s respectively. Whereas emission rates in stack for PM, SO2 and NOx with ESP (99.98% efficiency), FGD (95% efficiency) and Advanced combustion technology with low NOx burners are 0.78 g/s, 39 g/s and 62.6 g/s respectively.

Without control measures result of dispersion modeling shows increase in maximum GLC for PM is 745 µg/m^3, SO2 is 14.1 µg/m^3 and NOx is 3.2µg/m^3. With control measures result of dispersion modeling reveals a likely increase in maximum GLC for PM is 0.02 µg/m^3, for SO_2 is 0.75 µg/m^3 and for NOx is 1.2 µg/m^3. From the above value we can see that installation of control equipment will help in considerably reducing GLC values. Overall concentration (with control equipment) including existing baseline status for PM is 98.52 µg/m^3, SO2 is 27.25 µg/m^3 and NOx is 39.7 µg/m^3. These values are within NAAQ standards 2009.

The proposed mitigation measures are

- Dust suppression/extraction facilities will be provided to mitigate the dust generated at coal transfer points and coal stockyard.
- Dust collection system will be provided in coal bunkers to evacuate dust and hazardous gases like methane from the coal bunkers.
- To reduce the dust nuisance while loading the ash into the trucks from fly ash silos, the fly ash would be conditioned with water spray
- To control SPM, SO2 and NOx in flue gas, ESP with 99.98%, efficiency, FGD with 95% efficiency and Advanced combustion technology with low NOx burners will be provided.

10.4.2.2 Impact on water quality

Total waste water of 5140 m^3/h is generated from Cooling tower blow down 4114 m^3/h, Clarifier rejects 88 m^3/h, RO1 reject 928 m^3/h, Neutralization pit 10 m^3/h. Waste water is discharged into sea through pipeline meeting discharge standards of maximum temperature not more than 5^o and salinity not exceed 50 PPT wrt to ambient seawater at release point.
Waste water from RO2 rejects 22 m^3/h will be reused for dust suppression, CHP dry fogging etc. Domestic waste water will be treated in the Sewage Treatment Plant of capacity 250 KLD and used for green belt development and Ash handling.

10.4.2.3 Impact on Noise Levels

The major sources of noise generation within plant are crusher unit; induced draft & forced draft fans; boiler feed pumps; turbines; generators; cooling towers; vehicular movement. The proposed mitigation measures are

- Properly designed plant and machinery (i.e. by providing inbuilt mechanisms like silencers, mufflers, and enclosures for noise generating parts) and shock absorbing pads at the foundation of vibrating equipment will be provided.
- In high noise intensity working areas/zones ear muffs or ear plugs or any other suitable personal protective equipment would be provided to the workmen.
- Development of greenbelt around plant boundary will diffuse noise pollution.
- Provision of isolation for major noise generating equipment's.
- Regular noise level monitoring to be carried out for taking corrective action, wherever required.
- Restricted vehicular movement and drivers will be informed to blow horns only when required.
- Periodical medical examination on hearing loss shall be carried out for all the workers and maintain audiometric record and for treatment of any hearing loss including rotating to non-noisy/ less noisily areas.

10.4.2.4 Solid and hazardous wastes

Power plant, being coal-fired, would generate coarse (bottom ash) & fly ash of about 84 & 336 TPD. Ash Management Plan will be developed for 100% utilization of fly ash (will be sent to needy vendors on e-auction basis) within time period prescribed by MoEF&CC. The unused ash, till such time, would be disposed in the existing ash pond.

Sludge generated from oil storage tank will be collected, stored in a safe and covered place to be disposed as per CPCB/SPCB/Hazardous wastes rules. Used oil from Lube oil & Transformer will be sold to authorized re-processor registered with CPCB.

10.4.2.5 Emergency preparedness plan in case of natural or in plant emergencies

To handle consequences of a major emergency inside factory or immediate vicinity of plant, a detailed disaster management plan is formulated. Emergency control center will be set up with emergency response team and communication system. It is essential that emergency plan be regularly tested to identify and correct any defect by keeping plan up to date.

10.4.2.6 Occupational health measures

ETPS will be equipped with a full-fledged Occupational Health Centre (OHC) within the plant premises as mandated under the Factories Act, 1948. As a part of the surveillance program, the following minimum medical examination will be undertaken during the pre-employment phase: 1. General physical examination and blood pressure, 2. X-Ray of chest & ECG, 3. Sputum examination, 4. Detailed routine blood & urine examination, 5. Audiometry and 5. Spirometer. As a part of the routine and annual medical examinations on the persons

working in the high noise generating areas, stress areas and dust exposure areas, a comprehensive surveillance program will be adopted.

10.5 Environmental management plan

Environmental Management Plan (EMP) is required to ensure a sustainable development of plant and surrounding areas. EMP will be integrated in all major activities of the project, with clearly defined policies, to ensure ecological balance of area is maintained and adverse effects are minimized. EMP requires multi-disciplinary approach with mitigation, management, monitoring and institutional measures taken during implementation and operation phases, to eliminate adverse impacts or reduce them to acceptable levels.

The mitigation measures are planned for construction and operation phases and the overall management plan helps to improve the supportive capacity of the receiving bodies. The EMP aims to control pollution at the source level to the possible extent with the available and affordable technology followed by the standard treatments before getting discharged. The recommended mitigation measures will synchronize the economic development of the study area with the environmental protection of the region.

Project Cost estimates

- Project Cost (Estimated) : Rs. 5421.38 crores (Rs 8.21 Crores/MW)
- EMP (Capital Cost) : Rs. 977 crores
- EMP (Recurring expenditure) : Rs. 98 crores
- CER Cost : Rs. 13.65 crores

10.6 Environmental monitoring program

Environmental Monitoring Program is designed for assessing efficiency of implementation of Environment Management Plan (EMP) and to take corrective measures in case of any degradation in surrounding environment. Different activities involved in proposed project (during construction and operation phases) and their impact on various environmental attributes is taken into account for designing a detailed environmental monitoring program.

Implementation of EMP and periodic monitoring is proposed to be carried out at plant level and area level for the proposed thermal power plant and allied activities like coal handling facilities, workshop, colony, etc. A comprehensive monitoring mechanism shall be devised for monitoring of impacts due to proposed project as a part of compliance to CTE/CTO.

Plant level environmental protection measures like dust suppression, treatment and recycling of wastewater, plantation and noise control in the plant premises, housekeeping, implementation of EMP and Environmental Clearance conditions will be monitored by the plant authorities in accordance with compliance to EC/CTE/CTO.

10.7 Project benefits

The contribution of the power plant on local social infrastructure is expected to be significant. The proposed power plant will stimulate the growth of industrial and commercial activities in and around the district, by improving the availability of the power. This Project will provide a significant amount of direct and indirect employment opportunities to the local people with different skills and trades.

The physical infrastructure and socio-economic status of the surrounding areas will be benefited as follows:

- Improvement in education, housing, banking facilities and postal & communication services
- Improvement in power supply, water supply and sanitation
- Improvement in economic conditions and Recreation facilities
- Training will be given to local people to improve employment potential
- Increase in revenue to state from taxes & duties from development of local businesses

10.8 Conclusions

EIA study made an overall assessment of potential environmental impacts due to proposed plant and proposed mitigative measures to eliminate adverse environmental impacts or reduce them to acceptable levels as part of the EMP.

The demand for electricity has been steadily increasing. Setting up of Power Plant in this area will benefit society by providing better infrastructural, educational, medical facilities, improvement in indirect employment and economic growth of the area.

Chapter-11
Disclosure of Consultants

Chapter 11

Disclosure of Consultants

11.1 About the group

Ramky, founded in the year 1994, with a specialist multi-disciplinary organization focused in areas of civil, environment & waste management Infrastructure with specific emphasis on 'Public Private Partnership' projects. The corporate office of the group is located at Hyderabad and the regional offices are located at Delhi, Mumbai, Ahmedabad, Bangalore, Chennai, Bhopal and Kolkata. The major companies of the group are 1) Ramky Infrastructure Ltd, 2) Ramky Enviro Engineers Ltd, 3) Ramky Enviro Services Private Limited, 4) Ramky Estates & Farms Pvt. Ltd. and 5) Smilax Laboratories Ltd.

11.2 Ramky enviro services private limited

Ramky Enviro Services Private Limited (RESPL) 100% subsidiary of Ramky Enviro Engineers Limited is the consulting arm of the group provides vital function of effectively providing the backward linkage to the project implementation function in the form of concepts, strategies, structuring, planning and designing infrastructure projects. It has a multi and cross disciplinary team of professionals, offering solution at each stage of the life cycle of a project.

It is one of the well-established and leading environmental management company in the country having under taken the duties of project scheduling and budgeting, topographical surveying and soil investigation, environmental and social impact assessment, market viability, master planning, land use planning, design of roads, water supply system, CETP, storm water drainage, electrical system, cost planning, financial feasibility, project structuring and draft concession agreement, bid process management etc.

RESPL also designs and supplies almost the entire range of equipments required for ETPs, STPs and WTPs. The services offered by the RESPL are given below.

11.2.1 Consultancy services

- Facilitating environmental clearances from MOEF, New Delhi/SEAC
- Obtaining consent for establishment and consent for operation from State Pollution Control Boards preparing of environmental impact assessment reports

- Environmental audits to help industries to recycle and reuse resources and plan for low polluting technologies
- Risk assessment studies for hazardous chemical storage & process in order to devise viable onsite and offsite emergency plans
- Identification and evaluation of hazardous waste disposal sites
- Characterization and quantification of biomedical waste, municipal solid waste and design of disposal facilities
- Environmental management strategies to mitigate adverse impacts arising out of developmental activities
- Effluent treatment plant design after thorough review of process, reaction mass balance and treatability studies of effluents
- Post project monitoring network design
- Consultancy services for setting up environmental laboratories
- Design of sewage treatment plants
- Design of waste treatment plants
- Health and socio- economic surveys
- Resettlement and rehabilitation plans

11.2.2 Laboratory services

- Analysis of air samples for ambient air quality and those collected from industrial sources for both routine and industry specific pollutants
- Water and waste water analysis for all parameters as for standard methods, including pesticides and poly hydro carbons
- Solid and hazardous waste analysis including TCPL tests
- Monitoring of noise levels at source and in ambient air
- Development of new methods and quality assurances of results obtained
- Design and settings of laboratories

11.2.3 Training services

- Monitoring of environmental parameters –Air, Water, Noise, Soil etc.,
- Environmental impact assessments
- Effluent treatment plant operations and maintenance
- Sewage treatment plant operations and maintenance
- ISO 9000 & 14000, OHSAS 18000 awareness, documentations, internal auditors
- Establishment environmental laboratories
- Pollution control in industries

- Biomedical waste management

11.2.4 Field services

- Site selection and suitability studies for settling up of Industries
- Ambient air quality monitoring for all pollutants
- Noise level monitoring
- Meteorological data collection as per CPCB norms
- Stack emission monitoring for all pollutants and assessment of efficiency of control equipment
- Water, wastewater and soil sample collection
- Assessment of efficiency of ETP and analyzing critical parameters of field
- Flora and fauna assessment through sectorial studies and damage assessment due to development projects
- Damage assessment studies in case of oil well blowouts, major industrial accidents, etc.,

11.2.5 Treatment plant services

- Water treatment plants-design, construction, operation and maintenance
- Efficiency studies of effluent treatment plants
- Design, construction, operation and maintenance of ETP
- Up gradation/modification of ETP
- Sewage treatment plants-design, construction, operation and maintenance along with mechanical equipment erection
- Supply of mechanical equipment

11.2.6 Solid waste management services

- Industrial waste management
- Hazardous waste management
- Municipal solid waste management
- Biomedical solid waste Management

Annexure -I

CRZ demarcation Map & summary

Superimposing the Proposed Project Site of ETPS Expansion Thermal Power Project (1X660 MW), Cooling Water Intake and Outfall Pipelines and Coal Pipe Conveyor at Ernavur Village, Thiruvottiyur Taluk, Tiruvallur District on Approved CZMP As per CRZ 2011 Notification of MoEF & CC, GoI

SHEET NO : 02 / 03

LEGEND

SOURCE : Approved CZMP as per CRZ Notification 2011

- HTL REFERENCE POINT
- LOW TIDE LINE (LTL)
- HIGH TIDE LINE (HTL)
- 100m (OR) RIVER/CREEK/CANAL WHICHEVER IS LESS FROM HTL
- 200m FROM HTL
- 500m FROM HTL
- SALT MARSH (CRZ - IA)
- MANGROVES (CRZ - IA)
- 50m BUFFER FROM MANGROVES (CRZ IA)
- CRZ - IB
- CRZ - II
- CRZ - IVA
- CRZ - IVB

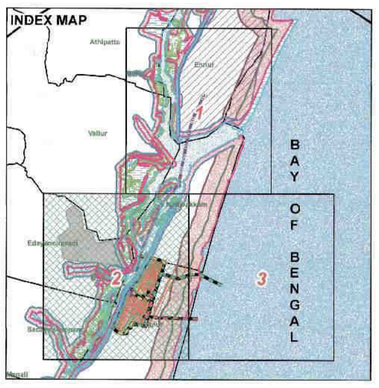
SOURCE : Cadastral Maps from Survey and Land Records Department, Govt. of Tamil Nadu

- VILLAGE BOUNDARY
- SURVEY BOUNDARY

Note:
1. *Coastal Regulation Zone Map of the site is prepared considering Approved CZMP as per CRZ Notification 2011 of MoEF, GoI*
2. *Superimposition of Approved CZMP is subject to scale and generalisation error*

SOURCE: Client

- INTAKE WELL
- OUTFALL LOCATION
- INTAKE PIPELINE
- OUTFALL PIPELINE
- PROJECT SITE DETAILS
- ASH SLURRY PIPELINE
- COAL PIPE CONVEYOR
- ASH DYKE
- ETPS EXPANSION TPP 1 X 660 MW (UNDER EXECUTION)
- ETPS REPLACEMENT TPP 1 X 660 MW (PROPOSED)
- GREEN BELT



SCALE 1:4,000

0 50 100 200 300 400 M

PREPARED BY

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY
CHENNAI - 25

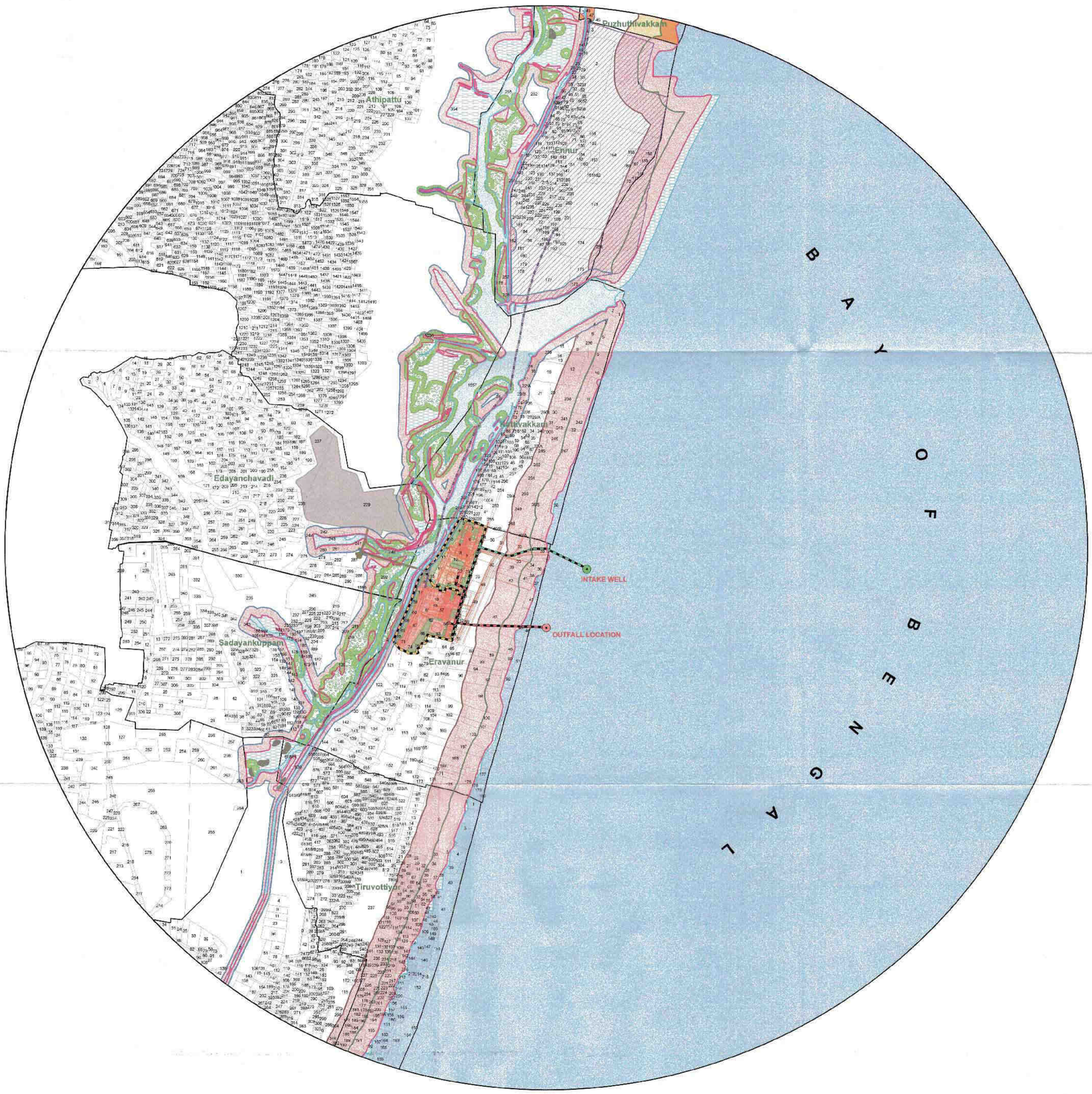
REF NO. AU/IRS/DTV/135-2019 DT. 08.07.2019

FOR

TANGEDCO (TNEB LTD)
CHENNAI-2

PREPARED BY	
VERIFIED BY	
APPROVED BY	Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

Superimposing the Proposed Project Site of ETPS Expansion Thermal Power Project (1X660 MW), Cooling Water Intake and Outfall Pipelines and Coal Pipe Conveyor at Ernavur Village, Thiruvottiyur Taluk, Tiruvallur District on Approved CZMP As per CRZ 2011 Notification of MoEF & CC, GoI



LEGEND

SOURCE : Approved CZMP as per CRZ Notification 2011

- HTL REFERENCE POINT
- LOW TIDE LINE (LTL)
- HIGH TIDE LINE (HTL)
- 100m (OR) RIVER/CREEK/CANAL WHICHEVER IS LESS FROM HTL
- 200m FROM HTL
- 500m FROM HTL
- SALT MARSH (CRZ - IA)
- MANGROVES (CRZ - IA)
- 50m BUFFER FROM MANGROVES (CRZ IA)
- CRZ - IB
- CRZ - II
- NO DEVELOPMENT ZONE (CRZ - III)
- CRZ - IVA
- 200m TO 500m FROM HTL (CRZ - III)
- CRZ - IVB

SOURCE : Cadastral Maps from Survey and Land Records Department, Govt. of Tamil Nadu

- VILLAGE BOUNDARY
- SURVEY BOUNDARY

SOURCE: Client

- INTAKE WELL
- OUTFALL LOCATION
- INTAKE PIPELINE
- OUTFALL PIPELINE
- PROJECT SITE DETAILS
- ASH SLURRY PIPELINE
- COAL PIPE CONVEYOR
- ASH DYKE
- ETPS EXPANSION TPP 1 X 660 MW (UNDER EXECUTION)
- ETPS REPLACEMENT TPP 1 X 660 MW (PROPOSED)
- GREEN BELT

Note:
1. *Coastal Regulation Zone Map of the site is prepared considering Approved CZMP as per CRZ Notification 2011 of MoEF, GoI*
2. *Superimposition of Approved CZMP is subject to scale and generalisation error*

SCALE 1:25000

0 0.25 0.5 1 1.5 2 2.5 Km

PREPARED BY

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY
CHENNAI - 25

REF NO. AU/IRS/DTV/135-2019 DT. 08.07.2019

FOR

TANGEDCO (TNEB LTD)
CHENNAI-2

PREPARED BY	
VERIFIED BY	
APPROVED BY	Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

SUPERIMPOSING THE PROPOSED PROJECT SITE OF ETPS EXPANSION THERMAL POWER PROJECT (1X660 MW), COOLING WATER INTAKE AND OUTFALL PIPELINES AND COAL PIPE CONVEYOR AT ERNAVUR VILLAGE, THIRUVOTTIYUR TALUK, TIRUVALLUR DISTRICT on Approved CZMP As per CRZ 2011 Notification of MoEF & CC, GoI

INDEX MAP

Athipattu
Ennur
Vallur
Kattivakkam
Eravanur
Edayanchavadi
Sadayankuppam

NORTH CHENNAI THERMAL POWER STATION
COAL YARD
ASH DYKE
ASH SLURRY PIPELINE
COAL PIPE CONVEYOR
BUCKINGHAM CANAL
ETPS REPLACEMENT TPP 1 X 660 MW (PROPOSED)
ETPS EXPANSION TPP 1 X 660 MW UNDER EXECUTION
INTAKE PIPELINE
INTAKE WELL
OUTFALL PIPELINE
OUTFALL LOCATION
100m (OR) RIVER/CREEK/CANAL WHICHEVER IS LESS FROM HTL
50m RUPPER FROM MANGROVES
500m FROM HTL
200m FROM HTL
HIGH TIDE LINE

1
2
3

BAY OF BENGAL

LEGEND

SOURCE : Approved CZMP as per CRZ Notification 2011

- HTL REFERENCE POINT
- LOW TIDE LINE (LTL)
- HIGH TIDE LINE (HTL)
- 100m (OR) RIVER/CREEK/CANAL WHICHEVER IS LESS FROM HTL
- 200m FROM HTL
- 500m FROM HTL
- SALT MARSH (CRZ - IA)
- MANGROVES (CRZ - IA)
- 50m BUFFER FROM MANGROVES (CRZ IA)
- CRZ - IB
- CRZ - II
- CRZ - IVA
- CRZ - IVB

SOURCE : Cadastral Maps from Survey and Land Records Department, Govt. of Tamil Nadu

- VILLAGE BOUNDARY
- SURVEY BOUNDARY

Note:
1. *Coastal Regulation Zone Map of the site is prepared considering Approved CZMP as per CRZ Notification 2011 of MoEF, GoI*
2. *Superimposition of Approved CZMP is subject to scale and generalisation error*

SOURCE: Client

- INTAKE WELL
- OUTFALL LOCATION
- INTAKE PIPELINE
- OUTFALL PIPELINE
- PROJECT SITE DETAILS
- ASH SLURRY PIPELINE
- COAL PIPE CONVEYOR
- ASH DYKE
- ETPS EXPANSION TPP 1 X 660 MW (UNDER EXECUTION)
- ETPS REPLACEMENT TPP 1 X 660 MW (PROPOSED)
- GREEN BELT

SCALE 1:6,000

0 75 150 300 450 600 M

PREPARED BY

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY
CHENNAI - 25

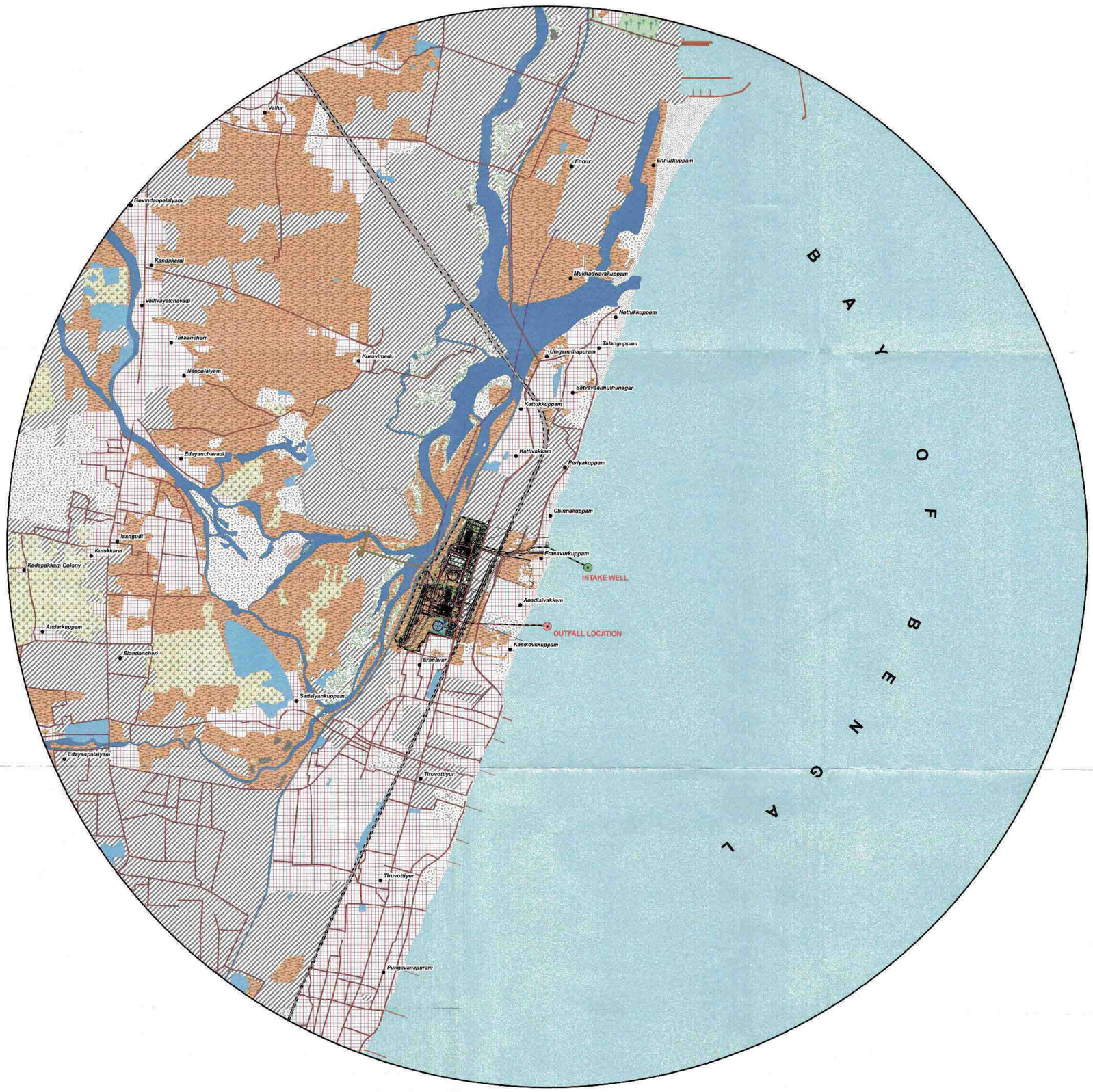
REF NO. AU/IRS/DTV/135-2019 DT. 08.07.2019

FOR

TANGEDCO (TNEB LTD)
CHENNAI-2

PREPARED BY	
VERIFIED BY	
APPROVED BY	Prof. S.S. Ramakrishnan, Ph.D., M.Tech., Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

Landuse / Landcover Map (7Km Radius) for the Proposed Project Site of ETPS Expansion Thermal Power Project (1X660 MW), Cooling Water Intake and Outfall Pipelines and Coal Pipe Conveyor at Ernavur Village, Thiruvottiyur Taluk, Tiruvallur District



LEGEND

- HAMLET
- ROADS
- AGRICULTURAL LAND
- CANAL
- DENSE SCRUB
- INDUSTRY
- JETTY
- MANGROVES
- OPEN SCRUB
- PLANTATION
- POND / TANK
- RAILWAY
- SALT AFFECTED
- SALT MARSH
- SANDY AREAS
- SEA
- SETTLEMENT
- WATER LOGGED

SOURCE: Client

- INTAKE WELL
- OUTFALL LOCATION
- INTAKE PIPELINE
- OUTFALL PIPELINE
- PROJECT SITE DETAILS
- ASH SLURRY PIPELINE
- COAL PIPE CONVEYOR
- ASH DYKE / ASH DYKE
- ETPS EXPANSION TPP 1 X 660 MW (UNDER EXECUTION)
- ETPS REPLACEMENT TPP 1 X 660 MW (PROPOSED)

STATISTICS FOR LANDUSE / LANDCOVER

CLASSIFICATION	AREA in ha	AREA in %
AGRICULTURAL LAND	318.79	2.07
CANAL	491.9	3.20
DENSE SCRUB	1851.73	12.03
INDUSTRY	2761.1	17.94
JETTY	8.8	0.06
MANGROVES	106.54	0.69
OPEN SCRUB	363.89	2.36
PLANTATION	18.04	0.12
POND	107.57	0.70
RAILWAY	53.44	0.35
SALT AFFECTED	4.16	0.03
SALT MARSH	6.43	0.04
SANDY AREAS	83.67	0.54
SEA	7694.24	49.98
SETTLEMENT	1487.83	9.67
TANK	34.32	0.22
WATER LOGGED	1.05	0.01
TOTAL	15393.50	100.00

SCALE 1:25000

0 0.25 0.5 1 1.5 2 2.5 Km

PREPARED BY

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY
CHENNAI - 25

REF NO. AU/IRS/DTV/135-2019 DT. 08.07.2019

FOR

TANGEDCO (TNEB LTD)
CHENNAI-2

PREPARED BY	
VERIFIED BY	
APPROVED BY	Prof. S.S. Ramakrishnan, Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

SUPERIMPOSING THE PROPOSED PROJECT OF ETPS EXPANSION THERMAL POWER PROJECT (1 X 660 MW), COOLING WATER INTAKE AND OUTFALL PIPELINES AND COAL PIPE CONVEYOR AT ERNAVUR VILLAGE, THIRUVOTTIYUR TALUK, TIRUVALLUR DISTRICT ON APPROVED CZMP AS PER CRZ NOTIFICATION 2011

SPONSORED BY

M/S TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
Superintending Engineer/Civil, Projects and Environment
NPKRR Maaligai, III Floor, Eastern Wing, 144, Anna Salai
Chennai 600 002.

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY, CHENNAI-25

JULY 2019

CONTENTS

Executive Summary

On the request of the M/S TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, Superintending Engineer/Civil, Projects and Environment, NPKRR Maaligai, III Floor, Eastern Wing, 144, Anna Salai, Chennai 600 002, the High Tide Line (HTL), Low Tide Line (LTL) and Coastal Regulation Zone (CRZ) indicated in Approved CZMP is superimposed onto the project site. The proposed site falls in the vicinity of Bay of Bengal. Part of the proposed project site falls inside CRZ-II as per approved CZMP published by TNCZMA in 2018.

The HTL, LTL, Ecologically sensitive areas along with setback lines as per CRZ Notification 2011 were superimposed on to georeferenced cadastral map to prepare a local level CRZ map at 1:4,000. The boundary of project site as provided by the client was superimposed on the CRZ map. The co-ordinates of the HTL in WGS84 system are presented in the Annexure-I. The site superimposed on approved CZMP as per CRZ Notification 2011 and its status in 2019 is presented in Annexure-II.

PROJECT TEAM

Technical Members

1. Dr. S.S.Ramakrishnan ... Project Manager
2. Dr. Thirumalaivasan D ... Project Leader
3. Mr. J.Premkumar ... Project Assistant

LIST OF FIGURES

1.0 INTRODUCTION

1.1 Coastal Regulation Zone

The coastal zone is the area of interaction between land and sea. The coastal Zone of Tamil Nadu has a very high concentration of population along with ecologically sensitive areas like mangroves. There is a spurt of developmental activities arising from huge residential colonies, new industries and tourism centres along the coast and in coastal zone. There is a need to protect the coastal environment while ensuring continuing production and development. This zone is extremely vulnerable and has to be managed judiciously striking a balance between ecological and developmental needs.

Government of India has issued a notification during February 1991 for regulating the developments along the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action. The land between 500 meters from the High Tide Line (HTL) and the Low Tide Line (LTL) is identified as Coastal Regulation Zone (CRZ). The coastal stretches within CRZ are classified into four categories, namely, Category I (CRZ-I), Category II (CRZ-II), Category III (CRZ-III) and Category IV (CRZ-IV). The notification has also laid down regulations to regulate the various activities in the coastal zone. The Ministry of Environment and Forests, Government of India, has approved a set of CRZ maps on 1:25,000 scale prepared from SPOT satellite imagery. On these maps, zones are demarcated as CRZ I, CRZ II and CRZ III, by TNCZMA.

Coastal Regulation Zone I includes the zone between High Tide Line and Low Tide Line. It also includes the areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests,

wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as may be declared by the Central Government or the concerned authorities at the State/Union Territory level from time to time.

CRZ-II covers the areas that have already been developed up to or close to the shoreline. For this purpose, the "developed area" is referred to as that area within the municipal limits or in other legally designated urban areas which are already substantially built up and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains. CRZ-III covers the areas that are relatively undisturbed and those which do not belong to either Category-I or II. These include the coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas which are not substantially built up. CRZ-IV refers to the coastal stretches in the Andaman and Nicobar, Lakshadweep and small islands other than those designated as CRZ-I, CRZ-II or CRZ-III.

The Ministry of Environment and Forest in the CRZ Notification, 2011 declared the following areas as CRZ and imposed with effect from the date of the notification the restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ. The areas that are defined as CRZ as per CRZ Notification, 2011 are

(i) The land area from High Tide Line (HTL) to 500mts on the landward side along the sea front.

(ii) CRZ shall apply to the land area between HTL to 100 meters or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance upto which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans.

(iii) The land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and through the Survey of India taking into account tides, waves, sea level rise and shoreline changes.

(iv) Land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

(v) The water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The Classification of the CRZ is also modified for the purpose of conserving and protecting the coastal areas and marine waters as CRZ – I, CRZ – II, CRZ – III and CRZ – IV. The CRZ – I include the areas that are ecologically

sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast like (a) Mangroves(b) Corals and coral reefs and associated biodiversity (c) Sand Dunes (d) Mudflats which are biologically active (e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas (f) Salt Marshes (g) Turtle nesting grounds (h) Horse shoe crabs habitats (i) Sea grass beds (j) Nesting grounds of birds (k) Areas or structures of archaeological importance and heritage sites and the area between Low Tide Line and High Tide Line. The CRZ-II includes areas that have been developed upto or close to the shoreline. The CRZ-III includes areas that are relatively undisturbed and those do not belong to either CRZ-I or II, which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up. The CRZ-IV includes the water area from the Low Tide Line to twelve nautical miles on the seaward side and the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

The Ministry of Environment and Forest has also provided guidelines for demarcation of High Tide Line in the CRZ Notification, 2011. As per the guidelines, Cadastral (village) maps in 1:3960 or the nearest scale shall be used as the base maps. HTL and LTL indicated in Approved CZMP published by TNCZMA(Prepared by NCSCM for Department of Environment, Government of Tamil Nadu) is superimposed in the CZMP Maps approved by the Central

Government. 500metre and 200metre lines shall be demarcated with respect to the HTL.

In order to facilitate classification of Coastal Regulation Zones Government of India has approved few agencies/institutions across the Country vide Lr. No. J17011/8/92-1A III, dated 10.05.1999 of Ministry of Environment and Forests. Institute of Remote Sensing, Anna University being one of them, has been carrying out CRZ Mapping following the guidelines issued by Ministry of Environment & Forests, Government of India.

1.2 BACKGROUND

M/S TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, Superintending Engineer/Civil, Projects and Environment, NPKRR Maaligai, III Floor, Eastern Wing, 144, Anna Salai, Chennai 600 002, has requested Institute of Remote Sensing, Anna University to superimpose HTL, LTL and CRZ from Approved CZMP for the Sea/Bay/tidal influenced water bodies and ecologically sensitive areas on 1:4,000 scale in the vicinity of proposed project site. The proposed project site has proximity to the Bay of Bengal. It is in this context, the proposed site needs to be evaluated to assess whether the proposed site falls under regulations of CRZ Notification, 2011 and CRZ Notification 2019.

1.3 OBJECTIVES

The objective of the present study is to examine the project site for the Proposed ETPS Expansion Thermal Power Project (1 X 660 Mw), Cooling Water Intake and Outfall Pipelines and Coal Pipe Conveyor at Ernavur Village,

Thiruvottiyur Taluk, Tiruvallur District, with reference to CRZ Notification, 2011. Keeping in view of the requirements of notification, Institute of Remote Sensing, Anna University under took the project with following agreed scope of work:

- Superimposition of HTL, LTL, Ecologically Sensitive Areas along with project site on to the georeferenced cadastral map
- Demarcation of Coastal Regulation Zone by mapping 200m, 500m setback lines from High Tide Line as per CRZ Notification in the neighbourhood of project site.

2.0 RESULTS AND CONCLUSIONS

The HTL, LTL and CRZ for Bay of Bengal were superimposed on to georeferenced cadastral map along with ecologically sensitive areas if any in the vicinity of project site. 200m, 500m setback lines from HTL were generated and superimposed on to map to prepare local level CRZ map at 1: 4,000. The processed HTL co-ordinates in WGS 84 system are presented at Annexure I. The satellite imagery of project site is presented below for reference.

2.1 Conclusions

- The project site of M/S TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED for the proposed ETPS Expansion Thermal Power Project (1 X 660 MW) does not fall within 500m from HTL of Bay of Bengal except for a part of Project Site falling within CRZ-II(100m from creek/River) i.e. 100m from HTL of Buckingham Canal.
- Cooling Water Intake and Outfall Pipelines and Coal Pipe Conveyor passes through CRZ. The HTL, LTL and Ecologically Sensitive Areas

indicated in Approved CZMP published vide CRZ Notification 2011 was used for preparation local level CRZ Map.

Figure 1 Satellite Imagery of the project site (Source: Google Earth)

ANNEXURE I
COORDINATES OF HTL REFERENCE POINTS

Reference System: WGS 84 Datum

HTL POINTS	LATITUDE	LONGITUDE
1	13° 14' 50.696" N	80° 20' 12.016" E
2	13° 14' 35.253" N	80° 20' 5.662" E
3	13° 14' 21.704" N	80° 19' 59.937" E
4	13° 14' 8.373" N	80° 19' 51.875" E
5	13° 14' 8.547" N	80° 19' 40.783" E
6	13° 14' 4.359" N	80° 19' 32.957" E
7	13° 13' 59.429" N	80° 19' 23.929" E
8	13° 13' 58.218" N	80° 19' 15.782" E
9	13° 13' 57.332" N	80° 19' 6.902" E
10	13° 13' 52.787" N	80° 19' 4.061" E
11	13° 13' 56.184" N	80° 18' 58.803" E
12	13° 14' 1.526" N	80° 18' 58.982" E
13	13° 14' 8.379" N	80° 18' 58.784" E
14	13° 14' 17.817" N	80° 19' 1.512" E
15	13° 14' 13.924" N	80° 19' 2.688" E
16	13° 14' 3.151" N	80° 19' 2.893" E
17	13° 13' 57.966" N	80° 19' 3.942" E
18	13° 14' 8.317" N	80° 19' 3.894" E
19	13° 14' 18.138" N	80° 19' 3.706" E
20	13° 14' 26.640" N	80° 19' 3.666" E
21	13° 14' 33.904" N	80° 19' 3.434" E
22	13° 14' 39.836" N	80° 19' 3.243" E
23	13° 14' 46.913" N	80° 19' 4.760" E
24	13° 14' 52.942" N	80° 19' 7.640" E
25	13° 14' 59.310" N	80° 19' 10.629" E
26	13° 15' 4.929" N	80° 19' 14.604" E
27	13° 15' 9.707" N	80° 19' 17.524" E
28	13° 15' 15.873" N	80° 19' 20.540" E
29	13° 15' 12.660" N	80° 19' 17.722" E
30	13° 15' 1.514" N	80° 19' 9.507" E
31	13° 14' 52.768" N	80° 19' 6.269" E
32	13° 14' 41.766" N	80° 19' 2.138" E
33	13° 14' 26.240" N	80° 19' 2.291" E
34	13° 14' 33.134" N	80° 19' 0.434" E
35	13° 14' 48.722" N	80° 19' 1.785" E
36	13° 14' 55.799" N	80° 18' 54.990" E
37	13° 14' 59.879" N	80° 19' 4.608" E
38	13° 15' 7.446" N	80° 19' 12.027" E
39	13° 15' 16.402" N	80° 19' 8.859" E
40	13° 15' 15.563" N	80° 19' 2.724" E
41	13° 15' 6.630" N	80° 18' 56.200" E
42	13° 15' 15.549" N	80° 18' 36.799" E
43	13° 15' 11.369" N	80° 18' 48.457" E
44	13° 15' 2.415" N	80° 18' 49.929" E
45	13° 14' 54.784" N	80° 18' 49.412" E
46	13° 14' 48.389" N	80° 18' 45.267" E
47	13° 14' 41.409" N	80° 18' 44.594" E
48	13° 14' 43.249" N	80° 18' 38.010" E
49	13° 14' 44.532" N	80° 18' 30.026" E
50	13° 14' 44.035" N	80° 18' 25.713" E
51	13° 14' 41.689" N	80° 18' 41.431" E
52	13° 14' 32.121" N	80° 18' 46.693" E
53	13° 14' 21.005" N	80° 18' 47.936" E
54	13° 14' 14.801" N	80° 18' 49.953" E
55	13° 14' 5.961" N	80° 18' 48.955" E
56	13° 13' 57.973" N	80° 18' 45.495" E
57	13° 13' 51.549" N	80° 18' 50.612" E
58	13° 13' 39.840" N	80° 18' 59.985" E
59	13° 13' 34.156" N	80° 19' 0.375" E
60	13° 13' 41.208" N	80° 18' 54.537" E
61	13° 13' 53.046" N	80° 18' 45.954" E
62	13° 14' 2.905" N	80° 18' 38.779" E
63	13° 14' 11.176" N	80° 18' 31.084" E
64	13° 14' 2.065" N	80° 18' 35.552" E
65	13° 13' 48.269" N	80° 18' 47.830" E
66	13° 13' 43.377" N	80° 18' 48.008" E
67	13° 13' 43.116" N	80° 18' 37.273" E
68	13° 13' 39.725" N	80° 18' 49.436" E
69	13° 13' 43.031" N	80° 18' 29.889" E
70	13° 13' 38.614" N	80° 18' 25.821" E
71	13° 13' 39.211" N	80° 18' 33.603" E
72	13° 13' 32.205" N	80° 18' 51.240" E
73	13° 13' 24.595" N	80° 18' 37.814" E
74	13° 13' 14.626" N	80° 18' 35.881" E
75	13° 13' 7.025" N	80° 18' 33.877" E
76	13° 12' 58.016" N	80° 18' 20.302" E
77	13° 12' 50.597" N	80° 18' 21.416" E
78	13° 12' 44.085" N	80° 18' 22.337" E
79	13° 12' 35.473" N	80° 18' 18.200" E
80	13° 12' 35.678" N	80° 18' 21.058" E

81	13° 12' 28.713" N	80° 18' 21.106" E
82	13° 12' 19.921" N	80° 18' 25.222" E
83	13° 12' 16.628" N	80° 18' 17.848" E
84	13° 12' 17.445" N	80° 18' 9.231" E
85	13° 12' 14.293" N	80° 18' 13.195" E
86	13° 12' 13.485" N	80° 18' 18.203" E
87	13° 12' 19.533" N	80° 18' 3.204" E
88	13° 12' 18.876" N	80° 17' 49.756" E
89	13° 12' 19.713" N	80° 17' 39.863" E
90	13° 12' 13.512" N	80° 17' 40.982" E
91	13° 12' 15.362" N	80° 17' 53.680" E
92	13° 12' 16.156" N	80° 18' 3.090" E
93	13° 12' 11.898" N	80° 18' 8.166" E
94	13° 12' 11.959" N	80° 18' 4.120" E
95	13° 12' 9.174" N	80° 18' 13.570" E
96	13° 12' 7.361" N	80° 18' 18.076" E
97	13° 12' 7.140" N	80° 18' 8.740" E
98	13° 12' 5.346" N	80° 18' 5.864" E
99	13° 11' 59.347" N	80° 18' 6.612" E
100	13° 11' 52.007" N	80° 18' 4.812" E
101	13° 11' 44.539" N	80° 18' 1.863" E
102	13° 11' 36.058" N	80° 17' 55.694" E
103	13° 11' 25.868" N	80° 17' 53.688" E
104	13° 11' 19.166" N	80° 17' 46.939" E
105	13° 11' 21.774" N	80° 17' 37.926" E
106	13° 11' 31.264" N	80° 17' 34.611" E
107	13° 11' 40.380" N	80° 17' 25.607" E
108	13° 11' 36.328" N	80° 17' 23.983" E
109	13° 11' 30.431" N	80° 17' 29.623" E
110	13° 11' 21.407" N	80° 17' 32.927" E
111	13° 11' 14.002" N	80° 17' 35.457" E
112	13° 11' 11.217" N	80° 17' 57.033" E
113	13° 11' 17.703" N	80° 18' 1.527" E
114	13° 11' 22.888" N	80° 18' 1.111" E
115	13° 11' 26.352" N	80° 18' 7.392" E
116	13° 11' 37.312" N	80° 18' 12.752" E
117	13° 11' 35.656" N	80° 18' 3.981" E
118	13° 11' 53.897" N	80° 18' 12.217" E
119	13° 11' 48.174" N	80° 18' 17.387" E
120	13° 12' 0.295" N	80° 18' 21.902" E
121	13° 12' 7.701" N	80° 18' 27.467" E
122	13° 12' 15.413" N	80° 18' 33.642" E
123	13° 12' 17.052" N	80° 18' 28.684" E
124	13° 12' 15.706" N	80° 18' 25.368" E
125	13° 12' 22.267" N	80° 18' 31.019" E

126	13° 12' 37.204" N	80° 18' 28.890" E
127	13° 12' 33.962" N	80° 18' 30.494" E
128	13° 12' 20.794" N	80° 18' 27.683" E
129	13° 12' 16.024" N	80° 18' 23.389" E
130	13° 12' 28.308" N	80° 18' 27.684" E
131	13° 12' 40.706" N	80° 18' 24.608" E
132	13° 12' 37.127" N	80° 18' 33.825" E
133	13° 12' 53.668" N	80° 18' 30.139" E
134	13° 12' 49.413" N	80° 18' 38.728" E
135	13° 13' 1.332" N	80° 18' 45.831" E
136	13° 12' 55.698" N	80° 18' 47.997" E
137	13° 12' 41.315" N	80° 18' 40.866" E
138	13° 12' 21.893" N	80° 18' 36.772" E
139	13° 12' 27.430" N	80° 18' 40.172" E
140	13° 12' 41.037" N	80° 18' 46.618" E
141	13° 12' 48.157" N	80° 18' 49.960" E
142	13° 12' 59.708" N	80° 18' 57.534" E
143	13° 13' 4.786" N	80° 19' 0.867" E
144	13° 13' 11.025" N	80° 18' 48.953" E
145	13° 13' 20.988" N	80° 18' 54.912" E
146	13° 13' 15.730" N	80° 19' 1.126" E
147	13° 13' 7.497" N	80° 19' 3.129" E
148	13° 12' 56.833" N	80° 18' 56.388" E
149	13° 12' 45.197" N	80° 18' 49.273" E
150	13° 12' 32.935" N	80° 18' 44.035" E
151	13° 12' 17.451" N	80° 18' 35.686" E
152	13° 12' 4.016" N	80° 18' 25.036" E
153	13° 11' 53.327" N	80° 18' 20.380" E
154	13° 11' 42.544" N	80° 18' 15.532" E
155	13° 11' 29.789" N	80° 18' 9.776" E
156	13° 11' 14.083" N	80° 17' 59.625" E
157	13° 11' 13.373" N	80° 18' 1.314" E
158	13° 11' 23.246" N	80° 18' 8.022" E
159	13° 11' 36.021" N	80° 18' 14.150" E
160	13° 11' 48.735" N	80° 18' 19.950" E
161	13° 12' 2.095" N	80° 18' 25.276" E
162	13° 12' 12.417" N	80° 18' 33.921" E
163	13° 12' 26.989" N	80° 18' 42.377" E
164	13° 12' 39.025" N	80° 18' 47.953" E
165	13° 12' 50.510" N	80° 18' 53.947" E
166	13° 13' 6.507" N	80° 19' 4.094" E
167	13° 13' 16.868" N	80° 19' 8.712" E
168	13° 13' 26.555" N	80° 19' 10.903" E
169	13° 13' 35.093" N	80° 19' 15.564" E
170	13° 13' 43.379" N	80° 19' 25.460" E

171	13° 13' 49.999" N	80° 19' 36.699" E
172	13° 13' 56.287" N	80° 19' 50.282" E
173	13° 13' 50.041" N	80° 19' 53.103" E
174	13° 13' 36.732" N	80° 19' 48.076" E
175	13° 13' 20.489" N	80° 19' 41.506" E
176	13° 13' 8.470" N	80° 19' 37.000" E
177	13° 12' 56.015" N	80° 19' 33.491" E
178	13° 12' 38.551" N	80° 19' 26.951" E
179	13° 12' 24.533" N	80° 19' 22.127" E
180	13° 12' 10.048" N	80° 19' 21.343" E
181	13° 11' 52.542" N	80° 19' 14.204" E
182	13° 11' 41.435" N	80° 19' 9.064" E
183	13° 11' 27.988" N	80° 19' 5.587" E
184	13° 11' 18.669" N	80° 19' 2.335" E

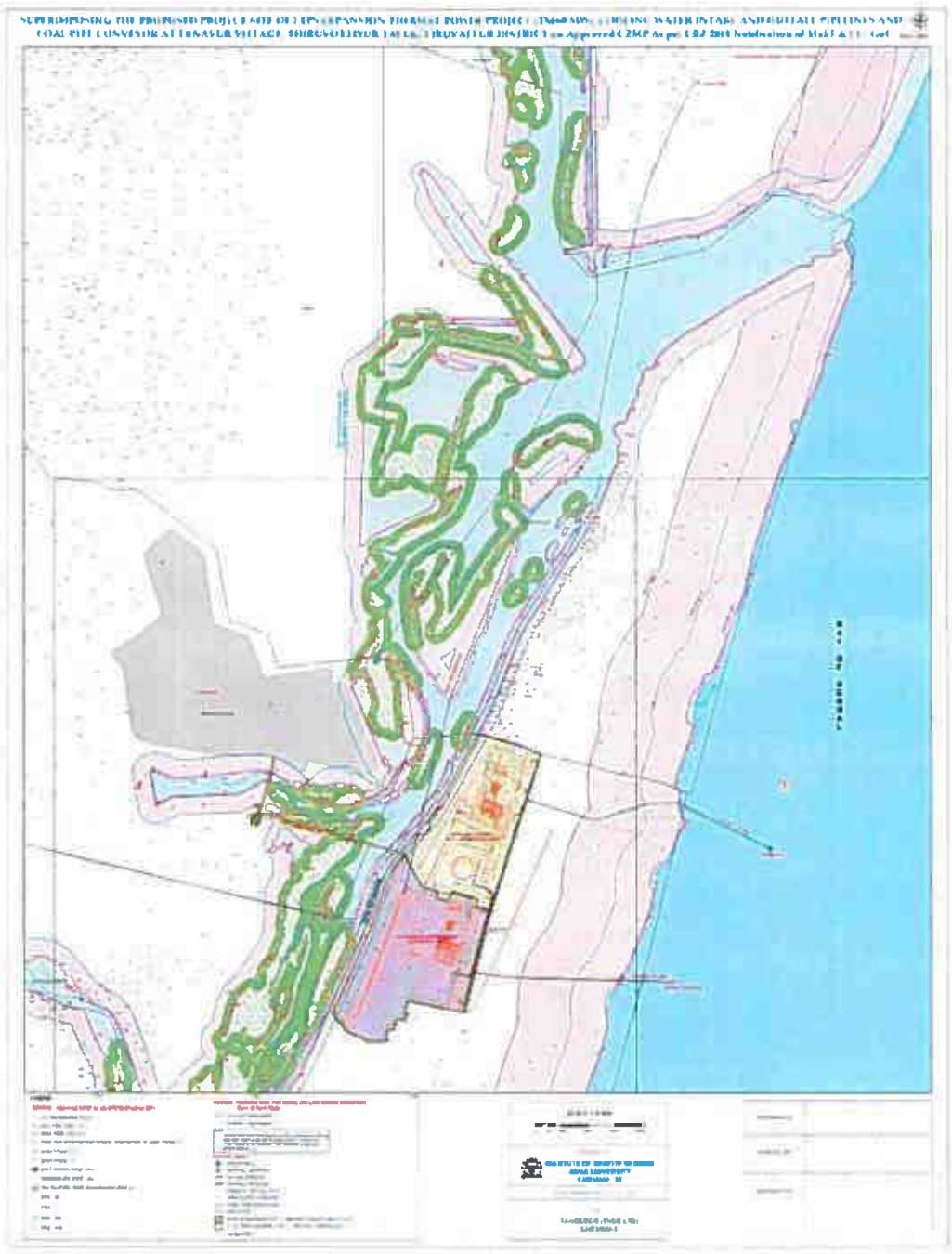
7/3/16

DIRECTOR, IRS

Director
Institute of Remote Sensing
Anna University,
Chennai - 600 025

ANNEXURE II

LOCAL LEVEL CRZ MAP



DIRECTOR, IRS

Director
Institute of Remote Sensing
Anna University,
Chennai - 600 025

Annexure -II

EAC recommended documents(AAQ Results & Bioaccumulation report)

Annexure - II

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				03.07.2018 to 04.07.2018	04.07.2018 to 05.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	42.1	35.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	84.5	76.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.2	10.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.5	26	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	35.8	27.9	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(D.L -1.15)	BDL(D.L -1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				12.07.2018 to 13.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	36.7	32.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	77.8	68.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.9	14.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	19.5	27.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.5	34.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				16.07.2018 to 17.07.2018	17.07.2018 to 18.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	34.1	32.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	74.8	68.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.8	12.4	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	22.5	26.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	21.9	27.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				26.07.2018 to 27.07.2018	27.07.2018 to 28.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.5	37.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	62.6	76.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.8	9.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	22.1	17.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	18.6	19.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.07.2018 to 31.07.2018	31.07.2018 to 01.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.6	30.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	75.1	62.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.9	12	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20.5	23.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	34.5	16.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				09.08.2018 to 10.08.2018	10.08.2018 to 11.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	42.5	44.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	81.4	84.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	15.2	10.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	24.8	21.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	36.5	29.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.08.2018 to 14.08.2018	14.08.2018 to 15.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	41.5	35.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	80.1	76	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11	9.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	25.5	18	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	26.8	24.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				23.08.2018 to 24.08.2018	24.08.2018 to 25.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.1	30.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	65.8	61.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	14.1	13.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	31.4	26.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	40.5	29.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.08.2018 to 31.08.2018	31.08.2018 to 01.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.5	41.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	63.5	81	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.8	8.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	24.1	17.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.6	27.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.09.2018 to 05.09.2018	05.09.2018 to 06.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	44.8	46.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.2	86.0	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.3	8.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20.8	16.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	18.2	20.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.09.2018 to 14.09.2018	14.09.2018 to 15.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	37.2	32.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	79.4	67.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.2	10.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20.8	22.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.5	21	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 1 - ETPS, Site**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'48.783'' N 80°18'40.56'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				17.09.2018 to 18.09.2018	18.09.2018 to 19.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.8	36	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	74.6	77.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.1	12.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.2	21	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	15.5	18.2	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.07.2018 to 05.07.2018	05.07.2018 to 06.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	29.3	27.4	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	63.8	64.7	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.1	10.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	25.6	21	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.1	17.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.07.2018 to 11.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	24.2	25.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	53.8	56.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.7	9.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.5	20.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.4	25.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				18.07.2018 to 19.07.2018	19.07.2018 to 20.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	33.5	32.7	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	71.7	73.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.5	8.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	22.1	17.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	28.4	31.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				23.07.2018 to 24.07.2018	24.07.2018 to 25.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	29.6	28.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	69.8	66.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.9	7.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	15.2	20.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	26.7	28.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				31.07.2018 to 01.08.2018	01.08.2018 to 02.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.7	32.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	74.9	68.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.4	7.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.1	16.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	24.1	14.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				08.08.2018 to 09.08.2018	09.08.2018 to 10.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	31.7	28.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	66.5	61.9	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.5	10.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20.4	22.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.1	26.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				15.08.2018 to 16.08.2018	16.08.2018 to 17.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	27.9	26.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	62.5	60.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.4	11.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	14.5	20.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	20.1	25.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				20.08.2018 to 21.08.2018	21.08.2018 to 22.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	23.5	30.2	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	58.7	63.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.6	7.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	23.4	18.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	28.7	15.2	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				28.08.2018 to 29.08.2018	29.08.2018 to 30.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.5	26.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	66.7	57.9	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12	6.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.5	13.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	30.5	15	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				03.09.2018 to 04.09.2018	04.09.2018 to 05.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.5	33.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	61.3	64.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11	8.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	18.5	17.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	21.4	16.2	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.09.2018 to 11.09.2018	11.09.2018 to 12.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	26.5	23.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	58.3	54.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.6	6.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20.2	15.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.1	20.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 2 - Ennore**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°13'23.103'' N 80°19'11.409'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				19.09.2018 to 20.09.2018	21.09.2018 to 22.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	27.5	28.3	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	59.9	61.2	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.2	11.4	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	25.1	28.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	31.2	34.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL :1.15)	BDL(DL :1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				05.07.2018 to 06.07.2018	06.07.2018 to 07.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.3	40.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	72.6	84.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.3	9.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	14.5	16.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	17.9	20.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.07.2018 to 11.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	56.5	55.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	95.5	94.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.5	9.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	23.3	14.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.9	21.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				16.07.2018 to 17.07.2018	17.07.2018 to 18.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	48.3	54.3	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	94.7	78.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.3	10.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.4	22.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.3	26.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				23.07.2018 to 24.07.2018	24.07.2018 to 25.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	47.9	43.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	89.5	96.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.3	8.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	15.7	19.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.2	22.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				01.08.2018 to 02.08.2018	02.08.2018 to 03.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	57.5	53.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	92.1	95.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.8	10.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	24.7	21.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	28.3	26.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.08.2018 to 07.08.2018	07.08.2018 to 08.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	50.5	47.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	94.1	88.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.4	8.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.3	19.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.5	21.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.08.2018 to 14.08.2018	14.08.2018 to 15.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	50.1	56.9	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	91.1	94.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.1	11.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	15.9	24.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.7	31.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				20.08.2018 to 21.08.2018	21.08.2018 to 22.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	47.6	54.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	88.7	95.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.3	10.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	26.5	24.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	34.5	37.9	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				27.08.2018 to 28.08.2018	28.08.2018 to 29.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	49.2	47.3	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	86.7	95.2	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.5	6.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	21.8	14.9	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	26.5	21.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.09.2018 to 07.09.2018	07.09.2018 to 08.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.2	38.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	72.5	77.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.8	5.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	19.5	13.9	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	24.8	18.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.09.2018 to 11.09.2018	11.09.2018 to 12.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	39.1	37.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	83.4	79.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.9	4.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	10.2	11.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	7.7	9.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 3 - Athipattu Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°14'58.731'' N 80°18'00.424'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				19.09.2018 to 20.09.2018	21.09.2018 to 22.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	43.8	42.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	92.5	86.7	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.8	11.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	15.9	20.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	13.3	34.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				03.07.2018 to 04.07.2018	04.07.2018 to 05.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	57.5	56.2	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	97.5	98.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	18.5	26.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	31.2	32.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	29.7	44.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				11.07.2018 to 12.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	48.5	51.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	84.5	92.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	21.2	18.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	34.1	28.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	50.8	46.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				18.07.2018 to 19.07.2018	19.07.2018 to 20.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	58.1	52.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	97.5	91.4	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	21.1	17.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	35.2	28.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	31.5	26.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				26.07.2018 to 27.07.2018	27.07.2018 to 28.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	46.2	55.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.6	98.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	19.5	16.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	29.1	24.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	42.5	32.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.07.2018 to 31.07.2018	31.07.2018 to 01.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	56.1	48.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	95.6	87.7	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	16.7	18.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.1	22.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	27.7	22.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				09.08.2018 to 10.08.2018	10.08.2018 to 11.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	48.6	56.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	89.4	97.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	14.2	17.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.1	32	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	26.1	29.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.08.2018 to 14.08.2018	14.08.2018 to 15.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	54.8	45.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	96.2	86.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	13.2	15.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	26.5	26.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	33.8	36.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				23.08.2018 to 24.08.2018	24.08.2018 to 25.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	46.8	44.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	87.5	82.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	19.4	21.4	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	31.1	35.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	48.7	50.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.08.2018 to 31.08.2018	31.08.2018 to 01.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	51.2	54.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	95.6	97.4	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	26.1	24.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	38.5	36.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	36.5	33.2	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.09.2018 to 05.09.2018	05.09.2018 to 06.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	57.1	51.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	95.4	92.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	21.1	18.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	30.2	27.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	29.7	21.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.09.2018 to 14.09.2018	14.09.2018 to 15.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	58.4	46	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	94.6	88.2	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	14.6	17.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	25.1	29.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.8	24.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 4 - NCTPS- Stage-II (Top of Fire Station office)**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'27.059'' N 80°9'54.42'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				17.09.2018 to 18.09.2018	18.09.2018 to 19.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	40.4	37.9	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	83.8	76.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	16.5	13.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.5	26.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.9	32.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				03.07.2018 to 04.07.2018	04.07.2018 to 05.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	46.7	47.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.4	88.7	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.2	12.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	22.5	24.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	32.5	28.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				11.07.2018 to 12.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	47.5	48.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	89.5	87.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.7	10.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.8	21	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.9	25.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				18.07.2018 to 19.07.2018	19.07.2018 to 20.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.2	32.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	76.2	74.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.6	9.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.6	21.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	15.3	17.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				26.07.2018 to 27.07.2018	27.07.2018 to 28.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	41.2	44.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.6	89.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.5	11.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	15.6	23.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	14.6	27.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				31.07.2018 to 01.08.2018	01.08.2018 to 02.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	34.2	44.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	72.1	86.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.2	10.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	19.5	21.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.6	28.9	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				08.08.2018 to 09.08.2018	09.08.2018 to 10.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.1	33.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	71.1	72.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.9	11.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.4	22.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	26.5	33.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				15.08.2018 to 16.08.2018	16.08.2018 to 17.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.2	35.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	74.5	76.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.5	10.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	24.1	20.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	30.5	24.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				20.08.2018 to 21.08.2018	21.08.2018 to 22.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	41.6	40.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.2	80.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	13.5	10	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	24.8	19.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	33.6	21	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				28.08.2018 to 29.08.2018	29.08.2018 to 30.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	33.6	33.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	70.2	68.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.6	9.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.5	18.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.5	21	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.09.2018 to 07.09.2018	07.09.2018 to 08.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	33	40.0	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	67.5	81.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.5	9.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	22.5	21	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.5	32.4	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.09.2018 to 14.09.2018	14.09.2018 to 15.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	41.5	37.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	84.7	76.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.1	10.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	18.6	21.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.3	26.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 5 - Shivagami nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'54.665'' N 80°19'5.089'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				17.09.2018 to 18.09.2018	18.09.2018 to 19.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	46.1	42.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	87.4	88.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11	8.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	23.5	17.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.7	18.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.07.2018 to 07.07.2018	07.07.2018 to 08.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.6	34.2	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	74.5	72.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.3	6.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	7.8	10.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	21.3	20.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				12.07.2018 to 13.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.4	42.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	70.6	86.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.1	9.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	11.5	15.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.7	23.4	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				18.07.2018 to 19.07.2018	19.07.2018 to 20.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.5	33.7	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	65.1	74.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.1	9.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	13.5	14.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	26.5	28.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				26.07.2018 to 27.07.2018	27.07.2018 to 28.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	38.9	36.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	77.8	75.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.5	6.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.8	19.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.1	23.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.07.2018 to 31.07.2018	31.07.2018 to 01.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.4	34.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	66.7	72.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.9	5.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	13.1	14.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.9	18.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				09.08.2018 to 10.08.2018	10.08.2018 to 11.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.5	40.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	75.9	85.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.3	9.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	9.7	15.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	21.3	18.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.08.2018 to 14.08.2018	14.08.2018 to 15.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	43.5	37.2	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	88.7	76.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.3	11.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20.8	15.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	24.6	19.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				22.08.2018 to 23.08.2018	23.08.2018 to 24.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	42.7	33.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.9	71.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	13.5	10.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.7	14.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.6	17.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.08.2018 to 31.08.2018	31.08.2018 to 01.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	44.3	35.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	86.8	78.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.3	7.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	13.2	11.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.2	19.2	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.09.2018 to 05.09.2018	05.09.2018 to 06.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.1	24.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	65.3	52.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.4	3.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	12.1	8.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.7	14.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.09.2018 to 14.09.2018	14.09.2018 to 15.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	32.6	28.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	69.5	73.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.1	3.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	9.5	12.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	13.2	15.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 6 - Vallur**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°15'10.928'' N 80°16'58.437'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				17.09.2018 to 18.09.2018	18.09.2018 to 19.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	34.1	36.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	70.8	79.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	3.5	4.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	7.1	6.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	13.2	18.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				05.07.2018 to 06.07.2018	06.07.2018 to 07.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	25.1	35.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	52.6	78.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.7	14.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	26.8	33.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	30.6	31.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.07.2018 to 11.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	33.5	32.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	67.5	66.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.6	13.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	28.9	28.9	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	33.4	25.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				16.07.2018 to 17.07.2018	17.07.2018 to 18.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.6	30.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	78.5	65.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.5	10.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	26.5	26.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.2	29.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				23.07.2018 to 24.07.2018	24.07.2018 to 25.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	34.6	33.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	77.5	71.2	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.8	9.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	28.7	21.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	35.6	29.7	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				01.08.2018 to 02.08.2018	02.08.2018 to 03.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	25.1	30.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	58.6	67.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.3	15.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	30.2	29.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	41.3	33.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.08.2018 to 07.08.2018	07.08.2018 to 08.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	41.5	31.0	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	83.3	64.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.5	7.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.1	16.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	21.2	19.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				15.08.2018 to 16.08.2018	16.08.2018 to 17.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	29.5	24.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	63.2	58.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.2	8.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	19.5	22.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.6	18.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				21.08.2018 to 22.08.2018	22.08.2018 to 23.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	31.7	30.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	67.5	68.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.1	12.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	21.8	23.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.4	18.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				27.08.2018 to 28.08.2018	28.08.2018 to 29.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	28.6	31.2	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	61.2	65.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.8	9.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.9	26.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.5	28.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				03.09.2018 to 04.09.2018	04.09.2018 to 05.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	31.8	32.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	63.4	65.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.9	9.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	15.3	16.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	19.4	20.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.09.2018 to 11.09.2018	11.09.2018 to 12.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	26.4	25.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	58.8	57.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.2	3.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	19.1	15.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.5	9.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 7 - Ponniamman nagar**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°12'18.243'' N 80°16'13.551'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				19.09.2018 to 20.09.2018	21.09.2018 to 22.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	29.4	24.7	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	61.2	55.7	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.8	3.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	13.4	5.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.7	12.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.07.2018 to 05.07.2018	05.07.2018 to 06.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	26.1	30.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	57.4	63.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.8	7.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.8	20.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	18.5	26.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.07.2018 to 11.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	27	32.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	58.6	68.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.9	9.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.5	21	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	15.2	24.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				18.07.2018 to 19.07.2018	19.07.2018 to 20.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	34.1	35.3	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	71.1	74.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	8.7	10.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	21.1	24.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.6	15.9	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				26.07.2018 to 27.07.2018	27.07.2018 to 28.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	22.6	25.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	48.5	56.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.6	9.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	10.2	22.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	14.4	18.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.07.2018 to 31.07.2018	31.07.2018 to 01.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	35.6	30.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	74.8	64.7	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	12.5	11.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	25.1	26.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	20.4	21.9	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				09.08.2018 to 10.08.2018	10.08.2018 to 11.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	29.6	32	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	61.5	67.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	13.8	7.4	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	27.5	19.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	33.1	21.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.08.2018 to 14.08.2018	14.08.2018 to 15.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.3	27.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	62.1	59.2	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	11.5	10.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	24	21.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.8	19.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				22.08.2018 to 23.08.2018	23.08.2018 to 24.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	28.6	31.9	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	65.2	64.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.6	12.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	16.5	23.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	20.1	26.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				30.08.2018 to 31.08.2018	31.08.2018 to 01.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	21.8	24.6	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	49.5	55.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	14.5	13.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	29	25.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	34.1	28.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.09.2018 to 05.09.2018	05.09.2018 to 06.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	25.7	24.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	57.8	55.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10	6.5	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	18.6	14.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	22.1	17.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				13.09.2018 to 14.09.2018	14.09.2018 to 15.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	22.8	24	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	47.6	52.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	5.8	12	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	13.6	22.4	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	12.5	20	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD.,** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 8 - Ernavur Village**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'22.548'' N 80°18'33.621'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				17.09.2018 to 18.09.2018	18.09.2018 to 19.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	30.8	25.5	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	66.1	57.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.5	5.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	20	13.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	17	15.2	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				04.07.2018 to 05.07.2018	05.07.2018 to 06.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	36.7	40.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	78.2	84.6	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.5	9.3	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	12.8	15.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	15.9	20.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(D.L -1.15)	BDL(D.L -1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				10.07.2018 to 11.07.2018	13.07.2018 to 14.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	39.7	36.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	82.1	80.8	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.9	10.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	11.4	18.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.3	23.8	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				16.07.2018 to 17.07.2018	17.07.2018 to 18.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	33.1	35.1	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	76.5	72.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	6.7	5.7	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	12.1	10.3	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	14.7	22.5	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				24.07.2018 to 25.07.2018	25.07.2018 to 26.07.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	44.8	46.3	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	87.3	81.1	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.1	11.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	13.8	14.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	25.1	28.9	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				01.08.2018 to 02.08.2018	02.08.2018 to 03.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	42.1	36.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	85.3	79.2	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.2	6.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	18.3	13.5	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	23.5	18.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.08.2018 to 07.08.2018	07.08.2018 to 08.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	37.2	33.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	78.3	69.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.7	6.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	11.9	13.2	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	17.3	18.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				15.08.2018 to 16.08.2018	16.08.2018 to 17.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	25.6	42.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	57.5	86.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	7.4	12.6	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	12.8	23.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	17.2	29.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				20.08.2018 to 21.08.2018	21.08.2018 to 22.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	36.9	33.9	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	76.5	72.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	9.3	11.2	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	17.4	24.1	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.5	22.1	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				27.08.2018 to 28.08.2018	28.08.2018 to 29.08.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	42.9	39.8	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	86.8	81.4	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	10.2	11.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	23.1	20.6	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	32.8	15.3	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				06.09.2018 to 07.09.2018	07.09.2018 to 08.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	36.1	40.4	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	77.3	81.5	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	5.6	7.1	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	11.7	13.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.9	18.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

END OF REPORT

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				11.09.2018 to 12.09.2018	12.09.2018 to 13.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	33.8	31.9	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	75.3	66.3	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.9	5.9	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	12.5	11.8	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	16.1	8.4	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

CHENNAI
TESTING LABORATORY PRIVATE LIMITED
Testing redefined

www.ctllabs.in
www.foodenvironmenttesting.com

TEST REPORT

Customer Name & Address	**M/s.TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD** 5th Floor,Western Wing,144,Anna Salai. Chennai - 600 002.		
SAMPLE DETAILS			
Project At	**TANGEDCO,TPP(1x660 MW) at ETPS Area,ENNORE**		
Sampling Location	**AAQ - 9 - Manali New Town Area**		
Sampling Method	IS 5182 (Part V) and (Part XIV)	Sampled By	Chennai Testing Laboratory (P) ltd
GPS Coordinates	**13°11'37.294'' N 80°16'33.648'' E**		

SL.NO	PARAMETERS	METHODS	UNITS	SAMPLING DATE		NAAQS*
				19.09.2018 to 20.09.2018	21.09.2018 to 22.09.2018	
				RESULTS		
1	PARTICULATE MATTER ($PM_{2.5}$)	CTL/SOP/AIR/03 - 2016	$\mu g/m^3$	26.9	27.9	60
2	PARTICULATE MATTER (PM_{10})	IS 5182 Part 23 - 2006	$\mu g/m^3$	59.8	55.4	100
3	SULPHUR DIOXIDE (SO_2)	IS 5182 Part 2 - 2001	$\mu g/m^3$	4.3	3.8	80
4	OXIDES OF NITROGEN (NO_2)	IS 5182 Part 6 - 2006	$\mu g/m^3$	12.9	7.7	80
5	OZONE (O_3)	CTL/SOP/AIR/08 - 2016	$\mu g/m^3$	9.5	5.6	180
6	CARBON MONOXIDE (CO)	CTL/SOP/AIR/23 – 2016	mg/m^3	BDL(DL:1.15)	BDL(DL:1.15)	4

*National Ambient Air Quality Standards - CPCB
BDL - Below Detection Limit(D.L - Detection Limit)

*****END OF REPORT*****

For Chennai Testing Laboratory Pvt Ltd

Authorised Signatory

A - Super 19 | T.V.K. Industrial Estate | Guindy
Chennai - 600 032 | Tamil Nadu | India
E-mail : chennaitestinglab@gmail.com
Telefax : +91-44-2250 1757

National Accreditation Board for Testing and Calibration Laboratories

(A Constituent Board of Quality Council of India)

CERTIFICATE OF ACCREDITATION

CHENNAI TESTING LABORATORY PRIVATE LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

A Super 19, TVK Industrial Estate, Guindy, Chennai, Tamil Nadu

in the field of

TESTING

Certificate Number TC-6133 *(in lieu of T-1873 & T-3491)*

Issue Date 08/06/2017 **Valid Until** 07/06/2019

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Signed for and on behalf of NABL

N. Venkateswaran
Program Director

8907697010003000061

Anil Relia
Chief Executive Officer

Gmail **Chennai Testing Lab <chennaitestinglab@gmail.com>**

RE: T-1349_extension of validity

sunitarawat@nabl.qcin.org <sunitarawat@nabl.qcin.org> Fri, Jun 28, 2019 at 12:23 PM
To: chennaitestinglab@gmail.com

Dear Sir

Further to my mail below dated 24 May 2019, kindly be informed of the correction in date for extension of validity.

Please be informed that NABL has decided to extend the validity of your current accreditation for the existing scope and authorized signatories in Chemical & Biological testing disciplines for the existing scope and authorized signatories till 07.09.2019.

You may continue to issue test reports with NABL symbol for the existing scope and authorized signatories.

Best regards

SUNITA RAWAT
Joint Director
National Accreditation Board for Testing and Calibration Laboratories
(राष्ट्रीय परिक्षण और अंशशोधन प्रयोगशाला प्रत्यायन बोर्ड)
A Constituent Board of Quality Council of India (QCI)
NABL House, Plot No.45, Sector 44,
Gurugram-122002, Haryana

Mobile: +91-9540871844
Ph. +91-124-4679711(Direct)

From: sunitarawat@nabl.qcin.org <sunitarawat@nabl.qcin.org>
Sent: 24 May 2019 17:42
To: chennaitestinglab@gmail.com
Subject: T-1349_extension of validity

Dear Sir

Please be informed that NABL has decided to extend the validity of your current accreditation for the existing scope and authorized signatories in Chemical & Biological testing disciplines for the existing scope and authorized signatories till 28.06.2019.

You may continue to issue test reports with NABL symbol for the existing scope and authorized signatories.

Best regards

SUNITA RAWAT
Joint Director
National Accreditation Board for Testing and Calibration Laboratories
(राष्ट्रीय परिक्षण और अंशशोधन प्रयोगशाला प्रत्यायन बोर्ड)
A Constituent Board of Quality Council of India (QCI)
NABL House, Plot No.45, Sector 44,
Gurugram-122002, Haryana

Mobile: +91-9540871844
Ph. +91-124-4679711(Direct)

Annexure - II

Study of Bioaccumulation on plants and brakish water in Buckingham cana near ETPs Replacement TPP (1X660 MW)

Prepared for

Tamil Nadu Generation and Distribution Corporation Limited
(TANGEDCO)

144, Annasalai, Chennai, 600002.

Annamalai University
Centre of Advanced Study in Marine Biology
Faculty of Marine Sciences
Parangipettai, 608 502

February 2019

LIST OF FIGURES

1. BACKGROUND

Ennore Thermal Power Station (ETPS) is a coal fired power station in Ernavur village, Thiruvottriyur Taluk in Tiruvallur district, Tamil Nadu, India. ETPS is one of the major thermal power plants in the state which is owned and operated by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO), a subsidiary of the Tamil Nadu Electricity Board (TNEB). Heavy metal contamination is a globally recognized environmental issue, threatening human life very seriously. Increasing population and high demand for food resulted in release of various contaminants into environment that finally contaminate the food chain

2. PROJECT SCOPE AND OBJECTIVES

- To analysis the water and sediment quality condition of the Buckingham canal and ash dumping site at Ennore region
- To quantify the heavy metals concentration in the water sediment samples of Buckingham canal and ash dumping site at Ennore region
- To observe the heavy metal bioaccumulation in plants in and around the Buckingham canal and ash dumping site at Ennore region

3. MATERIAL AND METHODS

The present survey was conducted in selected plants from eight stations in and around ETPS complex during the period 11th and 12th February 2019 at Ennore region to study the water, sediment quality and heavy metals bioaccumulation in selected plants from eight stations.

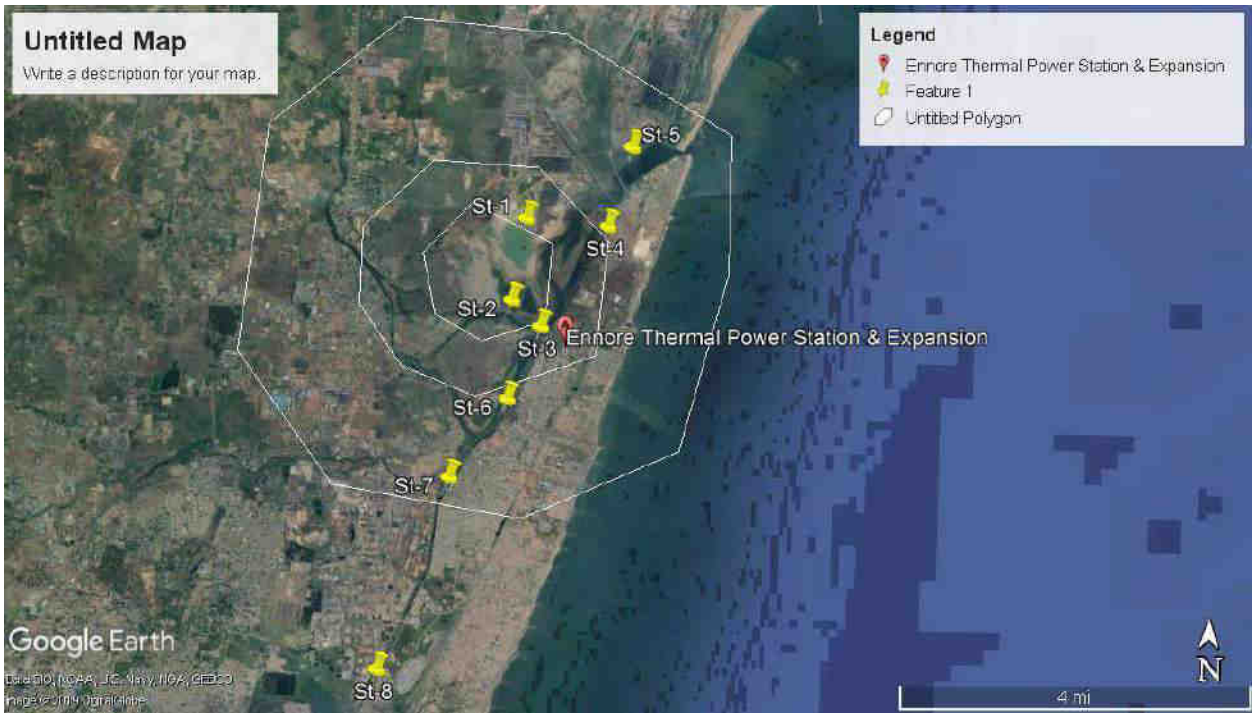


Figure 1. Map showing study area

Collection of samples

Water samples were collected at eight different stations, based on the sampling plan. water samples were collected by using Niskin water sampler and preserved and carefully transported to the laboratory for analyses.

Station code	Latitude	Longitude	Remarks
1	13°13'7.31"N	80°18'11.24"E	Ash dumping area
2	13°12'18.59"N	80°18'3.59"E	Under the bridge
3	13°12'3.17"N	80°18'21.40"E	Near to the bridge on Buckingham canal
4	13°13'3.40"N	80°19'1.08"E	Buckingham canal towards sea side
5	13°13'50.92"N	80°19'14.73"E	Buckingham canal towards sea side
6	13°11'19.92"N	80°18'2.17"E	Buckingham canal city side
7	13°10'32.66"N	80°17'28.07"E	Buckingham canal under the bridge Sathiyamoorthi nagar
8	13° 8'37.61"N	80°16'46.66"E	Buckingham canal near Shastri nagar

Water Sample -WTW – Profi Line Multi 3420 Multi-parameter portable meter

The onsite measurements like salinity and pH were carried out by WTW - ProfiLine 3420 Multi-parameter portable meter.

Preservation of Water Sample and Laboratory Analysis

Water samples were collected in a polypropylene bottle, and all samples were carefully placed in the ice box maintaining 4◦C to transport laboratory. In the laboratory, water samples were filtered through Whatman GF/C filter paper and analyzed for organic matter and all other nutrients; ammonia (NH_4), silicate (SiO_3), inorganic phosphate (Po_4), nitrate (NO_3) and nitrite (NO_2) were determined by following the methods described by Strickland and Persons (1972)

Sediment Sampling

Sediments samples were collected at each station, by using a sediment sampler van Veen grab. The collected sediment samples were transferred to polyethylene bags and preserved for further analyses. The sediment samples from the center of the crab samplers collected to avoid metal contamination using plastic scopes and stored in plastic bags were subjected to examine heavy metal concentrations such as, Zinc, Cadmium, Lead, Nickel, Copper, Fe.

Heavy metals analysis

The following heavy metals (Cd, Cu, Ni, Pb, Zn and Fe) were analyzed in sophisticated instrumentation facility ICP-OES at the center. The instrument Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) is used in atomic spectroscopy, and during analysis, the sample is decomposed by intense heat into a cloud of hot gases containing free atoms and ions of the element(s) of interest. The high temperatures cause significant amounts of collisional excitation and ionization of the sample atoms. Once the atoms or ions are in their excited state, they can decay to lower states through thermal or radiative (emission) energy transitions. During

ICP-OES analysis the intensity of the light emitted at specific wavelengths is measured and used to determine the concentration of the element(s) of interest. In ICP-OES analysis the thermal excitation sources can populate a large number of different energy levels for several different elements at the same time. All of the excited atoms and ions can then emit their characteristic radiation at the same time. This results in the flexibility to choose from several different emissions concurrently and allows detection of multiple elements simultaneously.

The installation qualification (IQ), operational qualification (OQ), and performance qualification (PQ) were complete prior to analysis. Water samples were filtered and preserved with 1 ml of nitric acid. The sediment samples were oven dried at 110°C for 24 hours and ground in a mortar. For the extraction of heavy metals acid digestion procedure was adopted as described by Watling and Watling (1982). The heavy metals were analyzed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES 5100). The instrument was calibrated with standard after every five samples to ensure analytical accuracy.

4. RESULTS

4.1.Physico chemical parameters

The temperature in the study area was ranged between 28.6 and 28.9 ^{o}C. The minimum temperature was recorded at station 1 and the maximum was observed at station 8. The pH value in the study area ranged between 7.64 and 7.99. The minimum ph value was recorded at station 4 and the maximum was recorded at station 8. The salinity concentration in the water samples of Ennore region ranged between 0 and 7 ppt. The dissolved oxygen value in the water samples of Ennore region ranged between 3.14 and 5.21 mg/l. the minimum value was recorded at station 4 and the maximum was recorded at station 1.

The nitrite concentration in the water samples of Ennore region ranged between 1.014 and 3.059 µmol/l. The minimum concentration was recorded at station 7 and the maximum was recorded at station 5. The nitrate concentration in the water samples of Ennore region ranged between 1.28 and 6.22 µmol/l. the minimum concentration was recorded at station 3 and the maximum was recorded at station 4. The ammonia concentration in the water samples of Ennore region ranged between 6.22 and 15.7 µmol/l. the minimum concentration was recorded at station 1 and the maximum was recorded at station 5. The inorganic phosphate concentration in the water samples of Ennore region ranged between 14.44 and 100.52 µmol/l. The minimum concentration was recorded at station 3 and the maximum was recorded at station 4. silicate concentration in the water samples of Ennore region ranged between 54.44 and 246.79 µmol/l. The minimum concentration was recorded at station 3 and the maximum was recorded at station 4

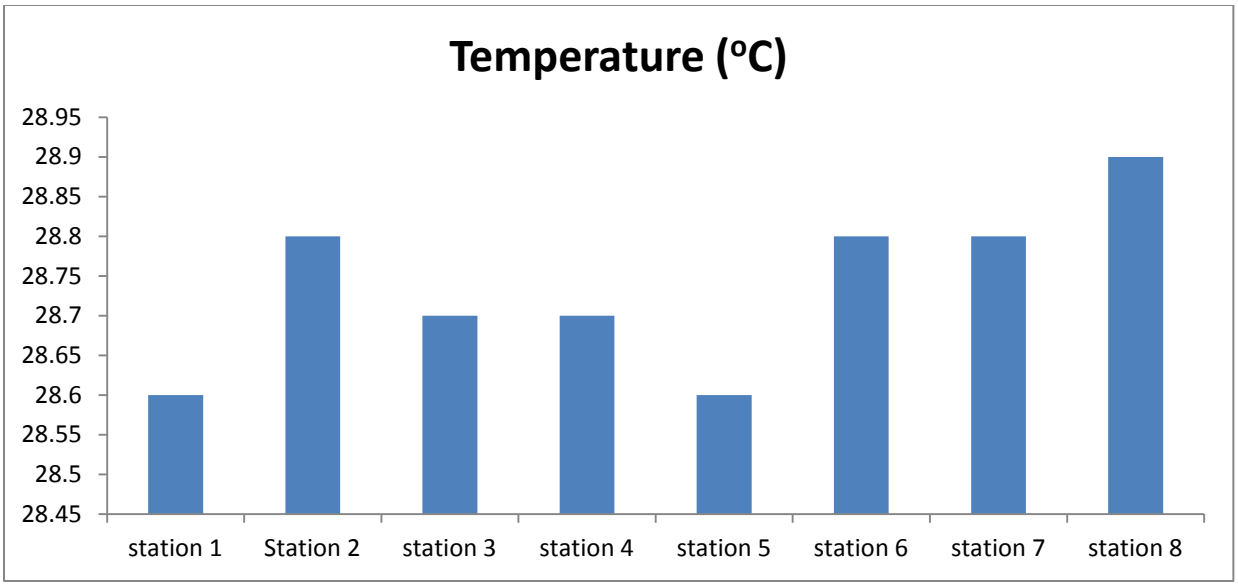


Figure 2. Temperature in the water samples of Ennore region

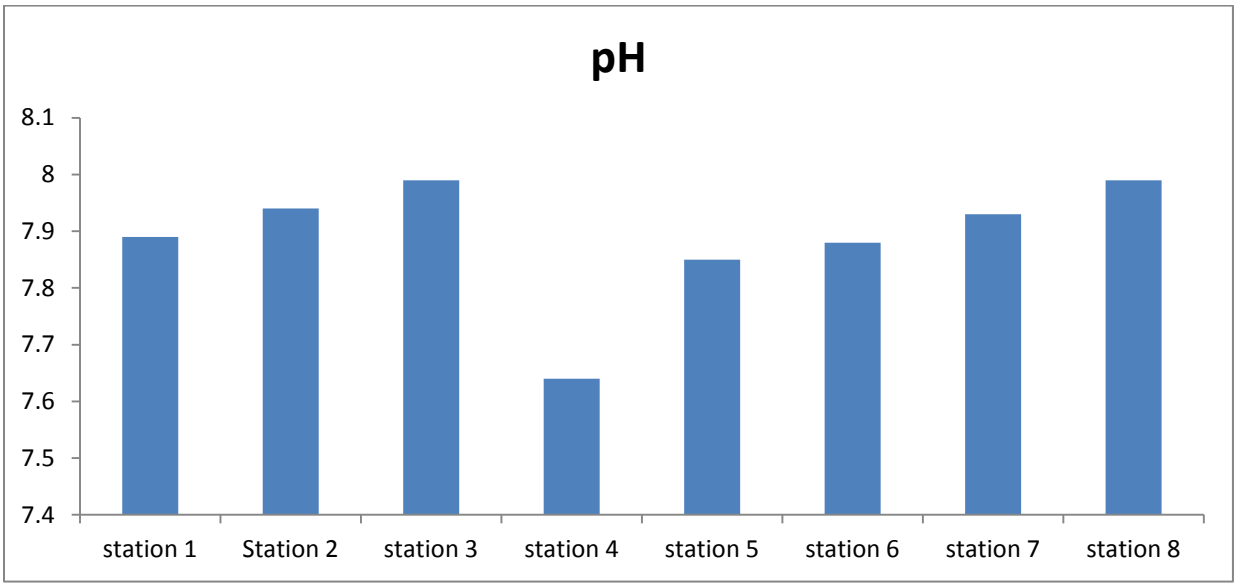


Figure 3. pH value in the water samples of Ennore region

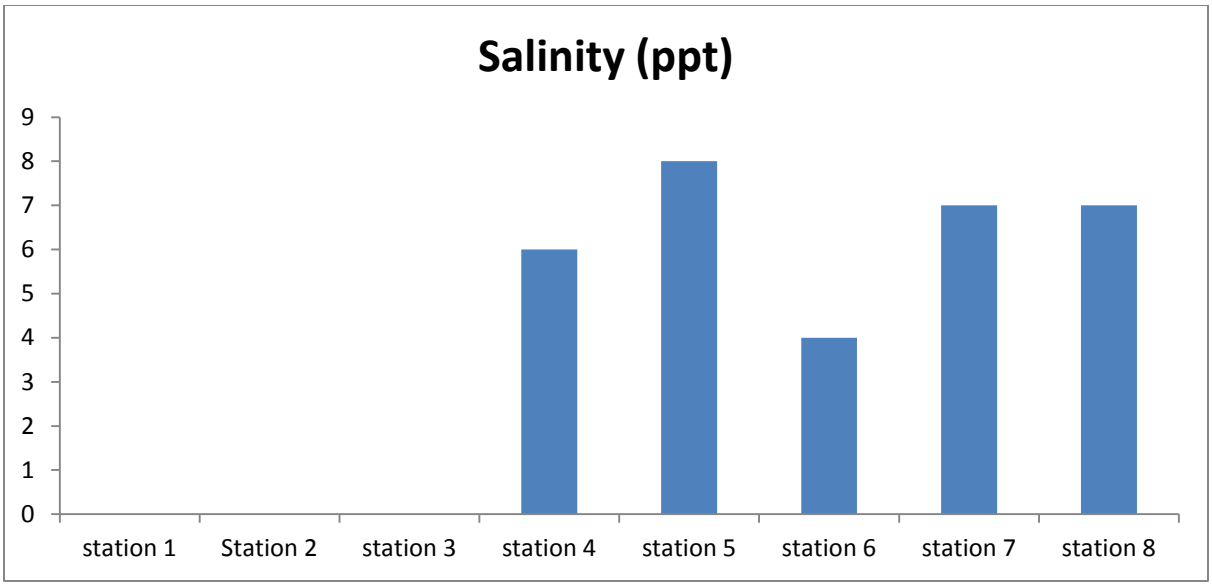


Figure 4. Salinity concentration in the water samples of Ennore region

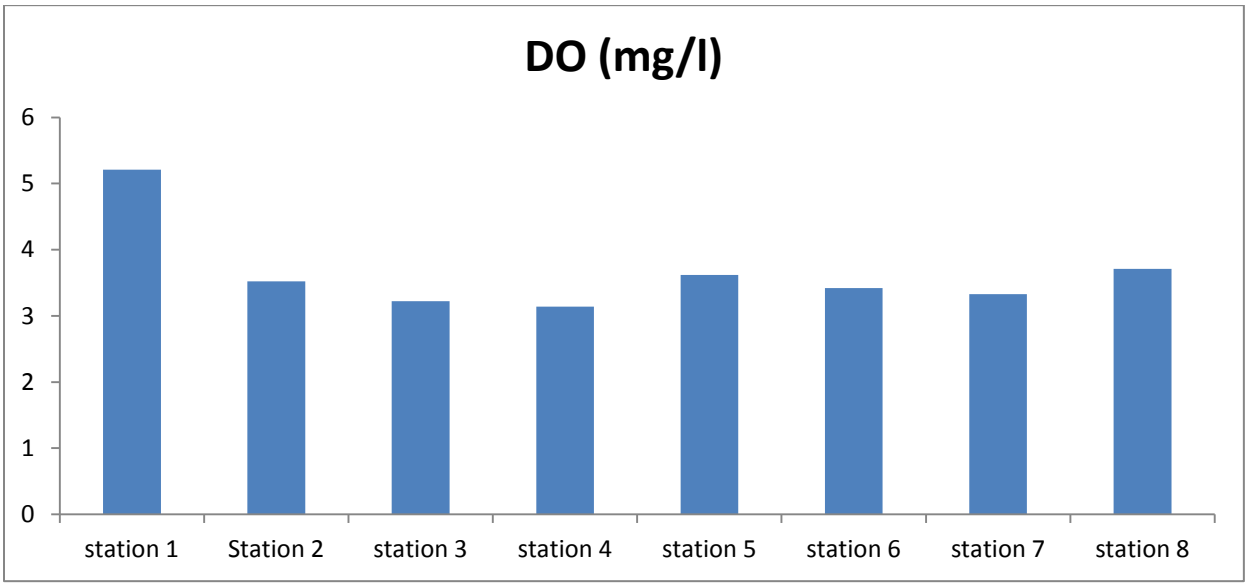


Figure 5. Dissolved oxygen in the water samples of Ennore region

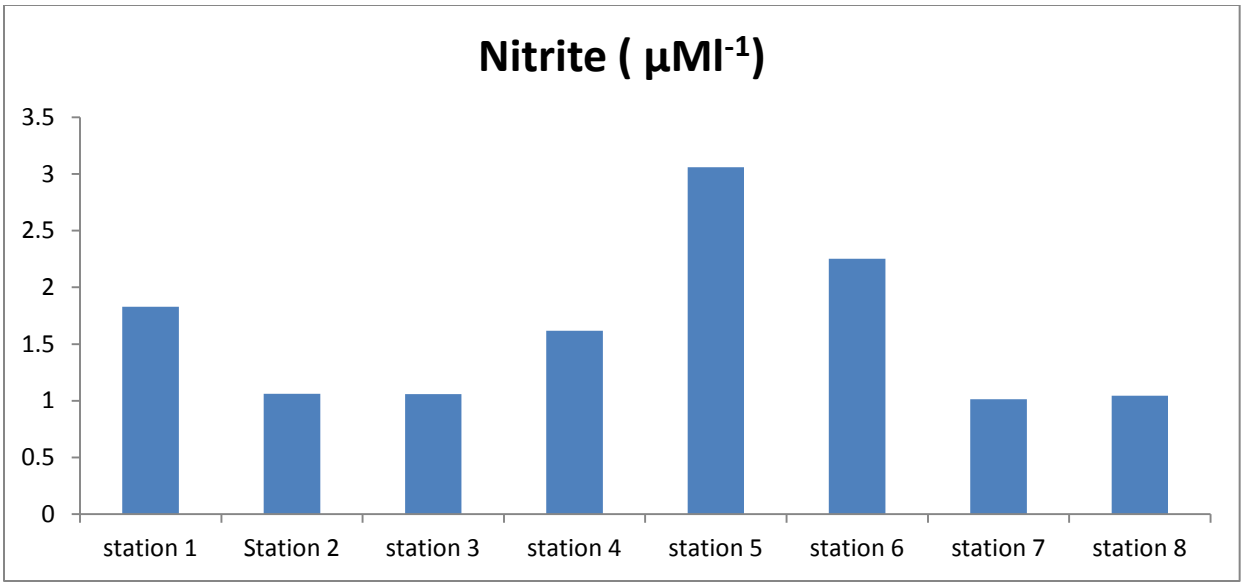


Figure 6. Nitrite concentration in the water samples of Ennore region

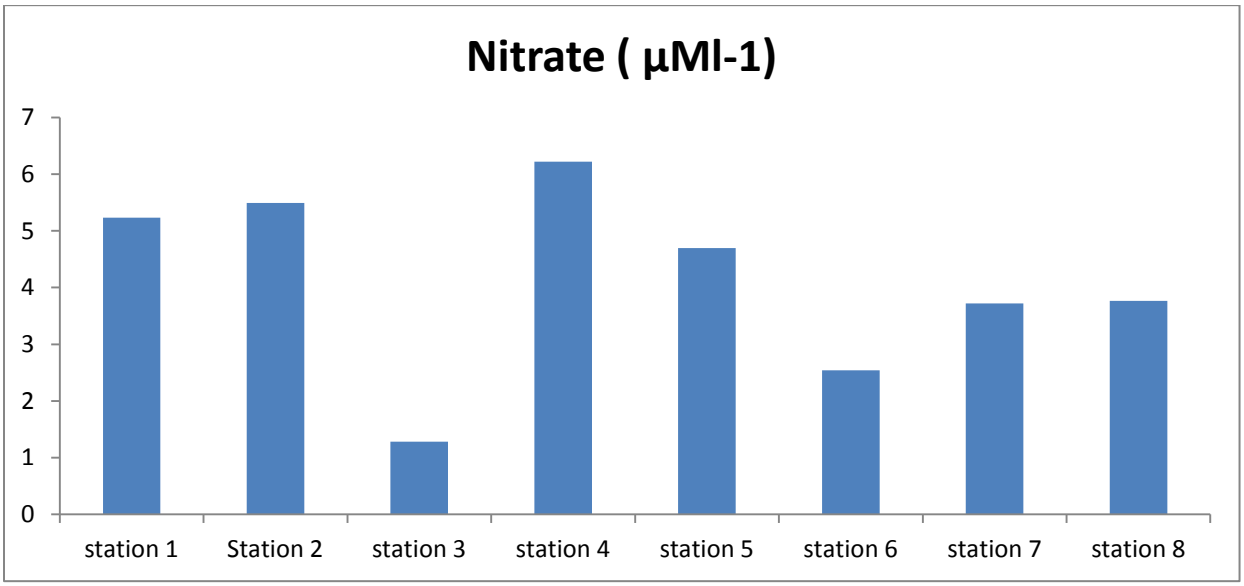


Figure 7. Nitrate concentration in the water samples of Ennore region

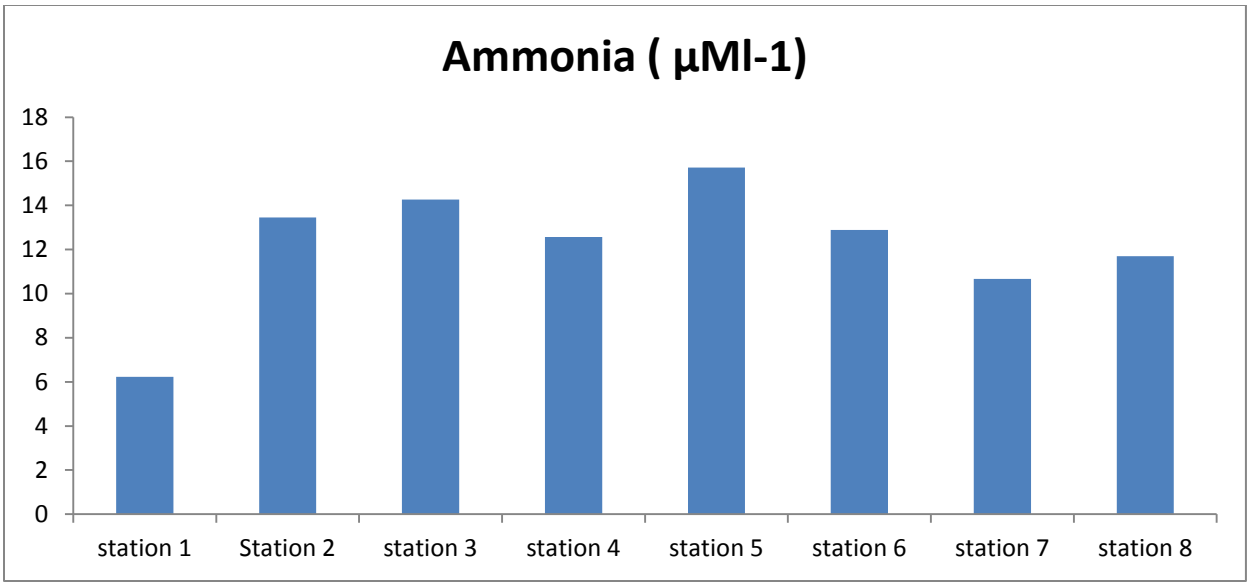


Figure 8. Ammonia concentration in the water samples of Ennore region

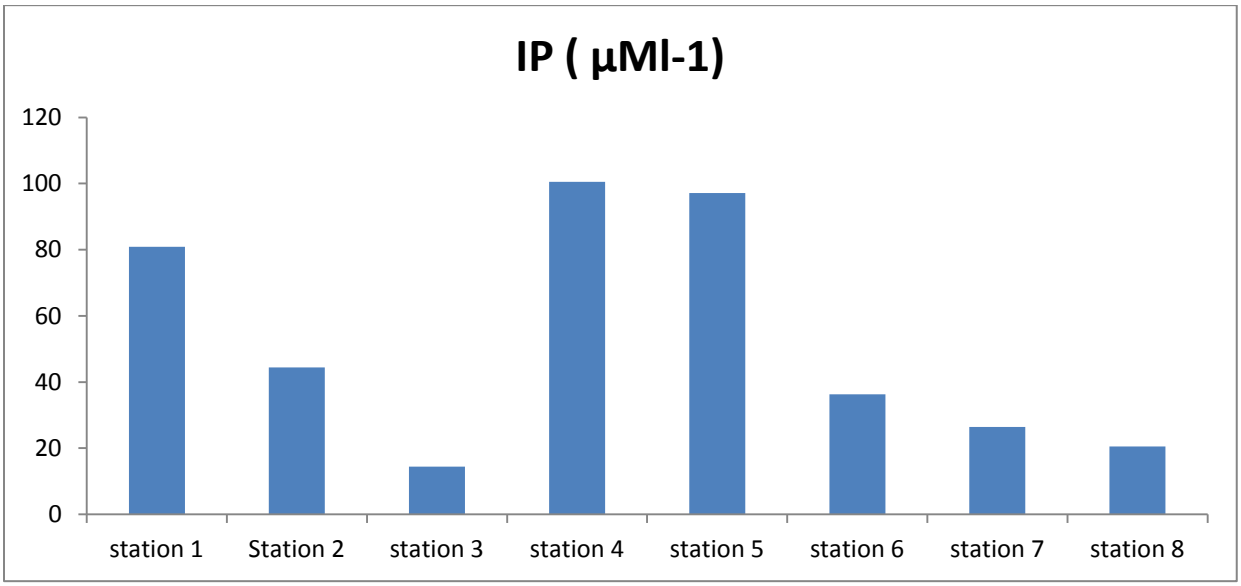


Figure 9. Inorganic phosphate concentration in the water samples of Ennore region

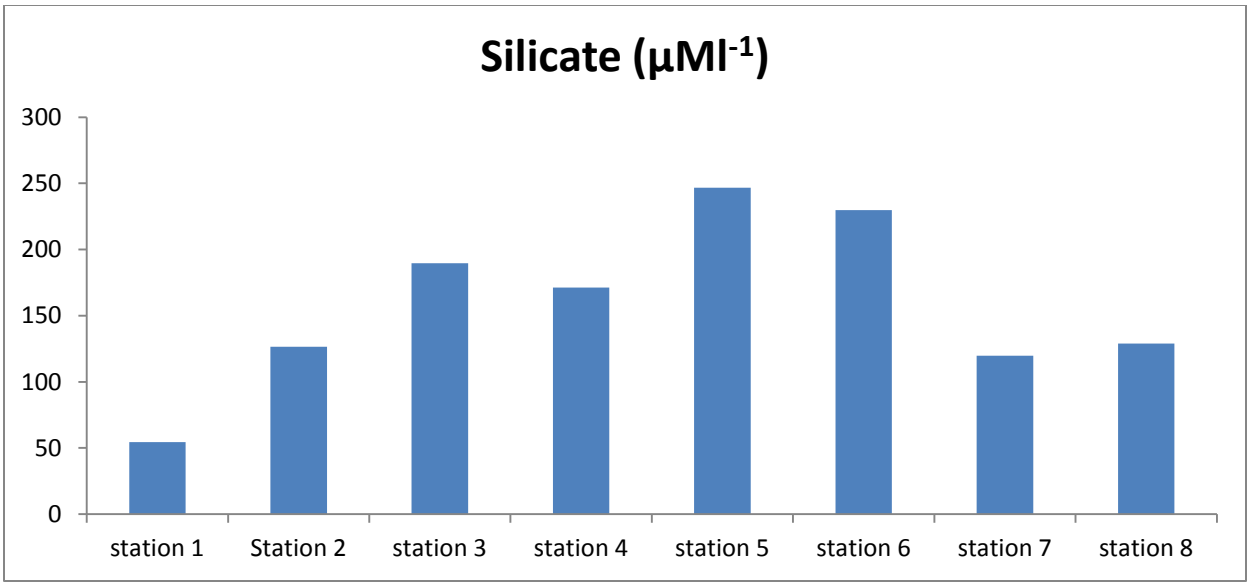


Figure 10. Silicate concentration in the water samples of Ennore region

4.2.Heavy metals concentration in water samples

In this survey six heavy metals were analyses (cadmium, copper, iron, nickel, zinc and lead) among then cadmium and lead found to be below detectable level.

The copper concentration in the water samples of Ennore region ranged between 6.24 and 11.63 ppb. The minimum concentration was recorded at station 4 and the maximum was recorded at station 8. The iron concentration in the water samples of Ennore region ranged between 398 and 573 ppb. The minimum concentration was recorded at station 3 and the maximum was recorded at station 2. The nickel concentration in the water samples of Ennore region ranged between 5.4 and 10.9 ppb. The minimum concentration was recorded at station 2 and the maximum was recorded at station 6. The zinc concentration in the water samples of Ennore region ranged between 6.9 and 13.2 ppb. The minimum concentration was recorded at station 8 and the maximum was recorded at station 4.

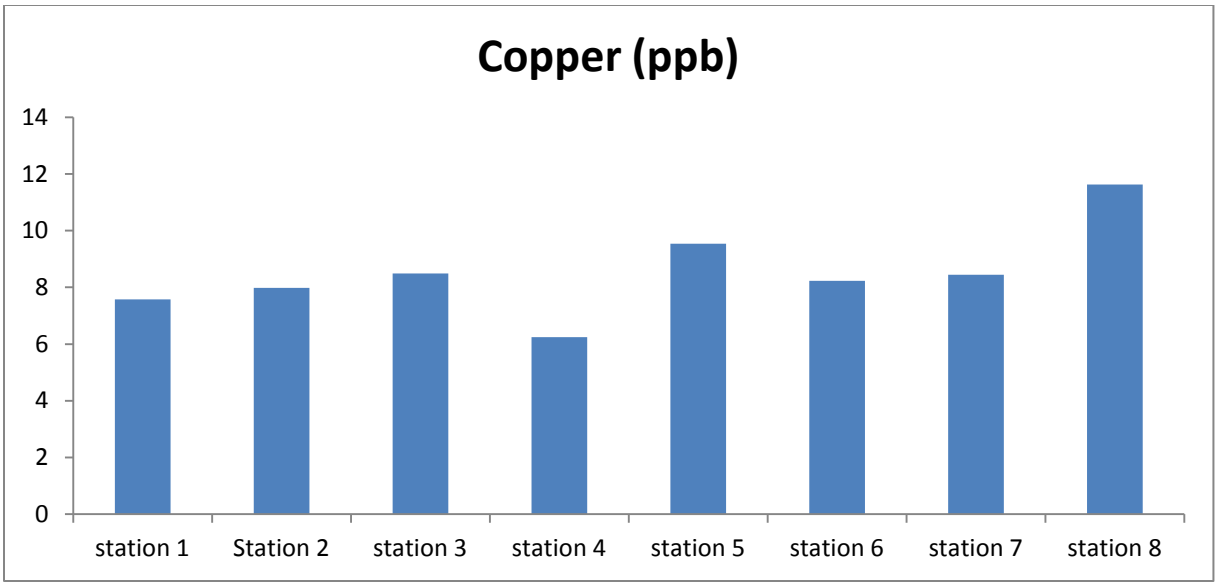


Figure 11. Copper concentration in the water samples of Ennore region

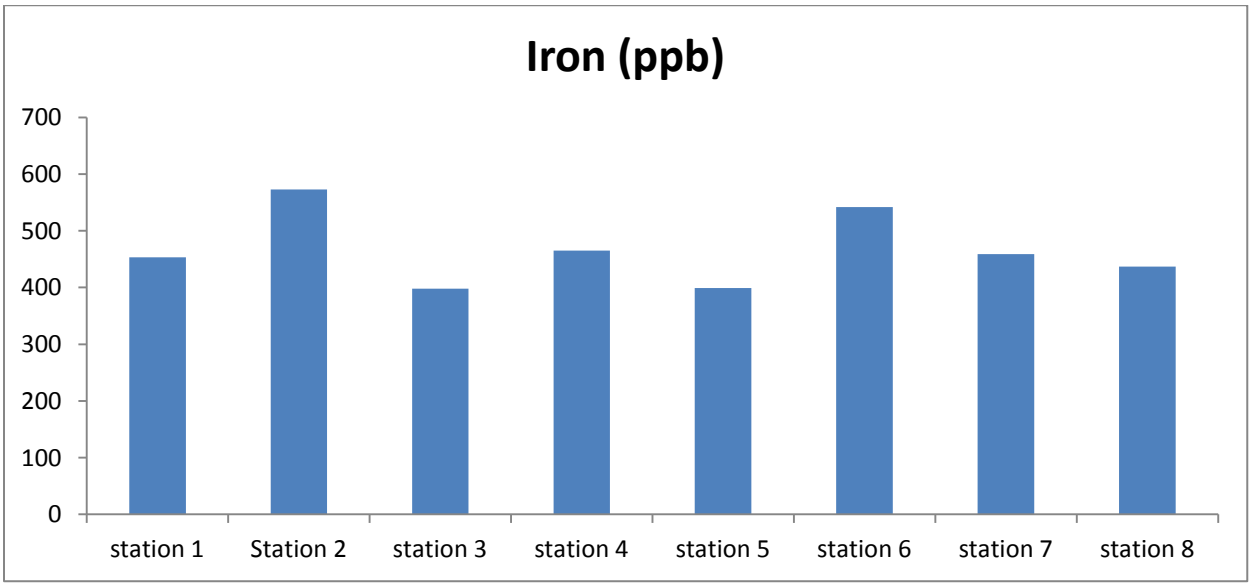


Figure 12. Iron concentration in the water samples of Ennore region

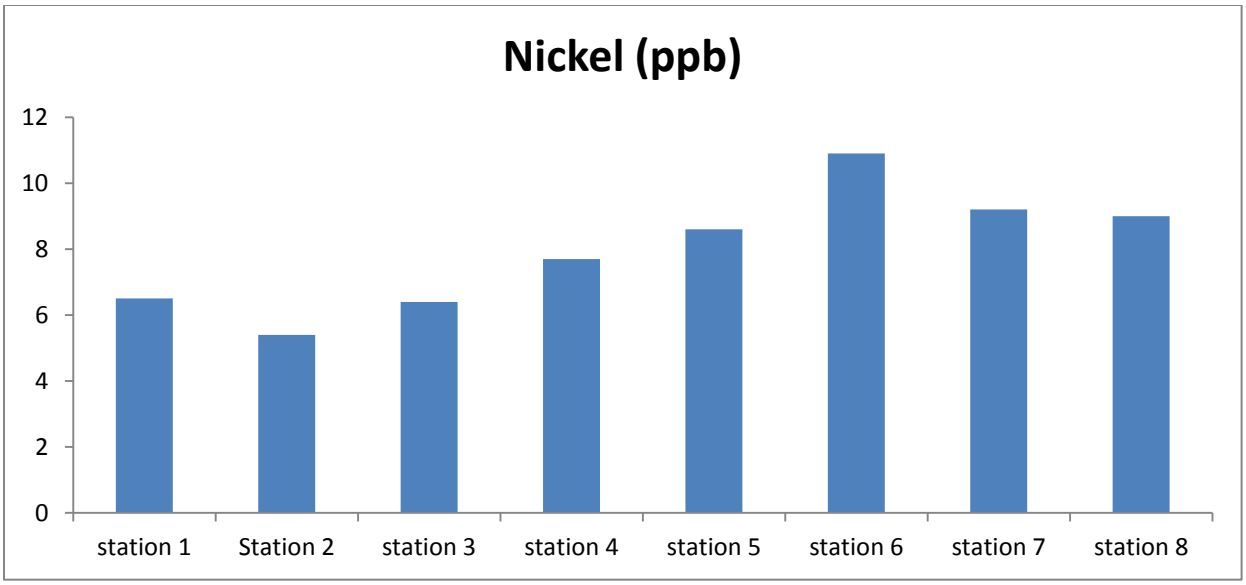


Figure 13. Nickel concentration in the water samples of Ennore region

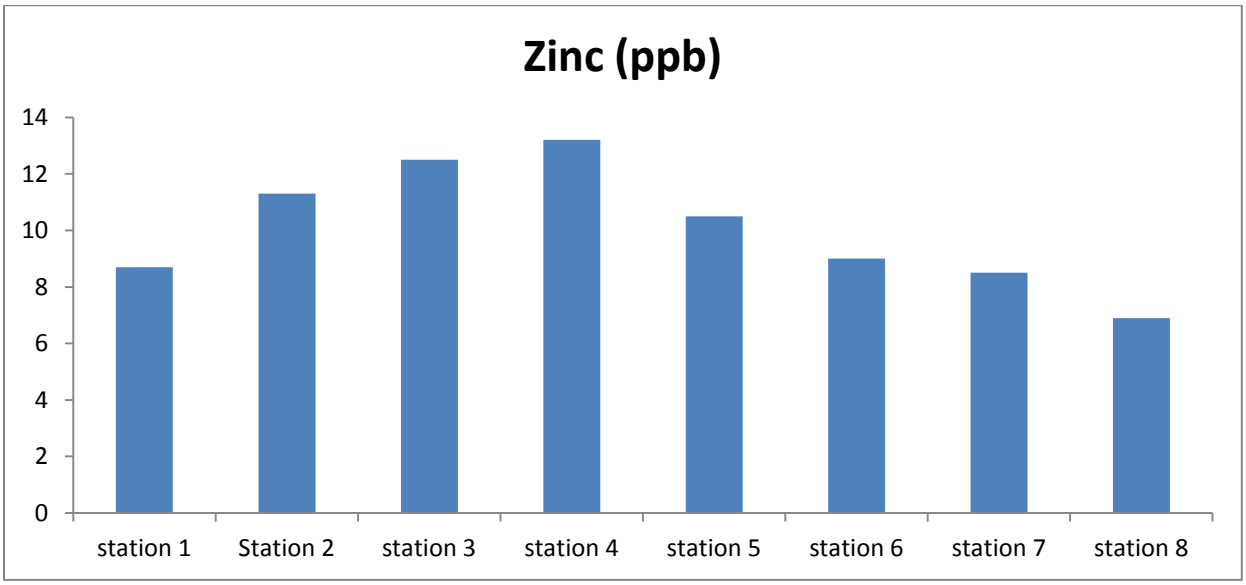


Figure 14. Zinc concentration in the water samples of Ennore region

4.3.Heavy metals concentration in sediments samples

The cadmium concentration in the sediment samples of Ennore region ranged between 0.9and 98.7 ppm. The minimum concentration was recorded at station 1 and the maximum was recorded at station 2. The copper concentration in the sediment samples of Ennore region ranged between 5.9and 484.4 ppm. The minimum concentration was recorded at station 1 and the maximum was recorded at station 2. The iron concentration in the sediment samples of Ennore region ranged between 3124.3 and 87904 ppm. The minimum concentration was recorded at station 1 and the maximum was recorded at station 2. The lead concentration in the sediment samples of Ennore region ranged between 2.996 and 95.1 ppm. The minimum concentration was recorded at station 1 and the maximum was recorded at station 5. The nickel concentration in the sediment samples of Ennore region ranged between 4.657 and 79.7 ppm. The minimum concentration was recorded at station 1 and the maximum was recorded at station 2. The zinc concentration in the sediment samples of Ennore region ranged between 33 and 3516 ppm. The minimum concentration was recorded at station 1 and the maximum was recorded at station 3.

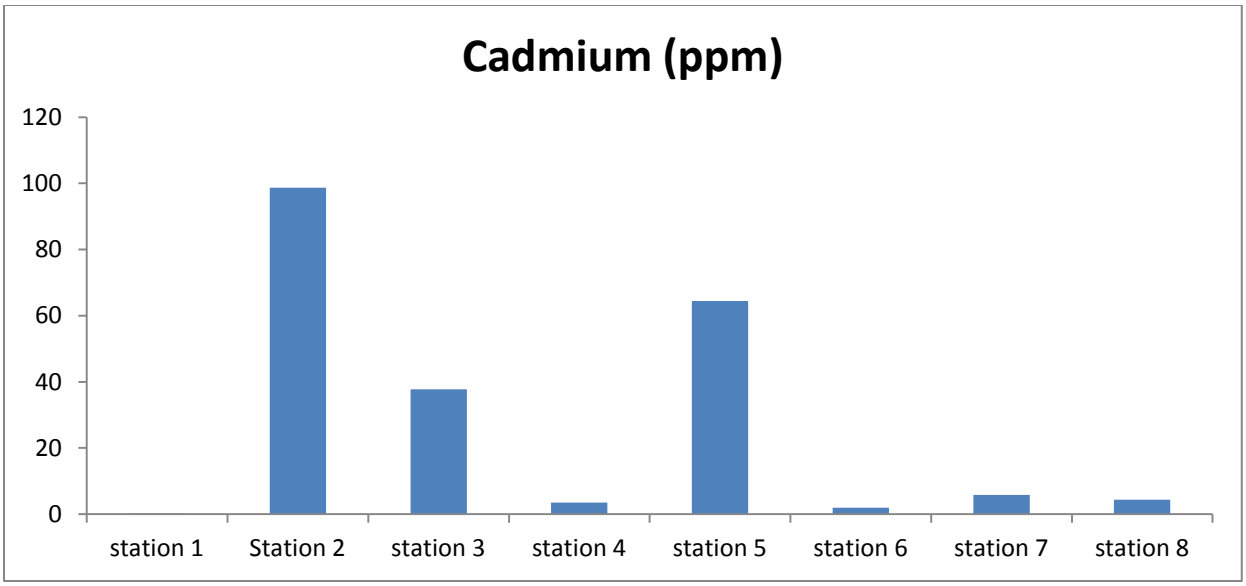


Figure 15. Cadmium concentration in the sediment samples of Ennore region

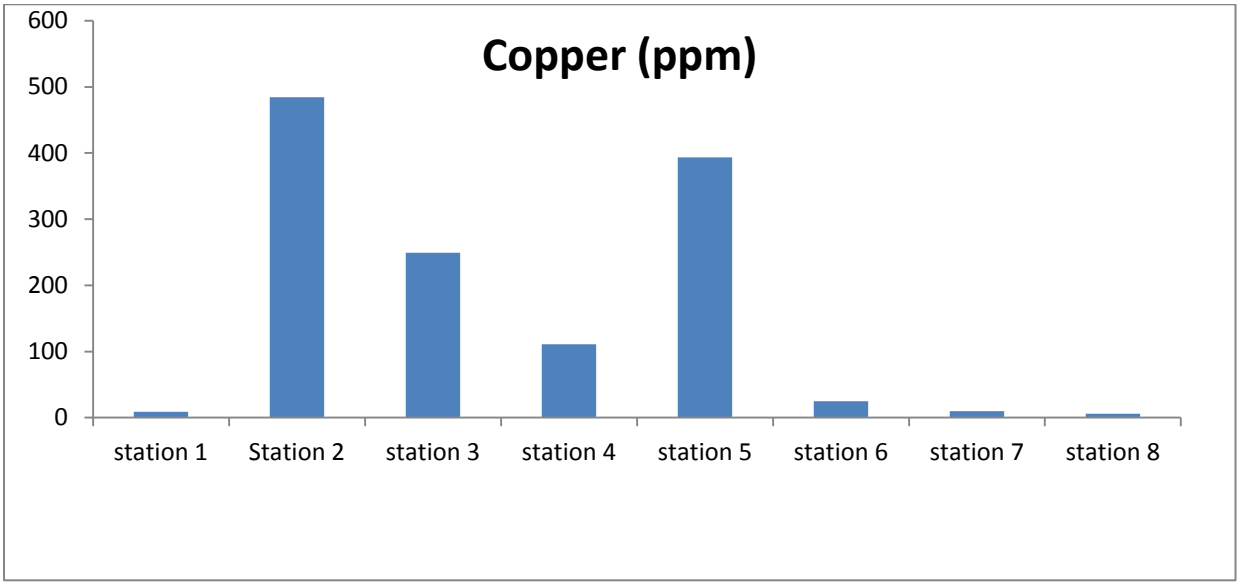


Figure 16. Copper concentration in the sediment samples of Ennore region

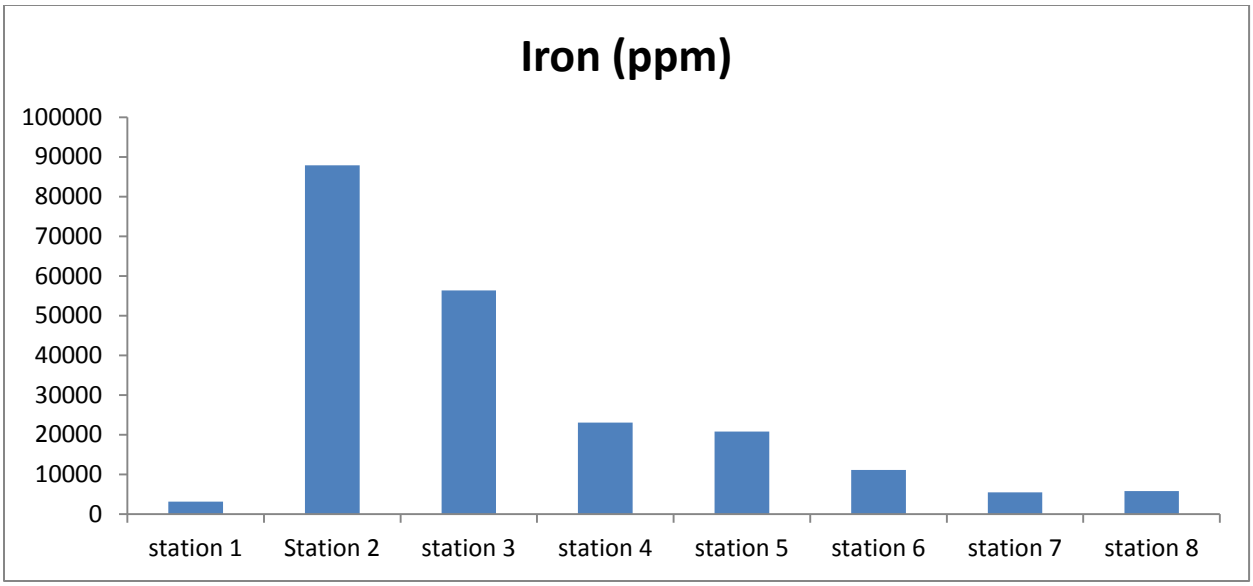


Figure 17. Iron concentration in the sediment samples of Ennore region

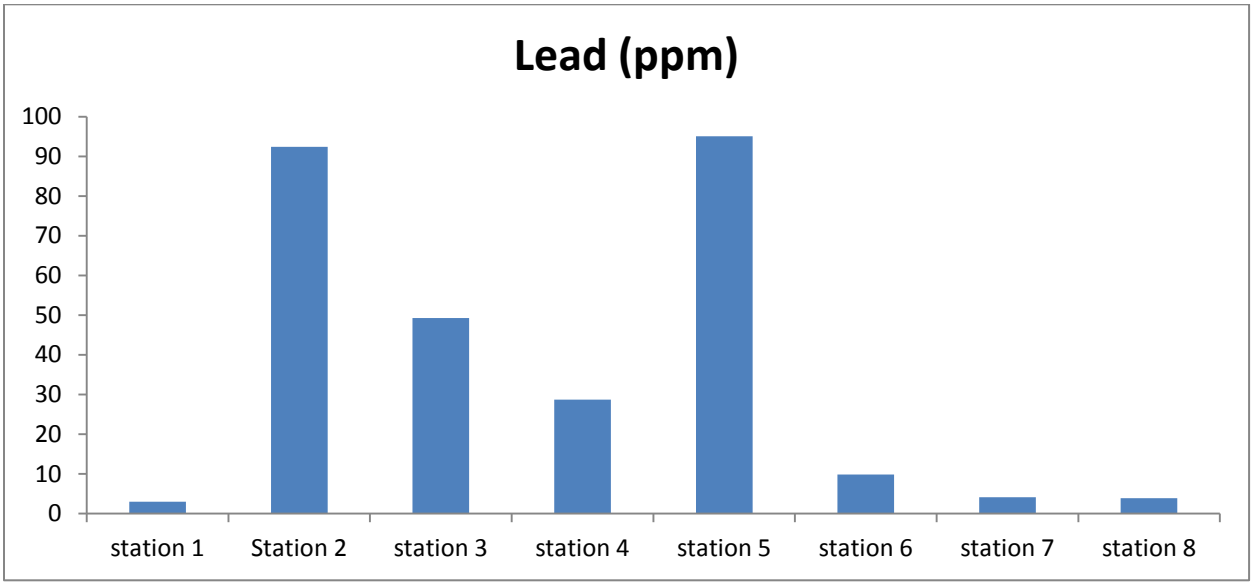


Figure 18. Lead concentration in the sediment samples of Ennore region

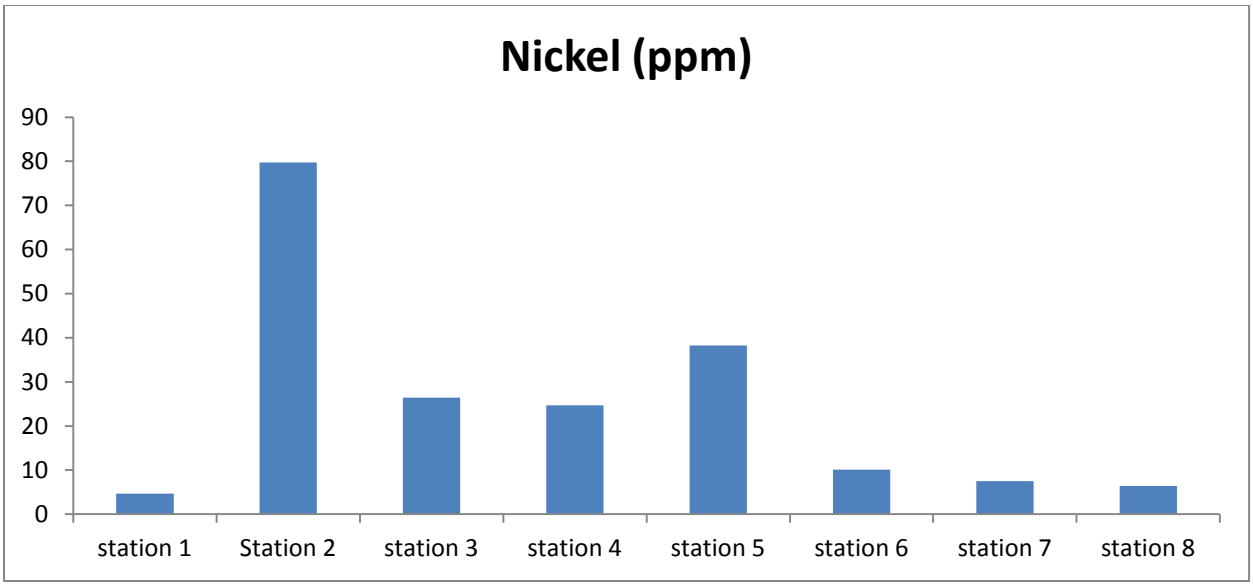


Figure 19. Nickel concentration in the sediment samples of Ennore region

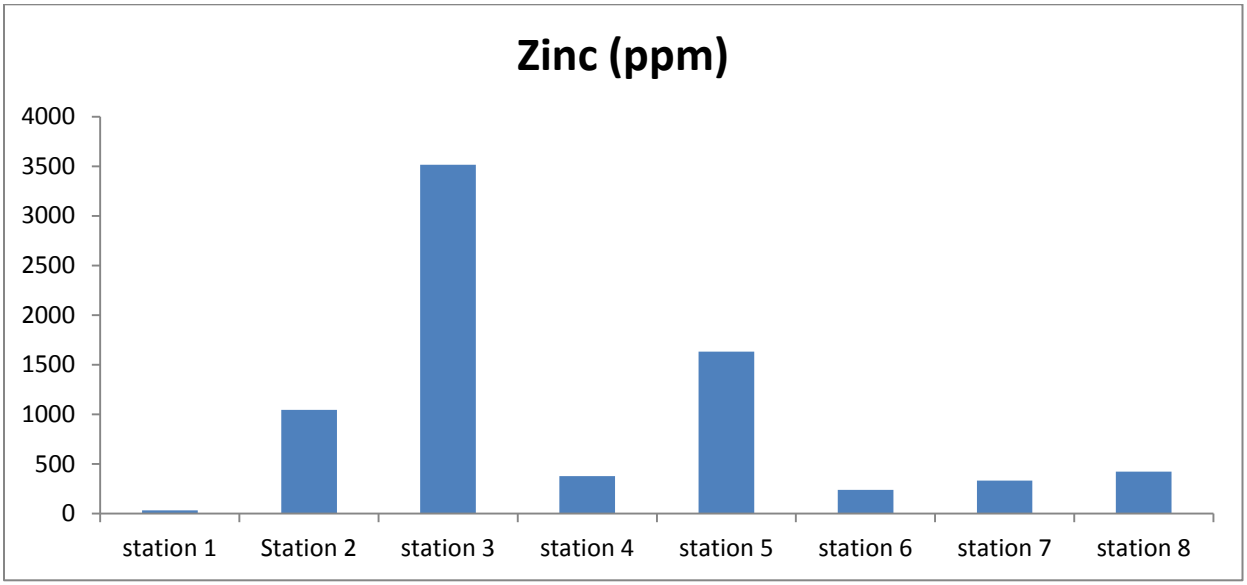


Figure 20. Zinc concentration in the sediment samples of Ennore region

4.4. Heavy metal accumulation in plants

Prosopis juliflora is the terrestrial plant collected from the ask dumping site for the analysis of heavy metals (cadmium, copper, lead, nickel zinc and iron). The concentration of heavy metals found in the following order Zinc>copper>nickel>lead>cadmium. Almost, the concentration of heavy metals found to be similar in all the station except zinc recorded higher value in station 2 and 3.

Avicennia marina is the mangrove plants collected from five different stations based on the availability. The heavy metal accumulation found to be similar in all the stations. The concentration of heavy metals in the following order Zinc>copper>nickel>lead>cadmium.

Salicornia sp. is the salt marsh plant collected from seven different station based on the availability. The heavy metals concentration recorded in the following order Zinc>copper>nickel>lead>cadmium. Station 5 found to be slightly higher concentration of all the heavy metals.

Sesuvium portulacastrum is a salt marsh plant collected from eight different locations at Ennore region for heavy metals analysis. The heavy metals concentration found in the following order Zinc>copper>nickel>lead>cadmium.

Grass samples were collected from all the station. The heavy metals concentration observed in the following order Zinc>copper>nickel>lead>cadmium. Among them, zinc and copper found to be higher in all the station when compare with other heavy metals.

Ricinus communis is the terrestrial plant collected from five different station based on the availability. The heavy metals concentration found in the following order

Zinc>copper>nickel>lead>cadmium. Among them zinc found to be higher in all the station than other heavy metals.

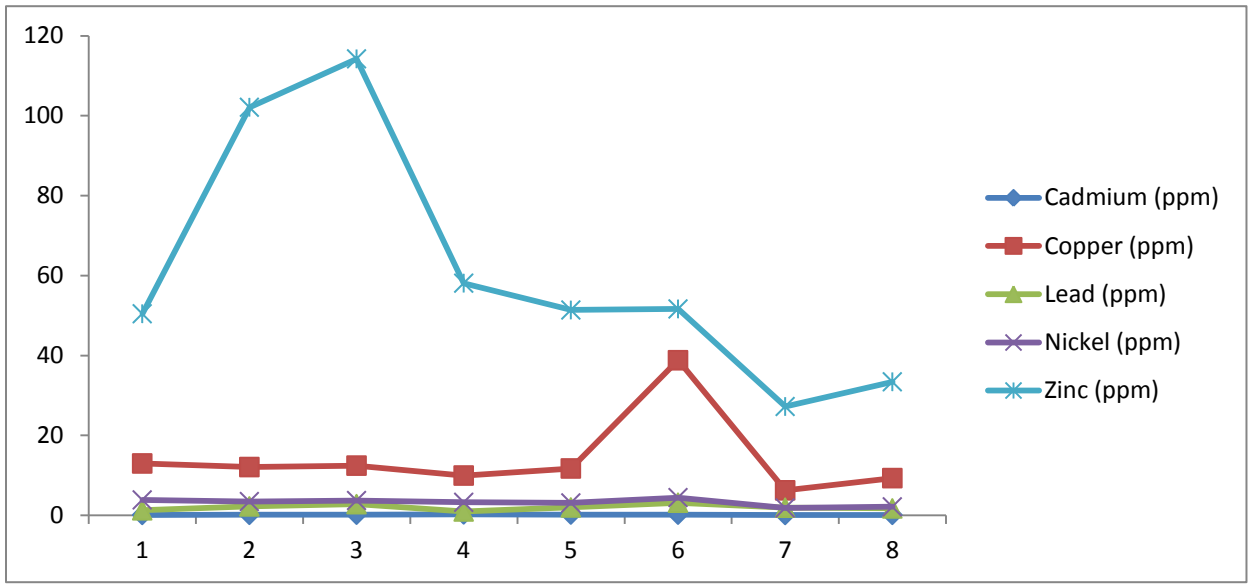


Figure 21. Heavy metals concentration in *Prosopis juliflora*

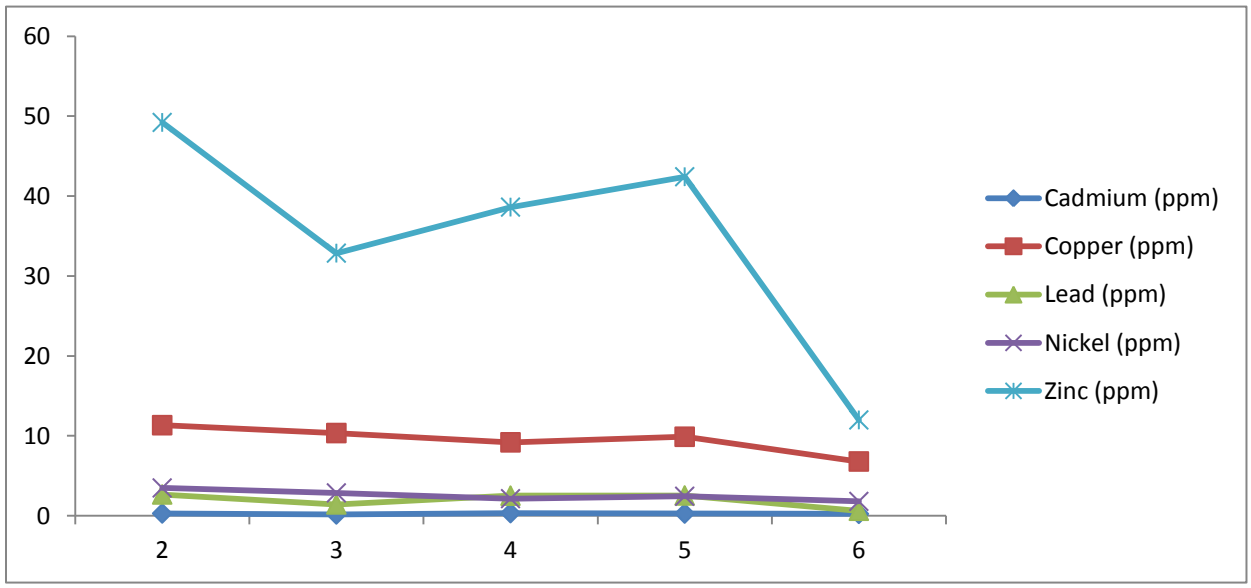


Figure 22. Heavy metals concentration in *A. marina*

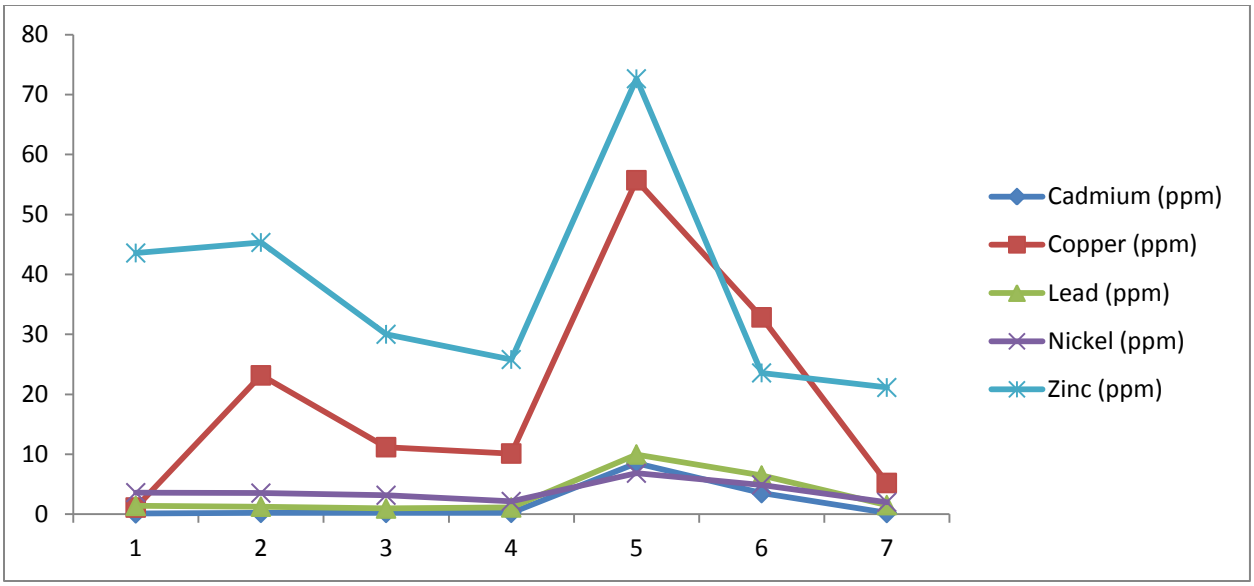


Figure 23. Heavy metals concentration in *Salicornia* sp.

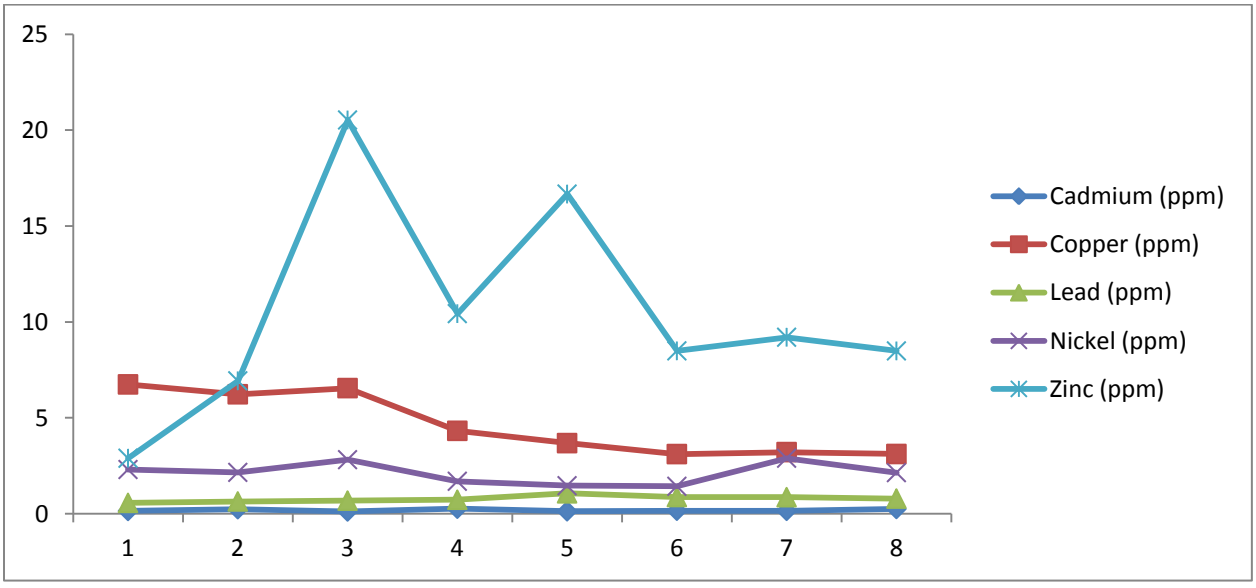


Figure 24. Heavy metals concentration in *Sesuvium portulacastrum*

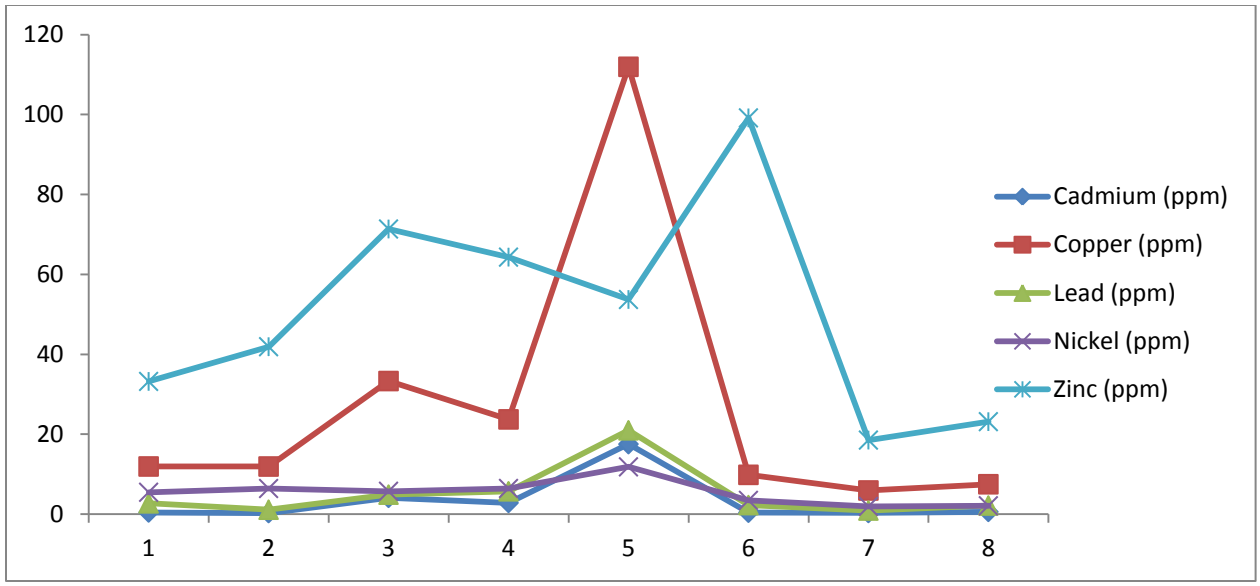


Figure 25. Heavy metals concentration in *grass*

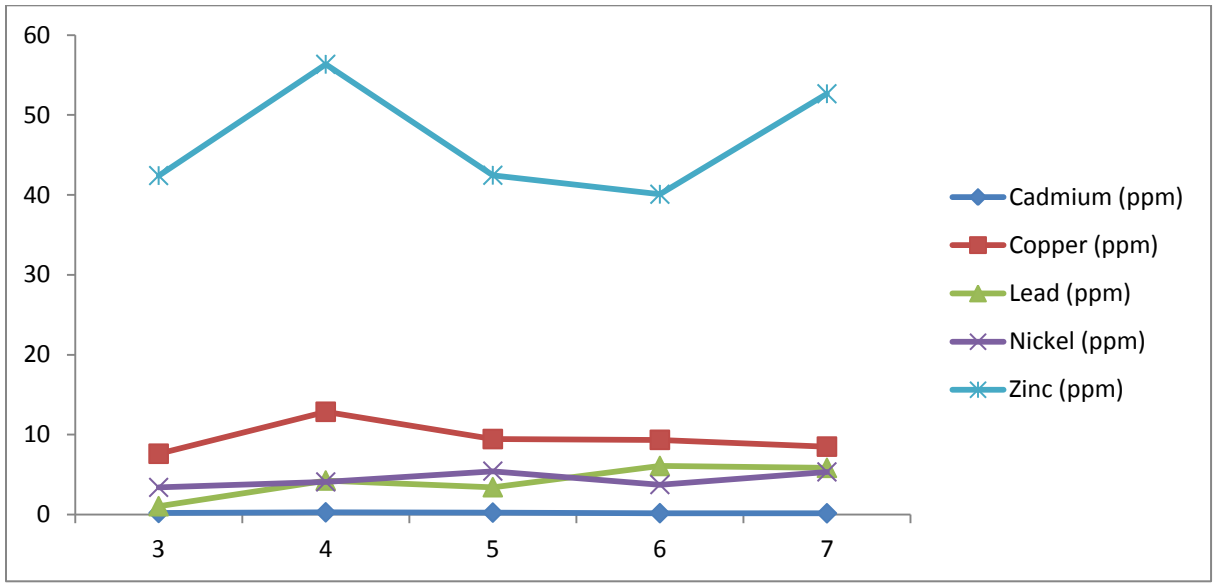


Figure 26. Heavy metals concentration in *Ricinus communis*

The iron concentrations in six selected plants were analyzed from the Ennore region. Among them, the concentrations were higher in grass and *Salicormia* sp. at station 5.

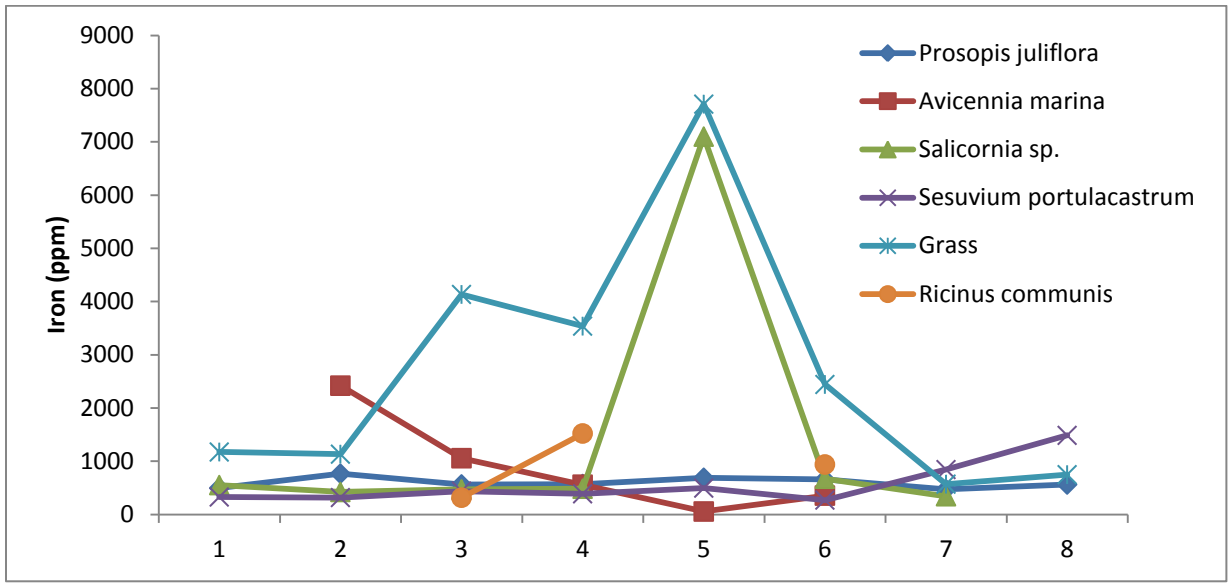


Figure 27. Iron accumulation in plants

Bioconcentration factor (BCF)

The Bioconcentration factor of heavy metals (cadmium, copper, lead, nickel, zinc and iron) in different habitats of plants in Ennore region were analysed and results given in the below table. Sequence of Bio Concentration Factor of heavy metals within the different stations was *grass>Ricinus cummunis>Prosopis juliflora>Salicornia sp.> Sesuvium portulacastrum>A. marina*.

Prosopis juliflora						
	Cadmium	Copper	Lead	Nickel	Zinc	Iron
station 1	0.608	1.490	0.427	0.829	1.528	0.159
Station 2	0.001	0.025	0.024	0.044	0.098	0.009
station 3	0.005	0.050	0.057	0.141	0.032	0.010
station 4	0.072	0.090	0.034	0.133	0.154	0.025
station 5	0.003	0.030	0.021	0.082	0.032	0.033
station 6	0.098	1.560	0.322	0.441	0.217	0.059

station 7	0.018	0.648	0.465	0.248	0.082	0.085
station 8	0.031	1.571	0.445	0.335	0.079	0.097
A. marina						
Station 2	0.003	0.023	0.029	0.044	0.047	0.028
station 3	0.004	0.042	0.029	0.109	0.009	0.019
station 4	0.093	0.083	0.088	0.087	0.102	0.024
station 5	0.004	0.025	0.027	0.064	0.026	0.003
Salicornia sp.						
station 1	0.747	0.127	0.465	0.770	1.319	0.177
Station 2	0.002	0.048	0.014	0.044	0.043	0.005
station 3	0.006	0.045	0.019	0.120	0.009	0.008
station 4	0.066	0.091	0.039	0.086	0.068	0.021
station 5	0.132	0.142	0.105	0.179	0.045	0.341
station 6	1.825	1.320	0.653	0.484	0.099	0.060
station 7	0.035	0.538	0.365	0.265	0.063	0.062
Sesuvium portulacastrum						
station 1	0.758	0.774	0.190	0.493	0.088	0.105
Station 2	0.002	0.013	0.007	0.027	0.007	0.004
station 3	0.003	0.026	0.014	0.107	0.006	0.008
station 4	0.075	0.039	0.026	0.069	0.028	0.017
station 5	0.002	0.009	0.011	0.038	0.010	0.024
station 6	0.083	0.125	0.089	0.142	0.036	0.024
station 7	0.026	0.332	0.208	0.385	0.028	0.153
station 8	0.057	0.525	0.202	0.335	0.020	0.255
Grass						
station 1	2.258	1.370	0.906	1.173	1.006	0.376
Station 2	0.003	0.025	0.012	0.081	0.040	0.013
station 3	0.109	0.134	0.099	0.217	0.020	0.073
station 4	0.801	0.214	0.200	0.261	0.170	0.153
station 5	0.272	0.285	0.221	0.310	0.033	0.370
station 6	0.197	0.396	0.231	0.343	0.417	0.219
station 7	0.054	0.613	0.221	0.258	0.056	0.103
station 8	0.133	1.263	0.554	0.331	0.055	0.129
Ricinus cummunis						
station 3	0.048	0.228	0.213	0.592	0.594	0.076
station 4	0.097	0.542	0.742	0.633	0.876	0.430
station 5	0.014	0.084	0.163	0.459	0.790	0.128
station 6	0.438	0.948	2.663	1.078	0.404	0.385
station 7	0.487	1.432	6.358	2.747	2.838	1.578

Standard for safe limits of heavy metals

Sample	Standards	Cd	Cu	Pb	Zn	Mn	Ni	Cr
Soil (µg g^{-1})	Indian Standard (Awashthi 2000)	3-6	135-270	250-500	300-600	-	75-150	-
	WHO/FAO (2007)	-	-	-	-	-	-	-
	European Union Standards (EU 2002)	3.0	140	300	300	-	75	150
Water (µg ml^{-1})	Indian Standard (Awashthi 2000)	0.01	0.05	0.10	5.0	0.10	-	0.05
	FAO (1985)	0.01	0.20	5.0	2.0	0.20	0.20	0.10
	European Union Standards (EU 2002)	-	-	-	-	-	-	-
Plant (µg g^{-1})	Indian Standard (Awashthi 2000)	1.5	30.0	2.5	50.0	-	1.5	20.0
	WHO/FAO (2007)	0.2	40.0	5.0	60.0	-	-	-
	Commission regulation (EU 2006)	0.2	-	0.30	-	-	-	-

5. INFERENCES

The nutrients concentration in water in all the station found to be higher in side. Some toxic nutrient like ammonia level found to be very high which is not suitable for any living organisms. The higher concentration of nutrients by the results of dumping of domestic waste and industrial effluent on Buckingham canal from Chennai corporation area and Manali Industrial area

The cadmium, copper and zinc concentration in the soil sample found to be under the permissible limit except the stations 2,3 and 5 found to be higher in side. Lead concentration found to be in the below value of safe limit. Nickel concentration was found under the permissible limit in all the stations. As per the Indian standard value (Awashthi, 2000)

In the water samples the cadmium and lead found to be below detectable level in all the stations. The heavy metals like Ni, Zn and copper concentration found to be higher than the permissible limit.

The heavy metals concentration in the plant samples were analyzed. The cadmium concentration was below the permissible limit in all the plants sample except *Salicornia* at station 5 and 6 and stations 3,4 and 5 in grass (Awashthi, 2000).

The copper concentration found to be lower than permissible limit at most of the stations except salicornia and grass station 5 (Awashthi, 2000).

The lead concentration found to be lower than permissible limit at most of the stations except salicornia station 5 (Awashthi, 2000).

The nickel concentration found to be higher than permissible in all the stations (Awashthi, 2000).

The zinc concentration found to be lower than permissible limit at most of the stations except salicornia station 5 and grass station 6 (Awashthi, 2000).

6. Mitigation Measures

Concerns were raised about the black colouration of the Buckingham canal and possible role of fly ash for the same. However, sampling made up to 10 km upstream indicates the black colour nature of the canal. This is largely because of the mixing of untreated domestic and industrial wastes in the canal and settlement of degradable and biodegradable wastes and subsequent degradation of and formation of sludge along the canal. As the canal usually flushed with fresh water only during rainy days usually 10-20 days per year there is limited chance for transport of these wastes to far-away places. It is also note worthy to mention that the Buckingham canal not dredged for several years. This ensures that the solid wastes deposited in the canal are trapped over decades and made the canal black in colour. As the thermal power

station intake and discharge points are directly in the sea the role of fly ash for change of colour is very negligible. The possible mitigation measures are given below;

a. Regularizing the domestic and industrial discharge along the Buckingham canal
b. Setting up of treatment plants and ensuring the discharge of treated water in the canal
c. Dredging of Buckingham canal to ensure the seawater flesh there by deporting the sludge
d. Increasing plantation along the thermal power plant and fly ash deposition sites to reduce aerial transport of fly ash
e. Toxic heavy metal concentrations in plants are well with in the permissible limits. This may even go low if the samplings have been made after the monsoon. Hence, it nothing to do with the heavy metal concentrations. Point (d) will also reduce the metal concentration in plants and soil in future.

7. MONITORING MECHANISM

a. Monthly fly ash deposition rate may be recorded along the Buckingham canal at permanent monitoring sites
b. Annual monitoring of heavy metal concentration during summer and post monsoon periods
c. Concurrence heavy metal load in the discharge water and fly ash may also be monitored during summer and post monsoon periods

Collection photos

Ash dumping site

Ennore Creek

Buckingham canal Ennore

Annexure -IIA

PH Exemption letter

Annexure - IIA

F.No. J-13012/15/2018-IA-I(T)
Government of India
Ministry of Environment, Forest and Climate Change

3rd Floor, Vayu Block,
Indira Paryavaran Bhawan, Jor Bagh Road,
Aliganj, New Delhi-110003

Dated: 10.07.2019

To

The Chief Engineer (Projects)
M/s Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)
5th Floor, Western Wing,
NPKRR Maaligai, 144,
Anna Salai, Chennai-600002.

Email: cepr@tnebnet.org; **Telephone No.** 044-28520878; **Fax No.** 044-28520878.

Sub: 1x660 MW Ennore Supercritical Thermal Power Project (Expansion), Village Ernavur, District Ennore, Tamil Nadu by M/s Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)- reg. exemption of Public Hearing.

Sir,

The undersigned is directed to refer to your letter dated 9.5.2019 regarding exemption of Public Hearing for obtaining a fresh Environmental Clearance for the 1x660 MW Ennore Thermal Power Project (Expansion) under construction which had been issued an Environmental Clearance on 3.6.2009.

2. The Environmental Clearance (EC) for 1x660 MW Ennore Expansion Power Project accorded on 3.6.2009 was valid for 10 years, i.e. till 2.6.2019. As informed, 17% of physical progress has been made at site by the EPC contractor and 18% (Rs.703 crores) of payment has been made to them so far. Meanwhile, you had have requested for extending the EC beyond 10 years. The Ministry vide letter dated 29.10.2018 advised the Project Proponent to initiate the process of obtaining EC *denovo* as there is no provision to extend the EC beyond 10 years in the EIA Notification, 2006 and its amendments. Based on your new application, the Ministry vide letter dated 21.1.2019 has issued Terms of Reference (ToR) for conducting Environmental Impact Assessment studies including Public Hearing.

3. Subsequently, you had requested for certain amendments in the ToR including the exemption of Public Hearing.

4. It is noted that you have requested to exempt the public hearing as the public hearing at the same location had been conducted for another project i.e. Proposed 1x660 MW Ennore Replace Power Project on 30.5.2017. The proposal for which Public Hearing was held on 30.5.2017 has been deferred by the EAC in its meeting held on 26.10.2017 for want of details of compliance with reference to the observations made in the site visit report. It has been requested that since the present project is under construction and Rs.703 Crores had already been spent, conducting public hearing will substantially delay the construction as the validity of Environmental Clearance expired on 2.6.2019.

Further, it was stated that the project is also following the full procedure under EIA Notification to obtain Environmental Clearance a second time.

5. In view of the justification submitted by you and as outlined in para 4 above, **the Ministry hereby exempts the Public Hearing for the above mentioned project.**

This issues with the approval of the Competent Authority.

Yours faithfully,

(Dr. S. Kerketta)
Director, IA.I

Copy to: -

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
4. The Additional Director General of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (SEZ), Ist and IInd Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai – 34.
5. The Principal Secretary to Government, Environment and Forests Department, Government of Tamil Nadu, No.1, Jeenis Road, Panagal Building, Ground Floor, Saidapet, Chennai-600 015
6. The Chairman, Tamil Nadu Pollution Control Board, 76, Mount Salai, Guindy, Chennai - 600 032.
7. The District Collector, Ennore District, Govt. of Tamil Nadu, Tamil Nadu -623 503.
8. Guard file/Monitoring file.
9. Website of MoEF&CC.

(Dr. S. Kerketta)
Director, IA.I

Annexure -III

Executive summary Marine EIA

7 SUMMARY AND CONCLUSION

Ennore Thermal Power Station (ETPS)is a coal fired power station located in Ernavur village, Thiruvottiyur Taluk in Tiruvallur district, Tamil Nadu, India. ETPS is owned and operated by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO), a subsidiary of the Tamil Nadu Electricity Board (TNEB).The existing ETPS was of 450 MW capacity which was in operation from 1975. The facility has been dismantled on 31st March 2019 and is proposed to be replaced with a 1x660 MW unit within the same facility. It has been also proposed that to expand the ETPS by an additional 1x660 MW super-critical technology.

The proposal for expansion would improve the capacity of the power generation by ETPS and the environmental clearance for the expansion of ETPS has been obtained in the year 2009. The validity of the clearance was upto 2nd June 2019. But the works relating to the construction of the facility has not been completed. Since the maximum validity of the clearance has been obtained. A fresh proposal has been submitted by TANGEDCO and ToR has been accorded by MoEF&CC for which the marine EIA study has been entrusted to Cholamandalam MS Risk Services Ltd, Chennai.

The proposed expansion facility will use super-critical technology. The water requirement will be met by Bay of Bengal. The outfall and the intake locations have been located as per the detailed study by NIO, Goa. The intake pipeline and the outfall pipeline has been provided at a distance of 650m and 250m respectively from the shore. The intake and the outfall are provided at different directions from each other to avoid mixing of water. The total quantity of intake for the Replacement unit and the Expansion unit is 25000 m^3/hr and the total quantity of discharge is 16000 m^3/hr.

The baseline monitoring has been carried out for the proposed facility for one season. The water and sediment samples have been collected from the offshore locations (inclusive of intake and outfall) and the creek. The creek samples have been analysed since the coal conveyor belt is proposed across the creek. The water and sediment samples have been analysed for the physio-chemical parameters and biological parameters. The results have shown a few traces of contamination in the creek. The offshore samples have shown diversified phytoplankton, zooplankton and benthos. Since the nature of the ocean is dynamic, the pollutants, if present, shall get dissipated in no time.

The thermal and salinity dispersion modelling has been conducted for a combined intake and outfall for the replacement unit as well as expansion unit which accounts to 2x660 MW capacity. The temperature and salinity at the intake and the outfall locations have been considered for the modelling study. The outcome has revealed that the temperature and salinity at the discharge location has been dissipated to a distance within 1 km for spring and neap tides for the ebb and flood conditions irrespective of the seasons.

The impacts of the temperature and salinity dispersion on the ecology and the marine environment has been analysed. Since the temperature and salinity at the discharge point diffuses and disperses within a short span of time, there will not be major impacts on the marine environment as well as ecology. Furthermore, the effect of anti-fouling agents on the marine ecosystem has also been discussed. It is mentioned that the levels of chlorine in discharge has to be limited so that it will not affect the marine ecology and environment.

The environmental management plan has been discussed to mitigate the impacts at the construction and the operation phase of the project. The management of the water quality in the marine environment is addressed with respect to the discharge characteristics of the outfall water from the Thermal Power Plant. The precautionary measures taken for the laying of pipeline and the measures to manage the ecology in the marine environment during the construction and the operation phase has been addressed in the respective sections.

Environmental Monitoring Program is provided to ensure that the surrounding environment is stable and not affected by the proposed project. It is also helpful to monitor and maintain the temperature of discharge within the standards set for Thermal Power Plants. Similar to the Environment Management Plan, Environmental monitoring plan is also devised for the construction and the operation phases of the project.

So, the overall outcome of the study reveals that the impacts of thermal and salinity dispersion of the discharge waters on the marine environment is negligible. Since the dispersion is fast and does not travel longer distances to match the ambient conditions, the proposed project is acceptable.

Annexure -IV
Vision document

Annexure – IV

ETPS Vision document specifying prospective long term plan of the site

TANGEDCO established by Government of Tamil Nadu under the Indian Electricity Act 2003 is planning to develop Supercritical Ennore Thermal Power Station (ETPS) Expansion 1x660 MW Thermal Power Project at Ernavur village, Ennore, Tamil Nadu, in the same ETPS complex where ETPS expansion 1x660 MW Thermal Power Plant is also proposed.

Vision Statement of the TANGEDCO:

TANGEDCO has formulated environmental Policy, Procedures & Framework. Some points of the Procedures & Framework document of TANGEDCO regarding site vision are given below:

Site selection for establishing new or expansion units shall be done with a vision to operate the units without interruption on account of deficiency of infrastructure, environmental performance and social aspects and legal consequences.

Achieve sustainable development through optimization of natural resources such as land, water and fuel (Coal/ Gas), complying environmental and ecological requirements to enhance the quality of environment and eco-system.

The above policy procedures are considered while proposing new or expansion units. Application of the vision statement is substantiated as follows:

In order to meet the demand in Tamil Nadu, 660 MW supercritical coal based unit is proposed in the ETPS complex with the following vision:

- ETPS has a track record of product performance and environmental performance optimizing natural resources for unit electrical energy production and maintaining better environment and healthy ecology.
- All infrastructures such as land, water common facilities like roads, railway line and colonies area available. Minimum disturbance to the natural environment can be achieved with maximum benefits from the project.
- Many cement industries are existing within 100 km of the plant for utilization of dry fly ash.

The following facts are substantiated for the above vision:

a) Environmental conditions:

ETPS is complying environmental standards and is being operated with valid CFOs. The ambient air quality with respect to SO_2 & NO_x is below threshold of the limits. Project can be established without serious environmental impacts as the existing baseline levels have sufficient buffer capacity.

b) There are no major social and legal issues.

c) Compatibility of the site for expansion unit:

The site proposed for expansion unit is having adequate infrastructure facilities. The site is environmentally compatible as the existing ambient pollution levels are 50% below the stipulated limits. The expansion unit can be operated without any problems on infrastructure front and environmental and social conflicts during its life time.

d) The project being supercritical unit will reduce the carbon footprint and pollution levels.

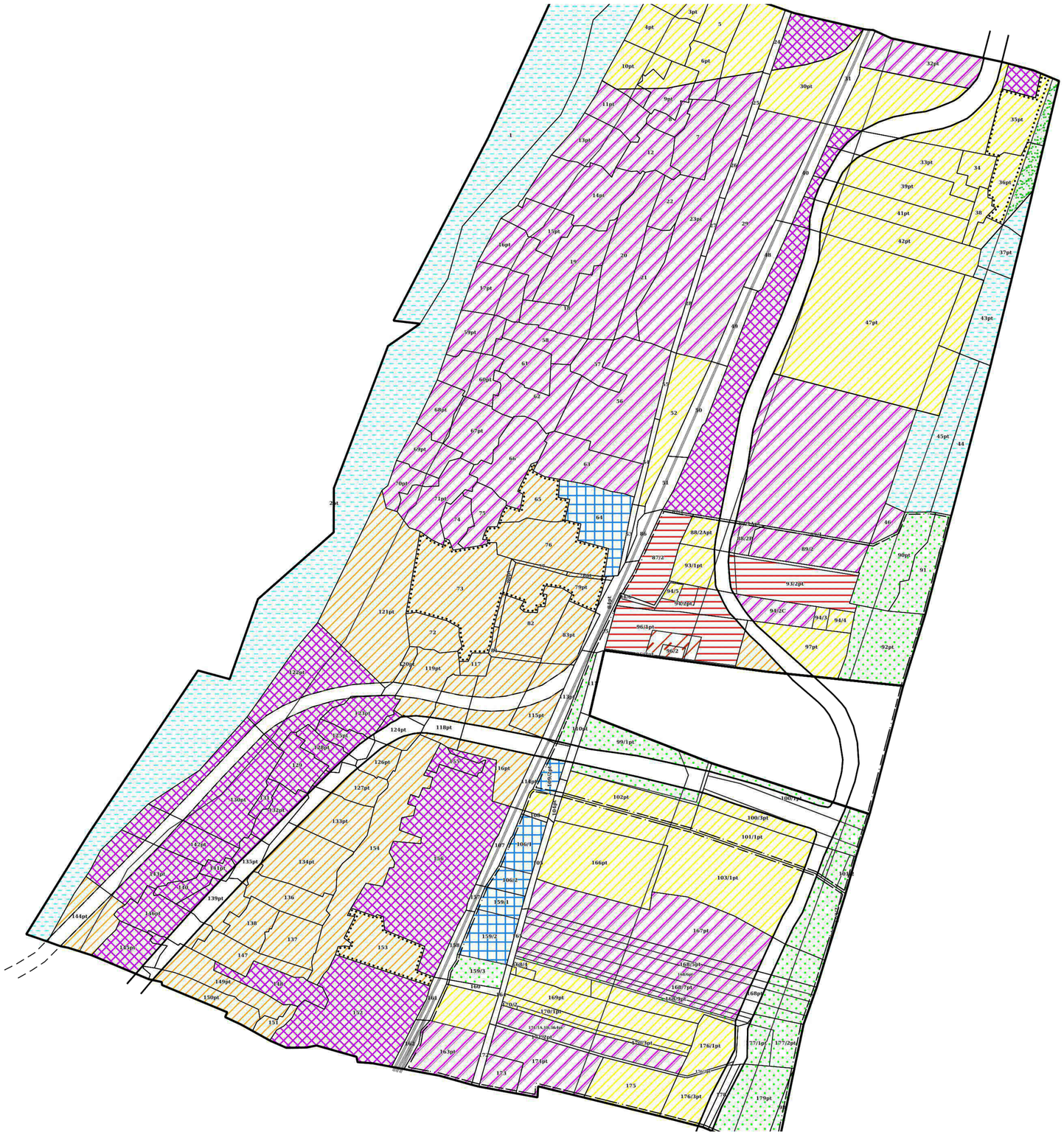
e) The project contributes to availability of power to ensure growth in all sectors and overall development of the country.

Annexure -V

CMDA land use map

Annexure - V

Eranavur



Eranavur

46

Ambattur

Thiruvallore

Municipality

DDP-Thiruvottiyur TP Scheme No.1

Legend

- DEVELOPMENT PLAN BOUNDARY
- VILLAGE BOUNDARY
- REVENUE BLOCK BOUNDARY
- PRIMARY RESIDENTIAL
- MIXED RESIDENTIAL
- COMMERCIAL
- INSTITUTIONAL
- INDUSTRIAL
- LIGHT INDUSTRIAL (EQUATED TO INDUSTRIAL AS PER SECOND MASTER PLAN)
- GENERAL INDUSTRIAL (EQUATED TO INDUSTRIAL AS PER SECOND MASTER PLAN)
- SPECIAL AND HAZARDOUS INDUSTRIAL
- OPEN SPACE & RECREATIONAL
- URBANISABLE
- NON URBAN
- WATER BODY
- AGRICULTURAL
- RESERVED FOREST
- REDHILLS CATCHMENT AREA
- C.R.Z LINE
- CRZ - I
- CRZ - III
- AREA AROUND IAF STATION PROHIBITED FOR DEVELOPMENT
- PALLIKARANAI SWAMP AREA FOR CONSERVATION
- CONTINUOUS BUILDING AREA
- EWS AREA
- I. T. CORRIDOR
- GREEN BELT ALONG N. H. ROAD BYE PASSES
- NATHAM AREA
- RESTRICTED DEVELOPMENT ZONE

0 100 200 300m

17.04.2018

Disclaimer:In the Land use 'others' classification has to be checked from CMDA records for its classification. This is only an information on Land use and can not be used for any legal purposes.

Annexure -VI

Executive summary Social report

Annexure - VI

SOCIO ECONOMIC STUDY REPORT ON THE ONGOING ETPS EXPANSION THERMAL POWER PROJECT (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

EXECUTIVE SUMMARY

1.CSR activities of Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)

Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) is a unit of TNEB takes care of the infrastructure relating to the power generation and distribution of power to the state.

Established in 1957, Tamil Nadu Electricity Board (TNEB) is now the largest vertically integrated power utility in the country with an installed generating capacity of 10,098 MW. TNEB ranks No.1 in India and 4th globally in wind power generation. It is also one of the best performing power utilities in the country with lowest AT&C losses of 18% and the highest revenue collection of 99%. Celebrating its Golden jubilee, TNEB is poised towards a powerful future.

Tamil Nadu is also blessed with many partnerships in power generation with the private and Central Public Sector Units. TANGEDCO's collaboration with many CPSU is expected to meet the additional energy requirements to meet the ongoing and upcoming industrial requirements.

TANGEDCO owns and operates a number of thermal power stations in the state of Tamil Nadu now proposes to expand Ennore Thermal Power Station (1x660 MW) within the existing Ennore Thermal Power Station Complex of TANGEDCO in Tiruvottiyur Taluk, Thiruvallur district of Tamilnadu. Total land area required for the power plant is available at Ernavoor Village, Tiruvottiyur Taluk, Thiruvallur District within the existing Ennore Thermal Power Station Complex of TANGEDCO in Tiruvottiyur Taluk, Thiruvallur district of Tamil Nadu. The identified land for the power plant is free from resettlement and rehabilitation issues since it is expansion of existing plant.

As part of Corporate Social Responsibility, Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) has also intended to identify the needs of the communities living near the project site and to support them through a series of socio economic and infrastructure projects.

The Madras School of Social Work has been assigned with the task of carrying out a socio economic study and community needs assessment around 10 km radius from the plant area to arrive at the CSR plan for the Thermal Power Project.

2. Research methodology of the study

2.1 Objectives of the study

The main objective of the Socio Economic and Community Needs Assessment Study in the project area was to support the efforts of TANGEDCO in designing the Corporate Social Responsibility framework and socio economic programs in the study areas.

2.2 Focus of the Socio Economic Study

A Socio Economic Study was conducted covering 500 families for eliciting the socio economic status of the communities living in the villages and settlements within 10 kms radius of the plant site.

2.3 Focus of the Community Needs Assessment (CNA) Study

As part of the Socio Economic Study, a Community Needs Assessment (CNA) was conducted in the study areas. The Community Needs Assessment started at the grassroot with the maximum involvement of the local communities and groups. This process involved considerable time to arrive at a well-defined plan. It focused on the Community Action Plan preparation which was incorporated as part of the Village Level Framework Plan.

A CNA is an approach followed for collecting the data on the infrastructure, socio economic status of the communities and deficiencies in the services to formulate strategies to eliminate or considerably reduce it.

2.4 The purpose of the CNA study

- To collect first-hand information on the prevailing social situation in the project areas.
- To collect the perceptions on various dimensions of community needs by the primary as well as secondary stakeholders through Focus Group Discussions and individual interactions.
- Identify areas for capacity enhancement.
- To create a local level networking system for post- project management (Village level working group).

- To identify and interact with all stakeholders related to the users and service providers and related individuals/institutions.
- To enhance coordinated approaches to poverty reduction through converging Government and Civil Society Organizations.
- To generate information for TANGEDCO CSR partnerships and identify micro level interventions based on the prioritized activities.
- To strengthen the community's involvement and participation for better delivery mechanisms.

2.5 Objectives of Village Level Framework Plan (VLFP)

The primary objective of the Village Level Framework Plan is a bottom up roadmap focusing on the physical, social and economic requirements of the backward strata population living in rural and urban communities which require CSR interventions to improve their quality of life. Village Level Framework Plan will serve as a blueprint in convergent based delivery of services to the communities. Some of the key objectives of the plan are:

i To involve the local people in the preparation of a plan
ii To identify and prepare activities to address the issues and findings from CNA
iii To facilitate convergence of resources within and outside the Villages
iv To sensitize and enhancing the capacity of people through strategic planning
v To promote decentralized planning and make the plans relevant to local needs

2.6 Sampling selected for the study

[vii]

The sample size including the household interviews have been limited to 500 families. In addition to the households study, Key Informants interviews, field level focus group discussions, case studies and transect walks have been organized to get additional information to supplement the quality and quantity data on the community needs

3. Socio economic status of the respondents of project areas (Findings based on the sample household survey):

3.1 FISHERMEN AREAS

- The study revealed that 25.5% of the families represented Tiruvottiyur Kuppam followed by 20.3% of the families from AIR Colony and Ernavoor Kuppam, 13.5% of

families from K.V.K. Kuppam and 6.8% families each from Kattu Kuppam, Thazhan Kuppam and Mugathuvara Kuppam.

- 50% of the respondents belonged to Most Backward community, followed by 44.7 % of SC community.
- 59% of the households have a monthly family income from Rs.10001 to Rs.20000, followed by 30% up to Rs.10000 and 11% more than Rs.20000.
- It was inferred that 50% of the respondents had studied up to 10^{th} standard, 6% were illiterates, 26% up to 12^{th}Standard, 11% were Graduates, 3% were Post Graduates and 4% were ITI and Diploma holders.
- 75 per cent of the respondents were living in concrete houses (Pucca), 19% residing in Semi pucca houses and only 6% in kutcha houses
- It was established that 66% of the respondents lived in their own houses, 14% in rental houses and 20% in slum tenements.
- It was ascertained that 78% of the families were drawing water from Metro water (Lorries), 30% were using hand pumps and 2% had bore well facility.
- 86.4% of the respondents expressed that the water supply is inadequate and does not meet their demand and the remaining 13.4 % stated that it was adequate.
- Only 25.5% of the respondents expressed that the areas have adequate street lights and markets, followed by 94% with cemetery and burial ground, 91% with transportation, 82% with motorable roads, 40% with bus shelters and 60 % with community Hall.
- 52% of the respondents had availed loan from various sources. It was revealed that 48% had no debts. 12 % had availed loans for marriage purpose, 11.5% to meet medical expenses, 7% towards food expenditure, 7.5% for children's education, 6% for house construction and 3% to attend family rituals and festivals and 5% for other reasons.
- 48% of the respondents had not availed any loans. 20% had taken loans from SHGs and micro finance institutions, 15% borrowed from money lenders, 8% from relatives and friends, 4 % through private chits, 3% from Nationalised banks and 2% from private banks
- 49% of the respondents had no savings. 24% of the respondents saved through SHGs, 10% through Chit Fund, 8.6% were having postal savings and 8.4% through banks.
- It was found that 44% of the respondents in the study area are members of SHGs.

- It was ascertained that 100% of families were relying on Corporation Tricycles for solid waste disposal and management.
- 95% of the respondents' families own Fibre boats and 5% of them own trawlers.
- It was ascertained that 55.6% of the respondents face problems related to frequent damage to nets and hence unable to buy new nets due to financial constraints and 40.7% unable to bear the repairing and operation cost of equipment.
- Only 34% of the respondents have insured their fishing Equipment.
- Only 5% of the respondents have installed GPS in their Boats.
- 100% of the respondents are not satisfied with the dredging activities in the study area.
- 61% of the respondents listed fishing harbour as their priority need, followed by Jetty (24%) and Cold Storage (15%)
- For the employable skills 45.5% of the respondents (fisher youth -Men) are interested to undergo training in Assistant Vessel Driver course, followed by 28.5% for boat engine repairing, 15% for heavy vehicle driving and 10% for other employable skill development training courses.
- 32% of the respondents (Female members from fishing settlements) are interested to undergo training in online fish marketing, followed by Nursing (25%), Tailoring (21%), Catering & Hospitality (17%) and 5% in other job oriented training courses.

3.2 NON FISHERMEN AREAS

- The study revealed that 21.9% of the families are residing in AIR Nagar, 17% each from Raja Shanmugham Nagar and Ambedkar Nagar. 14.6% of families living in Nehru Nagar and 9.7% families each are residing in Thiruvallur Nagar, Annai Sivagami Nagar and Bharathiyar Nagar.
- 59% of the respondents belonged to Most Backward Community followed by SC with 24 %, 16% belongs to BC and FC 1%.
- It was found that 90.7% of the families were male headed and only 9.3% were female headed families.
- It was found that 19.5% of the households have a monthly family income up to Rs.10000, followed by 69.3% between Rs.10001 to Rs.20, 000 and 11.2% more than Rs.20, 000.
- 40% of the respondents had studied upto 10^{th} standard, 7% were illiterates, 14% upto 12^{th}Standard, 31% were Graduates, 6% Post Graduates and 2% were Diploma holders and I.T.I. course.

- 82% of the respondents were living in concrete houses and slum tenements, followed by 16% in semi pucca houses and only 2% in Katcha houses.
- 52% of the respondents were living in their own houses, 26% in rental houses and 22% in slum tenements.
- It was ascertained that 78% of the families were drawing water from Metro water, 30% were using hand pumps and 2% had bore well facility.
- 90% of the respondents expressed that the water supply is inadequate and does not meet their daily requirement and the remaining 10% stated that it was adequate.
- It was found that 58% of the respondents are not SHG members.42% of the respondents in the study area hold SHG Membership.
- 57% of the respondents had not availed any loans. 16% of them have borrowed from money lender, 12% from SHGs and micro finance institutions, 7% from relatives and friends, 5 % through private chits and 3% from banks.
- 69% of the respondents do not have the habit of savings. 12% of them save money through Chit Funds, 8% through SHG, 6% through postal savings and 5% through banks.
- 75.2 % of the respondents had not taken any insurance against Life and health coverage.
- It was ascertained that 100% of families were disposing solid waste through Corporation Tricycles.

4. Findings based on the stakeholder consultations:

Out of the 13 study areas, 7 are fishermen habitations. One of the study areas is Mugathuvara Kuppam is located on the Creek. The community during the Focus Group discussion felt that the carrying capacity of the river has reduced and it cannot perform it complete draining action, which means the area around would be waterlogged during the monsoon., they also added that their boats which is their main source of livelihood were drastically affected since the depth of the river has been reduced to minimum of 1 feet. It was also scientifically proved that the fish caught around Ennore contain toxic elements due to effluents released from adjacent factories, making the fish unfit for consumption.

They suggested that job oriented skill development training for the youth in vessel navigation and ornamental fish culture may be provided as an alternate livelihood options. They also requested the corporates to provide engines, and netting materials to the small fishermen in enhancing their livelihood. They also expressed that any further expansion or development of

factories surrounding the creek will endanger the aquatic species which will have a direct impact on the livelihood of fishermen community.

Some of the respondents from Thazhan Kuppam suggested that frequent dredging should be done to facilitate the boat movement and also installing boulders to prevent sea erosion. They were also of the opinion that the Ennore Coast may be developed as a tourism centre due to its unique features and the existing harbour may generate more employment opportunities for the fishermen who have seasonal employment. The Fishing community also felt that the local youth and eligible persons may be provided with jobs and other opportunities in industries and factories located in and around Ennore and also in upcoming industries.

They also expressed that the occurrence of regular oil spill has affected their livelihood to a great extent. Therefore such incidents should be prevented by the Government and industries in future by taking necessary precautions.

It is heartening to know that women of the fishing community are undergoing training in online marketing to cope up with the technology development in the marketing field.

Tamilnadu Slum Clearance Board has allotted 200 tenements to the transgender in AIR colony. During the discussion, it was expressed that they are still discriminated and not accepted by the neighbourhood community. They requested that special clinics exclusively for their gender may be run by Urban Health Centre once in a week.

The community requested for a Police outpost to handle the menace of drug trafficking which is affecting the youth and children.

Earlier, the fishing community used to venture into fishing everyday but, at present they could go once in 2 days due to depleted catch and dead fish. The attributed this situation due to release of effluents from industries and factories located in Ennore.

The local fishing community felt that consortium of industries in Ennore was conducting meetings to assess the livelihood needs of the fisherman community. At present, this activity has been ceased to exist. It has been also expressed by the Senior Scientist, (Centre for Marine Fishing Research Institute) Ennore coast is the most polluted, which affect the fish biological Resource enhancement. The Joint Director, Department of Fisheries, Government of Tamilnadu, expressed that there is an increase in the fishing vessels from 1000 to 2000 nos. in Chennai region in recent times and 40,000 households are depending on fishing for their livelihood.

Keeping the future vision of livelihood options, the women desired to acquire alternative skill development training courses in Tailoring and Embroidery, Beautician, Car Driving, Mobile servicing, Computer Training and Nurse aid.

The children of non-fishermen community belong to the under privileged category. It is viewed that scholarships may be provided to them to pursue their school education, impart job oriented skill development training and on the job training for them to work in the field which they desire.

5. Activities identified for the CSR projects in the study areas:

Village Level Framework plans were based on focus group discussions, community meetings and transect walks.

The Qualitative study and survey findings brought out the genuine needs of the selected villages as mentioned below in the study area by TANGEDCO. Details of area, sector- wise needs, required interventions a long term with budget and implementing mechanism are spelt out in the report.

The Study suggests the following sector wise interventions for implementing the CSR initiatives. Suitable modifications may be made by the TANGEDCO based on further consultation if it is required.

Sector wise budget for next five years:

S.N	Sector	Budget (in Rs)
1	Infrastructure	3,53,90,000
2	Livelihood	1,58,30,000
3	Skill Detraining	36,00,000
4	Education	10,00,000
5	Health	35,00,000
6	Environment	7,00,000
7	NGO interventions support	3,00,000
Total		**6,03,20,000**

6. Suggestions

i. Specialized agencies such as CMFRI, CIFNET, MSSRF and Department of Fisheries may collaborate to have special plans for enhancing the livelihood of fishing community in the Ennore coast by implementing innovative self-employment schemes and to cope up with the latest technology (Deep sea fishing, usage of electronic gadgets etc.)

ii. To install artificial reef in Ennore coast to increase fish breeding and catch.

iii. The district administration may take necessary steps by arranging interface session between fishing community and PSU of Ennore coast to review the environmental issues at frequent intervals.

iv. One of the headmistress of a nearby school suggested that vocational training can also be imparted to the school children, to compete in the job market in future. This need a serious consideration.

v. Most of the respondents of the non-fishing area expressed their views that infrastructure up gradation may be addressed on priority basis to enable them to have a quality living and reduce risk factors related to socio economic and environmental degradation.

vi. It is necessary to supplement and support for ensuring adequate quantity and quality of drinking water supply in all the study areas.

vii. TANGEDCO through its CSR monitoring cell suggested facilitate and coordinate with various Government Departments, Educational institutions and Non-Governmental Organizations to impart skill training courses in all the study areas.

viii. To create awareness and support in conservation of water and also the importance of rain water harvesting among the community.

ix. It is also suggested that TANGEDCO may establish a special out sourced cell to conduct Pre Funding appraisals, stakeholders' involvement in CSR interventions, monitor the CSR initiatives, and act as a link between the community and TANGEDCO for fulfilling the objectives of CSR initiatives. This proposed CSR cell would help the interventions and enhance the branding of TANGEDCOs CSR interventions.

7. Conclusion

Ennore and its neighbourhood areas are surrounded by several of Public Sector Undertakings and Private Industrial Units. PSUs like NTPL, NPCL, KPL, IOC (bottling unit), Balmier &Laurie and CPCL have been initiating CSR activities by assessing community needs and implementing CSR interventions under various sectors such as water and sanitation, infrastructure to the Educational Institution and community, Women's Empowerment Environment /Green Cover Development and Sustainable Livelihood by spending huge funds.

Ashok Leyland, a private industrial unit also initiated CSR projects in Ennore neighbourhood. Inspite of the above CSR interventions, fishing community in and around Ennore is affected severely due to increased release of effluents resulted in the depletion of fish resource. Hence they are forced for to look for alternative source of livelihood. They also felt that steps may be taken to protect the environment at Ennore by regulating industrial pollution and control, infrastructure development for sustainable livelihood of fishermen, which has been followed for generation as a traditional occupation.

TANGEDCO through the commissioning of the power project must address the water issue in Ennore. TANGEDCO may also take steps to protect the environment in the Ennore coast by prioritising greenery initiatives. One of the major grievances of the inhabitants of Ennore coast is that TANGEDCO may consider sustainable development goals which will have a visible impact in the sectors of Water, Sanitation, Environment Protection and Livelihood support.

It is also suggested that TANGEDCO may establish a special cell to monitor the CSR initiatives and act as a link between the community and TANGEDCO for fulfilling the objectives of CSR initiatives and mutual benefits.

****

Annexure -VII

Coal analysis report

Annexure - VII

MONARCH BIOTECH PVT. LTD.

UNIT : MONARCH LABORATORY SERVICES

ORIGINAL

TEST REPORT

Report Number: MBT / CL / 0129 **Date:. 06.04.2015**

PART – A: PARTICULARS OF SAMPLE SUBMITTED

Sample Described by customer as	:	**Imported Coal**
Customer Name	:	**The Chief Engineer/ Projects, TANGEDCO (A Successor entity of TNEB)**
Customer Address	:	**5th Floor Western Wing, NPKRR Malligai, 144, Anna Salai Chennai-2.**
Postal Code	:	**600 002**
State	:	**Tamilnadu**
Country	:	**India**
Sample Code No	:	**1504001**
Sample Type	:	**---**
Sample Received Date	:	**01/04/2015**
Sample Qty. Recd.	:	**100gm**
Batch No	:	**---**
Brand Name	:	**---**
Mfg Date	:	**---**
Exp. Date	:	**---**

Terms and Condition

This report in full or in part shall not be published, advertised, used for any legal action, unless prior permission has been secured. This test report pertains only for the sample tested and such samples are retained for 7 days (in case of perishable) and 15 days for all other samples. In case of Complaint received from customers sample will be kept for 30 days. The samples from regulatory bodies are to be retained as specified. Sample Not Drawn by Laboratory.

MONARCH BIOTECH (P) LTD. CHENNAI 600 017 Nuclear Counting Division

For MONARCH BIOTECH PVT. LTD.

AVULA MALLIKARJUN
Mg. Director

Regd. Office & Sample Collection Centre : New No. 17/1, Sadullah Street, T. Nagar, Chennai - 600 017. INDIA.
Phone : 91-44-24352756 / 24312656 Tele Fax : 91-44-24312759. E-mail : info@monarchnuclearlab.com
Website : www.monarchnuclearlab.com
LAB : 37-A, SIDCO Industrial Estate, Thirumazhisai, Chennai - 600 124, INDIA.

MONARCH BIOTECH PVT. LTD.

UNIT : MONARCH NUCLEAR COUNTING LABORATORY

Accredited by : AERB & NABL Recognized by : BIS & fssai

TEST REPORT

Date: 23.12.2016

Sample No	**: 1612028**
Job Card No	**: 927**
Report No	**: MBT / CL / 0723 / 16-17**
Reference to sampling procedure, Wherever applicable	**: Not applicable**
Deviation from the test methods as prescribed in relevant ISS/Work Instructions, if any	**: NIL**
Test Commenced On	**: 20.12.2016**
Test Completed On	**: 23.12.2016**

S.No	Test Parameters	Test Method	Result	Unit
1	Nickel as Ni	MBT/CL/SOP/ 091	8.13	mg/kg
2	Iron as Fe		1359	mg/kg
3	Arsenic as As		0.22	mg/kg
4	Lead as Pb		8.83	mg/kg
5	Zinc as Zn		24.82	mg/kg
6	Mercury as Hg		0.02	mg/kg
7	Selenium as Se		BLQ (LOQ : 0.01)	mg/kg
8	Sulphur as S	IS 1350 (Part-III) 1969 (RA : 2000)	0.84	%
9	Chromium (VI)	Eurasian J Anal Chem 8(1) : 10 -16, 2013	4.89	mg/kg

BLQ: Below Limit of Quantification, LOQ: Limit of Quantification

*********End of Report*********

MONARCH BIOTECH (P) LTD. CHENNAI 600 017. Nuclear Counting Division

A.Kanagavel
Authorized Signatory

Regd. Office & Sample Collection Centre : New No. 17/1, Sadhanandam Street, T. Nagar, Chennai - 600 017, Tamilnadu, INDIA.
Phone: 91-44- 24352756 / 24312656. E mail : monarchbio@gmail.com, info@monarchtestinglab.com Website : www.monarchtestinglab.com
LAB : 37-A, SIDCO Industrial Estate, Thirumazhisai, Chennai - 600 124, Tamilnadu, INDIA. Phone: 91-44- 26810052

MONARCH BIOTECH PVT. LTD.

UNIT : MONARCH NUCLEAR COUNTING LABORATORY

Accredited by : AERB & NABL Recognized by : BIS & fssai

TEST REPORT

ORIGINAL

Report Number: MBT / CL / 0723 / 16 – 17 **Date: 23.12.2016**

PARTICULARS OF SAMPLE SUBMITTED

Sample Described by customer as	:	**DOMESTIC COAL**
Customer Name	:	**The Chief Engineer/ Projects, TANGEDCO (A Successor entity of TNEB)**
Customer Address	:	**5th Floor Western Wing, NPKRR Malligai, 144, Anna Salai, Chennai-2.**
Postal Code	:	**600 002**
State	:	**Tamil Nadu**
Country	:	**India**
Sample Code No	:	**1612028**
Sample Type	:	**COAL**
Sample Received Date	:	**20.12.2016**
Sample Qty. Recd.	:	**750 gms**
Batch No	:	**Nil**
Mfg Date	:	**Nil**
Exp. Date	:	**Nil**

Terms and Condition

This report in full or in part shall not be published, advertised, used for any legal action, unless prior permission has been secured. This test report pertains only for the sample tested and such samples are retained for 7 days (in case of perishable) and 15 days for all other samples. In case of Complaint received from customers sample will be kept for 30 days. The samples from regulatory bodies are to be retained as specified. Sample Not Drawn by Laboratory.

For MONARCH BIOTECH PVT. LTD.

M. Sayanthan

Authorised Signatory

MONARCH BIOTECH (P) LTD. CHENNAI 600 017. Nuclear Counting Division

Regd. Office & Sample Collection Centre : New No. 1/1, Sadullah Street, T. Nagar, Chennai - 600 017, Tamilnadu, INDIA.
Phone: 91-44- 24352756 / 24312656. E mail : monarchbio@gmail.com, info@monarchtestinglab.com Website : www.monarchtestinglab.com
LAB : 37-A, SIDCO Industrial Estate, Thirumazhisai, Chennai - 600 124, Tamilnadu, INDIA. Phone: 91-44- 26810052

MONARCH BIOTECH PVT. LTD.

UNIT : MONARCH NUCLEAR COUNTING LABORATORY

Accredited by : AERB & NABL Recognized by : BIS

T - 1697 NABL

RADIOACTIVITY MEASUREMENT / TEST REPORT

Test Report. No. MB / NCL / 1612135 / Original / 17503 **Date: 24 / 12 / 2016**

1. Sample identification : **016540**
2. Sample received from : **The Chief Engineer /Projects, TANGEDCO, Chennai**
3. Nature of sample : **Domestic Coal**
4. Volume / weight : **4 kg X 1 No**
5. Sample received on : **20 / 12 / 2016**
6. Testing completed on : **23 / 12 / 2016**

S.No	Nuclides Analyzed	Activity Determination Limit Of Instrument MDA (3σ)	Method Of Testing	Result (Bq / kg)	Exemption levels as per IAEA BSS
1.	Nat Th	9.27 Bq/kg	AERB – Standard Analytical method (Clause 4.3.4 : 2003)	45.64 ± 9.36	1000 Bq/kg
2.	Nat U	8.65 Bq/kg	AERB – Standard Analytical method (Clause 4.3.4 : 2003)	18.38 ± 8.47	1000 Bq/kg
3.	K - 40	53.67 Bq/kg	AERB – Standard Analytical method (Clause 4.3.4 : 2003)	73.04 ± 51.48	1,000,000 Bq/kg

BDL: Below Detection limit

Remarks: The above sample was analyzed for the radioactivity content. This is to certify that the activity level of Nat Th, Nat U, K-40 in the sample was found to be below the IAEA Basic safety series limits.

The spectrum / result files are stored as part of Nuclear Counting Facility Records.

Sample return: The sample will be kept for one month and disposed-of or returned on request after one month. If there is any discrepancy / complaint received from the customer within one month from the date of report, the sample will be kept for two months.

This report pertains to only for the sample given to this laboratory.

Disclaimer: This certificate should not be produced in any court of law as part or in full without the written approval of this Laboratory.

To

The Chief Engineer/Projects,
TANGEDCO(A Successor entity of TNEB),
5th Floor Western Wing,
NPKRR Maaligai,
144, Anna Salai, Chennai-600 002.

MONARCH BIOTECH (P) LTD. CHENNAI 600 017

M. SARAVANAN
Authorised Signatory

Regd. Office & Sample Collection Centre : New No. 17/1, Saidullah Street, T. Nagar, Chennai - 600 017, INDIA.
Phone : +91-44-2435 2756, 2431 2656. Tele Fax : +91-44-2431 2789. E-mail : info@monarchnuclearlab.com
Website : www.monarchnuclearlab.com
LAB : 37-A, SIDCO Industrial Estate, Thirumazhisai, Chennai - 600 124, INDIA.

MONARCH BIOTECH PVT. LTD.

UNIT : MONARCH NUCLEAR COUNTING LABORATORY

Accredited by : AERB & NABL Recognized by : BIS

T - 1697 NABL

RADIOACTIVITY MEASUREMENT / TEST REPORT

Test Report. No. MB / 1504004 / NCL / Original / 13268 **Date: 03 / 04 / 2015**

1. Sample identification : **012310**
2. Sample received from : **M/s. TANGEDCO (A Successor Entity of TNEB), Ch-2**
3. Nature of sample : **Imported Coal**
4. Volume / weight : **2200 g**
5. Sample received on : **01 / 04 / 15**
6. Testing completed on : **03 / 04 / 15**

S.No	Nuclides Analyzed	Activity Determination Limit Of Instrument MDA (3σ)	Method Of Testing	Result (Bq / kg)	Exemption levels as per IAEA BSS
1.	Nat Th	16.4 Bq/kg	AERB – Standard Analytical method (Clause 4.3.4 : 2003)	≤ 16.4 Bq/kg (BDL)	1000 Bq/kg
2.	Nat U	11.4 Bq/kg	AERB – Standard Analytical method (Clause 4.3.4 : 2003)	≤ 11.4 Bq/kg (BDL)	1000 Bq/kg
3.	K - 40	68.4 Bq/kg	AERB – Standard Analytical method (Clause 4.3.4 : 2003)	≤ 68.4 Bq/kg (BDL)	1,000,000 Bq/kg

BDL: Below Detection limit

Remarks: The above sample was analyzed for the radioactivity content. This is to certify that the activity level of Nat Th, Nat U, K-40 in the sample was found to be well below the minimum detectable limit of our counting system. The level of activity found in the sample is well below the IAEA Basic safety series limits.

The spectrum / result files are stored as part of Nuclear Counting Facility Records.

Sample return: The sample will be kept for one month and disposed-of or returned on request after one month. If there is any discrepancy / complaint received from the customer within one month from the date of report, the sample will be kept for two months.

This report pertains to only for the sample given to this laboratory.

Disclaimer: This certificate should not be produced in any court of law as part or in full without the written approval of this Laboratory

To
The Chief Engineer/ Projects,
TANGEDCO (A Successor entity of TNEB),
5th Floor Western Wing, NPKRR Malligai,
144, Anna Salai, Chennai-2.

MONARCH BIOTECH (P) LTD. CHENNAI 600 017

M. SARAVANAN
Authorised Signatory

Regd. Office & Sample Collection Centre : New No. 17, Sadullah Street, T. Nagar, Chennai - 600 017, INDIA.
Phone: 91-44- 24352756 / 24312656. Tele Fax : 91-44-24312759. E-mail : info@monarchnuclearlab.com
Website : www.monarchnuclearlab.com

LAB : 37-A, SIDCO Industrial Estate, Thirumazhisai, Chennai - 600 124, INDIA.

MONARCH BIOTECH PVT. LTD.

UNIT : MONARCH LABORATORY SERVICES

TEST REPORT

PART - B : SUPPLIMENTARY INFORMATIONS :

Sample No : **1504001**
Job Card No : **261**
Report No : **MBT/CL/0129** **Date : 06.04.15**

a) Reference to sampling procedure, wherever applicable : **Not applicable**
b) Deviation from the test methods as prescribed in relevant ISS/Work Instructions, if any : **Nil**

Test Commenced On : **03.04.15**
Test Completed On : **06.04.15**

PART C. TEST RESULTS

Tested Parameters	Test Method	Result	Unit
Nickel as Ni	MBT/CL/SOP/ 091	2.11	mg/kg
Iron as Fe		2712	mg/kg
Arsenic as As		BLQ (LOQ : 0.01)	mg/kg
Lead as Pb		1.37	mg/kg
Zinc as Zn		9.12	mg/kg
Mercury as Hg		BLQ (LOQ : 0.01)	mg/kg
Selenium as Se		BLQ (LOQ : 0.01)	mg/kg
Sulphur as S	IS 1350 (Part-III) 1969 (RA : 2000)	0.41	%
Chromium (VI)	Eurasian J Anal Chem 8(1) : 10-16, 2013	6.05	mg/kg

BLQ - Below Limit of Quantification; LOQ – Limit of Quantification

PART D REMARKS

*********End of Report*********

Report Prepared & Verified By

MONARCH BIOTECH (P) LTD. CHENNAI 600 017 Nuclear Counting Division

Authorized Signatory

Regd. Office & Sample Collection Centre : New No. 17/1, Sadullah Street, T. Nagar, Chennai - 600 017. INDIA.
Phone : 91-44-24352756 / 24312656 Tele Fax : 91-44-24312759. E-mail : info@monarchnuclearlab.com
Website : www.monarchnuclearlab.com
LAB : 37-A, SIDCO Industrial Estate, Thirumazhisai, Chennai - 600 124, INDIA.

Annexure -VIII

Coal MOU MMT .

Annexure - VIIIA

एमएमटीसी
लि मि टे ड
MMTC
LIMITED
भारत सरकार का उपक्रम
A GOVT. OF INDIA ENTERPRISE
touching lives, adding value

001844

Office of the C.E./Projects TANGEDCO 27 JUL 2012 4976 Chennai-2

SE/E/T&H
SE/C/P&E
SE/C/TP
CE/PROJECTS

27 JUN 2012

SE/C/P&E/EE/M/F.Import coal/Imp./2012-13/1130 — 24th July 2012

To,

Er. J.Uthayasooriyan B.E., MIE
Chief Engineer/Projects
Tamil Nadu Generation and
Distribution Corporation Limited
5th Floor, Western Wing,
NPKRR Maaligai,
144, Anna Sali,
CHENNAI-600 002

SE/C/P & F

Sub: TANGEDCO – Projects – Establishing of "1x660 MW Supercritical ETPS Expansion project" within the existing Ennore Thermal Power Station, Chennai -57 – MOU in original duly signed.

Dear Sir,

This has reference to your letter dated no. SE/C/P&E/EE/M/F.Import coal/D 759/12 dated 23.7.2012 wherein you have forwarded signed MOU for our signature.

The duly signed MOU in original is returned herewith after retaining one original with us.

Thanking you,

Yours faithfully,
for MMTC LTD.

(Alok Srivastava)
General Manager

Encl: MOU in Original

कोर–1, "स्कोप कॉम्पलैक्स", 7 इंस्टीट्यूशनल एरिया, लोधी रोड, नई दिल्ली–110 003 भारत
Core-1, "SCOPE COMPLEX", 7 Institutional Area, Lodhi Road, New Delhi-110 003 INDIA
दूरभाष / Tel. : 011- 24362200
E-mail : mmtc@mmtclimited.com Website : www.mmtclimited.com
PAN No. : AAACM1433E

தமிழ்நாடு TAMIL NADU 77AA 544222

V. RAMOVENGADAM
STAMP VENDOR
L.No.C-4-13531/75
37, K.B. DASAN ROAD.
CHENNAI-600 018

7722 CE/PROJECT/TANGEDCO

26 JUL 2012
21 JUL 2012

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (hereinafter referred to as "**MOU**") entered into on this 23rd Day of July 2012 by and between:

A. M/s. MMTC Limited, a Government of India Enterprise having its Registered office at Core 1, Scope complex, 7,Institutional area, Lodhi Road, New Delhi - 110 003, (hereinafter referred to as 'MMTC" which expression shall unless the context requires otherwise, include its successors and permitted assigns) of the **First Part.**

and

आलोक श्रीवास्तवा / ALOK SRIVASTAVA
महाप्रबन्धक / General Manager
एम एम टी सी लिमिटेड / MMTC LTD.
(भारत सरकार का उद्यम / A Govt. of India Enterprise)
कोर-1, स्कोप कॉम्प्लेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली-110003 / Lodhi Road, New Delhi-110003

Chief Engineer / Projects
TANGEDCO
144, Anna Salai, Chennai - 600 002.

B. The TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED a company incorporated under Companies Act, 1956, having its office at NPKRR Maaligai, 144, Anna Salai, Electricity Avenue, Chennai – 600 002, (hereinafter called as "TANGEDCO" which expression shall unless the context requires otherwise, include its successors and permitted assigns) of the **Second Part**.

WHEREAS:

a) TANGEDCO has proposed to establish "1x660 MW ETPS Annexe (Supercritical Ennore Thermal Power Station Expansion Project)" a coal based super critical thermal power project (hereinafter referred to as "**Project**") within the existing Ennore Thermal Power Station premises, at Ernavur village, Madhavaram Taluk, Tiruvallur district, Tamil Nadu to improve the power supply situation in Tamil Nadu;

b) TANGEDCO propose to operate the plant with imported coal in view of the shortage of indigenous coal prevailing in India;

c) MMTC is having vast experience in supplying imported coal for various thermal plants of TANGEDCO;

d) MMTC has agreed to supply imported coal over **2.0 Million tonnes per annum (2.0 MTPA)** for the above proposed project at the request of TANGEDCO.

e) For the aforesaid purpose, the parties hereby agree to sign these presents on mutually agreed terms and conditions mentioned hereunder:

NOW THEREFORE THIS MEMORANDUM OF UNDERSTANDING (MOU) WITNESSTH AS FOLLOWS:

1. <u>INTENT:</u>

a) MMTC shall import coal for Long term supply for operation of "1X660 MW ETPS Annexe (Supercritical Ennore Thermal Power Station Expansion Project)". The imported coal shall be non- coking coal (steaming) as per the following Price basis.

i)	GCV (ADB)	: 6000 Kcal/Kg.
ii)	Total Moisture (ARB)	: 15%
iii)	Ash Content (ADB)	: 8%
iv)	Sulphur	: 0.6%

b) The characteristics of imported coal shall be

आलोक श्रीवास्तव / ALOK SRIVASTAVA
महाप्रबन्धक / General Manager
एम एम टी सी लिमिटेड / MMTC LTD.
(भारत सरकार का उद्यम / A Govt. of India Enterprise)
कोर–1, स्कोप कॉम्प्लेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली–110003 / Lodhi Road, New Delhi-110003

Chief Engineer / Projects
TANGEDCO
144, Anna Salai, Chennai - 600 002.

(A) CHARACTERISTICS OF IMPORTED COAL(TYPE I)

Sl. No	Description	Unit	Typical	Guaranteed
1	Total Moisture (as received basis)	%	7-23	15
2	Inherent Moisture (air dried basis)	%	4-14	
3	Ash Content (air dried basis)	%	2-8	
4	Fixed Carbon (air dried basis)	%	30 - 50	
5	Volatile Matter	%	25-42	
6	FC/VM Ratio	--	0.80 to 1.3	
7	Total Sulphur (air dried basis)	%	0.3-0.8	0.6
8	Gross calorific value(air dried basis)	Kcal/kg	5800 - 6700	6000
9	Gross calorific value (as received basis)	Kcal/kg	5400 – 6300	
10	NCV (as received basis)	Kcal/kg	5100 - 6000	
11	Grindability of coal according to Hard Grove Index (HGI)	--	45-60	
12	Ash fusion Temperature – (IDT)	^{0}C	1200	
	- (Softening Point)	^{0}C	1250	
	- (Flow Point)	^{0}C	1300	
13	Size of Coal	mm	0 to 50	

c) Quantity:

The quantity of imported coal shall be 2.0 MTPA if the power plant is operated with 100% imported coal.

d) MMTC shall source the coal of the above specification as per clause 1(b) above.

e) The plant is expected to be commissioned by March 2016. The supply of imported coal shall commence from March 2016 tentatively.

f) TANGEDCO shall intimate exact date of commissioning of the Project to MMTC in advance (i.e. three months) so that MMTC shall arrange necessary logistics.

g) TANGEDCO shall furnish month-war requirement of coal to MMTC sufficiently in advance for supply of coal.

h) The imported coal is to be unloaded in existing Coal Berth 1 and 2 or Future coal berth 3 to be established by Ennore Port Limited and MMTC shall arrange Panamax Vessels for transporting the coal.

आलोक श्रीवास्तव / ALOK SRIVASTAVA
महाप्रबन्धक / General Manager
एम एम टी सी लिमिटेड / MMTC LTD.
(भारत सरकार का उपक्रम / A Govt. of India Enterprise)
कोर-1, स्कोप कॉम्प्लेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली-110003 / Lodhi Road, New Delhi-110003

Chief Engineer / Projects
TANGEDCO
144, Anna Salai, Chennai - 600 002

i) MMTC shall follow CVC guidelines and other Govt. notifications issued from time to time for procurement of imported coal.

j) MMTC shall furnish the split up details of imported coal including taxes, duties, insurance charges, Load transportation, port charges and all other incidental expenses such as pilotage and berth hire charges, light dues, harbour dues, clearing and forwarding, assessment and other charges with respect to the vessels at port of discharge. The rates shall also include overhead charges of MMTC.

k) MMTC and TANGEDCO shall mutually discuss and agree on the price of coal every year for the supply of imported coal.

l) TANGEDCO shall pay the customs duty direct to customs authority after receipt of High Seas sales agreement, Invoice based on load port results, copy of Bill of lading, copy of certificate of origin, copy of Load port weighment certificate, load port draft survey, load port sampling and analysis confirming to the specification.

MMTC shall furnish the certificate of origin as per standard formats prescribed by Ministry of Finance/Dept. of Revenue/ Govt. of India along with other shipping documents. The stevedoring charges and cargo related wharfage charges at the discharge port shall be borne by TANGEDCO.

m) MMTC shall arrange for sampling Analysis weighment of coal shipment at load port and discharge port through mutually agreed Internationally accredited inspection Agency.

n) C&F Price shall be adjusted for Gross Calorific Value, Total moisture, ash and Sulphur as per mutually agreed terms before shipment.

o) Payment for imported coal shall be against LC/CAD basis.

p) The quantity of imported coal to be supplied will vary depending on the Plant load factor of the Power Plant as well as the supply of indigenous coal based on Long term coal linkage, if any granted by Ministry of Coal. TANGEDCO shall not responsible for any variation in the quantity of imported coal that may be imported.

(B) SPECIFICATION OF VESSELS TO BE USED/SALIENT DETAILS OF ENNORE PORT:

The coal shall be unloaded in existing Coal Berths 1and 2 or Future coal berth/3 to be established by Ennore Port Limited. The draught of this port

आलोक श्रीवास्तव / ALOK SRIVASTAVA
महाप्रबन्धक / General Manager
एम एम टी सी लिमिटेड / MMTC LTD.
(भारत सरकार का उद्यम / A Govt. of India Enterprise)
कोर-1, स्कोप कॉम्पलेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली-110003 / Lodhi Road, New Delhi-110003

-4-

Chief Engineer / Projects
TANGEDCO,
144, Anna Salai, Chennai - 600 002.

area 14.5m, hence Panamax type vessels shall be engaged by MMTC and the Vessel may be loaded for a maximum draught at Ennore port for 13.5m at CB 1 and 2 or in CB 3. The discharge in each berth shall be through shore unloader of capacity 2 x 2000T/ hour. TANGEDCO shall guarantee the above Discharge.

2. REPRESENTATION AND WARRANTIES:

Neither party shall have the right of power to bind the other party to any agreement without the prior written consent of the other party. Unless specifically agreed in writing, no party is authorized to make commitments, representations, warranties to agreements on behalf of the other party and each party agrees that it will not hold itself out as having such authority. If any party acts in violation of the foregoing, the said party agrees to indemnify, defend and hold the other parties harmless from and against any and all claims, demands, losses, damages, liabilities, law suits and other proceedings, judgments and awards, the reasonable cost and expenses, (including but not limited to reasonable attorneys fee) arising directly or indirectly in whole or in part, out of the breach of this article by such party whether committed by the indemnifying party, its employees, agents, successors or assigns.

3. LIMITATION OF LIABILITY:

Neither party shall be liable to each other for any financial liability or any consequential loss incurred by the party individually in respect of the MOU.

4. ASSIGNMENT:

The assignment by any party of all its rights and obligations under this MOU to a third party shall be subject to the written consent of the other party provided that such assignee shall also specifically agrees in writing to be bound by the terms of this MOU.

5. SETTLEMENT OF DISPUTES AND ARBITRATION:

In the event of any difference / dispute arising between the parties hereof under these presents, such disputes/difference shall in the first instance

आलोक श्रीवास्तवा / ALOK SRIVASTAVA
महाप्रबन्धक / General Manager
एम एम टी सी लिमिटेड / MMTC LTD.
(भारत सरकार का उद्यम / A Govt. of India Enterprise)
कोर–1, स्कोप कॉम्प्लेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली–110003 / Lodhi Road, New Delhi-110003

Chief Engineer / Projects
TANGEDCO
144, Anna Salai, Chennai - 600 002.

be resolved amicably by mutual consultations within 45 days of the reference of dispute by either party.

If amicable settlement is not reached between the parties in any dispute or difference, whatsoever arising between the parties out of or relating to the construction, meaning, scope, operation or effect of this MOU or the validity or the breach thereof shall be settled by arbitration in accordance with the Rule of Arbitration of the Indian Council of Arbitration and the award made in pursuance thereof shall be binding on the parties. The provisions of Arbitration and Conciliation act -1996 shall apply to such Arbitration proceedings. The venue of the Arbitration shall be at Chennai.

6. GOVERNING LAWS & JURISDICTION :

This MOU shall be governed by the laws of India and the rules framed there under. The Courts of Chennai shall have exclusive jurisdiction in all matters relating to or arising out of this MOU.

7. NOTICE:

Any notice to be given under this MOU shall be in writing and shall be deemed to have been duly and properly served upon the Parties hereto if delivered against acknowledgement or by registered mail with acknowledgement or by registered mail with acknowledgement due, addressed to the Parties herein at the following addresses or such changed addresses as will be duly notified by the Parties from time to time.

Address

Attention

MMTC Limited, represented by General Manager/Thermal coal,
Core 1, Scope complex,
7, Institutional area,
Lodhi Road,
New Delhi - 110 003.
Tel No. : 011-24392149.

Attention

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED,
represented by Chief Engineer/Projects,
5th floor, Western wing,
NPKRR Maaligai,
144, Anna Salai,
Electricity Avenue,
Chennai – 600 002.
Tamil Nadu State.
Tele Fax .No. 044-28520878.

K SRIVASTAVA
Manager
एम एम टी सी लि. / MMTC LTD.
कोर-1, स्कोप कॉम्प्लेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली-110003 / Lodhi Road, New Delhi-110003

Chief Engineer / Projects
TANGEDCO
144, Anna Salai, Chennai - 600 002.

8.0 CONFIDENTIALITY:

a. The parties, to the extent of their respective rights to do so, shall exchange such technical information and data as is reasonably required of each party to perform its responsibilities under this MOU. Each party agrees to keep in confidence and to use the same degree of care as it uses with respect to its own proprietary data to prevent the disclosure to third parties of all technical information, data and confidential business information (hereinafter referred to as "Data").

b. Exchange, use and maintenance of confidential data shall be mutually discussed and agreed to by the parties.

c. The preceding provisions of confidentially and restriction on use of data shall not apply to by the Parties.

- Information in the public domain of information, which subsequently enter into public domain without committing breach of this clause.
- Information in possession of the party at the time of disclosure and was not acquired, directly or indirectly, from the other party.
- Information which a party is required to disclose under law, rules or regulations to any judicial or other authorities.
- Consultants / advisors, provided they, in turn, sign undertaking of confidentially.

9. TERMINATION OF MOU:

The MOU shall stand terminated without any liability on either party,

i) If the parties hereto by mutual consent agree that the MOU could not be continued for any reason whatsoever, or

ii) On expiry of the notice period if either party gives a written notice of not less than three months expressing inability to continue with the MOU.

ALOK SRIVASTAVA
आलोक श्रीवास्तव / General Manager
महाप्रबन्धक / MMTC LTD.
एम एम टी सी लिमिटेड / A Govt. of India Enterprise
(भारत सरकार का उपक्रम)
कोर-1, स्कोप कॉम्प्लेक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली-110003 / Lodhi Road, New Delhi-110003

Chief Engineer / Projects
TANGEDCO
144, Anna Salai, Chennai - 600 002.

10. EFFECTIVE DATE:

This MOU shall come into force as soon as it is signed for all purposes and intents.

IN WITNESS WHEREOF, the parties hereto have signed this Memorandum of Understanding at Chennai on the date first mentioned above in the presence of witnesses as mentioned hereunder.

For and behalf of MMTC Limited

GENERAL MANAGER/THERMAL COAL

आलोक श्रीवास्तवा / ALOK SRIVASTAVA
महाप्रबन्धक / General Manager
एम एम टी सी लिमिटेड / MMTC LTD.
(भारत सरकार का उपक्रम / A Govt. of India Enterprise)
कोर-1, स्कोप कॉम्पलैक्स / Core-1, Scope Complex
लोधी रोड, नई दिल्ली-110003 / Lodhi Road, New Delhi-110003

For and behalf of TANGEDCO

CHIEF ENGINEER/PROJECTS

WITNESSES:

1. (R. Ganapathy Sankaran, SE/Civil/PRE TANGEDCO)

2. B. Selvakumar (B. SELVAKUMAR). SR. MANAGER MMTC LTD., N.DELHI.

Annexure -IX

PWD clearance for pipe conveyor routing

Annexure - IX

(21)

DRAFT LETTER-8.doc

WATER RESOURCE DEPARTMENT

From

Er. G.MADUSUDEN, B.E.
Chief Engineer, WRD.,
Chennai Region, PWD.,
Chepauk, Chennai 600 005.

To

The Chief Engineer,
Ennore Thermal Power Station,
Ennore,
Chennai-600 057.

Lr.No.TS (3) / 7949 / 2008 / Dt.21.05.2008.

Sir,

Sub : TNEB - ETPS - Formation of 1 x 600 MW Thermal Power Project at ETPS - Movement of Coal from Ennore Port / NCTPS Yard to ETPS directly through a pipe conveyor for the existing 450 MW Station as well as for the proposed 1 x 600 MW Power Project - To carry out the work at Ennore Creek and Buckingham Canal and track rent approved - permission - Reg.

Ref : 1. Chief Engineer, ETPS / Ennore Lr.No.CE / ETPS / SE / CM / EA / F1 x 600 MW / D 131 / 08 / Dt.08.02.2008.

0oio0

With reference to the Chief Engineer / EPTS / Ennore Letter cited, I have inform that the Right of way permission is given to proposed establish a 1 x 600 MW Thermal Power Project at Ennore Thermal Power Station for which a new pipe conveyor system is to be formed for feeding the coal from North Chennai. Thermal Power Station to Ennore Thermal Power Station through Ennore Creek and Buckingham Canal.

I have also offered remarks on his subject as below :

The site was inspected along its route right from crossing at NCTPS Campus and running over the creek portion to a length of about 3600 metres before taking a crossing of Buckingham Canal just opposite to the present cooling water intake point of the ETPS.

Considering the declaration of Buckingham Canal as National Inland Waterway and Formation of terminal etc; the said alignment can be divided on to three stretches.

Stretch-I : The Stretch crossing the creek via the present Chennai Gummidipoondi Railway (i.e.) this area between off take point of Buckingham Canal at North and Railway Track. The length is about 600 metres. C to D

Streteh-II : After crossing the Railway line, running along the creek up to the point just before the crossing of Buckingham Canal near present cooling water intake point. It is about 3000 m. E to C_1

Stretch-III : The crossing over the Buckingham Canal to reach the ETPS Campus. It is about 120 metres minimum. C_1 to H

The No Objection Certificate is given subject to the following conditions:

Stretch-1 : Buckingham Canal has been declared as inland waterways by Government of India. The Inland Water Transport Authority is going to develop the waterway according the requirement and guidelines. One of the terminal is proposed in this area. Hence, the following parameters as to be observed while designing the infra-structure for the conveyor pipe.

1)	Minimum No. of Span to be provided with a clear width of 36.0 m	:	6 Nos. (Six)
2)	The bottom level of the conveyor pipe (or) the saddle / slab which ever is lowest to be	:	+ 8.50 m MSL (or) 6.00 m above the High tide line.

3) The top level of pile cap slab : (-) 2.00 m MSL

4) The size of pile (or) trestle unit shall be as short as possible to ensure maximum clear waterways.

Stretch-II : This is obviously running along the creek, the Kosasthalaiyar river estuary etc. Here the orientation and sizes of the piers / trestles have necessarily to be made as parallel as possible, subject to following conditions :

5) The bottom of saddle / slab / or pipe has to be fixed as : (+) 6.00 MSL

Observed Maximum Flood Level	:	(+) 2.90
Minimum Vertical Clearance	:	(+) 3.00
		(+) 5.90 m or 6 m

6) The top level of pile capping beam (or) slab : (-) 2.00 MSL

7) No Obstruction except this pier should be made, to establish the free flow of flood water in this backwater area.

Stretch-III : This is most important stretch in view of the development of the Buckingham Canal as a National Inland Waterways. The following conditions may be set out as strictly to be followed.

8)	The length of the crossing should be than (including the EPTS side bank)	:	100 metres (i.e) 50 m on either sides from the center of the Buckingham Canal.
9)	The Minimum cleaf span	:	36 metres
10)	Number of Spans	:	3 Nos. Minumum
11)	The bottom level of saddle / pipe to be of (For the entire 100 m)	:	(+) 8.50 m MSL

12) The top of pile capping slab beam etc : (-) 2.00 m MSL

13) In corporation all the above parameters in various stretches the approved drawing may be subjected to Executive Engineer, PWD., Araniyar Basin Division, Chepauk, Chennai-5 before commencement of work.

14) No damages should be made to the Canal Banks.

15) A sum of Rs.5.00 lakhs may be deposited towards the caution deposit in favour of the Executive Engineer, PWD., Araniyar Basin Division, Chepauk, Chennai-5. The same will be refunded after completion of the above work; if no damages to the PWD property is reported by the field official.

16) The track-rent works at Rs.12,000/-. per annum - as per G.O.Ms.No.202 / Dt.24.04.2000. (Rs.3000/- per Km per annum) the track rent fixed may be paid to this department.

17) The track rent amount fixed is for one year from the date of issue of order and it will have to renewed before 30 days of expiry of the order.

18) The track rent now fixed will be revised from time to time based on the Government orders in future if any.

19) The ETPS should be enter into a agreement with the Executive Engineer, PWD., Araniyar Basin Division, Chepauk, Chennai-5.

20) The EPTS shall always maintain the track in good condition.

21) If any damage is done to any of the PWD property the damages shall be repaired at the cost of the ETPS.

22) In case if any repairs are proposed to be carried out to the pipeline in future, prior permission of the department should be obtained.

23) The permission now granted is liable to be revoked or break or any of the conditions and in the event of such recoverable, the ETPS shall not be eligible to any compensation whatsoever.

24) This department is liable to cancel, the permission granted without any prior intimation whenever necessity arises.

25) Advance intimation should be communicated to the Executive Engineer before commencement of the work.

26) After the completion of work the materials used should be removed completely their own cost.

27) Necessary modification has to be carried out at your own cost according to any change of norms of National Waterway during the development.

28) If any change of alignment arises that should be got approved by this department well in advance.

Encl. : 1) Index Plan

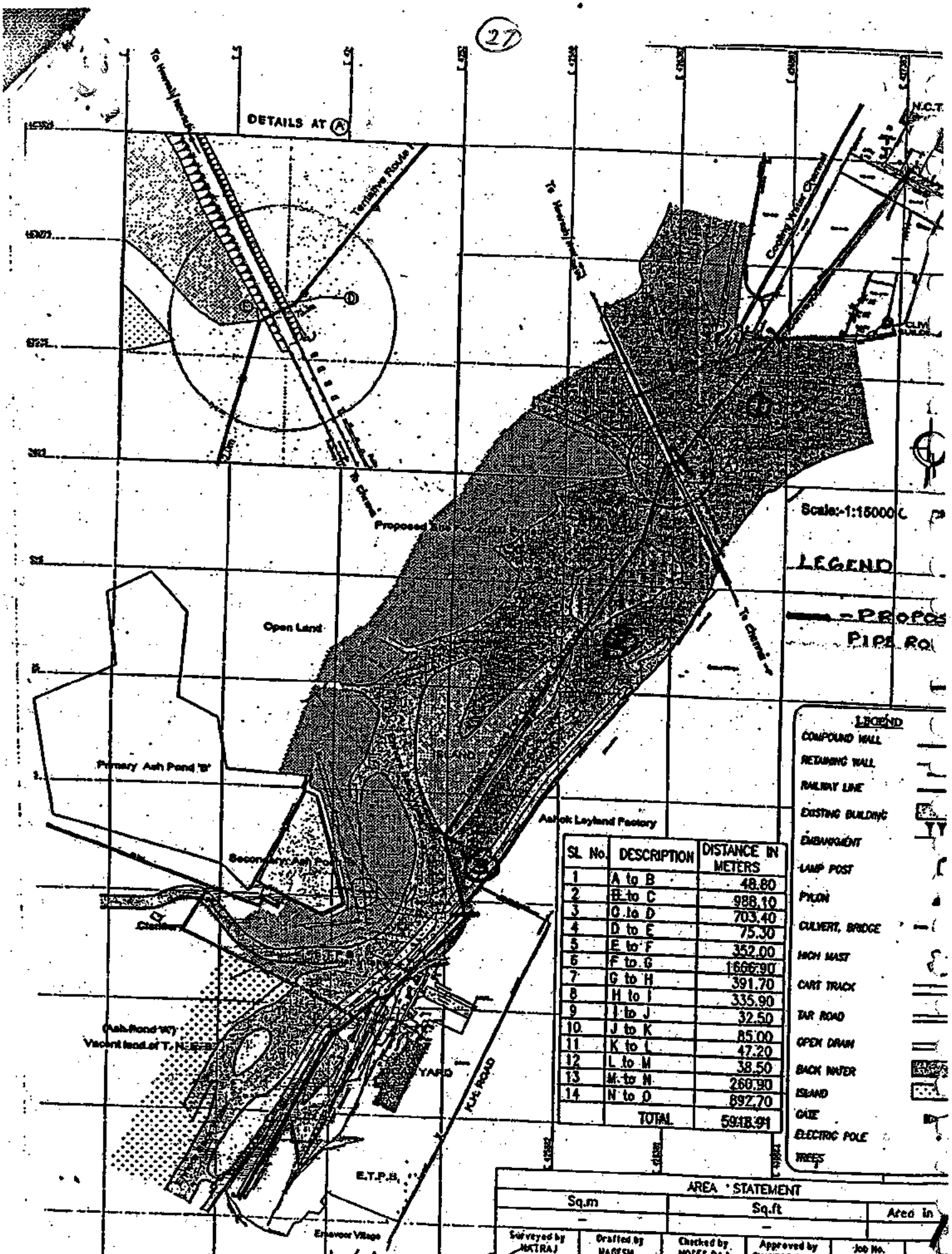
21/5/08

For CHIEF ENGINEER, PWD., WRO.,
CHENNAI REGION, CHENNAI-5.

Or.Bo
21/5/08

Copy with a copy of Chief Engineer, ETPS, Ennore Lr.No.CE / ETPS / SE / CM / EA / F 1 x 600 MW / D 131 / 08 / Dt.08.02.2008 communicated to the Secretary to Government, PWD. Secretariat, Chennai-9 for favour of kind information.

Encl. : CE / ETPS / Ennore Lr.No.CE / ETPS / SE / CM / EA / F 1 x 600 MW / D 131 / 08 / Dt.08.02.2008.



SL No.	DESCRIPTION	DISTANCE IN METERS
1	A to B	48.80
2	B to C	988.10
3	C to D	703.40
4	D to E	75.30
5	E to F	352.00
6	F to G	1666.90
7	G to H	391.70
8	H to I	335.90
9	I to J	32.50
10	J to K	85.00
11	K to L	47.20
12	L to M	38.50
13	M to N	260.90
14	N to O	892.70
	TOTAL	5918.91

AREA STATEMENT

Sq.m	Sq.ft	Area in
–	–	

Surveyed by	Drafted by	Checked by	Approved by	Job No.
NATRAJ	RAGESH	MOSES RAJ	CHANDRE GOWDA	PXL110

EXECUTIVE ENGINEER/CIVIL
Civil Project Division
Ennore Thermal Power Station
Ennore / Chennai-600 057.

ASSISTANT EXECUTIVE ENGINEER
Tamil Nadu Electricity Board
Project Subdivision
Ennore Thermal Power Station
Ennore / Chennai-600 057.

SURVEY CONSULTANTS:
PIXEL SOFTEK PVT. LTD.
(SURVEY And GIS CONSULTANTS)
8TH FLOOR, VENKALAGARA BHAVANA,
HUDSON CIRCLE, BANGALORE-560027.
Tel : 22485241, Fax : 22485247.

Title: TOPOGRAPHICAL ROUTE SU
PIPE CONVEYOR FROM N.C.T.
CLIENT : ENNORE THERMAL
STATION AT CHE
DRG. NAME

Annexure -X

Questionnaire for Environmental appraisal

QUESTIONNAIRE FOR ENVIRONMENTAL APPRAISAL
(THERMAL POWER SECTOR PROJECTS)

Note-1: All information given in the form of Annexures should be part of this file itself. Annexures as separate files will not be accepted.

Note-2: Please enter x in appropriate box where answer is Yes/No

I		**General Information**			
	A	Name of the Project		ETPS Expansion 1X660 MW TPP at Ernavur (V), Tiruvottiyur (T), Thiruvallur (D), Tamil Nadu by M/s. TANGEDCO.	
	1	Existing project/ proposed project/ expansion project/ modernization project		Expansion Project	
	2	If existing/ expansion/ Modernization project, whether Environmental clearance has been obtained		Existing ETPS - 450 MW (3x110 MW + 2x60 MW) established in 1970-75, decommissioned on 31.03.2017 Proposed Expansion: - EC obtained for 1x600MW on 3.6.2009 - Amendment to EC for 1x660MW obtained on 24.1.2013 - EC validity extension for 1x660MW obtained on 18.9.2014 valid till 2.6.2019 - CRZ clearance on 23.12.2008 - TOR obtained (fresh) 21.01.2019	
	B	Generation Capacity (MW)		1X660 MW	
	C	Location			
		Village	**Tehsil**	**District**	**State**
		Ernavur	Tiruvottiyur	Thiruvallur	Tamil Nadu
	D	Geographical Information			
	1	Latitude		$13^{O}11'30.1"$ N; $13^{O}12'04.5"$ N	
	2	Longitude		$80^{O}18'14.3"$ E; $80^{O}18'44.4"$ E	
	3	Elevation above Mean Sea Level (meters)		+ 9.5 meters	
	4	Total Area envisaged for setting up of project		(33.99 Hactares)/ 84 Acres	
	5	Nature of terrain (hilly, valley, plains, Coastal plains etc.)		Coastal plain	

	6	Nature of Soil (sandy, clayey, silty loam etc. with permeability in cm/sec)	Sandy loam
	7	Permeability (cm/sec)	-
	E	Alternate sites considered	No Alternative sites are proposed, coming up in open land available in the existing ETPS complex.
	F	Reasons for selecting the proposed site on comparative evaluation on environmental consideration	The project is proposed in the existing ETPS thermal Power plant area, so there is no alternative site considered • Infrastructure facilities such as Land, water transport system, conveyor, roads are available. • No R&R involved • Water from sea through desalination • No Forest land involved
II		**Current land usage of the proposed project site Area (in hectares)**	
	A	Notified Industrial Area/ Estate	It is in notified Industrial Area/ Estate (33.99 Ha)
	B	Agricultural	Nil
	1	Irrigated	Nil
	2	Un-Irrigated	Nil
	C	Homestead	Nil
	D	Forest	Nil
	E	Grazing	Nil
	F	Fallow	Nil
	G	Mangroves	Nil
	H	Marshes	Nil
	I	Others (Govt. Waste Land))	Nil
		Total	**33.99 Hectares**
III		**Is the proposed site located in a low-lying area?**	Yes/ No✓
		If Yes	-
	A	Level before filling (above MSL, in. meters)	Not applicable
	B	Level after filling (above MSL in meters)	Not applicable
		Quantity of Fill Material required (in cum.)	Not applicable
		Source	Not applicable

	C	Does the project involve land preparation/ reclamation	Yes/ No✓
		If yes provide details	-
IV		**Please indicate area earmarked for each of the following (in Ha.)**	
	(A) Inside power plant Boundary		
	A	Main power block & auxiliaries	9.7
	B	Switchyard & Transformers yard	0.8
	C	Water storage & facilities, cooling tower, etc.	7.2
	D	Coal storage & handling facilities	4.8
	E	Greenbelt area	5.6
	F	Miscellaneous	5.6
	G	Ash dump area & Staff colony	Existing
		Sub Total	**33.99**
	(B) Facilities outside the plant boundary		
	H	Corridor for water pipeline	1.2
	I	Corridor for pipe conveyor	1.2
		Sub Total	**2.4**
		Grand Total	**36.42**

V		**Proximity to sea/ water bodies**		
			Sea	**Other Water bodies like River/creek/lake etc. (Please specify)**
		Distance of site* boundary (in m)	• Bay of Bengal 815m in East	• Koratliyar river 575m • Ennore back waters 70m
		Distance of plant facilities (in m)		
	* From highest flood line/ high tide line			

VI		**Whether any of the following exist within 7 km of the periphery of the project site. If so, please indicate aerial distance and the name of the eco-system as given under the Table**			
			Name	**Area falling within 7 km periphery of project (Ha)**	**Aerial Distance (in km)**
	1	National Park/ Wildlife Sanctuary	No		
	2	Tiger Reserve/ Elephant Reserve/ Turtle Nesting ground	No		
	3	Core Zone of Biosphere Reserve	No		
	4	Habitat for migratory birds	No		
	5	Lakes/ Reservoir/ Dams	• Ennore back waters at 70 m		

	6	Stream/ Rivers	• Koratliyar River at 575 m in West direction.
	7	Estuary/ Sea	• Bay of Bengal 815 m towards East
	8	Mangroves	No
	9	Mountains/ Hills	No
	10	Notified Archaeological sites	No
	11	Any other Archaeological sites	No
	12	Industries/ Thermal Power Plants	• Ashok Leyland at 1 km (N) • Vallur Conventional Thermal Power Plant at 2.4km (NW) • Tamilnadu Petro products Limited at 2.8km(SW) • North Chennai Thermal Power Station at 2.9km (N) • Bharat Petroleum Corporation Limited at 3.1 (NNW) • Hindustan Petroleum Corporation Ltd at 3.2(NNW) • Reliance Terminal 3.7km(NW) • Chennai Petroleum Corporation Ltd at 4.1(SW) • Ennore SEZ TPP at 4.1(N) **Attached as Annexure Q1**
	13	Defense Installation	Nil
	14	Airports	Nil
		If located within limits of municipal bodies, please confirm	Not located in any Municipality limits
		From National/ State Highways and railway lines, distance of 0.5 km should be maintained	• Ennore Express Highway 200 m (East) • New Manali express Road at 600 m(South) • Kathivakkam railway station at 2 km (East) • Chennai (Meenambakkam) Airport at 26 km (SW)
		If located in the landing funnel of the airport, clearance from Airports Authority of India should be obtained.	Not applicable
VII		**Description of the flora/ vegetation within 7 km under following headings**	
	A	Agricultural crops	Paddy, Coconut, Cashew, Tapioca, Tobacco, Sweet Potato, Vegetables, Pulses, Banana, Ginger & Oil Seeds.
	B	Commercial crops	
	C	Plantation	Nil
	D	Natural Vegetation/ Forest Type	Nil

	E	Grass Lands	Nil
	F	Endangered species	Nil
	G	Endemic species	Nil
	H	Others (Please Specify)	Nil
VIII		**Description of fauna (non-domesticated) within 7 km under the following headings**	
	A	Total listing of faunal elements	Details are given in Chapter 3, Table 3.20 and Table 3.21
	B	Endemic fauna species	Nil
	C	Endangered species	Nil
	D	Migratory species	Nil
	E	Route of migratory species of birds and mammals	Nil
	F	Details of aquatic fauna (if applicable)	Details are given in Rapid Marine EIA study by M/s Cholamandalam MS Risk services limited (Attached as Annexure III in EIA)

IX		**Meteorological Parameters**	
	A	Seasonal – Monitoring Data (continuous monitoring for one full season except monsoon should be carried out)	• Ambient air quality monitoring during July to September 2018 carried out by Chennai testing laboratory Private limited. • LULC, Water, Noise, Soil, Ecological and Socio-economic Conditions carried out by Ramky Enviro Services Private limited during April- May 2019.
	1	Temperature (in ^{0}C)	Minimum : 22.5 Maximum : 37.8 Seasonal Average Temperatures
	2	Rainfall (in mm)	Nil
	3	Mean value of humidity (in %)	Minimum : 55 Maximum : 89 Seasonal Average Humidity
	4	Inversion occurrence	in percentage Not Applicable Height in meters Not Applicable

	5	Seasonal Wind-rose pattern (16 points on compass scale)	Wind rose Diagram is given in Chapter 3, Figure 3.1
	B	Hourly Mean Meteorological data (based on one full season data collected at site required as input for air quality modeling)	Mean Meteorological data Chapter 4, Table 4.2
X		**Ambient Air Quality Data**	
		[Frequency of Monitoring should be as per guidelines of CPCB and monitoring should cover one full season (excluding monsoon)]	Monitoring carried out as per guidelines of CPCB & MOEFCC
	A	Season and period for which monitoring has been carried out	Pre Monsoon Season (July to September, 2018)
	B	Frequency of sampling	2 days a week, four weeks in a month, three months in a season
	C	Number of samples collected at each site	24 samples

Date, Time & Location	**Wind direction & Speed**	**24 hourly Conc. as monitored (in μg/m^3) PM10,PM2.5 SO_2, NO_x**	**Permissible Standard (As per EPA/SPCB consent) (in μg/m^3.)**	**Remarks (Name of the instrument and sensitivity)**
2 days per week for four weeks in a month during July 2018 to Sep 2018 at 9 locations samples were collected	Predominant wind direction blowing from SW Average wind speed for the season is 2.85 m/sec.	Given in Chapter-3, Table: 3.5 to 3.7	PM_{10} : 100 $PM_{2.5}$: 60 SO_2 : 80 $NO_{x:}$: 80 O_3 :180(1 hour)	High Volume Air samplers with cyclone arrangement, Fine dust samplers for $PM_{2.5\&10}$, SO_2 NO_x & O_3

D	24 hourly concentrations (in μg/m3)				
	Pollutant(s)	**Maximum**	**Minimum**	**Mean**	**98%**
	PM 2.5 & 10	Given in Chapter-3, Table: 3.5 to 3.7			
	SO_2				
	NO_X				
	O_3 & CO				

	E	Specific air pollution issues in the project area.	No Specific Air Pollution is observed in the project area

XI		**Water Requirements (cum/day)**					
		Purpose	**Avg. Demand**	**Peak Demand**	**Source**	**Type Treated/ Untreated/ Fresh/ Recycled**	**Remarks**
		• Clarifier • DMF/PSF • RO I • RO II • Cooling water makeup • Dust conditioning • Potable water Green Belt &Others	Total Water requirement is 170712 m3/day. Source – Sea water, Bay of Bengal. Water Requirement and its source for the proposed project given in Chapter 2, Section 2.6, Table 2.2,Table 2.3 water balance is given in Figure 2.8 & 2.9 Waste water generations details given in Table 2.4.				

XII		**Source of Raw Water Supply**		
		Source	**Cum./hr**	**Cum./day**
	1	Sea (Bay of Bengal)	7113 (through Desalination plant)	170712
	2	River	Not Applicable	Not Applicable
	3	Groundwater	Not Applicable	Not Applicable
	4	Other surface water bodies (Please specify) – **CMWSSB**	Not Applicable	Not Applicable
XIII		Lean Season flow in case of surface water source (cusecs/ cumecs)	Nil	
XIV		**Ground Water**		
	A	Recharge Rate	Ground water is not used in the proposed project and the source of water is from Bay of Bengal	
	B	Withdrawal rate		
	C	Ground water level (meters)		
	1	Pre monsoon		
	2	Post monsoon		
XV		**Competing Users of the Water Source**		
		Present Consumption (cu.m/day)	**Addition Proposed as per local plan (cu.m./day)**	**Total (cu.m./day)**

		Surface	Ground	Surface	Ground	Surface	Ground
	Irrigation	Nil					
	Industry						
	Drinking						
	Others (Please specify)						
	Total						

XVI	**Physico chemical analysis of Raw Water at intake point**		Sea water sample Physico Chemical analysis results are given in Chapter 3 Table 3.10
XVII	**Physico chemical analysis of treated water to be used in project/ township**		Treated water will be used in Green Belt development & others
XVIII	**Waste Water Management**		
	A	Description of wastewater treatment plan with flow chart	The schematic diagram of the waste water treatment plan is given in Chapter 4, Figure 4.11
	1	Coal storage	
	2	Other than coal storage	
	B	Composition/ characteristics of discharge stream(s) before and after treatment	

	Sl.no	Item	**Characteristics**	
			Before treatment	**After treatment**
	1		Wastewater Characteristics are given in Chapter-4, Table 4.12;	Final Treated Characteristics after treatment is given Chapter-4 Table 4.13;
	2			
	3			
	4			
	C	**Daily Discharge (cum/ day) from different sources**		
	1	CW Make Up	98736	
	2	Clarifier reject	2112	
	3	RO I condensate	22272	
	4	Condensate polishing Unit regeneration	168	
	5	DM regenaration	72	
	6	Potable Water Requirement	216	
		Total	**1,23,576**	
	D	Quantity of water recycled		
	1	In %	The water balance table is given in Chapter 2 Figure 2.9	
	2	In cum./day		

	E	Details of Recycling Mechanism	Sewage Treatment Plant (STP)/ Effluent Treatment Plant (ETP)	
	F	Mode of final discharge/ disposal of treated effluent	Sea Dilution	
	S.No	**Mode**	**Length (In m.)**	**Quantity (in cum./day)**
	1	Open Channel	Nil	Nil
	2	Pipeline	-	
	3	Others (Please specify)	-	-
		Total	-	
	G	Point of Final Discharge	Bay of Bengal	
	Sl.no	**Final Point**	**Quantity (in cum./day)**	
	1	Green belt within the plant/ township, Ash sluicing, dust suppression	-	
	2	Agricultural land	-	
	3	Fallow Land	-	
	4	Forest Land	-	
	5	River/Stream	-	
	6	Lake	-	
	7	Estuary	-	
	8	Sea	Sea Dilution (123360)	
		Total	123360	
	H	Lean season flow rate in case of discharge in a river/stream (cusecs/cumecs)		
	Sl.no	**Final Point**	**Quantity (in cum./day)**	
	1	Human	Not Applicable	
	2	Irrigation		
	3	Industry		
	4	Others (pl. specify)		
	I	Analysis of river water 100 meters upstream of discharge point and 100 meters Downstream of discharge point (except in rainy/ monsoon season) along with Details of aquatic life.	Not Applicable	

	J	What is the predicted impact on water quality of the receiving body due to discharge? (Briefly state the prediction tool adopted)	Water meeting discharge standards, will sent to sea Details of Impact on water quality of the receiving body due to the discharge is discussed details in Rapid Marine EIA Study carried out by M/s Cholamandalam MS Risk Services Pvt ltd., Chennai., an accredited consultant of MoEFCC (Executive summary is attached as Annexure III in EIA)		
XIX		**Quantity of fly ash/residue produced per day (Tonnes) -100% imported coal**			
	Sl.no	**Solid waste**	**Dry**	**Wet**	
	1	Fly Ash	335	-	
	2	Bottom Ash		84	
	3	Others (Please specify)	-	-	
		Total	419		
XX		**Solid Waste Management**			
	A	**Details**	**Source**	**Qty (TPM)**	**Form**
	1	Raw water treatment Plant	Clarifier sludge	-	
	2	ETP/waste water Treatment	Sludge	-	
	3	Process	-	-	
	4	Others (pl. specify) STP	Organic sludge	-	
	B	If waste(s) contain any hazardous/toxic substance/ radioactive materials or heavy metals, provide data and proposed precautionary measures	Waste does not contain any hazardous/ toxic substance/ radioactive materials or heavy metals		
	C	What are the possibilities of recovery and recycling of wastes?	Nil		
	D	Possible users of Solid Waste (s)	Organic sludge generated in STP will be used as manure for greenbelt development		
XXI		**Method of disposal of solid waste (s)**			
	S.No	**Method**	**Quantity (TPM)**		
	A	Landfill	-		
	B	Incineration	-		
	C	Recovery	-		

<table>
<tr><td></td><td>D</td><td>Downstream users</td><td>
<table>
<tr><th>S.No</th><th>Fly ash utilization level</th><th>Target date</th></tr>
<tr><td>1</td><td>At least 50% of fly ash generation</td><td>One year from the date of commissioning</td></tr>
<tr><td>2</td><td>At least 70% of fly ash generation</td><td>Two years from the date of commissioning</td></tr>
<tr><td>3</td><td>90% of fly ash generation</td><td>Three years from the date of commissioning</td></tr>
<tr><td>4</td><td>100% of fly ash generation</td><td>Four years from the date of commissioning</td></tr>
<tr><td colspan="3">Source: MoEF Notification S.O.2804, dated 3.11.2009, as per notification fly ash means all ash generated such as ESP ash, dry fly ash, bottom ash, pond ash, and mound ash</td></tr>
</table>
</td></tr>
<tr><td>XXII</td><td></td><td colspan="2">Please indicate the methods used for handling ash</td></tr>
<tr><td></td><td>A</td><td>Collection</td><td>ESP (99.98% efficiency), dry collection</td></tr>
<tr><td></td><td>B</td><td>Transport</td><td>Vacuum & Pressurized pumps</td></tr>
<tr><td></td><td>C</td><td>Disposal</td><td>By E-auction to the vendors</td></tr>
<tr><td>XXIII</td><td colspan="2">Utilization of ash (TPD)</td><td>Fly ash Utilization plan Provided in Chapter 4, Table 4.19</td></tr>
<tr><td></td><td>A</td><td>Proposed use</td><td></td></tr>
<tr><td></td><td>1</td><td>Bricks</td><td rowspan="6">100% Fly ash in dry form will be collected in silos and will be disposed through e-auction. The bottom ash slurry will be disposed to the existing ash dyke/ash pond.</td></tr>
<tr><td></td><td>2</td><td>Cement</td></tr>
<tr><td></td><td>3</td><td>Road construction</td></tr>
<tr><td></td><td>4</td><td>Landfill</td></tr>
<tr><td></td><td>5</td><td>Soil amendment</td></tr>
<tr><td></td><td>6</td><td>Others (Specify)</td></tr>
<tr><td></td><td>B</td><td>In case of landfill</td><td>Not Applicable</td></tr>
<tr><td></td><td>1</td><td>Is solid amenable for landfill?</td><td rowspan="3">Nil</td></tr>
<tr><td></td><td>2</td><td>Dimensions of landfill</td></tr>
<tr><td></td><td>3</td><td>Life of landfill (Years)</td></tr>
<tr><td></td><td>4</td><td>Proposed precautionary and mitigation measures along with design features</td><td>Nil</td></tr>
<tr><td></td><td>C</td><td>Indicate the phased programme for utilization of fly ash. (Number of years for full utilization, area etc.)</td><td>In 4 Years 100% utilization of Fly ash will be done through e-auction as per MoEF Notification S.O.2804, dated 3.11.2009.</td></tr>
</table>

XXIV		**Noise Pollution Control and Management**	
	A	Source	ID & FD fans, Crusher unit, Boilers feed pump, Turbine generator, DG set, Cooling tower, Vehicular movement

	B	Level at Source (dB)	85 dB(A) to 90 dB(A)
	C	Level at project boundary	42.1 dB(A) to 64.2 dB(A)
	D	Abatement measures (give source-wise details)	• The use of damping material such as thin rubber/ lead sheet for wrapping the work places like turbine halls, compressor rooms etc; • Shock absorbing techniques shall be adopted to reduce impact; • All the openings like covers, partitions shall be acoustically sealed; • Ear plugs will be provided to workmen working near high noise generating sources; • Noise levels shall be reduced by the use of absorbing material on roof walls and floors; • Provision of separate cabins for workers/ operators/ working near high noise sources • The boundary shall be thickly vegetated with species of rich canopy all along
XXV		**Fuel Requirements**	
	A	Details of Fuel used	

Sl. No	**Fuel**	**Daily Consumption (TPD)**		**Calorific value (K.Cals/kg)**	**% Ash**	**% Sulphur (Max)**
		Existing	**Proposed**			
1	Gas	-	-			
2	Naphtha	-	-			
3	HSD	-	5786KL/Year @ 1ml/Kwh			
4	Fuel Oil	-	-			
5	Coal Foreign (F) I 30: F 70 I 50: F 50	-	 6322 7053 7642	 5805 5203 4802	 6.62 18.13 25.81	 0.53 0.52 0.52
6	Lignite	NA				
7	Other (Please specify)					

B	Source of Fuel (Distance in km)	
1	Port	Imported Coal through M/S MMTC, New Delhi.
2	Mine	
3	Refinery	-

	4	Storage depot/ Terminal		7 days storage inside the plant boundary	
	C	Mode of Transportation of fuel to site			
	1	Trucks (numbers/ day)		Nil	
	2	Pipeline (length in km.)		Capacity of pipe conveyor 2X1000 TPH for the ETPS Expansion project which is having the spare capacity of 10000TPD of ETPS replacement project.. Length of the Pipeline Conveyor is 3 km from NCTPS complex.	
	3	Railway Wagons (numbers/ day)		Nil	
XXVI		**Coal handling and dust suppression**			
		Give details of dust suppression/ collection equipment for reducing pollution from coal fines and other fugitive emissions from coal handling			
	A	Wagon tippling		Details of Coal handling and dust suppression are given in chapter 4 Section 4.4.2.4.	
	B	Conveyer transfer points			
	C	Storage			
	D	Crushing mills			
	E	Bunker filling			
	F	Other (pl. Specify)			
XXVII		**Emissions and Stack details**			
	A	Flue gas characteristics (SPM, SO_2, NO_x) **(outlet standard) 100% imported coal.**			
	S.no	**Pollutant**	**Source of Emission**	**Emission rate g/s**	**Concentration in flue gas ($\mu g/m^3$)**
	1	Particulate matter	Chimney	0.78	0.36
	2	SO_2	Chimney	776	1.2
	3	NOx	Chimney	62.6	1.2
	B	Size distribution of SPM at the top of the stack			
	S.no	**Range**		**% by weight**	
	1	Micron		Average size is 3 micron	
	2	1-10 Micron			
	3	10-20 Micron			
	4	<20 Micron			
	C	Stack Emission Details			
	Frequency of stack emission monitoring as per CPCB guidelines			Continuous online Monitoring	
	Emission rate for each pollutant (kg/hr)				

	S.No.	Stack Attached to	Stack Height (m)	Stack Internal diameter (m)	Temp. of exhaust gases (deg K)	Exit Velocity (m/sec)	PM (g/s)	SO2 (g/s)	NOX (g/s)	Heat emission rate (in K.Cals/ hour)
	1	660 MW	275	7	407	22	0.78	776 (With FGD 39)	62.6	103 x 10^6
		Equipment used for stack monitoring should be indicated.								
XXVIII		**Predicted impact on air quality (as per CPCB Guidelines for conducting the Air Quality Modeling) (outlet standard) 100% imported coal.**								
		24- Hourly Concentrations						**PM_{10}**	**SO_2**	**NO_X**
		Baseline Scenario (Max)						98.5	26.5	38.5
		Predicted Ground Level Concentration (Max)						0.36	1.2	1.2
		Overall Scenario (Worst Case)						**98.86**	**27.7**	**39.7**
		CPCB limits for rural & residential areas						**100**	**80**	**80**

XXIX		**Storage of chemicals (inflammable/ explosive/ hazardous/ toxic substances)**							
	Sl.no	**Name**	**No. of Storages**	**Capacity**	**Physical and Chemical Composition**	**Consum-ption (in TPD)**	**Maximum Quantity of storage at any point of time**	**Source of Supply**	**Means of transport-ation**
	1	HFO	1	2000KL	Liquid	-	2000KL		
	2	LDO	1	1000KL	Liquid	-	1000KL		

XXX	Occupational Health and Industrial Hygiene		
	A	What are the major occupational health and safety hazards anticipated (Explain Briefly)	Detailed in Chapter 7 of Section 7.1.3 and in Chapter 9 Section 9.6
	B	What provisions have been made/ propose to be made to conform to health/ safety Requirements (Explain briefly)	Detailed in Chapter 7 of 7.1.6 and in Chapter 9 Section 9.6
	C	Details of personal protective equipment provided/ to be provided to the workers.	Personal Protective equipment like helmets, safety shoes, ear plugs, aprons, separate cabins for workmen and staff, etc will be made available for the workers working in the plant

	D	Details of proposed measures for control of fugitive emission/ odour nuisance from different sources.	• Dust suppression and dust extraction systems will be installed in the coal stockyard, coal handling areas and transfer points. • All internal roads will be concreted/ asphalted to reduce fugitive emission. • Greenbelt will be developed along the boundary, along the ash pond and along the internal roads. • Water spraying will be practiced frequently at coal stock yard
	E	Details of fire protection and safety measures envisaged to take care of fire and explosion hazards	Details of fire protection and safety measures details are discussed in Chapter-7 in Section 7.1.4.2
XXXI		**Green Belt Plan**	
	A	Total area of project/ township (in ha.)	33.99 Ha.
	B	Area already afforested (for existing projects), in ha	Nil
	C	Area proposed to be afforested (in ha.)	5.6 ha (additional 5.6 Ha at outside boundary) total 11.2 Ha
	D	Plant species Proposed	Plant species proposed for this project is given in Chapter 4 section 4.6.1 in Table 4.21 and Chapter 9 Section 9.8. Table 9.1
	1	Indigenous	
	2	Exotic	
	E	Width of green belt (minimum, in metres)	
	1	Along plant boundary	• In addition to 14 acres/5.6 Ha greenbelt proposed, additional 14 acres of land in the purview of CRZ area will be developed as greenbelt to meet 33% of the total land area as greenbelt. • Total Area of green belt is 28Acres or 11.2 Ha • Green belt is planned along the boundary of the project and as well around the buildings & road pathways. • Detailed plan is enclosed in Chapter 4 section 4.6.1 in Table 4.21 and Chapter 9 Section 9.8 Table 9.1
	2	Roads and avenues within the plant	
	3	Ash Dike	
	4	Township	
	5	Other-ornamental, Garden spaces, Commercial Plantations etc.	
	F	Trees planted & proposed	• Year wise target for the development of the green belt avenue and block plantation is given in Chapter 4, Section 4.6, list of trees identified for green belt is given Table 4.21. Details are given in chapter 9 Section 9.8. in Chapter 9 Table 9.1
		1.Planted	
		2. Proposed	
		3. List of species planted	

XXXII		**Construction Phase**			
	A	Estimated duration of construction in months	42 months from 'zero date' (39 months commissioning & 3 months commercial operation)		
	B	Number of persons to be employed for construction 1. Peak 2. Average	During construction – 300 (Permanent 100 & Temporary 200)		
	C	What provision has been made for the sewage treatment for the construction workers?	The sewage generated during construction activity will be sent to septic tank followed by soak pit		
	D	How the fuel (kerosene/ wood, etc.) requirement of labour force will be met to avoid cutting of trees from the adjoining areas	Construction workers will be brought from nearby villagers so there won't be any requirement of fuel for labour force.		
	E	Proposed Health care Measures with emphasis on protection from endemic diseases	Dispensary facilities will be provided for the services for staff working in the proposed project.		
	F	Educational and other social welfare measures proposed	Drinking water facilities, sanitation facilities, protective equipment, dispensary etc will be provided.		
XXXIII		**Human Settlement**			
		Aerial distance from the periphery of the site			
			Upto 500m from periphery	**500m to 3000 m from the periphery**	**3000m to 7000m from the periphery**
		Population	2081	Approx. 48928	Approx 40446
		Number of Houses	573	Approx 12410	Approx 157884
		Present Occupational Pattern	Total workers: 882 Work participation rate: 42.4% Main workers: 704 (33.8%) Marginal workers: 178 (8.6%) Non-workers 1199 (57.6%) Dependency ratio: 1:4	Total workers: 18193 Work participation rate: 37.2% Main workers: 14705 (30.1%) Marginal workers: 3488 (7.1%) Non-workers 30735 (62.8%) Dependency ratio: 1:7	Total workers 59066 Work participation rate: 37.4% Main workers: 50089 (31.7%) Marginal workers: 8977 (5.7%) Non-workers: 98818 (62.6%) Dependency ratio: 1:7
XXXIV		**Rehabilitation & Resettlement Plan (Wherever applicable)**			
	A	Village(s) affected by the project			

	S.No	**Village (Tribal/ Others)**	**Population**	**Occupation**	**Average Income per annum**
		No village is affected			
	B	Population to be displaced			
	S.No	**Name of Village**	**Population**		
			Land oustees only	Homestead oustees only	Land and Homestead oustees
		Not applicable – No population is displaced			
	C	Salient features of Rehabilitation Plan for oustees			
	1	Site where the people are proposed to be resettled		Not applicable	
	2	Facilities proposed at the resettlement site			
	3	Compensation package		Not applicable	
	4	Agency/Authority responsible for their resettlement			
XXXV		**Pollution Control Aspects**			
	A	Details of Pollution Control Systems			
	S.No	**Control system for**	**Existing**	**Proposed to be installed**	
	1	Air	Nil	Stack height of 275 m for proper dispersion of stack gases PM, FGD (Flue gas Desulfurization), SCR (Selective catalytic reduction) Electrostatic Precipitator (ESP).	
	2	Water	Nil	Effluent treatment plant for treating plant effluents and Sewage treatment plant for domestic waste of plant and township	
	3	Noise	Nil	Thick vegetation along the boundary of the plant and around noise generating equipment source plant	
	4	Solid Waste	Nil	100% dry ash collection systems will be provided and fly ash will be issued to Cement and Brick manufacturing industries through e-auction	
	B	Efficiency of each pollution control equipment/ system installed for the existing Units			
	Sl. no	**Name of the System/ Equipment**	**Design Efficiency %**	**Present Working efficiency %**	
	1	ESP	99.98	--	
	2	FGD	95%	--	
	3	SCR	-	--	
XXXVI		Expenditure on Environmental Measures			

	A	Capital cost of the project (as proposed to approved by the funding agency/ financial institutions (Rs. Crores)	5421.38 Crores	
	B	Cost of environmental protection measures (Rs. Crores)	977 Crores	
			Recurring cost per annum (Rs. in crores)	**Capital Cost (Rs. in crores)**
	1	Dust control system i) ESP ii) Dust Suppression system for coal handling	192.00 3.50	98
	2	Chimney	88.90	
	3	Water treatment plant including clarifier, UF, RO, DM, electrical and Instrumentation	42.24	
	4	Effluent treatment plant	3.50	
	5	Dense phase, pneumatic ash handling plant including bottom ash & fly ash silos, conveying compressors and other equipment's	106.56	
	6	Development of greenbelt	0.68	
	6	Sewage system	1.44	
	7	Effluent Treatment Plant	3.50	
	8	Chemical dosing and chlorination plant	9.70	
	9	Pollution monitoring instruments/ equipment	14.16	
	10	Other unforeseen items	14.16	
	11	FGD and SCR	500	
		Total	**977**	**98**

Q.18

	C	Details of organizational set up/ cell for environmental management and monitoring	TANGEDCO has an environmental wing in each power station to monitor and implement the requisite measures to protect the environment as directed by the statutory authorities and TANGEDCO has Environmental cell under the control of Chief Engineer/ Projects to monitor the issues and make necessary report to Directors & CMD.
	D	Details of community welfare/ peripheral development programmes envisaged/ being undertaken b**y** the project proponent	Additional Greenbelt endowment fund of Rs. 1.0 Crore
XXXVII		**Public Hearing details**	
	A	Date of Advertisement	The Public hearing was exempted by MOEFCC vide letter no F.No.J-1302/15/2018-IA-I(T) dated 10-07-2019.
	B	Newspapers in which the advertisement appeared (with copies)	
	C	Date of Public Hearing	
	D	Panel Present	
	E	List of public present along with address and occupation	
	F	Summary/ details of Public Hearing report	-
		Issue Raised / **Recommendation of panel**	**-**
		-	

Date:

Place: Tamil Nadu

The data and information given in this Performa are true to the best of my knowledge and belief

Signature of the applicant
With name and full address
Name:
Designation:

Given under the seal of Organization on

Behalf of whom the applicant is signing

Major Industry around the Site

ETPS Expansion 1x660 MW TPP

Ennavur (V), Thiruvottiyur (T), Thiruvallur (D), Tamil Nadu

N

Ind-9
Ind-4
Ind-5
Ind-6
Ind-7
Ind-2
Ind-1
Ind-3
Ind-8

LEGEND

- Major Industry Location
- ETPS Replacement TPP
- ETPS Expansion TPP
- 2 km Buffer
- 5 km Buffer
- 10 km Buffer

List of major industries

ID	Name	Distance (km)	Direction
Ind-1	Ashok Leyland	1	N
Ind-2	Vallur Conventional Thermal Power Plant	2.4	NW
Ind-3	Tamilnadu Petroproducts Limited (TPL)	2.8	SW
Ind-4	North Chennai Thermal Power Station (NCTPS)	2.9	N
Ind-5	Bharat Petroleum Corporation Limited	3.1	NNW
Ind-6	Hindustan Petroleum Corporation Limited	3.2	NNW
Ind-7	Reliance	3.7	NW
Ind-8	Chennai Petroleum Corporation Limited - CPCL	4.1	SW
Ind-9	Ennore SEZ TPP	6.9	N

0 1 2 4 6 8 10 Kilometers

***Note: Distance has been calculated from industry boundary not from center, but map showing location of individula industry ,that is tentatively center/ boundary of respective industry.

Marine EIA Report for Cooling Water Intake System of the Proposed 1 x 660MWExpansionPower Plant at Ennore Thermal Power Station, Village Ernavur, District Thiruvallur, Tamil Nadu

Proposed by

Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)

EIA CONSULTANT

NABET Accredited EIA Consulting Organisation
Certificate No: NABET/EIA/1619/SA 076

Cholamandalam MS Risk Services Limited

PARRY House 3rd Floor,
No. 2 N.S.C Bose Road, Chennai - 600 001
Tamil Nadu

JULY 2019

DECLARATION BY PROJECT PROPONENT

Tamil Nadu Generation and Distribution Corporation Limited has conducted the "Rapid Marine EIA Report for the Cooling Water Intake System of the Proposed 1x660 MW Expansion Power Plant at Ennore Thermal Power Station, Ernavur Village, Thiruvallur District, Tamil Nadu"

The Rapid Marine EIA report preparation has been undertaken in compliance with the EIA Notification 2006 and CRZ Notification 2011 issued by MoEF&CC. Information and content provided in the report is factually correct for the purpose and objective for such study undertaken.

We hereby declare the ownership of contents (information and data) of Rapid EIA/EMP Report.

For on behalf of Tamil Nadu Generation and Distribution Corporation Limited.

Signature:

Name:

Designation:

DECLARATION BY EIA CONSULTANT

Rapid Marine EIA Report on "Cooling Water Intake System of the Proposed 1x660 MW Expansion Power Plant at Ennore Thermal Power Station, Ernavur Village, Thiruvallur District, Tamil Nadu"

This Rapid Marine EIA report has been prepared by ***Cholamandalam MS Risk Services Limited (CMSRSL)****, in line with "EIA Notification, dated 4th September 2006 and CRZ Notification, dated 6th January 2011, seeking Environmental Clearance and CRZ Clearance from the Ministry of Environment, Forests and Climate Change, New Delhi.*

This work has been undertaken in accordance with ***ISO 9001:2008 Quality Management System*** *with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our General Terms & Conditions of Business and taking account of the resources devoted to it by agreement with the client.*

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

Further, this report is confidential to the client and the use of this report by unauthorized third parties without written authorization from CMSRSL shall be at their own risk.

For and on behalf of ***Cholamandalam MS Risk Services Limited***

Approved by : ***N V Subba Rao***

Sign : 

Designation : *Chief Executive*

DECLARATION BY EIA CONSULTANT

Declaration by Experts contributing to the Rapid EIA for ***"Cooling Water Intake System of the Proposed 1x660 MW Expansion Power Plant at Ennore Thermal Power Station, Ernavur Village, Thiruvallur District, Tamil Nadu*** *". I, hereby, certify that I was part of the EIA team in the following capacity that developed the above Rapid EIA.*

EIA Coordinator: In-House
Name: **Mr. V. S. Bhaskar**

Signature:
Date: 31st May, 2019
Period of Involvement: May 2019 to Present
Contact Information: M/s. Cholamandalam MS Risk Services Limited
Parry House 3rd Floor,
No. 2 NSC Bose Road, Chennai – 600 001
+91-044- 3044 5448

Functional Area Experts:

S. No	Functional Areas	Name of the Expert/s	Involvement (Period and Task)	Signature
1	WP- Water Pollution Monitoring Prevention & Control	Mr. V S Bhaskar	**Period :** May 2019 to Present **Task:** Finalization of water sampling locations, characterization. Identification of Potential during construction and developed management plan to prevent contamination of water during coal transportation	31st May, 2019

S. No	Functional Areas	Name of the Expert/s	Involvement (Period and Task)	Signature
2	EB Ecology and Biodiversity	Dr. T. Balakrishnan	**Period :** May 2019 to Present **Task:** Primary Survey of Terrestrial Flora and Fauna, Marine Biological Sampling. Identifiation and Analysis of Phytoplankton, Zooplankton and benthos. Identification of Nesting/breeding grounds of reptiles, mammals and avifauna including rare/threatended/endangered/endemic species and their habitat within the study area. Impact assessment and environmental management plan for Mangroves Conservation, Habitat Conservation Measures.	 31st May, 2019

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

M/s Ennore Thermal Power Station (ETPS) is a coal fired power station located in Ernavur village, Thiruvottiyur Taluk in Tiruvallur district, Tamil Nadu, India. ETPS is one of the major thermal power plants in the state. ETPS is owned and operated by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO), a subsidiary of the Tamil Nadu Electricity Board (TNEB). The existing ETPS was established during 1970 - 1975 in an area of about 237 acres having an installed station capacity of 450 MW (3x110 MW + 2x60 MW).

Figure 1-1 Satellite View of Ennore Thermal Power Station

Source: Google Earth

In order to meet the high power demand in the state, TANGEDCO had proposed a 1x660MW supercritical ETPS expansion project in the vacant land within the existing ETPS complex for which the Environmental Clearance was obtained in the year 2009. However, the expansion of ETPS with the supercritical technology within the stipulated period of the extended Environmental Clearance, i.e., 2.6.2019., could not be completed. However, there has been an overall progress of the project which only accounted to 17% of the project which include civil construction of boiler, chimney, ESP and pump house, water treatment plant etc. Upon the

direction of the MoEF&CC to TANGEDCO to initiate the EC process de-novo as per the provisions of the EIA Notification, the Terms of Reference (ToR) was obtained.

The National Institute of Oceanography has undertaken the multidisciplinary oceanographic investigations to determine the suitable location for cooling water intake & hot water discharge outfall and a Marine Environmental Impact Assessment report was prepared to obtain the clearance from Ministry of Environment, Forests, and Climate Change (MoEF&CC). The details of the earlier EC are given in **Table 1-1**and the same has been attached in **Annexure I**.

Table 1-1 Details of Earlier obtained EC

EC letter number	Date of obtaining	Purpose
J-13011/62/2008-IA.II (T)	3rd June, 2009	Expansion unit of 600MW Subcritical
	24th January 2013	Change in Project configuration from 600MW Subcritical to 660MW Supercritical
	18th September,2014	Extension of Validity of EC
	2nd June, 2019	Expiration of 10 Year Validity of EC

As the existing units have served for over 40 years and are in the last phase of their life span, the existing 450 MW units were decommissioned on 31stMarch, 2017. The proposal for expansion by, adopting supercritical technology of 1X660 unit, would improve the capacity of the power generation by ETPS. The Ennore Thermal Power Station has entrusted Cholamandalam MS Risk Services Limited (CMSRSL), Chennai, (an ISO 9001:2008 certified and QCI-NABET accredited EIA consultant organization) to conduct the Marine Environmental Impact Assessment due to intake of seawater for cooling and discharge of coolant water in to Marine environment.

1.1 Project Objectives and Scope

The proposed expansion proposal with 1x660 MW is proposed at the facility of ETPS, and as the project also involves the intake of seawater from the sea for their internal cooling and process. Further, the water used, after use, will be released back into the sea. As per the recommendations of NIO, Goa, the intake has been proposed 650m away from shore and outfall fixed at 250m from shore in different directions to avoid mixing of return water. Owing to that, it is mandated to undertake a Marine Impact Assessment Study for the proposed expansion for the required

statutory clearance – Environmental Clearance from the Ministry of Environment, Forests and Climate Change MoEF&CC. The study would emphasize on the impact the project would incur upon development and commissioning.

1.2 Need for the Study

The proposed expansion project at ETPS involves a 660 MW supercritical technology operating unit which would be classified as Category A project under 1(d) of the Environmental Impact Assessment Notification 2006 - ≥500 MW (coal/lignite/naphtha & gas based) thermal power plant, which attracts environmental clearance from the MoEF&CC. Also, under section 4 clause (ii) sub-clause (f) of the Coastal Regulation Zone Notification, 2011 states that "*foreshore requiring facilities for transport of raw materials, facilities for intake of cooling water and outfall for discharge of treated wastewater or cooling water from thermal power plants*" requires clearance from MoEF&CC. In line with the aforesaid, an EIA assessment for both terrestrial and marine environment is mandated. This report has been drafted exclusively for assessing the marine environment and the potential impact the proposed development would incur.

1.3 Wastewater Discharge Standards for Thermal Power Plants

The proposed facility will generate rejects from desalination plant and also thermal water. As per The Environment (Protection) Rules, 1986, thermal power plants should meet the following discharge standards (**Table 1-2**).

Table 1-2 Discharge Standards for Thermal Power Plants

S. No.	Industry	Parameter	Standards
1	Thermal Power Plants		Maximum Limiting concentrations milligrams per litre (except pH)
2	Condenser Cooling Water (Once through cooling systems)	pH Temperature Free available Chlorine	6.5-8.5 Not more than 5°C higher than the intake water temperature 0.5 mg/l
3	Boiler Blow down	Suspended Solids Oil and Grease Copper(Total)	100 mg/l 20 mg/l 1.0 mg/l

S. No.	Industry	Parameter	Standards
4	Cooling Tower Blow down	Free available Chlorine Zinc Chromium (Total) Phosphate Other Corrosion Inhibiting Material	0.5 mg/l 1.0 mg/l 0.2 mg/l 5.0 mg/l Limit to be established by CPCB
5	Ash Pond Effluent	pH Suspended Solids Oil and Grease	6.5-8.5 100 mg/l 20 mg/l
5A	Thermal Power Plant (Water Consumption Limit)*	Water Consumption	New plants to be installed after 1st January, 2017 shall have to meet specific water consumption upto a maximum of 2.5 m^3/MWh and achieve zero water discharge.
6	Air Emissions*	Particulate Matter Emissions -generation capacity 210 MW or more Sulphur Dioxide (SO2) Oxides of Nitrogen (NOx) Mercury (Hg)	30 milligram per normal cubic meter 100 milligram per normal cubic meter 100 milligram per normal cubic meter 0.03 milligram per normal cubic meter
7	Stack Height/Limit in Meters#	Power Generation Capacity : 500 MW and above 200 MW/210MW and above to less than 500 MW Less than 200 MW/210MW	275m 220 m H=14(Q)0.3 where Q is emission rate of SO2 in kg/hr and H is Stack Height in meters

*TPP (units) to be installed after 1st January, 2017 and mentioned in **Annexure-3**.

As per '*The Environment (Protection) Rules, 1986'* S.No 33 of Schedule-I refers stack height /limit in meters for Thermal power plants

1.3.1 Temperature Limit for Discharge of condenser Cooling water from Thermal Power Plant

The Environment (Protection) Rules under the Environment (Protection) Act,1986 also lays down specific standards for quality of water effluents to be discharged into different type of water bodies (sewers, surface water bodies like lakes and rivers, marine discharge). The proposed project will discharge thermal water along with desalination plant rejects water into sea. The Water (Prevention and Control of Pollution) Act, 1974 for discharge of quality of water effluents into marine should meet the following marine discharge standards:

i. New thermal power plants commissioned after June 1, 1999 - New Thermal Power Plants, which will be using water from rivers/ lakes/ reservoirs shall install cooling towers- irrespective of location and capacity. Thermal power plants which will use sea water for cooling purposes, the conditions below will apply.

ii. New Projects in coastal areas using sea water - The thermal power plants using sea water should adopt suitable system to reduce water temperature at the final discharge point so that the resultant rise in the temperature of receiving water does not exceed 5ºC[1] over and above the ambient temperature of the receiving water bodies.

iii. Existing Thermal Power Plant - Rise in temperature of condenser cooling water from inlet to the outlet of condenser shall not be more than 5ºC. This is not applicable to the proposed project.

iv. Guidelines for discharge point –

1. The discharge point shall preferably be located at the bottom of the water body at mid-stream for proper dispersion of thermal discharge,

2. In case of discharge of cooling water into sea, proper marine outfall shall be designed to achieve the prescribed standards,

3. No cooling water discharge shall be permitted in estuaries or near ecologically sensitive areas such as mangroves, coral reefs/spawning and breeding grounds of aquatic flora and fauna.

1.3.2 Water Quality Standards for Coastal Waters Marine Outfalls

[1] *As per the schedule- I of The Environment (Protection) Rules ,1986*

As per S.No:86 of The Environment (Protection) Rules, 1986 on Water Quality Standards for Coastal Waters Marine Outfall states that "*In a coastal segment marine water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various types of uses there is one use that demands highest level of water quality/purity and that is termed a "designated best use" in that stretch of the coastal segment*". Based on this, primary water quality criteria have been specified for following five designated best uses.

Table 1-3 Primary Marine Water Quality Criteria

Class	Designated Best Use
SW-I	Salt Pans, Shell fishing, Mariculture and Ecologically Sensitive Zone
SW-II	Bathing, Contact Water Sports and Commercial fishing
SW-III	Industrial Cooling, Recreation(non-contact) and Aesthetics
SW-IV	Harbour
SW-V	Navigation and Controlled Waste Disposal

For the proposed project, Primary Water Quality Criteria for Class SW-III waters for Industrial Cooling is applicable and the same has been mentioned below in **Table 1-4.**

Table 1-4 Primary Water Quality Criteria for Class SW-III Waters

S. No.	Parameter	Standards	Rationale/Remarks
1	pH range	6.5-8.5	The range is conducive for propagation of aquatic species and restoring natural systems
2	Dissolved Oxygen	3.0 mg/lit or 40 percent saturation value whichever is higher	To protect aquatic lives
3	Colour and Odour	No noticeable colour or offensive odour	None in such concentration that would impair usages specifically assigned to this class
4	Floating matters	No visible, obnoxious floating debris, oil slick, scum	None in such concentration that would impair usages specifically assigned to this class
5	Fecal Coliform	500/100 ml(MPN)	Not exceeding 1000/100 ml in 20 percent of samples in the year and in 3 consecutive samples in monsoon months.
6	Turbidity	30 NTU	Reasonably clear water for

S. No.	Parameter	Standards	Rationale/Remarks
			Recreation Aesthetic appreciation and Industrial Cooling Purposes
7	Dissolved Iron (as Fe)	0.5 mg/l or less	It is desirable to have the collective concentration dissolved Fe and Mn less or equal to 0.5 mg/l to avoid scaling effect
8	Dissolved Manganese (as Mn)	0.5 mg/l or less	Intentionally left blank as per standards

1.4 Marine EIA Methodology

To undertake the marine impact assessment study for the proposed expansion, TANGEDCO contracted CMSRSL. A Rapid Environmental Impact Assessment was proposed for assessing the marine impact. The study undertaken has been detailed in the following sub-sections.

The marine monitoring was conducted for the Ennore Thermal Power Station to assess the physicochemical properties and the biological characteristics of the marine water (Bay of Bengal), including the tidal influenced Korattaliyar River. An area (marine) encompassed within 10 km radius from the proposed project has been considered as the study area. The locations for assessment were identified off based on the proposed location for intake and outfall points provided by TANGEDCO.

1.4.1 Marine Ecology – Survey, Sampling and Analysis for one season

The biological parameters considered for the present study are phytoplankton, zooplankton, macro-benthos and fishery status. The phytoplankton and zooplankton reflect the productivity of a water column at the primary and secondary levels. Benthic organisms being sedentary animals associated with the sediment/rocky beds, provide information on the integrated effects of stress, if any, and hence are good indicators of early warning of potential damage. Sample collections for marine ecological studies were done by mechanized boat. Ten sampling locations were selected off the coast of Ennore.

1.4.2 Sampling Parameter of Water, Sediments & Marine Ecology

Parameters: The sampling was done with a view to study the existing physico-chemical, biological conditions of the site and the area around the site of around 10 km radius.

Table 1-5 Parameters of the Samples collected

S. No	Particulars	Parameters
1	Surface & Bottom Marine water	pH, TSS, DO, BOD (3days @ 27°C), salinity, Nitrite, Nitrate, Phosphate, Silicates, Oil& Grease, Petroleum Hydrocarbon, Phenols
2	Sediment	Texture (sand, silt, clay), Organic carbon, Calcium Carbonate, Organic Nitrogen, Phenols, Petroleum hydrocarbons
3	Heavy Metals	Copper, Zinc, Iron, Lead, Cadmium, Manganese, Nickel, Mercury, Total Chromium, Hexavalent Chromium

The samples were collected around the core area near the intake and outfall i.e. in the 1km to 3km radii point as well as within the 5km radii. The core area samples will give the direct effect on the ecology and those in the 5km radii will give the diminishing effect. The primary requirements for assessing the impacts are general baseline information as a whole and intensive site-specific data for the area were collected by Cholamandalam MS Risk Services Limited.**Table 1-6** shows the sampling equipment used for marine sampling.

Table 1-6Sampling Equipment used in the study

Components	Sampling Equipment	Pictorial Representation
Water	Depth sampler	

Components	Sampling Equipment	Pictorial Representation
Sediment	Van veen grab	
Phytoplankton & Zooplankton	Heron tranter net	
Benthos	Van veen grab	

Phytoplankton- Water samples were collected for Phytoplankton studies using standard water sampling devices. A measured amount of water samples were fixed by adding "Lugol's Iodine" and stored in cool place under dark condition. Samples were allowed to settle and concentrated to approximate volume in laboratory. 1 ml of each of these concentrates was examined using Sedgwick - Rafter and microscope, with standard reference material (Identifying Marine Phytoplankton – By Grethe R. Hasle and Carmelo R. Tomas, 1997).

Zooplankton- The zooplankton samples were collected as horizontal surface tow with a modified Heron-Tranter (HT) net (having 0.25 m^2 mouth area and 300 µm mesh size). All the samples were preserved in 5% neutralized formaldehyde solution. The zooplankton biomass was later estimated by displacement volume method and readings were converted for 100 m^3. Different zooplankton were sorted, identified and enumerated under stereoscopic zoom binocular microscope. The number were calculated for the whole samples and expressed for 100m^3 of water.

Benthic communities- Sediment samples for benthic community study were collected from the intertidal as well near shore sub tidal regions. Sub tidal sediments were collected with a stainless steel van Veen grab covering an area of 0.04 m^2. The materials collected were preserved in 10% seawater formalin containing Rose- Bengal stain. In the laboratory, all the samples were again washed through a 500-µm-mesh sieve in running water to clear adhering sediment. Later all the organisms were sorted counted and identified (Convey et al, 2003) up to group level. Biomass (wet weight) was taken after removing the debris and expressed as g m^{-2}.

1.5 Impacts assessment prediction

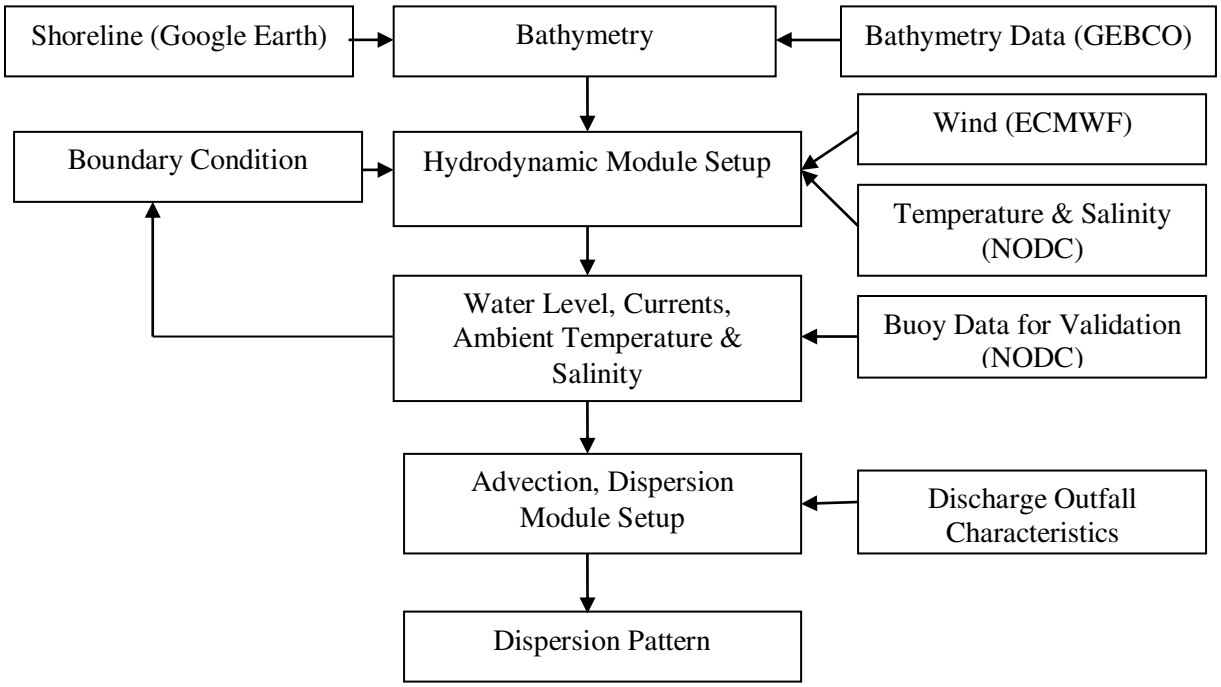
Modelling has been carried out to study the dispersion characteristics of thermal outfall considering the seasonal circulation pattern. The model domain was generated for the study area using General Bathymetry Chart of Ocean (GEBCO) data. To study the circulation features in the study area at base line condition, Hydrodynamic (HD) Module was used. The various parameters considered in Hydrodynamic (HD) module are wind, tide, salinity, and temperature. Wind data was taken from ECMWF (European Center for Medium-Range Weather Forecast). Tide data was simulated using global tidal model. Temperature and Salinity data were taken from the National Oceanographic Data Centre (NODC). The model was calibrated using buoy data from the Indian National Centre for Ocean Information Service (INCOIS).

Thermal and Salinity Dispersion Study has been carried out using Advection-Dispersion (AD) module. The various parameters need to be considered in Advection-Dispersion (AD) module are circulation features from the Hydrodynamic (HD) Module (Water level, Currents) and the characteristics of the discharge outfall (Temperature, Salinity). The methodology has been given in**Figure 1-2.**

Based on the modelling results, the impacts on the environment have been analysed. Temperature and salinity dispersion have been analysed quantitatively and its impacts on aquatic organisms such as phytoplankton, zooplankton and benthic organisms etc, have been qualitatively discussed.

The outcome of the modelling results would determine the impacts on marine ecology due to salinity and temperature. In case of significant impact, a robust Environment Management Plan was suggested to mitigate the impacts on marine ecology during construction and operation phase of the proposed project. To determine the effectiveness of the EMP, appropriate Environmental Monitoring have been suggested during construction and operation phase.

Figure 1-2 Model Methodology



1.6 Structure of EIA Report

The objective of this EIA report is to obtain CRZ clearance for seawater intake for cooling water and discharge of coolant water into Marine environment. Since the objective is to obtain CRZ clearance, the EIA report prepared for the 7 chapters which are detailed below. The chapters

prepared are in line with the EIA Notification 2006 Appendix III of Generic Structure of EIA document only for those sections mentioned in below.

- **Chapter 1** describes the introduction details about the project background, scope of work, methodology adopted for the studies, applicable regulatory context and structure of EIA report proposed.
- **Chapter 2** states the Project Description, details about the seawater intake and outfall of the cooling water from thermal power plants and its associated infrastructure requirements.
- **Chapter 3** presents the Marine Baseline Monitoring Studies of CRZ Area and describes about the marine monitoring sampling of seawater quality, sediment quality, phytoplankton, zooplankton and benthic communities' details.
- **Chapter 4** presents the Marine Impact Assessment and Prediction where the Seawater intake and outfall into marine environment impact will be assessed based on thermal and salinity dispersion modelling studies using 3-dimensional mathematical modelling.
- **Chapter 5** describes the Environment Management Plan of the cooling water intake stem, and the outfall from the thermal power plant
- **Chapter 6** details the Environmental Monitoring Program for the construction and operation phase of the proposed project.
- **Chapter 7** gives the summary and conclusion of the study carried out for the proposed project.

Remaining sections as per the Generic Structure of EIA Document has not been provided because the report is appendix to the EIA report prepared for obtaining EC under EIA Notification for Thermal Power Plant Sector.

2 PROJECT DESCRIPTION

2.1 Introduction

The Tamil Nadu Generation & Distribution Corporation Limited (TANGEDCO) has received Environmental Clearance from MoEF&CC, New Delhi vide letter J 13011/62/2008-IA.II(T) dated 3.6.2009 for ETPS Expansion Thermal Power Plant (1x600 MW) and further obtained amendment for establishing 1x660 MW on 24.1.2013. Subsequently, the extension of validity of EC was obtained for establishing the ETPS expansion with 1x660MW from Ministry of Environment, Forests and Climate Change, Government of India vide letter no: J-13011/62/2008-IA.II (T) dated 18th September, 2014 and the project work is undertaken within the land available in ETPS Complex. However, the construction of the proposed infrastructures could not be completed within the stipulated time as in the EC accorded. Hence, as advised by the MoEF&CC, TANGEDCO has initiated the EC process de novo by obtaining new ToR and conducting the EIA. As the proposed unit will be commissioned within the existing complex, no displacement of people or resettlement and rehabilitation (R&R) are envisaged.

The proposed 1x660MW ETPS expansion works on super critical technology in order to enhance the plant's efficiency and to reduced greenhouse emissions, environmental-friendly/CDM benefits, operation flexibility to grid fluctuations, shorter start-up times, reduced O&M cost and reduced coal consumption.

2.2 Coal Requirement & Transport

100% of the imported coal will be transported through Ennore Port and the annual coal requirement will be about 2 MTPA. For the proposed 660 MW supercritical power plant, it is estimated that 5700 tonnes of imported coal would be required daily. The coal will be transported to the ETPS from the Coal Berth III of Ennore Port through pipe conveyors at the rate of 2x1000 tonnes per hour.

2.3 Water Requirement

As per the MoEF&CC standards and regulations, the thermal power plants using sea water for the process and cooling of facilities has to adopt suitable technology / methods to reduce water

temperature at the final discharge point. The ETPS should ensure that the resultant rise in temperature of the water at the outfall does not exceed 5ºC above the ambient seawater temperature. The seawater requirement for the ETPS for cooling and other purposes is presented inTable 2-1. The total water requirement for the proposed 1x660 MW ETPS expansion project will be about 12,000 m^3/hr, out of which 4,360 m^3/hr will be used for Natural Draft cooling water (CW) makeup for condenser, 5,000 m^3/hr will be used for Auxilliary Cooling Water makeup, 400 m^3/hr will be used as feed to RO plant and 2,000 m^3/hr will be used for Ash and coal handling units and fire protection systems.

Table 2-1Water Requirement

S. No.	Description	Estimated Quantity for the proposed 1x660MW ETPS expansion project	
		m^3/hr	m^3/day
1	CW makeup for condenser	4,360	1,04,640
2	ACW	5,000	1,20,000
3	RO plant	400	9,600
4	Ash Handling system, Coal Handling System & Fire Protection System	2,000	48,000
Total		**11,760**	**2,82,240**

2.4 Flue Gas De-sulfurization (FGD)

To remove the sulphur dioxide from the exhaust flue gas of the thermal power plants the Flue Gas De-sulfurization (FGD) would be used. This measure is also recommended by the International Finance Corporation (IFC) as a good engineering practice for thermal power plants. The same has been considered as part of the ETPS expansion by TANGEDCO. However, TANGEDCO has considered using the Wet FGD using limestone for removal of sulphur dioxide.

2.4.1 Wet FGD

This is also known as “Wet Scrubbing” or the “closed loop system”. In this process, the flue gas is saturated with seawater and the reagents that can be used are limestone ($CaCO_3$), Lime (CaO),

Ammonia (NH_4), and Sodium (Na). The exhaust gases may be neutralized with caustic Soda (NaOH) which is added to freshwater in the closed system.This is a most widely used process since its removal efficiency is upto 98%. Since lime or limestone is not dissolved in water, both are pumped into the scrubber in the slurry form. Though wet scrubbers dominate the market, it has the following disadvantages: high water consumption, wastewater has to be treated and gypsum is the sealable by-product or waste. The wet scrubbers are to be operated with wash water treatment which includes a multicyclone, or a cyclonic separator to remove water-soluble pollutants (SO_2, SO_3, and NO_2). The wet scrubbers also have the advantage of reducing emissions of HCl, HF and gaseous heavy metals.

2.5 Description of Seawater Intake Outfall System

The seawater is proposed to be used for the CW system from the intake well which was earlier proposed by ETPS based on the studies conducted by NIO. The intake water is 25,000m^3/hr, which is adequate to provide water for both the proposed 1x660MW ETPS expansion as well as for 1x660MW ETPS Replacement project, which has been proposed by TANGEDCO. The water requirement for each unit is about 12000m^3/hr. The desalination plant is proposed to provide for sweet water generation which will be used for DM plant and other plant utilities. The physico-chemical characteristics of the sea water are given is**Table 2-2**.

Table 2-2 Intake Seawater Characteristics

Parameter	Units	Value
pH	-	7.6 – 8.0
Temperature	°C	28.3 °C - 28.7
Salinity	ppt	36.6 - 36.9
Total Suspended Solids	mg/l	6 – 10
Dissolved Oxygen	mg/l	6.5 – 6.8
Biological Oxygen Demand	mg/l	2 – 6

The combined intake quantity of both the power plants is 24,000 m^3/hr (2 x 12,000 m^3/hr) and the total discharge quantity will be in the order of 16,000 m^3/hr (2 x 8000 m^3/hr). The intake

system design includes piping from intake point and desilting basin. Two pipelines of OD 1.5m diameter are considered to cater the design requirements of both the plants.

The desalination plant reject (brine) will be let into the sea along with the cooling water return. The total dissolved solids from brine will be diluted when mixed along with the cooling water return. Based on the feasibility assessment done by NIO, the locations for intake of seawater to the plant, and the outlet of the reject and water return has been finalised. The details of the identified location of intake and outfall point are given in **Table 2-3**and illustrated in**Figure 2-1**.

Table 2-3 Details of Intake and Outfall points

Description	Latitude Longitude	Distance from Shore	Depth
Intake point	13°12'7.72"N 80°19'37.96"E	650 m	(-) 8.2 m
Outfall point	13°11'41.53"N 80°19'19.70"E	250 m	(-) 5.4 m

Figure 2-1 Map showing the Intake and Outfall locations of ETPS

Source: Google Earth

The current study is to assess the dispersion of salinity and temperature of the water at the point of outlet and its effect on the marine life. The marine dispersion modelling was conducted and the same were discussed in Chapter 4 of this report.

2.6 Utilization and Infrastructure

The utilities that are required for sea water intake and outfall consists of only cooling water system and is discussed below.

2.6.1 Cooling water system

Natural draft cooling towers are proposed for the cooling water system. The cooling water inlet maximum temperature is to be at 31°C, and the coolant water outfall temperature at the sea is expected to be not more than 36°C. The condenser is to operate at a pressure of 0.1 atm, and the water requirement for the Natural Draft cooling water makeup for condenser will be 4,360 m^3/hr and the water requirement for the ACW makeup will be in the order of 5,000 m^3/hr.

2.7 Employment Potential and Project Cost

The total personnel required for the proposed 1x660MW ETPS expansion will be around 500, of which, 200 will be unskilled workers. The unskilled workforce is to be locally sourced through EPC Contractor.

The overall project cost has been made in the Detailed Project Report. The following fixed and variable costs are considered along with appropriate escalations. The fixed costs include; interest on loan, O&M expenses, interest on working capital, income tax, and depreciation. The variable cost covers the fuel cost (both primary and secondary).

3 MARINE BASELINE ENVIRONMENT CONDITION OF THE STUDY AREA

3.1 Introduction

Marine ecosystems are a complex of habitats defined by the wide range of physical, chemical, and geological variations that are found in the sea. Habitats range from highly productive nearshore regions to the deep sea floor inhabited only by highly specialized organisms. Marine ecosystems are important to humankind both ecologically and economically, providing numerous vital goods and services, and supporting the processes that sustain the entire biosphere.

Marine ecosystem services are provided at the global scale (for example. oxygen production, nutrient cycles, carbon capture through photosynthesis and carbon sequestration) and at the regional and local scales (for example stabilizing coastlines, bioremediation of waste and pollutants, and a variety of aesthetic and cultural values) (MARBEF, 2008).

Marine services include several important economic benefits such as food provision and tourism (Kettunen, 2007). Some of the environmental changes taking place at the global levels are likely to have significant and far-reaching consequences for marine biodiversity. Changes in marine biodiversity are extremely complex processes driven by numerous factors, making it difficult to determine precisely which changes are results of direct human influence. It is clear, however, that deteriorating biodiversity impairs a marine ecosystem's capacity to provide food, maintain water quality and recover from perturbations (Worm et al., 2006).

3.2 Physical Processes:

3.2.1 Geomorphology

Ennore is located in the Thiruvallur district of TamilNadu. The coastline near Ennore is eroding. The mineral resource found in this region is silica sand. The groynes and seawalls are found near Ennore. Ennore creek is located in the northern part of ETPS and the river Korattaliyar discharges in to the Bay of Bengal. Lot of fishing villages are found south of Ennore and these are protected by a combination of seawall and groynes. The region has a very vast coastal plain. The coast consists of sandy beaches. The main geological formations along the coast are upper

Gondwana sands and silts, Quartenary sand and clay undulation by Archean crystalline rocks (Chornockite).

3.2.2 Climate:

The Long-term meteorological data from the "Climatological Normals" published by Indian Meteorological Department (IMD) was referred for understanding the historical trend of meteorology in the study area. The nearest IMD observatory for the project site is located at Chennai (Nungambakkam). The consolidated 30 years (1971- 2000) Climatological data for Chennai (Nungambakkam) Observatory is presented below.

3.2.3 Temperature

In the month of January, the minimum temperature is 20.9° C and maximum is 28.8°C. For the month of May, the minimum temperature is 27.9°C and maximum is 36.8°C. Relative humidity is higher during morning than evening due to sea breeze and land breeze effect. The highest humidity of 83% occurs during the month of November at morning. The lowest relative humidity of 62% occurs during the month of June at evening.The Indian Meteorological Department (IMD) data for temperature is given in **Table 3-1**.

Table 3-1 IMD - Recorded Temperature at Chennai (Nungambakkam)

Month	MEAN*				EXTREMES	
	Daily Max °C	Daily Min °C	Highest in the Month °C	Lowest in the Month °C	Highest °C	Lowest °C
January	28.8	20.9	30.7	18.4	33.1	13.9
February	30.5	22.0	33.0	19.3	36.7	15.0
March	32.5	23.8	35.2	21.2	40.6	16.7
April	34.3	26.4	38.0	23.6	42.8	20.0
May	36.8	27.9	41.4	24.4	45.0	21.1
June	36.9	27.5	40.2	23.7	43.3	20.6
July	35	26.3	38.2	22.9	41.1	21.0
August	34.3	25.7	37.0	22.7	40.0	20.6
September	33.9	25.5	36.0	22.8	38.9	20.6
October	31.8	24.5	35.0	22.2	39.4	16.7
November	29.6	23.0	32.3	20.2	35.4	15.0
December	28.5	21.9	30.2	19.1	32.8	13.9

Annual Mean or High/Low	32.8	24.6	41.4 (5)	18.4(1)	45.0(5)	13.9 (1,10)

3.2.4 Rainfall

The total rainfall in this region was 1202.9 mm in 2017 according to Customized RainfallInformation System (CRIS) of Indian Meteorological Department. The rainfall trend in thelast 5 years (2013-2017) according to the CRIS of IMD department is represented in **Figure 3-1.**The consolidated 30 years (1971- 2000) rainfall data for Chennai (Nungambakkam) Observatory is presented in **Table 3-2.**

Figure 3-1 Total Rainfall per year (2013-2017) from IMD data

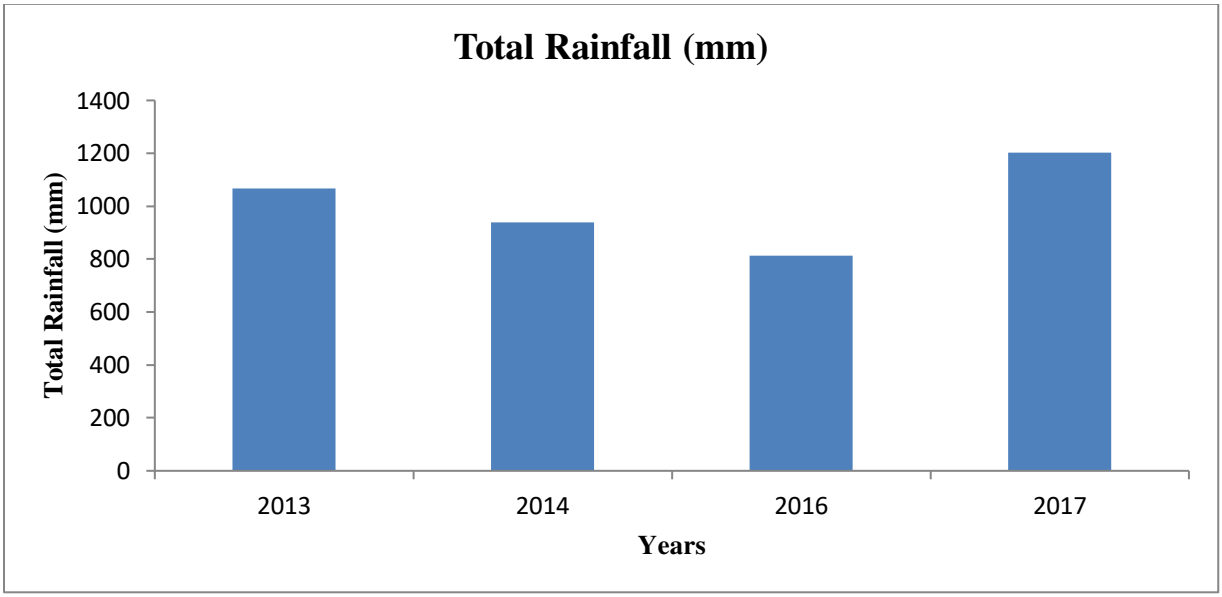


Table 3-2 IMD - Recorded Rainfall at Chennai (Nungambakkam)

Month	Total Rainfall in mm	No. of Rainy days	Heaviest fall in 24 Hours	
			Rainfall in mm	Date and Year
January	22.5	1.3	212.9	15-1915
February	2.2	0.4	294.0	17-1984
March	4.0	0.3	88.1	5-1944
April	7.7	0.6	100.3	12-1951
May	43.9	1.4	244.3	22-1952
June	55.9	4.0	347.9	14-1996
July	100.3	6.9	116.3	28-1910
August	140.4	8.5	94.0	1-1973

Month	Total Rainfall in mm	No. of Rainy days	Heaviest fall in 24 Hours	
			Rainfall in mm	Date and Year
September	137.3	7.1	167.4	12-1996
October	278.8	10.6	279.7	22-1969
November	407.4	11.7	452.4	25-1976
December	191.1	6.3	261.6	10-1901
Annual Mean or High/Low	1391.5	59.1	452.4 (11)	25-1976

3.2.5 Wind Speed

Given below in the **Table 3-3**, is the consolidated 30 years (1971- 2000) Climatological data for wind speed and direction recorded at Chennai (Nungambakkam) Observatory.

Table 3-3 IMD - Recorded IMD wind data at Chennai (Nungambakkam)

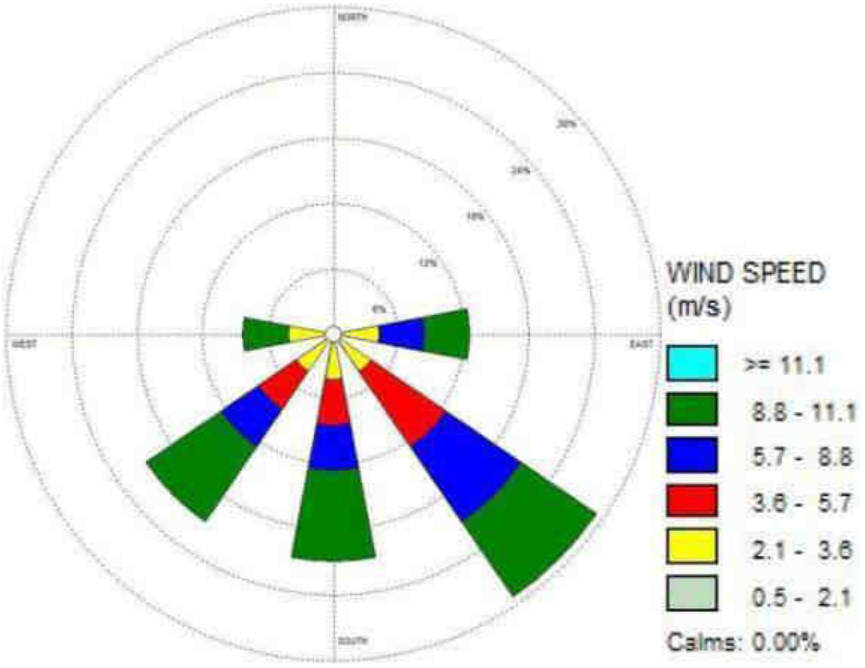
Month	No. of Days with Wind Speed (Km.p.h.)					Percentage No. of Days Wind From							
	62 or more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	Calm
January	0	0	18	13	19	14	5	1	0	2	6	9	44
	0	0	28	3	9	44	30	6	1	0	0	0	10
February	0	0	17	11	7	5	6	4	5	10	15	9	39
	0	0	26	2	2	20	37	26	7	1	1	0	6
March	0	0	24	7	3	2	3	5	13	27	18	5	24
	0	0	30	1	1	3	28	46	16	1	1	0	4
April	0	0	26	4	1	0	1	7	30	39	8	1	13
	0	0	29	1	0	1	17	54	24	2	0	0	2
May	0	0	28	3	1	0	1	5	19	38	24	3	9
	0	0	30	1	1	1	12	48	27	5	2	1	3
June	0	1	27	2	0	0	0	1	4	31	54	4	6
	0	0	28	2	0	1	9	30	26	11	14	2	7
July	0	0	27	4	0	0	0	0	3	32	49	2	14
	0	0	27	4	1	1	10	27	22	13	11	2	13
August	0	0	27	4	0	0	0	0	2	30	50	5	13
	0	0	26	5	0	2	7	24	19	16	14	1	17
September	0	0	24	6	1	0	0	2	4	28	39	5	21
	0	0	25	5	1	2	14	30	16	8	8	3	18
October	0	0	19	12	7	6	1	1	3	12	24	7	39
	0	0	24	7	7	21	18	15	8	2	4	2	23
November	0	0	20	10	21	17	5	2	1	3	6	14	31

Month	No. of Days with Wind Speed (Km.p.h.)					Percentage No. of Days Wind From							
	62 or more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	Calm
	0	0	26	4	20	41	15	4	2	1	0	3	14
December	0	0	22	9	28	23	6	2	0	1	2	11	27
	0	0	29	2	22	53	12	3	1	0	0	1	8
Annual	0	2	278	85	7	6	2	3	7	21	24	6	24
	0	2	325	38	5	16	17	26	14	5	5	1	11

Windrose Plot

The wind data has been analysed as per the IMD data and the Wind rose plot has been represented in **Figure 3-2.**

Figure 3-2 Windrose plot of the nearest IMD Station – Summer (IMD-Chennai)[2]



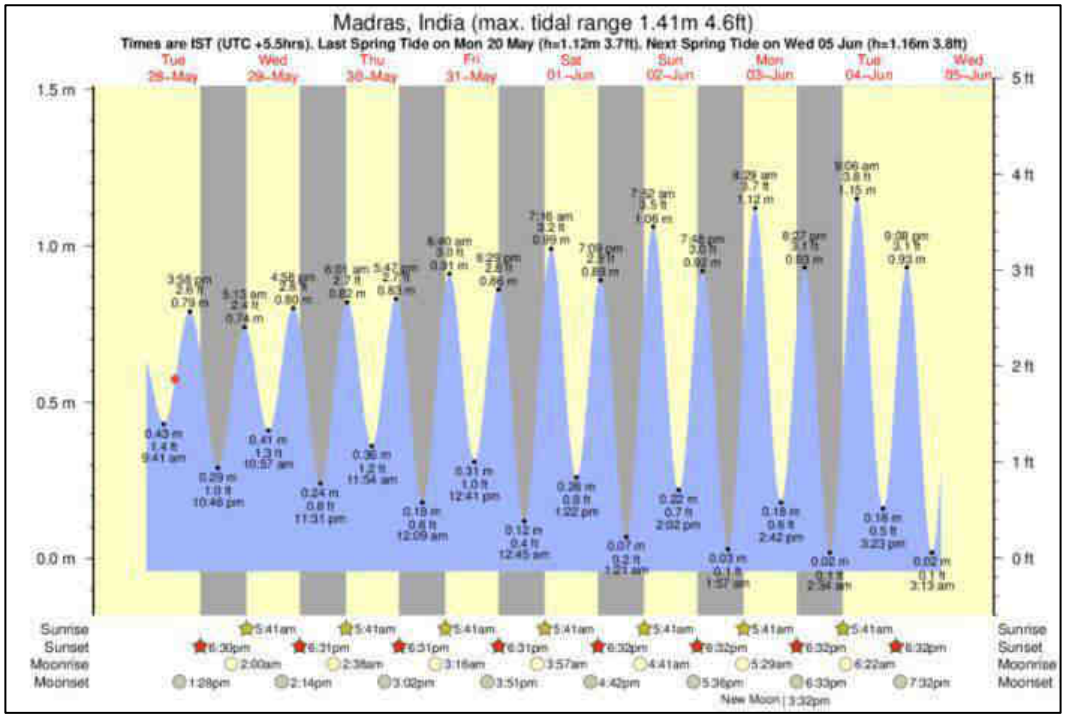
3.2.6 Tides

The maximum tidal range of Chennai coast is 1.41 m. The tides at Ennore are semi-diurnal in nature. The spring tides are the tides with highest water levels and the neap tides indicate the

[2] Climatological Normals (1971-2000) issued by Office of the Additional Director General of Meteorology(Research)- Indian Meteorological Department

lowest water level. The tidal levels for the period of 28th May to 5th June has been obtained and represented in **Figure 3-3**. From the **Figure 3-3**it can be interpreted that the highest water level during spring tides are about 1.12 m on 20th May and 1.16m on 5th June.

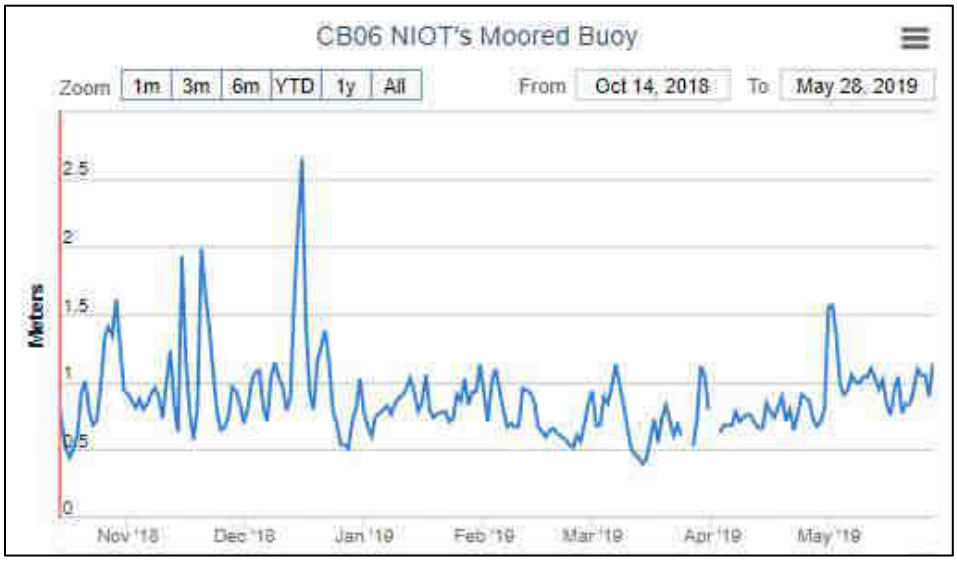
Figure 3-3 Tide Chart of Chennai



3.2.7 Waves

The wave height in the Ennore Coast is maximum to a height of 2.5 m which is as represented below. As shown in the**Figure 3-4** the wave height has been measured by the NIOT moored buoy and the wave height was high during the Northeast Monsoon and the wave height was considerably less during the summer. This is because the wind speeds are high during the Northeast monsoon along the Coromandel Coast.

Figure 3-4 Wave Height in Ennore Coast

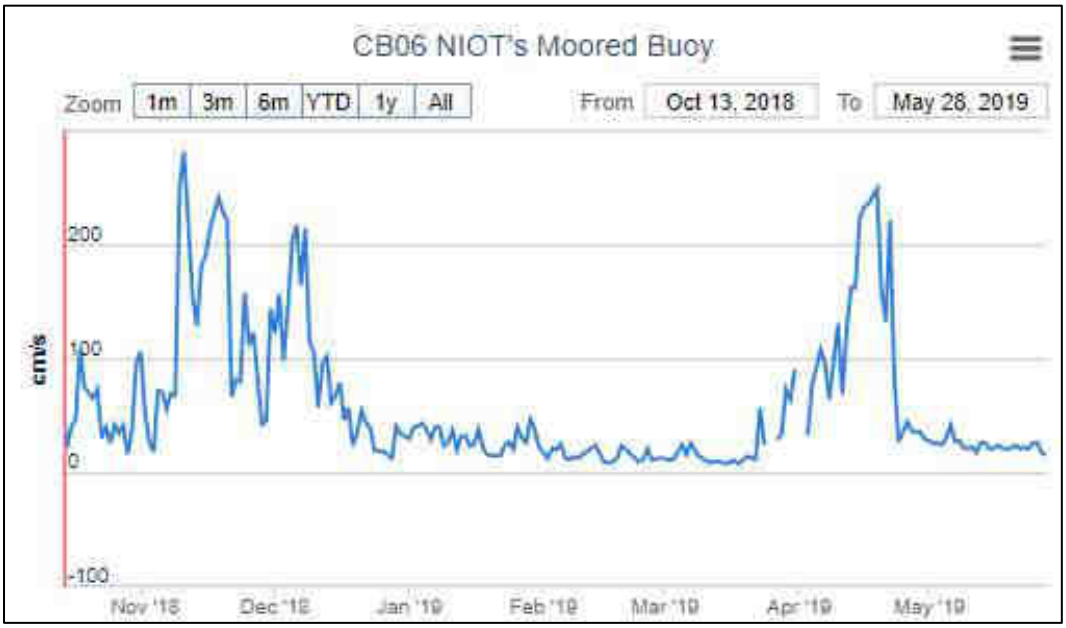


Source: INCOIS- Moored Buoy Data

3.2.8 Currents

The currents in Ennore coast are unidirectional towards south upto February and north for the rest of the time. The current speed as represented in **Figure 3-5** reveals that the current speed during the Northeast monsoon is higher than 200 cm/s (2 m/s) which is directed towards the South and the speed during the other times of the year tend to be below 200 cm/s (2 m/s) which is directed towards North.

Figure 3-5 Current Speed in Ennore Coast



Source: INCOIS- Moored Buoy Data

3.2.9 Bathymetry

The seabed morphology of Ennore coast is complex with varied slopes. The slope is steep (1 in 300) at Ennore creek, while the slope on the northern side is flat (1 in 500) with submerged shoals. These shoals might have been formed due to the interaction of northerly coastal currents and sediment supply through Ennore creek.

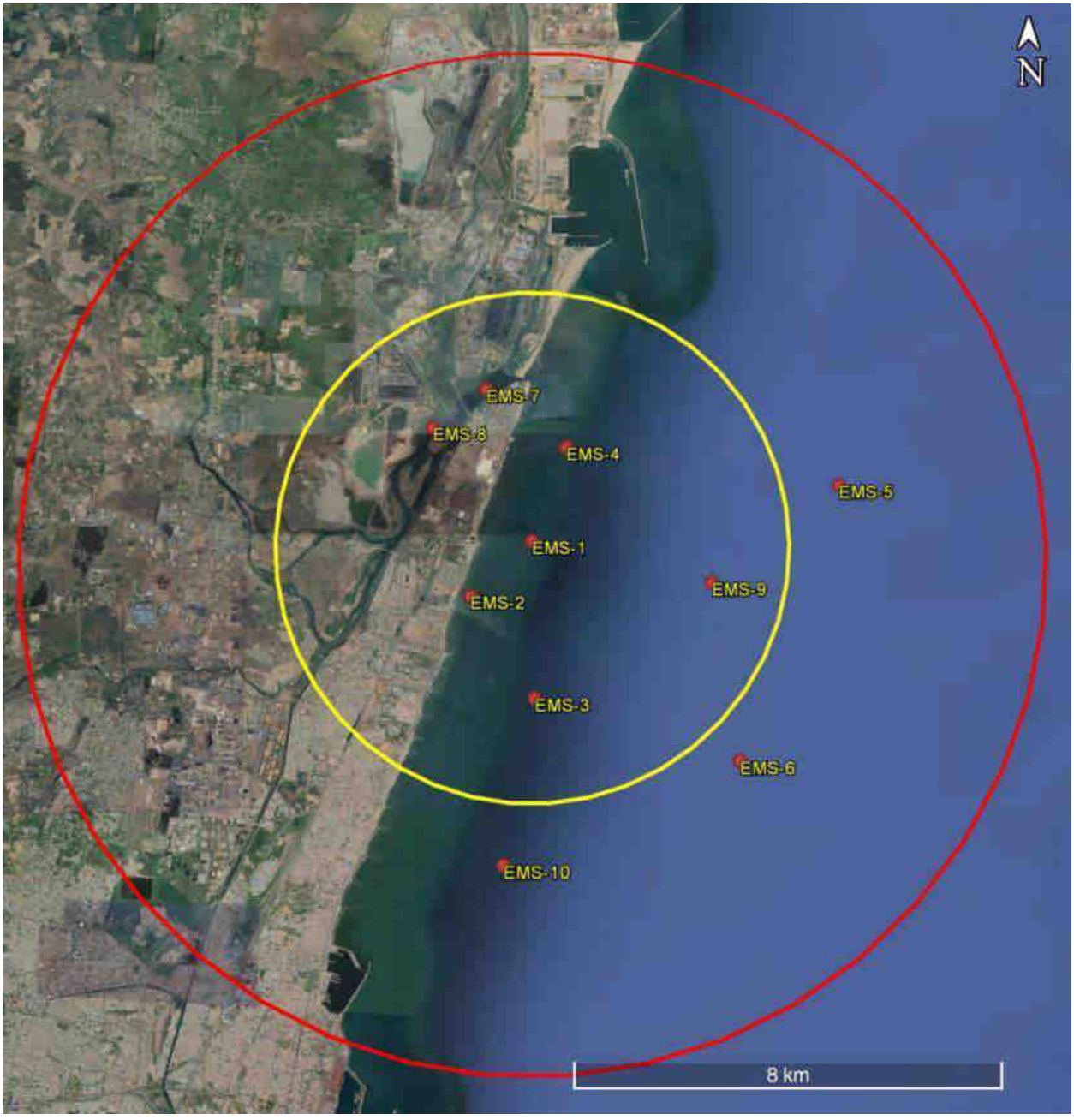
3.3 Sea Water Quality

The sampling was done with a view to study the existing physicochemical, biological conditions of the site and the area around the site of around 10 km radius. **Table 3-4** provides the geo-coordinates of the sampling stations. The samples were collected and were tested in a NABL accredited laboratory. The samples collected from core area will give the direct effect on the ecology and those collected in the 10 km radii will give the diminishing effect. **Figure 3-6** shows the marine baseline sampling locations for 10 km radius. The site sampling photographs are shown in **Figure 3-7.**

Table 3-4 Geo-coordinates of sampling stations off Ennore Coastline

Sr.No	Station	Latitude	Longitude
1	MS-1	13°12'11.93"N	80°19'56.28"E
2	MS-2	13°11'36.86"N	80°19'16.95"E
3	MS-3	13°10'33.16"N	80°19'59.15"E
4	MS-4	13°13'12.17"N	80°20'17.76"E
5	MS-5	13°12'49.05"N	80°23'15.23"E
6	MS-6	13° 9'55.36"N	80°22'9.86"E
7	MS-7	13°13'49.45"N	80°19'25.20"E
8	MS-8	13°13'24.32"N	80°18'50.62"E
9	MS-9	13°11'46.42"N	80°21'52.37"E
10	MS-10	13° 8'50.86"N	80°19'40.69"E

Figure 3-6 Map showing Marine Baseline Sampling Locations (10 km radius)



EMS- ETPS Marine Sampling Locations

Figure 3-7 Marine Sampling Photographs

Marine Sampling (Open Ocean)		
		
Surface Water Collection	Bottom Water Collection	Phyto & Zoo plankton Collection
		
Benthos Collection	Sediment Collection	Sediment collection
Marine Sampling (Creek Region)		
		
onsite temperature measurement	Bottom Water Collection	

3.4 Surface and Bottom Sea Water

The surface seawater quality in the study area was analyzed for 32 parameters including Petroleum Hydrocarbons as per the standard procedures to assess the physico-chemical properties of the water. The temperature of the surface water was recorded between 28.1 °C and

28.6 °C and salinity varied from 36.6 ppt to 37.0 ppt for all the seawater-sampling locations. The conductivity of all the locations was found to be ranging between 56300-56500 µs/cm. The pH ranged between 7.8 and 8.1 indicating that the seawater is slightly alkaline. The values of total suspended solids were found be raging between 2-6 mg/L. The total dissolved solids were found to be between the range of 36615-37000 mg/L for all the sampling locations. The Dissolved Oxygen was found to be between 6.5 mg/L and 6.8 mg/L indicating well mixing of water. BOD values were found to be ranging between 2-6 mg/L indicating that all the locations are free of organic pollution. COD values were found to be ranging between 14-26 mg/L. Nutrients values like nitrite, nitrate were observed to be within the normal range. The value of phosphate was found to be ranging between 210-640 µg/L. All the petroleum hydrocarbons were below detectable limits. Calcium, sodium, potassium and magnesium concentrations were found to be in the range of 470 mg/L – 510 mg/L, 10,350 mg/L- 10,920 mg/L, 420 mg/L- 438 mg/L, 1310 mg/L- 1370 mg/L respectively. Silica was found to be ranging from 0.39-1.10 mg/L. Iron (as Fe) was found to be present in range of 0.10-0.29 mg/L.

The surface water samples were tested for heavy metal concentration and it was observed that at all the locations the concentrations of cadmium, lead, mercury, zinc, arsenic chromium and barium were below the detection limit. Copper and manganese were detected to be in the range of 0.08 mg/L- 0.12 mg/L and 0.05 mg/L- 0.09 mg /L.

Oil and grease were below 2 mg/L for all the samples. The presence of total coliform was observed to be less than 2 MPN/100 ml for sample locations 1, 3, 4, 6, 9 and for sample 2, 5, and 10 it was found to be 11 MPN/100ml. The E.coli count was found to be less than 2 MPN/100ml for all the locations. The total viable count was found to be ranging between 100-300 CFU/ml.

Similarly, the bottom seawater quality in the study area was analyzed for 32 parameters as per the standard procedures to assess the physicochemical properties. The temperature of the seawater was recorded between 27.9-28.7 °C with pH value 7.5- 7.8 indicating that the seawater is slightly alkaline. Total suspended solids were found to be ranging from 4-10 mg/L. The conductivity of all the locations was found to be ranging between 56270-57120 µs/cm. The total dissolved solids were 36582-36986 mg/L for all the marine bottom water sampling locations. The Dissolved Oxygen occurred between 6.3 mg/L and 6.7 mg/L indicating well mixing of

water. BOD values ranged between 3-6 mg/L indicating that all the locations are free of organic pollution. COD values were found to be ranging between 16-28 mg/L. Nutrients values like nitrite, nitrate were observed to be within the normal range. The value of phosphate was found to be ranging between 490-1000 µg/L. All the petroleum hydrocarbons were found to be below detectable limits. Calcium, sodium, potassium and magnesium concentrations were found to be in the range of 430 mg/L – 510 mg/L, 9,990 mg/L- 10,850 mg/L, 420 mg/L- 446 mg/L, 1310 mg/L- 1370 mg/L respectively. Silica was found to be ranging from 0.36-3.60 mg/L. Iron (as Fe) was found to be present in range of 0.26-0.81 mg/L.

The bottom water samples were tested for heavy metal concentration and it was observed that at all the locations the concentrations of cadmium, lead, mercury, zinc, arsenic chromium and barium were below the detection limit. Copper and manganese were found to be in the range of 0.08 mg/L- 0.13 mg/L and 0.05 mg/L- 0.08 mg /L.

Oil and grease were found to be below 2 mg/L for all the samples. The presence of total coliform was observed to be less than 2 MPN/100 ml for all the samples except sample 3, which was found to be 13 MPN/100ml. The E.coli count was found to be less than 2 MPN/100ml for all the locations. The total viable count was found to be ranging between 100-380 CFU/ml. **Table 3-5** shows the details of marine surface and bottom water samples.

Table 3-5 Seawater Quality for Marine Surface and Bottom water samples

S.NO	PARAMETERS	METHOD	UNITS	SW1	BW1	SW2	BW2	SW3	BW3	SW4	BW4	SW5	BW5	SW6	BW6	SW9	BW9	SW10	BW10
1.	Salinity	2520-B-APHA 23rd Edn.2017	ppt	36.6	36.9	36.7	36.6	36.8	36.7	36.7	36.7	37.0	36.7	36.6	36.5	36.9	36.9	36.7	36.6
2.	Conductivity	2510-B-APHA 23rd Edn.2017	µs/cm	56350	56880	56300	56330	56340	56550	56440	56490	56490	56580	56330	56270	56500	57120	56490	56370
3.	Temperature	2550-B-APHA 23rd Edn.2017	°C	28.3	28.7	28.6	28.3	28.2	28.5	28.6	28.1	28.4	28.6	28.2	27.9	28.1	28.6	28.6	28.1
4.	Total Suspended Solids	2540-D-APHA 23rd Edn.2017	mg/l	6	10	2	4	4	8	6	6	4	8	4	6	4	10	6	5
5.	Total Dissolved Solids	2540-C- APHA 23rd Edn.2017	mg/l	36684	36986	36708	36622	36790	36754	36686	36716	37000	36778	36615	36582	36950	36982	36719	36644
6.	pH @ 25°C	4500-H^+-B-APHA 23rd Edn.2017	-	7.9	7.7	8.0	7.6	7.9	7.7	8.1	7.5	7.8	7.8	7.8	7.8	7.8	7.5	8.0	7.7
7.	Dissolved Oxygen	4500-O-C-APHA 23rd Edn.2017	mg/l	6.7	6.5	6.8	6.7	6.5	6.4	6.7	6.6	6.6	6.3	6.7	6.6	6.7	6.7	6.6	6.6
8.	Biochemical Oxygen Demand (BOD) 3 days at 27°C	5210-B-APHA 23rd Edn.2017	mg/l	6	5	2	3	4	4	6	4	4	3	2	3	4	4	3	6
9.	Chemical Oxygen Demand (COD)	5220-B- APHA 23rd Edn.2017	mg/l	24	26	16	16	20	24	26	20	22	18	14	18	20	20	16	28
10.	Oil & Grease	5520-O&G-B APHA 23rd Edn.2017 (Partition Gravimetric Method)	mg/l	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
11.	Nitrite as NO_2	IS 3025 (Part 34)-1988 (R.2014)	mg/l	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.01	BDL(DL:0.01)	BDL(DL:0.01)	BDL(DL:0.01)	0.02	BDL(DL:0.01)	0.02	0.03	0.04
12.	Nitrate as NO_3	IS 3025 (Part 34)-1988 (R.2014)	µg/l	620	680	410	1200	890	520	970	1100	1100	730	830	1300	900	700	600	1100
13.	Phosphate as PO_4	4500-P-D-APHA 23rd Edn.2017	µg/l	340	900	260	600	440	980	630	790	260	490	210	700	490	1000	640	630
14.	Silica as SiO_2	IS 3025 (Part 35)-1988 (R.2014)	mg/l	0.79	0.36	0.92	0.47	0.71	1.40	1.10	1.30	0.60	3.60	0.42	1.80	0.43	1.40	0.39	2.20

S.NO	PARAMETERS	METHOD	UNITS	SW1	BW1	SW2	BW2	SW3	BW3	SW4	BW4	SW5	BW5	SW6	BW6	SW9	BW9	SW10	BW10
15.	Iron as Fe	IS 3025 (Part 53)-2003 (R.2014)	mg/l	0.26	0.71	0.18	0.36	0.29	0.26	0.22	0.43	0.14	0.80	0.10	0.39	0.23	0.53	0.21	0.81
16.	Sodium as Na	IS 3025 (Part 45)-1993 (R.2014)	mg/l	10800	10840	10900	9990	10920	10570	10610	10700	10500	10640	10350	10380	10500	10850	10740	10650
17.	Potassium as K	IS 3025 (Part 45)-1993 (R.2014)	mg/l	430	442	424	436	426	430	420	420	438	446	420	420	428	436	432	426
18.	Calcium as Ca	IS 3025 (Part 40)-1991 (R.2014)	mg/l	490	430	485	450	478	464	485	472	498	480	470	492	490	510	510	470
19.	Magnesium as Mg	IS 3025 (Part 46)-1994 (R.2014)	mg/l	1334	1344	1310	1310	1316	1360	1370	1370	1340	1360	1320	1340	1320	1340	1360	1350
20.	Copper as Cu	3111-B-APHA 23rd Edn.2017	mg/l	0.10	0.09	0.09	0.11	0.12	0.13	0.11	0.11	0.10	0.10	0.08	0.09	0.10	0.08	0.12	0.11
21.	Manganese as Mn	3111-B-APHA 23rd Edn.2017	mg/l	0.07	0.06	0.06	0.08	0.07	0.07	0.08	0.08	0.06	0.06	0.05	0.07	0.07	0.05	0.09	0.07
22.	Total Coliform	IS 1622:1981 (R.2009)	MPN/100ml	< 2	< 2	11	< 2	< 2	13	< 2	< 2	11	< 2	< 2	< 2	< 2	< 2	11	< 2
23.	*E.coli*	IS 1622:1981 (R.2009)	MPN/100ml	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
24.	Total Viable Count	IS 5402:2012	CFU/ml	300	100	150	200	200	380	100	150	100	100	200	200	100	100	200	100

Note: SW-Surface Water, **BW**- Bottom Water
Locations 1,2,3,4,5,6,9 & 10 are taken in offshore while locations 7 and 8 are taken in creek.

3.5 Marine Sediment

The sediment texture at locations 3, 5, 6 and 9 had maximum percentage of sand and locations 1, 2 ,4, 10 has maximum percentage of clay. The sediments were slightly alkaline in nature with pH values ranging between 7.6 and 7.9. Total Organic carbon ranged from 0.11 to 0.84 %. Calcium carbon was found between 1.92-3.01%. Organic nitrogen ranged between 384-812 mg/kg. Oil and grease were detected to be less than 10 mg/kg for all the samples. Iron levels varied from 0.54-1.22 mg/kg. The details of Marine Sediment Quality are given in**Table 3-6.**

The sediment samples were tested for heavy metal concentration and it was observed that at all the locations the concentrations of cadmium, lead, mercury, arsenic, and barium were below the detection limit. Chromium was found to be BDL for location 3 and 6 and for all other locations it was found to be ranging from 13.36-20.94 mg/kg. Manganese levels were found to be ranging from 44.28-156.45 mg/kg. The concentration of Copper ranged from 3.56-7.62 mg/kg for locations 1, 3, 6, 9, 10 and it was found to be below detection limit for locations 2, 4, 5. Zinc content was found to be ranging from 14.33-33.18 mg/kg. All the Petroleum hydrocarbons tested were found to be below detectable limits for all the samples tested. This indicates that port activities have minimal effect on the sediment quality.

Table 3-6 Marine Sediment Quality Analysis

S.NO	PARAMETERS		UNITS	MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 9	MS 10
1. 1	pH (at 25 °C)		--	7.7	7.6	7.8	7.7	7.9	7.9	7.9	7.8
2. 3	Sediment Texture	Sand	%	21.6	23.2	92.7	23.5	84.2	94.3	88.3	21.7
		Silt		16.7	10.3	5.5	7.7	6.8	4.2	2.1	13.6
		Clay		61.7	66.5	1.8	68.8	9	1.5	9.6	64.7
3. 4	Total Organic Carbon		%	0.71	0.82	0.11	0.75	0.31	0.21	0.38	0.84
4. 5	Calcium Carbonate as $CaCO_3$		%	2.72	3.01	1.92	2.96	2.42	2.1	2.72	2.98
5. 6	Organic Nitrogen		mg/kg	784	812	384	608	544	452	488	677
6. 7	Oil & Grease		mg/kg	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
7. 8	Copper as Cu		mg/kg	3.56	BDL(DL:3.0)	7.62	BDL(DL:3.0)	BDL(DL:3.0)	5.15	3.88	4.12
8. 9	Zinc as Zn		mg/kg	25.64	33.18	20.14	29.9	14.33	18.22	17.77	30.46
9. 10	Iron as Fe		%	0.63	0.54	1.22	0.57	0.61	1.16	0.54	0.59
10. 13	Manganese as Mn		mg/kg	126.32	156.45	44.28	142.44	98.44	48.34	107.38	139.78
11. 15	Total Chromium as Cr		mg/kg	16.44	18.22	BDL(DL:5.0)	20.94	13,36	BDL(DL:5.0)	16.61	17.65

Note: MS- Marine Sediment

3.6 Creek water Quality

3.6.1 Surface and Bottom Creek Water

The surface creek water quality in the study area was analyzed for 32 parameters including Petroleum Hydrocarbons as per the standard procedures to assess the physico-chemical properties of surface sea water quality. The temperature of the surface water was recorded between 28.3 °C and 28.5 °C and salinity varied from 36.4 ppt to 37.1 ppt. The conductivity of all the locations was found to be ranging between 55930-56590 µs/cm. The pH ranged between 7.8 and 7.9 indicating that the seawater is slightly alkaline. The values of total suspended solids were found be raging between 6-9 mg/L. The total dissolved solids were found to be 37066-36355 mg/L. The Dissolved Oxygen was found to be between 6.4 mg/L and 6.5 mg/L indicating well mixing of water. BOD values were found to be ranging between 4-5 mg/L indicating that all the locations are free of organic pollution. COD values ranged between 24-26 mg/L. Nutrients values like nitrite, nitrate were observed to be within the normal range. The value of phosphate was found to be ranging between 340-720 µg/L. All the petroleum hydrocarbons were found to be below detectable limits. Calcium, sodium, potassium and magnesium concentrations were found to be in the range of 465 mg/L – 478 mg/L, 10,650 mg/L- 10,700 mg/L, 430 mg/L- 440 mg/L, 1280 mg/L- 1310 mg/L respectively. Silica was found to be ranging from 1.2-1.3 mg/L. Iron (as Fe) was found to be present in range of 0.42-0.69 mg/L.

The surface water samples were tested for heavy metal concentration and it was observed that at all the locations the concentrations of cadmium, lead, mercury, zinc, arsenic chromium and barium were below the detection limit. Copper and manganese were found to be in the range of 0.10 mg/L- 0.11 mg/L and 0.07 mg/L- 0.08 mg /L.

Oil and grease values were found to be below 2 mg/L for all the samples. The presence of total coliform was observed to be less than 2 MPN/100 ml for both the samples. The E.coli count was found to be less than 2 MPN/100ml for all the locations. The total viable count was found to be ranging between 150-200 CFU/ml.

Similarly, the bottom creek water quality in the study area was analyzed for 32 parameters as per the standard procedures to assess the physico-chemical properties. The temperature of the seawater was recorded between 28.3-28.4 °C with pH value 7.5- 7.6 indicating that the seawater is slightly alkaline. Total suspended solids were found to be ranging from 4-8 mg/L.

The conductivity of all the locations was found to be ranging between 56480-56560 µs/cm. The total dissolved solids were found to be 36708-36768 mg/L. The Dissolved Oxygen was observed between 6.5 mg/L and 6.8 mg/L indicating well mixing of water. BOD values were found to be ranging between 4-5 mg/L indicating that all the locations are free of organic pollution. COD values ranged between 22-26 mg/L for both the creek samples. Nutrients values like nitrites, nitrates were observed to be within the normal range. The value of phosphate was found to be ranging between 1100-1200 µg/L. All the petroleum hydrocarbons were found to be below detectable limits. Calcium, sodium, potassium and magnesium concentrations were found to be in the range of 482 mg/L – 510 mg/L, 10,480 mg/L- 10,520 mg/L, 418 mg/L- 434 mg/L, 1310 mg/L- 1326 mg/L respectively. Silica was found to be ranging from 0.62-3.10 mg/L. Iron (as Fe) occurred between 0.66-0.98 mg/L

The creek bottom water samples were tested for heavy metal concentration and it was observed that at all the locations the concentrations of cadmium, lead, mercury, zinc, arsenic chromium and barium were below the detection limit. Copper and manganese were found to be in the range of 0.1 mg/L- 0.12 mg/L and 0.06 mg/L- 0.09 mg /L.

Oil and grease was found to be below 2 mg/L for all the samples. The presence of total coliform was observed to be less than 2 MPN/100 ml for all the samples. The E. coli count was found to be less than 2 MPN/100ml for all the locations. The total viable count was found to be ranging between 150-200 CFU/ml. **Table 3-7** illustrates the details of the lab test analysis.

Table 3-7 Creek Water Quality for Surface and Bottom water samples

S.NO	PARAMETERS	UNITS	SW7	BW7	SW8	BW8
1.	Salinity	ppt	37.1	36.7	36.4	36.7
2.	Conductivity	µs/cm	56590	56560	55930	56480
3.	Temperature	°C	28.5	28.4	28.3	28.3
4.	Total Suspended Solids	mg/l	6	4	9	8
5.	Total Dissolved Solids	mg/l	37066	36768	36355	36708
6.	pH @ 25°C	-	7.9	7.5	7.8	7.6
7.	Dissolved Oxygen	mg/l	6.4	6.8	6.5	6.5
8.	Biochemical Oxygen Demand (BOD) 3 days at 27°C	mg/l	4	5	5	4
9.	Chemical Oxygen Demand (COD)	mg/l	24	26	26	22
10.	Oil & Grease	mg/l	< 2	< 2	< 2	< 2

S.NO	PARAMETERS	UNITS	SW7	BW7	SW8	BW8
11.	Nitrite as NO_2	mg/l	0.04	0.05	0.07	0.07
12.	Nitrate as NO_3	µg/l	690	1600	510	290
13.	Phosphate as PO_4	µg/l	340	1100	720	1200
14.	Silica as SiO_2	mg/l	1.20	0.62	1.30	3.10
15.	Iron as Fe	mg/l	0.42	0.66	0.69	0.98
16.	Sodium as Na	mg/l	10650	10480	10700	10520
17.	Potassium as K	mg/l	440	434	430	418
18.	Calcium as Ca	mg/l	478	510	465	482
19.	Magnesium as Mg	mg/l	1310	1326	1280	1310
20.	Copper as Cu	mg/l	0.10	0.1	0.11	0.12
21.	Manganese as Mn	mg/l	0.07	0.06	0.08	0.09
22.	Total Coliform	MPN/100ml	< 2	< 2	< 2	< 2
23.	*E. coli*	MPN/100ml	< 2	< 2	< 2	< 2
24.	Total Viable Count	CFU/ml	150	200	200	150

Note: SW-Surface Water, **BW**- Bottom Water

3.7 Creek Sediment Quality

The sediment texture at both the creek locations was found to be maximum clay. The sediments were slightly alkaline in nature with pH values ranging between 7.5 and 7.8. Total Organic carbon was found to be ranging from 0.81 to 0.23 %. Calcium carbon occurred between 4.12-5.42%. Organic nitrogen ranged between 882-1286 mg/kg. Oil and grease were found to be less than 10 mg/kg for all the samples. Iron levels varied from 0.89-1.05 mg/kg.

The sediment samples were tested for heavy metal concentration and it was observed that at all the locations the concentrations of cadmium, lead, mercury, arsenic and barium were below the detection limit. Manganese levels were found to be ranging from 66.72-74.18 mg/kg. The concentration of Copper ranged from 40.64-51.98 mg/kg. Zinc content ranged from 278.32-351.84 mg/kg. The concentration of zinc was found to be high due to sewage contamination from the Chennai Corporation area. Chromium was also present in the creek sediment samples in the concentration 38.28-47.85mg/kg, due to the sewage contamination in the creek. All the Petroleum hydrocarbons tested were found to be below detectable limits for all the samples tested. This indicates that port activities have minimal effect on the sediment quality. The creek sediment analysis results are given in**Table 3-8**.

Table 3-8 Creek Sediment Quality Analysis

S.NO	PARAMETERS		UNITS	MS 7	MS 8
1.	pH (at 25 °C)		--	7.8	7.5
2.	Sediment Texture	Sand		7.2	8.1
		Silt	%	3.1	2.9
		Clay		89.7	89
3.	Total Organic Carbon		%	0.81	2.3
4.	Calcium Carbonate as $CaCO_3$		%	4.12	5.42
5.	Organic Nitrogen		mg/kg	882	1286
6.	Oil & Grease		mg/kg	< 10	< 10
7.	Copper as Cu		mg/kg	40.64	51.98
8.	Zinc as Zn		mg/kg	278.32	351.84
9.	Iron as Fe		%	0.89	1.05
10.	Manganese as Mn		mg/kg	66.72	74.18
11.	Total Chromium as Cr		mg/kg	38.28	47.85

3.8 Marine Ecology

Coastal and marine ecosystems are among the most productive ecosystems in the world, provide many services to human society and are of great economic value (UNEP, 2006). The services include provision of food and water resources, and raw materials like sand, and other high-value heavy minerals like ilmenite, zircon, monazite etc., which are collected from beach sand. They also provide regulating and cultural services, like storm protection, erosion control, tourism and support functions such as climate regulation, oceans and coastal biomes may provide as much as, two-thirds of the ecosystem services that make up the planet's natural capital (TEEB, 2010).[3]

Coastalhabitatsalone account for approximately 30% of all marinebiological productivity. The diversity and productivity are also important for humans. These habitats provide a rich source of food and income. They also support species that serve as animal feed, fertilizers,

[3]*TEEP 2010 The Economics of Ecosystems and Biodiversity: The Ecological and Economic Foundations a TEEP document prepared by Rudolf de Groot Brendan Fisher & Mike Christie, Eds)*

additives in food and cosmetics. Habitats such asmangrovesandsea grassesprotect the coastlines from wave action and erosion. Other areas provide sediment sinks or act as filtering systems.

Marine ecosystems are a complex of habitats defined by the wide range of physical, chemical, and geological variations that are found in the sea. Habitats range from highly productive near shore regions to the deep sea floor inhabited only by highly specialized organisms. Marine ecosystems are important to humankind both ecologically and economically, providing numerous vital goods and services, and supporting the processes that sustain the entire biosphere.

Marine ecosystem services are provided at the global scale (for example. oxygen production, nutrient cycles, carbon capture through photosynthesis and carbon sequestration) and at the regional and local scales (for example stabilizing coastlines, bioremediation of waste and pollutants, and a variety of aesthetic and cultural values).

Marine services include several important economic benefits such as food provision and tourism. Some of the environmental changes taking place at the global levels are likely to have significant and far-reaching consequences for marine biodiversity. Changes in marine biodiversity are extremely complex processes driven by numerous factors, making it difficult to determine precisely which changes are results of direct human influence. It is clear, however, that deteriorating biodiversity impairs a marine ecosystem's capacity to provide food, maintain water quality and recover from perturbations.

Baseline Condition (Secondary Source)

In a study conducted by Hussain, S.M. and Casey, K.E, (2016) on sediment and water samples collected from intertidal zone of north Chennai coast atotal of 34 species of foraminifera belonging to Order Foraminiferida and 14 Ostracoda species to belonging to Order Podocopida were reported. In thisstudy, 34 species of foraminifera, belonging to 15genera, 10 families, 7 super-families and 3 subordersof order Foraminiferida have been reported whereas 14 species ostracod belongingto 12 genera, 6 families, Cytheracea super-family,and Podocopa suborder of the order Podocopidahave been identified.

Foraminifers are almost exclusively marine,unicellular Protists generally consisting of a hardcovering of calcium carbonate called test, haveextensively been used for studies related topaleoclimatic reconstruction, sediment transport etc. Some of the species reported are:*E.incertum E.advenum E.norvangi A.trispinosa L.limbata C.lobatulus N.stella N.sp*

*N.elongatum N. boueanum N.elongatum N. boueanum S costifera S depresa Q polygona Q.lamarckiana Q.kerimbatica Q.costata Q.seminulum Q.sp***.** Ostracods are the tinybivalved Crustaceans found in environment where thecontrolling factors are temperature, bottomtopography, depth, salinity, dissolved oxygen,substrate, food supply and organic matter.Ostracods are considered one of the importantmicrofossil groups in interpreting andreconstructing the paleoclimate and/orpaleoenvironment. Some of the species are: *H. reticulate H. paiki N. iniqua S. kingmai C. keiji L.coralloides C. javana O.morkhovei X. variegate S. kingmai C. keiji* .[4]

In a study conducted by Elumalai et al., (2010) in the area of Ennore creek, Chennai a total of 30 species belonging to 24 genera, 15 families, 2 superfamilies and 2 suborders of Podocopida, have been identified. Of these, four species belong to Platycopa and the rest to Podocopa. Some ostracod species characteristic of brackish water, such as *Cyprideis* cf. *mandviensis*, species of *Hemicytheridea*, *Jankeijcythere mckenziei*, *Kalingella mckenziei*, *Loxoconcha megapora indica* and *Neosinocythere dekrooni* occur in the creek. Freshwater species like *Cyprinotus salinus* were also observedin the outer creek region, i.e. towards riverine side. The occurrence of *Cytherelloidea leroyi*, *Neomonoceratina iniqua*, *Keijella reticulata*, *Neocytheretta murilineata*, *Lankacythere reticulata* and *Mutilus pentoekensis* may be due to the tidal influence. However, *Tanella gracilis* occurs in almost all types of environments ranging from marginal marine to shallow marine environment. Some of the ostracod species like *Basslerites liebaui*, *Jankeijcythere mckenziei*, *Kalingella mckenziei* and *Neomonoceratina jaini* are endemic to Indian waters only. It was concluded that the ostracod assemblage strongly prefers tropical, shallow and brackish water (Oligohaline to Mesohaline) habitat. [5]

Kannan and Thirunavukkarasu, (2017), conducted a study in Ennore mangrove ecosystem and reported that diatoms formed the dominant group followed by blue greens algae and green algae. About 101 species of phytoplankton belonging to diverse groups, such as 48 species belong bacillariophyceae, 34 species to cyanophyceae and 19 species to chlorophyceae were recorded The *Bacillariophyceae*(diatoms) which were found to be

[4]*Hussain, S.M. and Casey, K.E., 2016. Distribution of foraminifera and ostracoda in the north chennai coast (Ennore to Thiruvanmiur), Tamil Nadu: Implications on microenvironment.*

[5]Elumalai, K., Hussain, S.M. and Dhas, C.S.I., 2010. Recent benthic Ostracoda from the sediments of Ennore Creek, Chennai, Tamil Nadu, India. *Journal of the Palaeontological Society of India*, *55*, pp.11-22.

dominant in the area are: *Apanocapsa banarasensis, A. microscopica , Lungbya semiplena, L. putealis, Johannesbaptistia pellucid, Chlorella vulgaris, Chlorella vulgaris, Korshikoviella limnetica, Pleurotanium ehrenbergi, Stephanodiscus niograroe, Lauderia annulata, Leptocylindrus danicus, L. minimus, Gyrosigma bolticum, Pleurosigma elongatum* and *Nitzschia longissima.* Some of the Cyanophyceae (Blue green Algae) reported are*Apanocapsa banarasensis, A. grevillei, A. microscopic, A. pulchra ,Chrooccoccus indicus,C. turgidus, Merismopedia minima, Oscillatioria earli Spirulina laxissima*, *Phormidium retzei*, *Johannesbaptistia pellucid.Some of the Chlorophyceae* (Green Algae) reported are: *Ankistrodesmus falcatus, Closteriopsis longissima, Senedesmus armatus, S.arquatus, S.obilius, Gonatozygon aculeatum, Penium cylindrus, Euastrum spinlosum,S.quaricauda.*[6]

The area comprises of brown or grey coloured mud like sandy sediment. The chanks occur burrowed in the sediment. Bivalves *Tellina coarctata*, *Mactra mera*, live gastropods *Babylonia spirata*, *Murex virqineus*, *Calliostoma tranquebarica, Clanulus microdon, Conus amadis,* egg capsules of sacred chank, egg ribbons of *Tonna dolium* and *Natica tigrina* are abundant. The sea urchins, crinoids, sponges, sea anemone sea fans, stomatopods, the crabs and other size groups Portunuspe/amicus, Charybdis sp, Ocypoda sp and hermit crabs have been recorded. The species of algae like *Gracilaria folifera*. Halimenia sp and Sargassum sp and Lithothamnion and the sea grass Cymodocea were represented in the fishing ground. In addition, empty shells of several bivalves Area complanata, *A. fusca, Cardita bicolar*, *Pecten plica, Pinctada fucata, Tellina* sp Pteria and the gastropods *Oliva gibbosa* and *Turritella acutangula* distributed over the bottom. A variety of fishes like rays, skates, sharks, Lutianus, Lactarius, *Sillago sihama*, Chirocentrus spp, Leiognathus spp, Carangids, Siganus sp, *Saurida tumbil*, *Pseudo rhombus, Lates calcarifer, Pseudosciaena diacanthus, Rachycentron* sp, Cynoglossus, *Pellona Thrissocxles*, *Therapon jarbua*, Nemipterus, *Plotosus*, Platycephalus spp Tetrodon sp, gobids, the prawns *Penaeus semisulcatus*, P. indicus, *Parapenaeopsis uncta* and P. maxillipedo, the lobsters *Panulirus homarus*, P. ornatus, P. versicolor and *Thunus orientialis,* the squid *Loligo duvauceli*, the cuttlefish *Sepia elliptica* and *Sepiella inermis* and octopods etc. have been reported in the trawl net catches.

3.8.1 Methodology

[6]*Kannan, N. and Thirunavukkarasu, N., 2017. Physico-Chemical Parameters and Phytoplankton Diversity of Ennore Mangrove Ecosystem. Res J. Chem. Environ. Sci. 5 (6): 62-72*

The marine monitoring for ETPS TANGEDCO project was conducted on 17th and 18th May 2019 starting 10:00 hrs and completed 16.30 hrs. Samples locations 1 to 6, 9 and 10 falls in offshore and locations 7 and 8 are in Creek area. The proposed sampling locations were identified off shore prior with the help of the co-ordinates. Based on the primary co-ordinates the sampling strategy was planned in such a manner so as to cover the entire area. The biological parameters considered for the present study were phytoplankton, zooplankton, macro-benthos biomass and population and fishery status. The first two reflect the productivity of a water column at the primary and secondary levels. Benthic organisms being sedentary animals associated with the sediment/rocky beds, provide information on the integrated effects of stress, if any, and hence are good indicators of early warning of potential damage. Sample collections for marine ecological studies were done by mechanized boat.

Phytoplankton

Water samples were collected for Phytoplankton studies using standard water sampling depth water sampler. A measured amount of water (2 Litre) samples were fixed by adding "Lugol's Iodine" and stored in cool place under dark condition. Samples were allowed to settle and concentrated to approximate volume in laboratory. 1 ml of each of these concentrates was examined using Sedgwick - Rafter and microscope with standard reference manual.

Zooplankton

The zooplankton samples were collected as horizontal surface tow with a modified Heron-Tranter (HT) net (having 0.25 m^2 mouth area and 300 µm mesh size). All the samples were preserved in 5% neutralized formaldehyde solution. The zooplankton biomass was later estimated by displacement volume method and readings were converted for organisms/m^3. Different zooplankton were sorted, identified and enumerated under stereoscopic zoom binocular microscope. The number were calculated for the whole samples and expressed for organisms/m^3 of water.

Benthos

Sediment samples for benthic community were collected from the intertidal as well near shore sub tidal regions. Sub tidal sediments were collected with a stainless steel Van Veen grab covering an area of 0.04m^2. The materials collected were preserved in 10% seawater formalin containing Rose- Bengal stain. In the laboratory, all the samples were again washed through a 500-µm-mesh sieve in running water to clear adhering sediment. Later all the organisms were sorted counted and identified up to group level.

3.8.2 Observations

Phytoplankton

Phytoplankton recorded from the 10 locations of the project site are represented by 35 species among them 21 species belongs to Bacillariophyceae and 9 species of Dynophyceae 2 species of Chlorophyceae and 3 species belongs to Cyanophyceae. The overall percentage composition of phytoplankton for the 10 locations revealed that the Bacillariophyceae was the dominant group (77%) and followed by Dinophyceae (17%), Cyanophyceae (4%) and Chlorophyceae (2%).

Hierarchy as follows;

Bacillariophyceae > Dinophyceae > Cyanophyceae > Chlorophyceae

Richness and abundance

Phytoplankton community of study area showed wide variation in abundance though species richness remained more or less similar over entire study area. The abundance, occurrence and percentage of phytoplankton species in the study area is given in **Table 3-9**, **Table 3-10** and **Table 3-11** respectively. However, significant temporal variations were observed. Maximum number of species (32 nos.) was observed at stations 1 & 6. Minimum number of species (28nos.) was observed at station 5. Maximum cell count was found at station 3 (11.3 X 10^3/L) minimum cell count was found at Station 6 (7.2 X 10^3/L). Phytoplankton Images recorded during observation are illustrated in **Figure 3-8**, and the dominant species at each of the location are presented in **Figure 3-9**.

Table 3-9 Abundance and species richness of phytoplankton

Station	Cell Count No.sx10^3/L	Total Species	Dominant Genera
1	8.4	**32**	*Coscinodiscus,Ceratium*
2	10.3	**29**	*Coscinodiscus, Chaetocerus*
3	11.3	**30**	*Coscinodiscus, Planktoniella*
4	9.8	**29**	*Coscinodiscus, Ceratium*
5	10.3	**28**	*Coscinodiscus, Ceratium*
6	7.2	**32**	*Coscinodiscus, Ceratium*
7	6.8	**30**	*Coscinodiscus, Chaetocerus*
8	8.5	**29**	*Coscinodiscus, Ceratium*
9	7.7	**29**	*Coscinodiscus, Biddulphia*
10	8.3	**30**	*Coscinodiscus, Ceratium*

Table 3-10 Occurrence of Phytoplankton species in the study area

S. No	Groups	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 7	MS 8	MS 9	MS 10
I	**Chlorophyceae**										
1	*Oocystis minuta*	+	-	+	+	+	+	+	+	+	+
2	*Pediastrum duplex*	+	+	+	+	-	+	+	+	+	+
II	**Cyanophyceae**										
3	*Lyngbya estuarii*	+	-	-	+	+	+	+	+	+	+
4	*Oscillatoria limosa*	+	+	+	+	+	+	+	-	+	+
5	*Phormidium sp.*	+	+	+	+	+	+	+	+	+	+
III	**Bacillariophyceae**										
6	*Amphora brevipes*	+	+	-	+	-	+	+	+	+	+
7	*Amphora bigibba*	-	+	+	-	+	+	+	+	+	+
8	*Bellerochea malleus*	+	+	+	+	+	+	+	-	+	+
9	*Bellerochea mobiliensis*	+	+	+	+	-	+	+	+	-	-
10	*Biddulphia sinensis*	+	-	+	+	+	+	+	+	+	+
11	*Biddulphia mobiliensis*	+	+	+	-	+	+	-	-	+	+
12	*Chaetocerus lorenzienus*	+	+	+	-	+	+	+	+	+	-
13	*Chaetocerus diversus*	+	+	+	+	+	+	+	+	-	+
14	*Coscinodiscus eccentricus*	+	+	+	+	+	+	+	+	+	+
15	*Coscinodiscus marginatus*	+	+	+	+	+	+	+	+	+	+
16	*Coscinodiscus radiatus*	+	+	+	+	+	+	+	+	+	+
17	*Coscinodiscus gigus*	+	+	+	+	+	+	+	+	+	+
18	*Gyrosigma sp.*	+	+	-	+	+	+	+	+	+	-
19	*Planktoniella sol*	+	+	+	+	+	+	+	+	+	+
20	*Pleurosigma sp.*	+	+	+	+	+	+	+	+	+	+
21	*Rhizosolenia sp.*	+	+	+	-	+	+	-	-	+	+
22	*Rhizosolenia alata*	+	+	+	+	+	+	+	+	+	+
23	*Triceratium reticulatum*	+	+	-	+	-	+	+	+	-	-
24	*Amphiprora gigantean*	+	-	+	+	+	-	-	+	+	+
25	*Climacosphenia elongate*	-	-	+	+	+	-	+	+	-	+
26	*Thalassiothrix frauenfeldii*	+	+	+	+	-	+	+	+	+	+
IV	**Dinophyceae**										
27	*Ceratium corridum*	+	+	+	+	+	+	+	+	+	+
28	*Ceratium macroceros*	+	+	+	+	-	+	+	+	+	+
29	*Ceratium trichoceros*	-	+	+	+	+	+	-	+	-	+
30	*Ceratium tripos*	+	+	-	+	+	+	+	+	+	+
31	*Ceratium furca*	+	+	+	+	+	+	-	-	+	+
32	*Peridinium oceanicum*	+	+	+	-	+	+	+	+	+	+

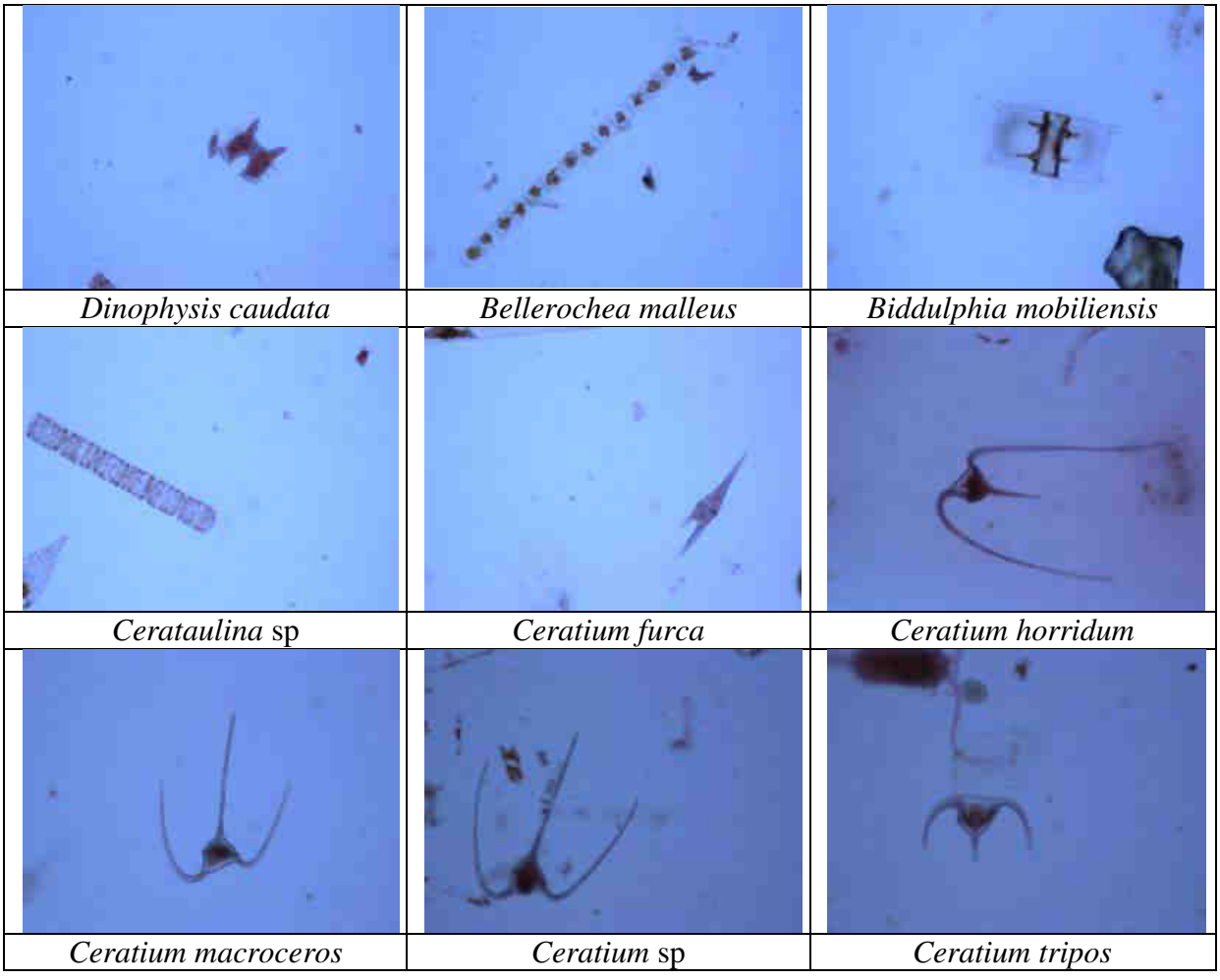
S. No	Groups	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 7	MS 8	MS 9	MS 10
33	*Protoperidinium sp.*	+	+	+	+	+	+	+	-	+	+
34	*Noctiluca miliaris*	+	+	+	+	+	-	+	+	-	+
35	*Dinophysis caudata*	+	-	+	-	-	+	+	+	+	-

Table 3-11 Percentage compositions of Phytoplankton species in the study area

S. No	Groups	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 7	MS 8	MS 9	MS 10
I	**Chlorophyceae**										
1	*Oocystis minuta*	2.1	0	2.23	0.76	1.24	0.52	0.42	0.56	1.3	1.2
2	*Pediastrum duplex*	1.44	1.36	1.43	1.45	0	0.26	1.11	1.84	0.1	0.32
II	**Cyanophyceae**										
3	*Lyngbya estuarii*	1.4	0	0	1.49	0.52	0.56	2.12	0.73	0.64	0.26
4	*Oscillatoria limosa*	3.38	2.73	1.64	1.24	0.83	1.17	2.14	0	2.17	0.46
5	*Phormidium sp.*	1.22	1.43	1.76	1.29	1.03	1	3.54	2.47	1.23	0.48
III	**Bacillariophyceae**										
6	*Amphora brevipes*	1.23	0.57	0	0.85	0	0.65	2.35	2.53	0.65	0.73
7	*Amphora bigibba*	0	2.17	1.64	0	3.4	1.28	3.45	1.44	1.37	5.9
8	*Bellerochea malleus*	2.47	3.65	2.34	2.68	12.4	1.34	6.35	0	1.27	2.53
9	*Bellerochea mobiliensis*	3.67	2.36	1.13	5.37	0	4.71	7.43	2.89	0	0
10	*Biddulphia sinensis*	1.45	0	3.97	1.34	6.43	3.14	5.93	1.78	6.78	2.89
11	*Biddulphia mobiliensis*	3.57	1.53	3.53	0	1.34	2.75	0	0	2.63	1.53
12	*Chaetocerus lorenzienus*	1.59	2.38	2.39	0	6.35	2.87	2.19	1.44	5.26	0
13	*Chaetocerus diversus*	8.15	7.89	4.38	8.72	6.93	7.34	12.65	9.43	0	1.78
14	*Coscinodiscus eccentricus*	10.37	9.63	9.47	7.37	8.65	4.76	6.89	12.94	11.87	9.43
15	*Coscinodiscus marginatus*	6.54	8.36	8.48	11.29	6.47	8.98	2.47	8.27	6.87	8.27
16	*Coscinodiscus radiatus*	12.16	8.34	7.39	8.28	4.78	11.27	4.78	8.14	9.46	8.14
17	*Coscinodiscus gigus*	4.67	6.45	9.35	14.28	0.51	12.98	2.88	4.92	7.87	12.94
18	*Gyrosigma sp.*	1.48	2.43	0	1.46	0.78	3.44	2.46	2.46	1.44	0
19	*Planktoniella sol*	3.29	7.45	8.96	4.48	2.88	2.56	3.98	3.85	5.78	4.92
20	*Pleurosigma sp.*	2.46	3.29	5.24	1.56	0.98	1.33	1.66	1.24	2.49	1.53
21	*Rhizosolenia sp.*	1.35	5.35	2.87	0	3.98	2.37	0	0	3.87	3.85
22	*Rhizosolenia alata*	2.14	1.38	1.81	2.65	2.46	2.49	2.78	5.67	4.43	2.46
23	*Triceratium reticulatum*	1.34	2.17	0	2.36	0	2.67	1.22	1.43	0	0
24	*Amphiprora gigantean*	2.49	0	2.53	2.18	4.67	0	0	3.34	6.67	5.67
25	*Climacosphenia elongate*	0	0	1.54	1.38	2.19	0	1.65	2.89	0	1.44
26	*Thalassiothrix frauenfeldii*	2.19	2.59	2.49	3.87	0	2.35	1.78	2.08	2.45	1.56

S. No	Groups	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 7	MS 8	MS 9	MS 10
IV	**Dinophyceae**										
27	*Ceratium corridum*	**2.15**	**1.57**	**1.34**	**3.15**	**3.5**	**1.45**	**4**	**3.54**	**1.5**	**3.75**
28	*Ceratium macroceros*	**3.24**	**2.6**	**1.56**	**3**	**0**	**2.2**	**2.34**	**4.62**	**1.43**	**4.24**
29	*Ceratium trichoceros*	**0**	**1.54**	**1.22**	**1.8**	**4.41**	**2.89**	**0**	**2.5**	**0**	**0.53**
30	*Ceratium tripos*	**2.19**	**1.68**	**0**	**0.35**	**4.37**	**2.57**	**2.35**	**1.44**	**2.74**	**3.43**
31	*Ceratium furca*	**3.19**	**1.36**	**1.24**	**1**	**3.28**	**2.53**	**0**	**0**	**2.12**	**2.84**
32	*Peridinium oceanicum*	**2.37**	**2.44**	**2.18**	**0**	**1.35**	**1.6**	**2.35**	**1.43**	**1.71**	**2.37**
33	*Protoperidinium sp.*	**1.3**	**1**	**1.45**	**2.89**	**3.02**	**2.53**	**2.14**	**0**	**1.55**	**2.55**
34	*Noctiluca miliaris*	**2.38**	**4.3**	**1.83**	**1.46**	**1.25**	**0**	**2.83**	**2.53**	**0**	**2**
35	*Dinophysis caudata*	**1.03**	**0**	**2.61**	**0**	**0**	**1.44**	**1.76**	**1.6**	**2.35**	**0**

Figure 3-8 Phytoplankton Images recorded during observation



Dinophysis caudata | *Bellerochea malleus* | *Biddulphia mobiliensis*

Cerataulina sp | *Ceratium furca* | *Ceratium horridum*

Ceratium macroceros | *Ceratium* sp | *Ceratium tripos*

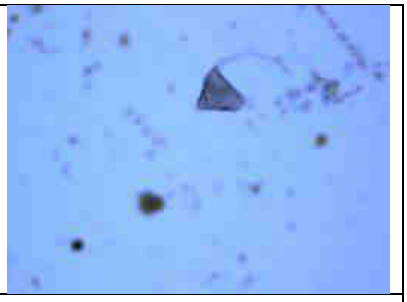
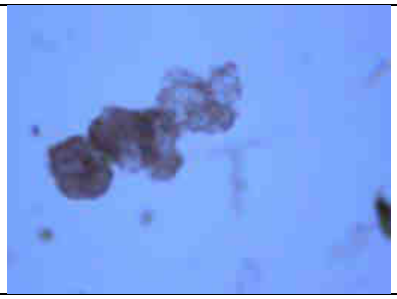
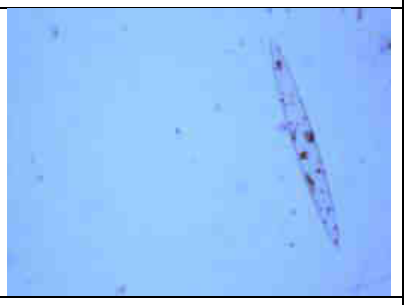
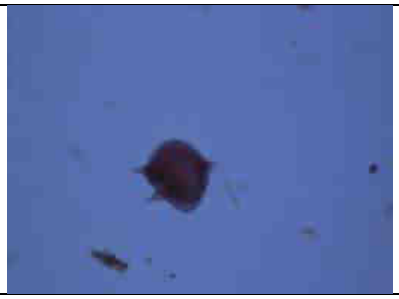
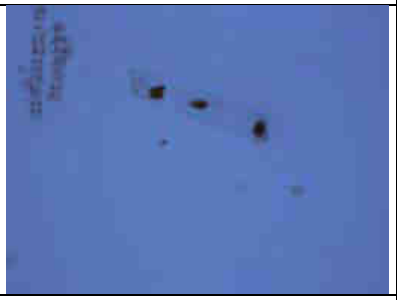
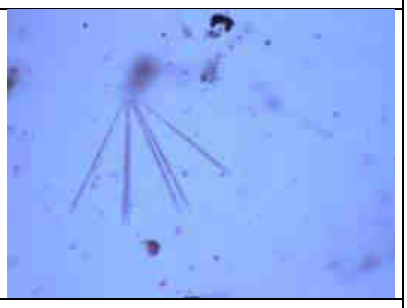
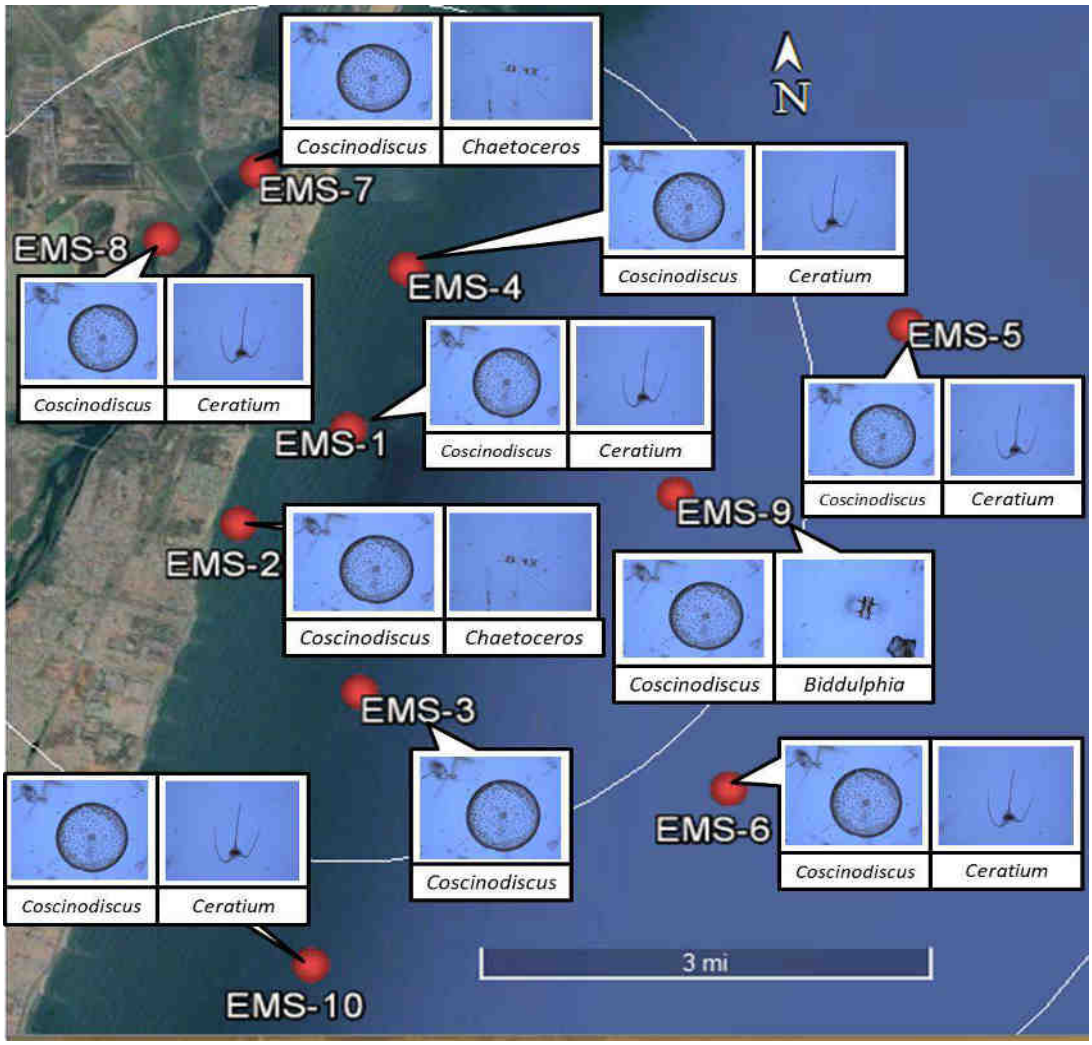
		
Chaetoceros sp	*Coscinodiscus* sp	*Triceratium reticulatum*
		
Gyrosigma sp	*Microcystis* sp.	*Navicula* sp
		
Pleurosigma sp	*Protoperidinium depressum*	*Rhizosolenia alata*
		
Rhizosolenia crassa	Rhizosolenia sp	*Thalassiothrix fraunfeldii*

Figure 3-9 Phytoplankton recorded during monitoring



3.8.3 Phytopigments

Phytoplankton biomass was estimated in terms of concentration of phytopigments. During May 2019 the levels of chlorophyll ***a***ranged from 1.51-2.73 mg/m^3; with an average of 2.46 mg/m^3 and phaeophytin ranged from 1.11-2.43 mg/m^3 with an average of 1.67 mg/m^3 varied in wide range in the coastal waters of Ennore. This homogenous nature of the water mass perhaps provided stability for the biological processes **(Table 3-12).**

Table 3-12Concentrations of Chlorophyll a and Phaeophytin in Ennore

Station No.	Chlorophyll a (mg/m^3)	Phaeophytin(mg/m^3)
MS 1	3.12	1.95
MS 2	2.97	2.43
MS 3	3.11	1.95

Station No.	Chlorophyll a (mg/m^3)	Phaeophytin(mg/m^3)
MS 4	2.56	2.12
MS 5	1.51	1.12
MS 6	1.76	1.23
MS 7	2.57	1.63
MS 8	2.75	1.57
MS 9	2.33	1.11
MS 10	1.89	1.56
Avg.	**2.46**	**1.67**

Zooplankton

Altogether zooplankton represented by 12 different faunal groups from the study area. Maximum groups were observed at station 5, 8 and 10 (11 groups) while minimum groups were observed in all the other Stations 2 and 6 (9 groups). The occurrence and percentage of zooplankton species in the study area is given in **Table 3-13** and **Table 3-14** respectively.

Composition

During present study zooplankton community in all the stations were mainly dominated by Copepods (average percentage composition 57.48), Polychaeta (avg. % composition 6.34), Amphipoda (avg. % composition 5.33), Crustacean, (avg. % composition 5.12), Tintinnids (avg. % composition 4.81), Bivalves (avg. % composition 4.13), Foraminifera (avg. % composition 3.86), Fish eggs (avg. % composition 3.15), Gastropoda (avg. % composition 2.7), Chaetognatha (avg. % composition 2.55), Fish larvae (avg. % composition 2.55), and Cladocera (avg. % composition 1.98) were commonly found.Zooplankton images recorded during observation are presented in **Figure 3-10**, and their dominance in each of the locations are presented in **Figure 3-11.**

Hierarchy as follows;

Copepoda > Polychaeta > Amphipoda > Crustacea > Tintinnida > Bivalvia > Foraminifera > Fish eggs > Gastropoda > Chaetognatha > Fish Larvae > Cladocera

Abundance and richness

It was evident that there was not much variation in spatial distribution (abundance as well as richness) of zooplanktons over entire study area. Maximum zooplanktons were observed at Station 3 (623X 102/ m3) while that of minimum were observed at Station 6 (302 X 102/ m3) (**Table 3-13**)

Table 3-13 Occurrence of Zooplankton species in the study area

S. No	Groups	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	M S 7	M S 8	MS 9	MS 10
1	Foraminifer	+	+	+	+	+	+	+	+	+	+
2	Tintinnida	+	+	+	+	+	+	+	+	+	+
3	Copepoda	+	+	+	+	+	+	+	+	+	+
4	Crustacea	+	+	+	-	+	+	+	+	+	+
5	Polychaeta	+	+	-	+	+	+	+	+	+	+
6	Cladocera	-	-	-	+	-	-	+	+	+	+
7	Amphipoda	+	+	+	+	+	+	+	+	+	+
8	Gastropoda	+	+	+	+	+	+	+	+	+	+
9	Bivalvia	+	+	+	-	+	+	+	+	+	+
10	Chaetognath	-	-	+	+	+	+	-	+	+	+
11	Fish eggs	+	+	+	+	+	+	-	+	-	-
12	Fish Larvae	+	-	+	+	+	-	+	-	-	+

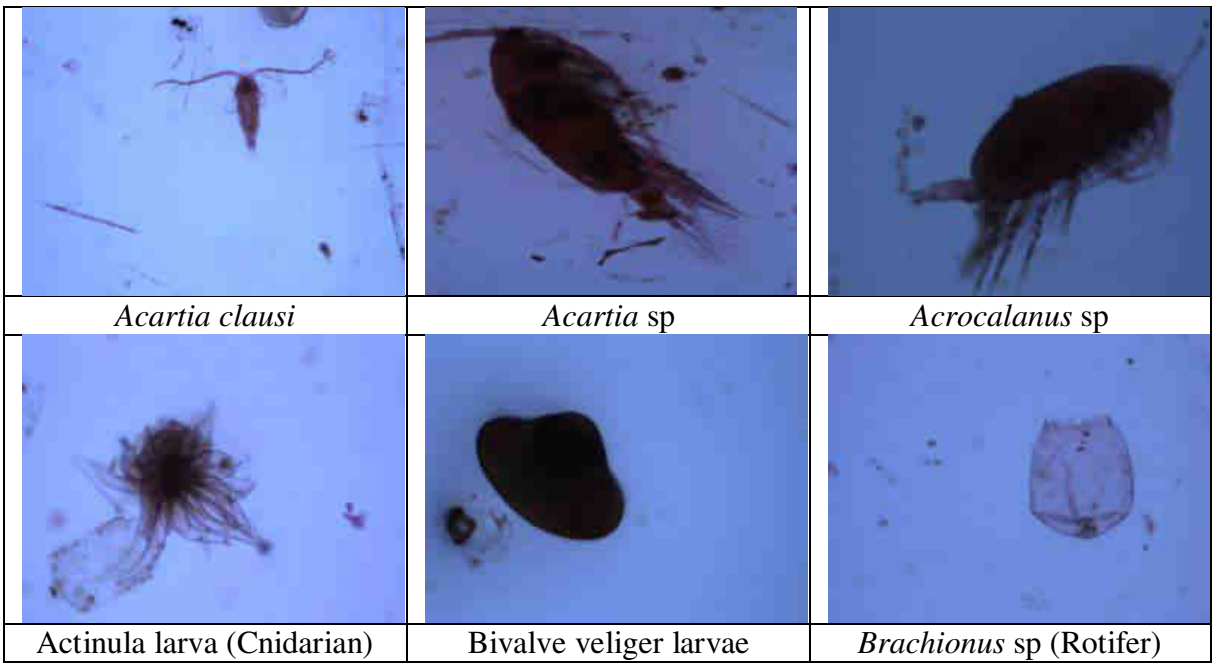
Table 3-14 Percentage compositions of Zooplankton species in the study area

S. No	Groups	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 7	MS 8	MS 9	MS 10
1	Foraminifer a	3.1	3.7	5.2	6	4.4	0	4.6	5.9	3.2	2.6
2	Tintinnida	2.7	8.5	9.3	2.2	2.2	4.8	8.1	4.3	2.3	3.8
3	Copepoda	56.6	49.8	53.9	58.2	48.6	54.3	61. 4	59. 4	63.8	68.8
4	Crustacea	1.3	17.3	2.3	0	7.3	6.8	1.5	3	6.4	5.4
5	Polychaeta	6.1	9	0	1.1	8.4	9.8	7.8	8.2	10.2	2.9
6	Cladocera	0	0	0	3	0	0	5.8	7.4	1.4	2.3
7	Amphipoda	11.2	3.8	5.1	8.5	7.3	5	1.7	4.3	3.9	2.4
8	Gastropoda	2.3	2.3	1.8	3.9	3	3.4	3.2	1.4	2.3	3.3
9	Bivalvia	4.8	1.8	4.1	0	9.8	7.8	3.3	2.2	3.5	4
10	Chaetognath a	0	0	6.1	4.8	3.1	4.9	0	1.3	2.9	2.4
11	Fish eggs	8.8	3.9	4.2	6.4	2.5	3.2	0	2.7	0	0
12	Fish Larvae	3.1	0	8.1	6	3.4	0	2.7	0	0	2.2

Table 3-15Abundance and group richness of Zooplankton

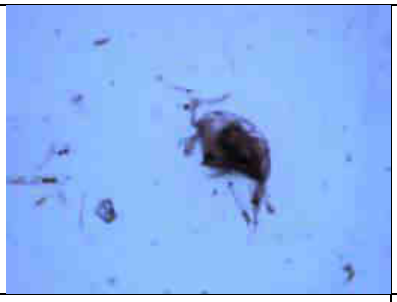
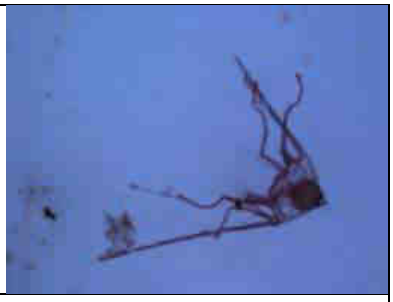
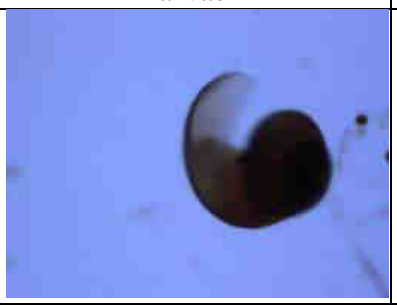
Station	Cell count Nos.x$10^2/m^3$	Total Groups	Dominant Groups
S 1	423	10	Copepod, Amphipoda
S 2	366	9	Copepod, Crustacea
S 3	623	10	Copepod, Tintinnids
S 4	397	10	Copepod, Amphipoda
S 5	364	11	Copepod, Bivalvia
S 6	302	9	Copepod, Polychaetes
S 7	518	10	Copepod, Tintinnids
S 8	378	11	Copepod, Polychaetes
S 9	375	10	Copepod, Polychaetes
S 10	562	11	Copepod, Crustacea

Figure 3-10Zooplankton Images recorded during observation



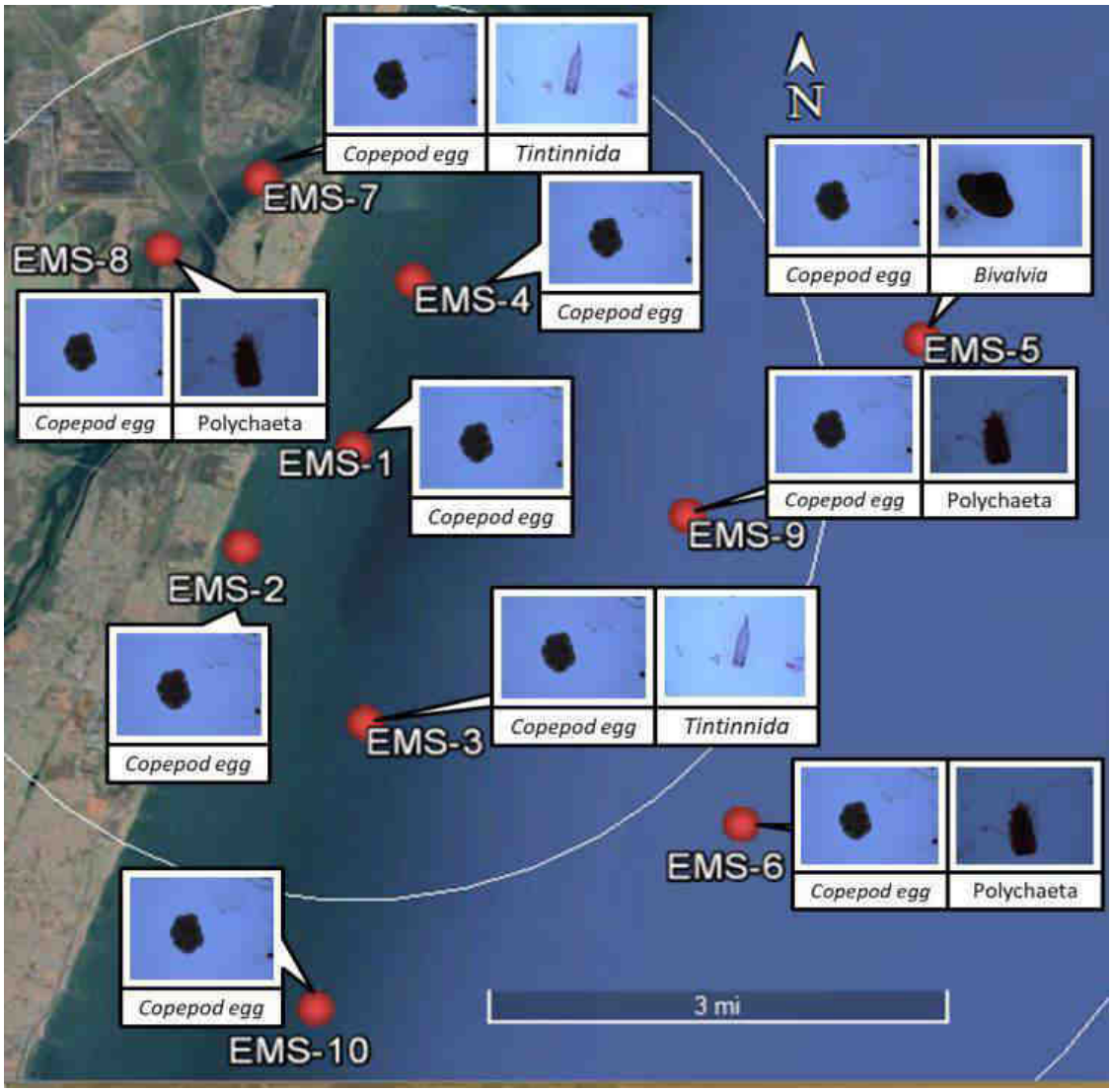
Acartia clausi | *Acartia* sp | *Acrocalanus* sp

Actinula larva (Cnidarian) | Bivalve veliger larvae | *Brachionus* sp (Rotifer)

		
Copepod egg	*Coreciousa typicus*	Echinopluteus larvae (of sea urchin and sand dollar)
		
Trochophore polychaete larvae	*Euterpina acutifrons*	*Evadne* sp.
		
Gastropod veliger larvae	*Microsetella* sp	Nauplius larvae
		
Nauplius larvae-Copepod	Oikopleura larvae	*Oithona nana*
		
Oithona sp	*Penilia* sp (Cladocera)	Polychaete larvae

		
Sagitta sp	Zoea larva	*Tintinnopsis corniger*

Figure 3-11Zooplankton recorded during Monitoring



Benthos

Depending upon their size, benthic animals are divided into three categories, microfauna, meiofauna and macrofauna. Benthic community responses to environmental perturbations are

useful in assessing the impact of anthropogenic perturbations on environmental quality. Macrobenthic organisms which are considered for the present study are animal species with body size larger than 0.5 mm. The macrofauna was constituted mainly by Foraminiferans, nematodes, bivalves, gastropods, Polychaetes and Ostracods

The total number of faunal groups varied from 3 (Station 3) to 4 (Station 5, &6). Overall about 6 groups of intertidal macrobenthos were recorded in the study area during the present investigation. The benthic community indicates variations in the faunal standing stock in the region and no clear trend in the distribution is discernible suggesting patchiness in the distribution of subtidal macrobenthos.

Composition

During present study macro benthos community in all the stations were mainly dominated by Nematodes (avg. % composition 24.17) followed by Foraminiferans (avg. % composition 19.81) Polychaetes (average percentage composition 19.71), Bivalvia (avg. % composition 17.57) Gastropods (avg. % composition 10.97) and Ostracods (avg. % composition 7.77). Distribution of Benthos in the study area is given in

Table 3-16**.**

Hierarchy of the Benthos

Nematodes >Foraminiferans > Polychaetes > Bivalvia > Gastropods > Ostracods

Table 3-16 Distribution of Benthos in the study area

S. No	Group (Nos./m^2)	Stations									
		MS 1	MS 2	MS 3	MS 4	MS 5	MS 6	MS 7	MS 8	MS 9	MS 10
1	Foraminiferans	23	56	34	11	23	23	0	0	11	23
2	Ostracods	0	0	0	23	0	0	34	23	0	0
3	Nematodes	23	34	11	23	0	0	45	67	23	23
4	Polychaetes	34	11	11	0	23	34	0	0	34	56
5	Bivalvia	34	0	23	0	23	11	23	11	45	11
6	Gastropods	11	23	11	11	0	0	34	0	23	0

Figure 3-12Benthos Images recorded during observation

		
Foraminiferan	Nematode	*Bivalve*

3.9 Statistical Analysis

Diversity Index

Following indices were used for estimation of ecological status of this area

1. Shannon's index
2. Margalef's index
3. Simpson's index

The indices were applied to phytoplankton, zooplankton and benthos.

Shannon' Index

Typically the value of the index ranges from 1.5 (low species richness and evenness) to 3.5 (high species evenness and richness), though values beyond these limits may be encountered. Because the Shannon Index gives a measure of both species numbers and the evenness of their abundance, the resulting figure does not give an absolute description of a sites biodiversity. It is particularly useful when comparing similar ecosystems or habitats, as it can highlight one example being richer or more even than another. There is always the need to inspect the data or use another index to unpack the true reasons for the difference.

$$H' = -\sum_{i=1}^{S}(p_i \ln p_i)$$

Where: where S is the total number of species and p_i is the frequency of the *i*th species. Average value of Shannon's index of phytoplankton community in the present study was observed to be 3.103 (**Table 3-17**), while that of zooplankton community is 1.55 (**Table 3-18**).Hence, the phytoplankton and zooplankton diversity of this area is very moderate.

Margalef's Index

It is calculated from the total number of species present and the abundance or total number of individuals.

Margalef Index (D) = S – 1/ log e N

Where: S – total number of species

N – total number of individuals

The higher the index the greater is the diversity. Average value of Margalef's index for phytoplankton was observed to be 6.473 while that of zooplankton was 1.997.

Simpson's Index

Simpson's Index measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

Simpson's Index$\lambda = \sum n(n-1)/N(N-1)$

Where: n – total individuals of each species

N – total individuals of all species

With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity. This is neither intuitive nor logical, so to get over this problem, D is often subtracted from 1 to give:

Simpson's Index of Diversity $1 - \lambda$

The value of this index also ranges between 0 and 1, but now, the greater the value, the greater the sample diversity. This makes more sense. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species. Simpson index values of phytoplankton and zooplankton are very close to 1 (0.943 and 0.639 respectively) phytoplankton indicating high diversity whereas zooplankton shows moderate diversity.

Table 3-17 Diversity Indices for Phytoplankton community

Sample	Taxa_S	Simpson_1-D	Shannon_H	Evenness_ e^H/S	Margalef
MS 1	32	0.947	3.208	0.773	6.906
MS 2	29	0.947	3.122	0.783	6.27
MS 3	30	0.946	3.147	0.776	6.528
MS 4	29	0.933	2.995	0.689	6.27
MS 5	28	0.943	3.052	0.756	6.061
MS 6	32	0.941	3.122	0.709	6.996
MS 7	30	0.949	3.191	0.811	6.528
MS 8	29	0.942	3.089	0.757	6.319
MS 9	29	0.941	3.052	0.73	6.303

Sample	Taxa_S	Simpson_1-D	Shannon_H	Evenness_ e^H/S	Margalef
MS 10	30	0.94	3.049	0.703	6.545
Avg.	**29.8**	**0.943**	**3.103**	**0.749**	**6.473**

Table 3-18 Diversity Indices for Zooplankton community

Sample	Taxa_S	Simpson_1-D	Shannon_H	Evenness_ e^H/S	Margalef
MS 1	10	0.650	1.554	0.473	1.972
MS 2	9	0.701	1.606	0.554	1.757
MS 3	10	0.681	1.655	0.523	1.967
MS 4	10	0.637	1.545	0.469	1.976
MS 5	11	0.731	1.811	0.556	2.191
MS 6	9	0.675	1.609	0.555	1.761
MS 7	10	0.602	1.461	0.431	1.976
MS 8	11	0.626	1.546	0.427	2.191
MS 9	10	0.573	1.388	0.401	1.976
MS 10	11	0.517	1.327	0.343	2.201
Avg.	**10.1**	**0.639**	**1.55**	**0.473**	**1.997**

Intertidal Zone

The intertidal zone close to shore is characterized by sandy beaches, creeks and mudflats. Occurrence of mangrove species was observed along the side of Korattaliyar River mouth fish landing jetty and near over-bridge area, 2 species of mangroves were observed viz. *Avicennia marina* are dense and *Rhizophora mucaranata*.The density and diversity of the mangroves is distinctly lower in the smaller creeks. Along the smallest creeks true mangroves are present; adjoining areas instead coastal runner *Ipomea pes-caprae* and associates *Sesuvium portulacastrum* and non-mangrove halophytes are present.

Figure 3-13 Diversity in Intertidal zones

	
Avicennaia marina	*Rhizophora mucoranata*
	
Mangrove associates *Sesuvium partulacastrum*	Coastal runner *Ipomea pes-caprae*

Diversity of crabs in Ennore Coast

Crabs are one of the important faunal communities serving as very good food source to human beings in the marine and brackish water ecosystems. They are predacious carnivores and scavengers and playing an important role in detritus formation, recycling of nutrients and overall dynamics of ecosystems. An attempt has been made to list the brachyuran crabs along the Ennore Coast and nearby creeks of the study area. The study area, mainly the coastal, mud flats and the mangroves was surveyed at random for crab observation. Two type of crabs fiddler and the sand crab, *Ocypode platytarsis* given in the **Figure 3-14.**

Figure 3-14 Identification of crabs

Fiddler crab

Ocypode platytarsis

Diversity of Molluscan Fauna along Ennore Coast

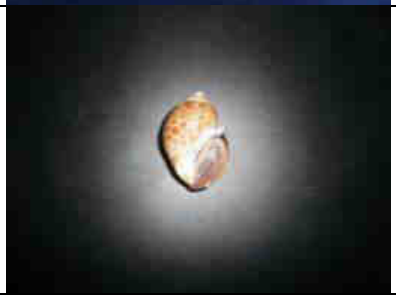
The largest and most diverse Phylum in the tropical seas is Molluscs. The molluscs are soft - bodied, heterogenous group of animals with great antiquity and diversity. The majority of molluscs inhabit marine biotopes and they occur from the backwater zone, mangroves, intertidal, shelf and down to deeper waters. The ecological assessment revealed a total of 10 species of molluscs were collected and identified during the coastal micro-level walk through along the Ennore Coast carried out on 14th May 2019 and the observation location and its coordinates are given in the**Table 3-19.** The coastal survey points are given in**Figure 3-15.** Diversity of Molluscs along the Ennore coast is illustrated in**Figure 3-17.**

Table 3-19 Coastal Observation Coordinates

Observation Location	Latitude	Longitude
CW 1	13° 8'27.93"N	80°17'58.46"E
CW 2	13° 9'0.57"N	80°18'12.94"E
CW 3	13° 9'16.85"N	80°18'20.05"E
CW 4	13°10'24.05"N	80°18'46.09"E
CW 5	13°10'54.83"N	80°18'58.09"E
CW 6	13°13'25.59"N	80°19'43.68"E
CW 7	13°13'37.00"N	80°19'47.72"E
CW 8	13°13'57.39"N	80°19'4.71"E

Figure 3-15Coastal Walk Survey Points

Figure 3-16 Diversity of Molluscs along the Ennore coast

Species Name	Dorsal	Ventral
Anadara sp		
Babylonia spirata		

Species Name	Dorsal	Ventral
Chicoreus virgineus		
Cypraea cicercula (Pustularia)		
Donax scortum		
Perna viridis		
Rapana rapiformis		

Species Name	Dorsal	Ventral
Tonna dolium		
Turritella sp		
Vasticardium sp		

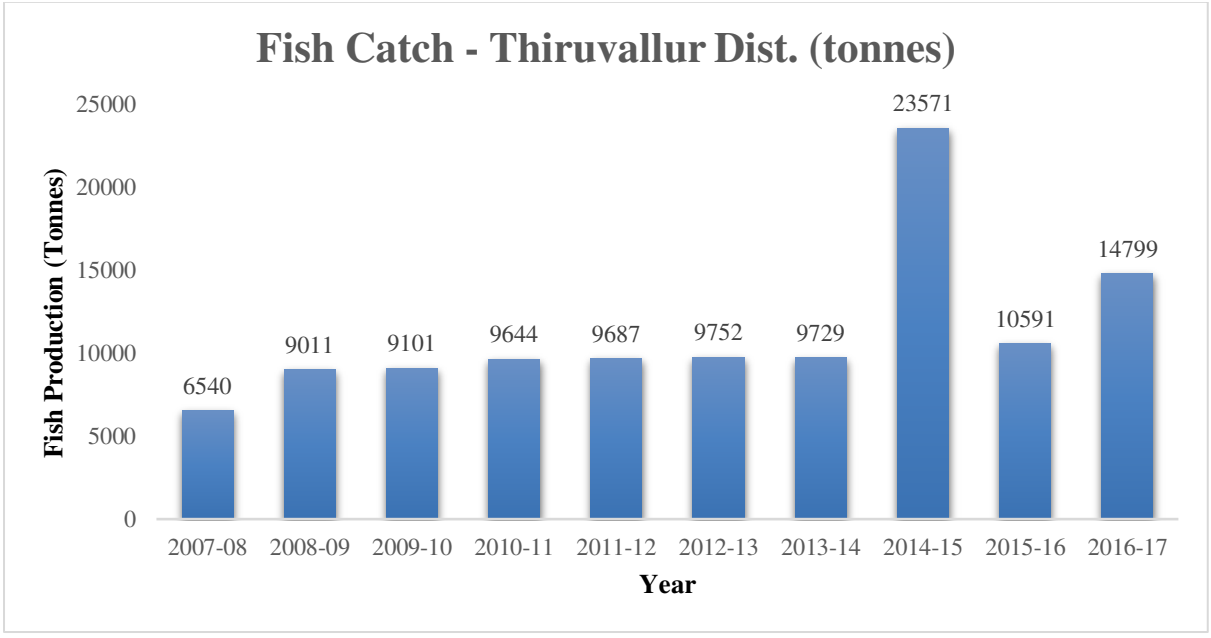
3.10 Fish Potential Catch

Indian National Centre for Ocean Information Services (INCOIS), an autonomous body under the Ministry of Earth Sciences, Govt of India has classified approximately 586 potential fishing zones along the coast of India. As per this map, Ennore falls under the potential fish catch zone. The potential fishing zones as marked by INCOIS has been shown in **Figure 3-17.**

Yearwise Fish catch data of Thiruvallur District is presented in **Figure 3-18.**

Figure 3-17 Map showing the Fish Potential Zones of India

Figure 3-18 Yearwise Fish catch data of Thiruvallur District



Source: *Commissioner of Marine Fisheries, Chennai; *Assistant Director of Fisheries, Ponneri*

3.10.1 Common fish Species

The dominant fish groups found in the Ennore coastal waters are Seerfish (*Scomberomorus guttatus*), Little tuna (*Euthynnus affinis*), Ribbonfish (*Trichiurus lepturus*), Sardines (*Sardinella gibbosa*, S.longiceps), Russel's Scad (*Decapterus russelli*) and Indian mackerel

(Rastrelliger kanagurta)[7]. The list of fishes found in ennore coastal waters are represented in the **Table 3-20.**

Table 3-20 List of Marine Fisheries Species Reported in the Ennore Coast

S.No	Common Name	Scientific Name	Reference*
1	Areolated cod	Epinephelus areolatus	4
2	Arius	Tachysurus dussumieri	3
3	Asian green mussel	Perna viridis	2
4	Barracuda	Sphyraena jello	4
5	Black banded trevally	Seriolina nigrofasciata	4
6	Blackfinned triplespine	Triacanthus brevirost	3
7	Butterfish	Tachysurus jella	3
8	Cichild	Mozambique tilapia	3
9	Common mussel	Mytilus gravincia	1
10	Dusky-finned bulleye	Priacanthus hamrur	2
11	Flat head fish	Platycephalus biomacula	3
12	Flat head mullet	Mugil cephalus	2
13	Flower crab	Portunus pelagicus	1
14	Flower prawn	Penaeus semisulcatus	4
15	Fouling oyster	Crossosstrea madrasensis	5
16	Giant tiger prawn	Penaeus monodon	1
17	Grey mullet	Mugil cephalus	1
18	Guitar fish	Rhincobatus djeddensis	4
19	Hammer head shark	Sphyrna zygaena	4
20	Indian goat fish	Parupeneus indicus	4
21	Indian Squid	Loligo duvaucelii	4
22	Indian white prawn	Penaeus indicus	1
23	Javanese cow ray	Rhinoptera Javanica	4
24	Jelly fish	Rhopilema spp.	4
25	Large-headed ribbon fish	Trichiurus lepturus	4
26	Leatherskin	Scomberoides lysan	4
27	Long spine sea-bream	Argyrops spinifer	4
28	Longarm mullet	Liza cunnesius	3
29	Manalai Liza	Macrolepis	3
30	Marine shrimp	Parapenaeopsis stylifera	4
31	Mozambique tilapia	Oreochromis mossambica	1
32	Mud crab	Scylla serrata	3

[7]Nammalwar et al (2012)- "*Applications of Remote Sensing in the validations of Potential Fishing Zones (PFZ) along the coast of North Tamil Nadu, India*"- Indian Journal of Geo-Marine Sciences, Vol.42(3), June 2013,pp.283-292

S.No	Common Name	Scientific Name	Reference*
33	Oyster	Crassostrea madrasens	2
34	Pearspot cichild	Etrophus suratensis	3
35	Ponyfish	Leiogtiathus fasciatus	3
36	Pufferfish	Tetrodon immacutus	3
37	Ray-finned fish	Anguilla bicolar	3
38	Red Snapper	Lutjanus spp.	3
39	Ribbon fish	Lepturacanthus savala	4
40	Scad	Alepes mate	4
41	Sea Crab	Charybdis cruciata	2
42	Sea cucumber	Holothuria atra	4
43	Serrated flat head fish	Platycephalus serratus	3
44	Silver sillago	Silago sharma	4
45	Snout	Rhynchorhamphus marginatus	3
46	Sole	Cynoglossus macrolepidotus	4
47	Spade fish	Ephippus orbis	4
48	Tade mellet	Liza tade	2
49	Target fish	Terapon jarbua	2
50	Thread-fin bream	Nemipterus japonicus	4
51	Tiger prawn	Penaeus monodon	1
52	Walking catfish	Clarias batrachus	1

Source: Reference in Footnote[8]

[8] 1. Chitrarasu et al., 2013, "*Study on the Bioaccumulation of Heavy Metals in Commercially Valuable and Edible Marine Species of Ennore Creek, South India"*. Int J Pharm Bio Sci . 4(2): 1063 – 1069.
2.Jaikumar et al., 2013, "*Heavy Metal Concentration of Sea Water and Marine Organisms in Ennore Creek, Southeast Coast of India"*. The Journal of Toxicology and Health.103 (192-201).
3. James et al., 1986, "*Water Pollution and Fish Mortality in Ennore Estuary, Madras .Marine Fisheries Information Service*". Central Marine Fisheries Research Institute. Cochin. India
4. Nirmala et al., 1988, Marine fishes of India. Myleripalayam Piriv.,
5.*"Waste Assimilative Capacity Studies of Ennore Creek, 2004"*, Integrated Coastal and Marine Area Management Programme. Department of Ocean Technology. National Institute of Ocean Technology. Chennai.

4 POTENTIAL ENVIRONMENTAL IMPACT

4.1 Impacts of marine water and sediment Quality

4.1.1 Temperature and Salinity Outfall Dispersion Modelling

In order to study the impact of the thermal outfall on the marine environment, advection dispersion modelling study has been carried out using scientific tools (DELFT -3d) for the proposed 1 X 660 MW ETPS expansion project. Marine outfall dispersion modelling study was carried out for a capacity of 2x660MW (ETPS expansion unit and replacement unit) for studying the dispersion pattern of temperature and salinity at the existing outfall location.

The objectives of the hydrodynamic and advection dispersion study are

- To establish numerical models to study the hydrodynamics and dispersion for the proposed ETPS expansion of 1x660MW.
- To assess the impact of temperature and salinity on the marine environment due to increase in outfall discharge.

A three dimensional coupled hydrodynamic and dispersion modelling study was carried out to determine the circulation pattern in the sea which considers the current pattern and surface elevation of the study area. The modelling was carried out for 2x660MW unit with the combined sea water intake flow of 24000 m^3/hr and combined outfall discharge flow of 16000 m^3/hr. The details of the intake and outfall points are given in**Table 4-1.**

Table 4-1 Details of the Marine Intake and Outfall

Location	Marine Co-Ordinate	Temperature (°C)	Salinity (ppt)	Depth (m)	Volumetric Flow Rate (m^3/hr)		
					1x660 MW ETPS Replacement	1x660 MW ETPS Expansion	Combined Flow
Sea Water Intake	13°12'7.72"N 80°19'37.96"E	28	33	8.2	12000	12000	24000
Outfall Discharge	13°11'41.53"N 80°19'19.70"E	33	50	5.4	8000	8000	16000

4.1.2 Modelling Methodology

To study the temperature and salinity dispersion pattern of the marine outfall, advection dispersion modelling study was carried out using delft 3d numerical model. The study area of 20km stretch from the outfall discharge point is considered for the modelling (**Figure 4.1**).

The model was validated for the hydrodynamic parameters for a period of 30 days (two tidal cycle). Bathymetry data of the study area is prepared using General Bathymetry Chart of the Oceans (GEBCO) data and Marine wind pattern of the study area is adopted from European Centre for Medium Range Weather Forecasting (ECMWF). The average ambient temperature and salinity of marine sea water in the study area is considered from NODC World Ocean Atlas (2013). Tidal data of the study area is taken from TPXO 6.2 Global Inverse Tide Model.

Figure 4-1 Google Earth Image showing the Intake and Outfall Location

Source: Google Earth

4.1.3 Hydrodynamic and Dispersion Model

The coastal oceans are the most challenging marine environments as the scattering pattern is unsteady and not uniform. They are subjected to changes in bathymetry, irregular coastlines and are forced both internal, lateral and surface by a complex array of tidal, wind and buoyancy forces on a broad range of space/time scales. The resulting coastal circulation patterns include both persistent and time-variable fronts, intense currents with strong spatial dependence, coastal trapped waves, internally generated mesoscale variability, large horizontal water mass contrasts, strong vertical stratification and regions of intense turbulent mixing in both surface and bottom boundary layers. Numerical modelling of the world's

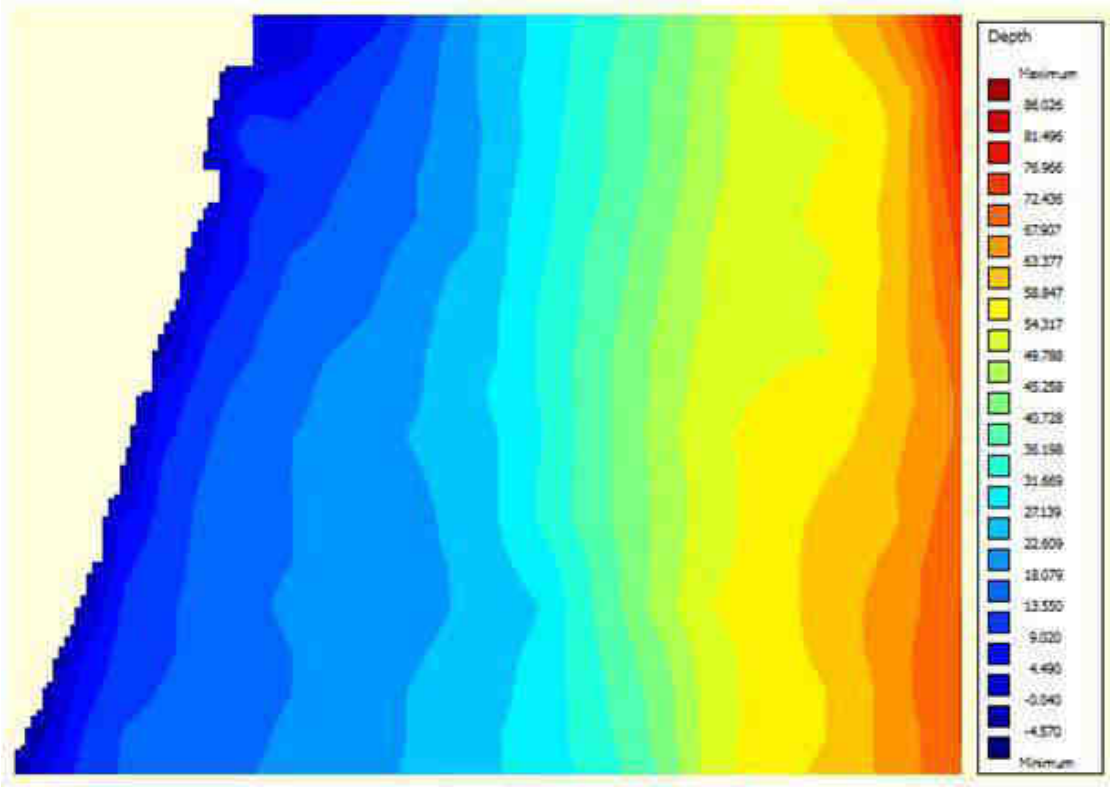
ocean clearly requires very flexible, highly optimized models of significant dynamical complexity. Recently, the models developed for lake and shelf-sea dynamics have become increasingly complex, and are now typically based on the fully non-linear stratified "primitive equations".

The scientific tool used for the current study is Delft-3d. Delft-3D is fully integrated computer software for a multidisciplinary approach and 3D computations for coastal, river and estuarine areas. It helps in understanding the wave-current interaction, hydrostatic flow(2D/3D), salinity, temperature, non cohesive/ cohesive sediment transport, morphology, particle tracking etc,. This model calculates the non-steady flow and transparent phenomena that results from the tidal and meteorological forcing on a rectilinear or a curvilinear boundary fitting grid. This is a sigma-coordinate model that follows the bottom topography. The input conditions include Bathymetry, temperature, Salinity, boundary conditions, initial conditions, forcing, time step, timeframe and numerical settings. The grid resolution is 10 m to 100 km.

4.1.4 Bathymetry

The bathymetry data for the modelling study has been collected from General Bathymetry Chart of the Oceans (GEBCO). The extracted bathymetry data is plotted using Delft-3D and shown in**Figure 4-2**. It has been observed that the model domain has a maximum depth of 60m and the depth near the shore is shallow ranging from 3m to 5m.

Figure 4-2 Bathymetry map of the study area



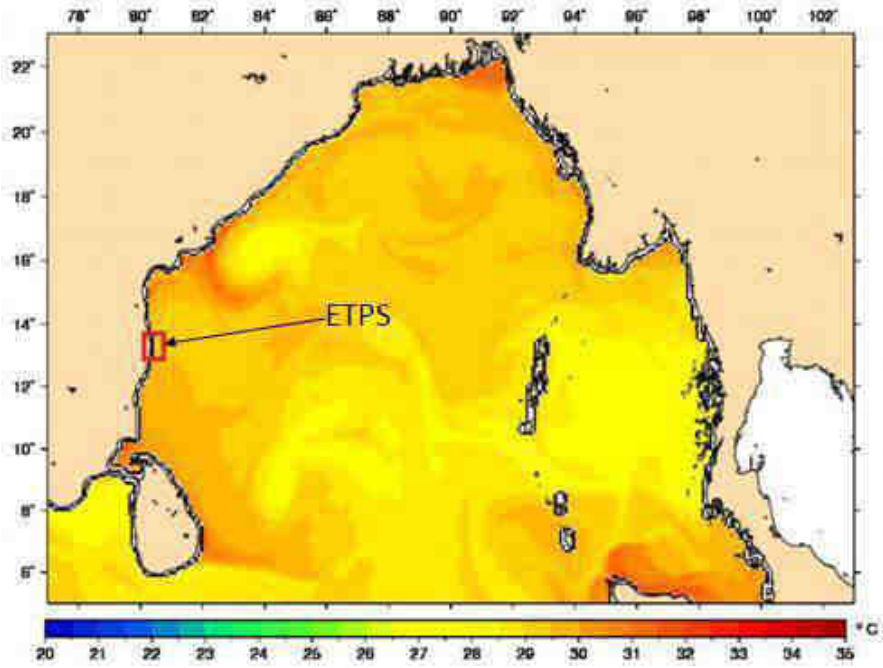
Source: General Bathymetry Chart of the Oceans

4.1.5 Temperature and Salinity

The temperature and Salinity data for the study area has been taken from the objectively analyzed mean of the NODC World Ocean Atlas (2013) with the resolution of 0.25º. Since the model domain has a maximum depth of 60 m and the depth near the outfall location ranges from 5 m to 6m which is shallow, the bottom temperature was found similar to the Surface temperature. With this consideration, it is taken that the study area has an ambient temperature of 28ºC in winter and North-East Monsoon whereas in summer and South-West Monsoon, the temperature is 30ºC. Similarly, the Salinity in winter and North-East Monsoon is 30ppt, whereas in Summer and South-West Monsoon the salinity is 33ppt.

As per the norms stated by CPCB (Central Pollution Control Board) the temperature of the outfall discharge should not be greater than 5ºC above ambient temperature. The salinity of the outfall discharge has been calculated using the mass balance equation considering the combined intake and outfall quantity. It is found to be 18ppt above ambient.

Figure 4-3 Temperature Plot of the study area



4.1.6 Other Physical Parameters

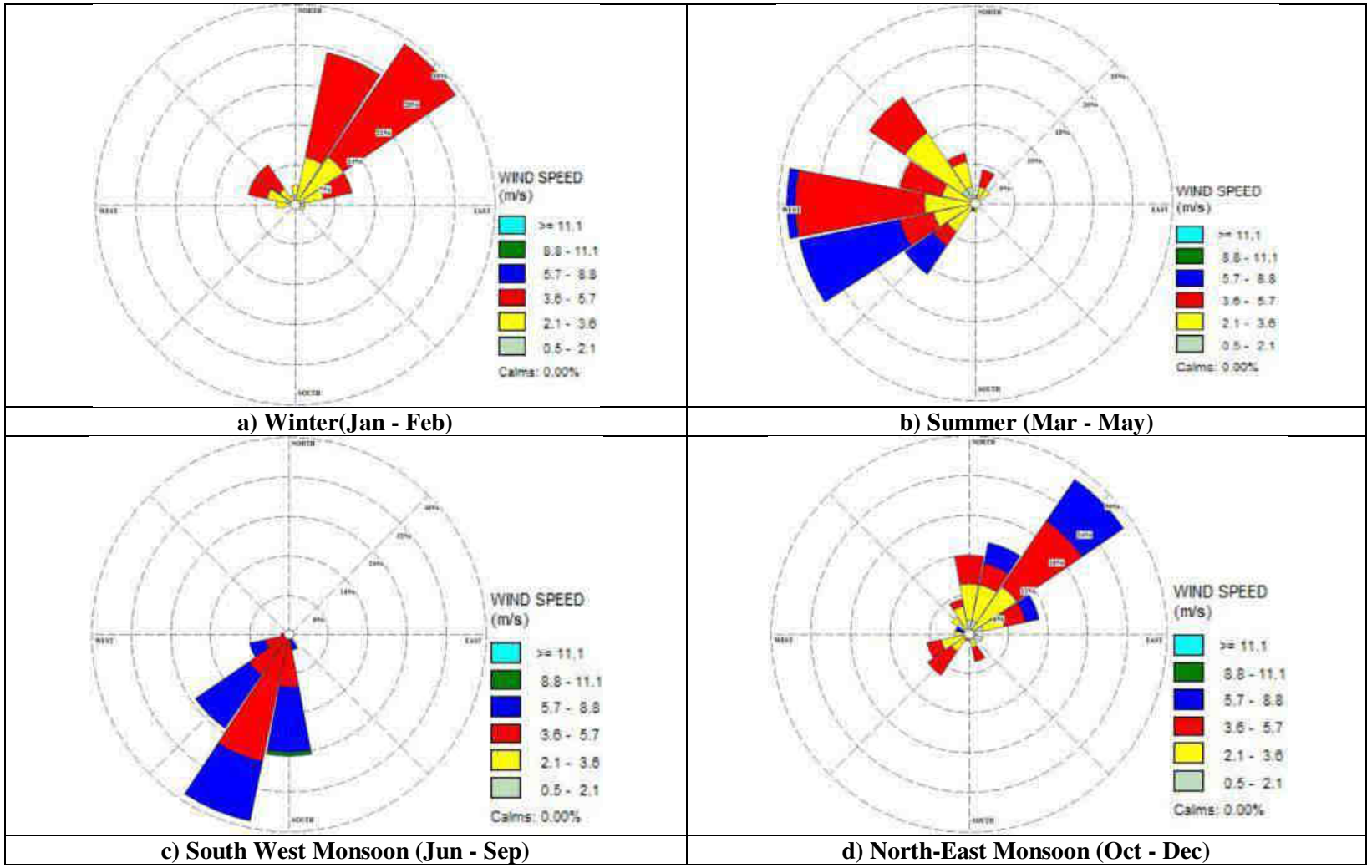
4.1.6.1 Wind

The wind data for the study area has been taken from the European Centre for Medium-Range Weather Forecast (ECMWF). Since the IMD wind data is available only for terrestrial region, the wind data for the coastal region/ocean is taken from ECMWF. The following wind parameter has been considered for Model simulation(**Table 4-2**). **Figure 4-4**and**Figure 4-5**shows the wind rose plot for the study area (ECMWF) and the wind rose plot for the nearby IMD station respectively. It has been observed from the wind rose plot that the wind pattern is almost same for both ECMWF and IMD.

Table 4-2 Wind Pattern in the Study Area

Season	Wind Speed (m/s)		Wind Direction	
	Minimum	Maximum	From	To
Winter	3.6	8.8	North-East	South-West
Summer	3.6	11.1	South-West	North-East
South West Monsoon	5.7	8.8	South-West	North-East
North East Monsoon	2.1	5.7	North-East	South-West

Figure 4-4 Seasonal Wind rose plot for the Study Area (ECMWF)



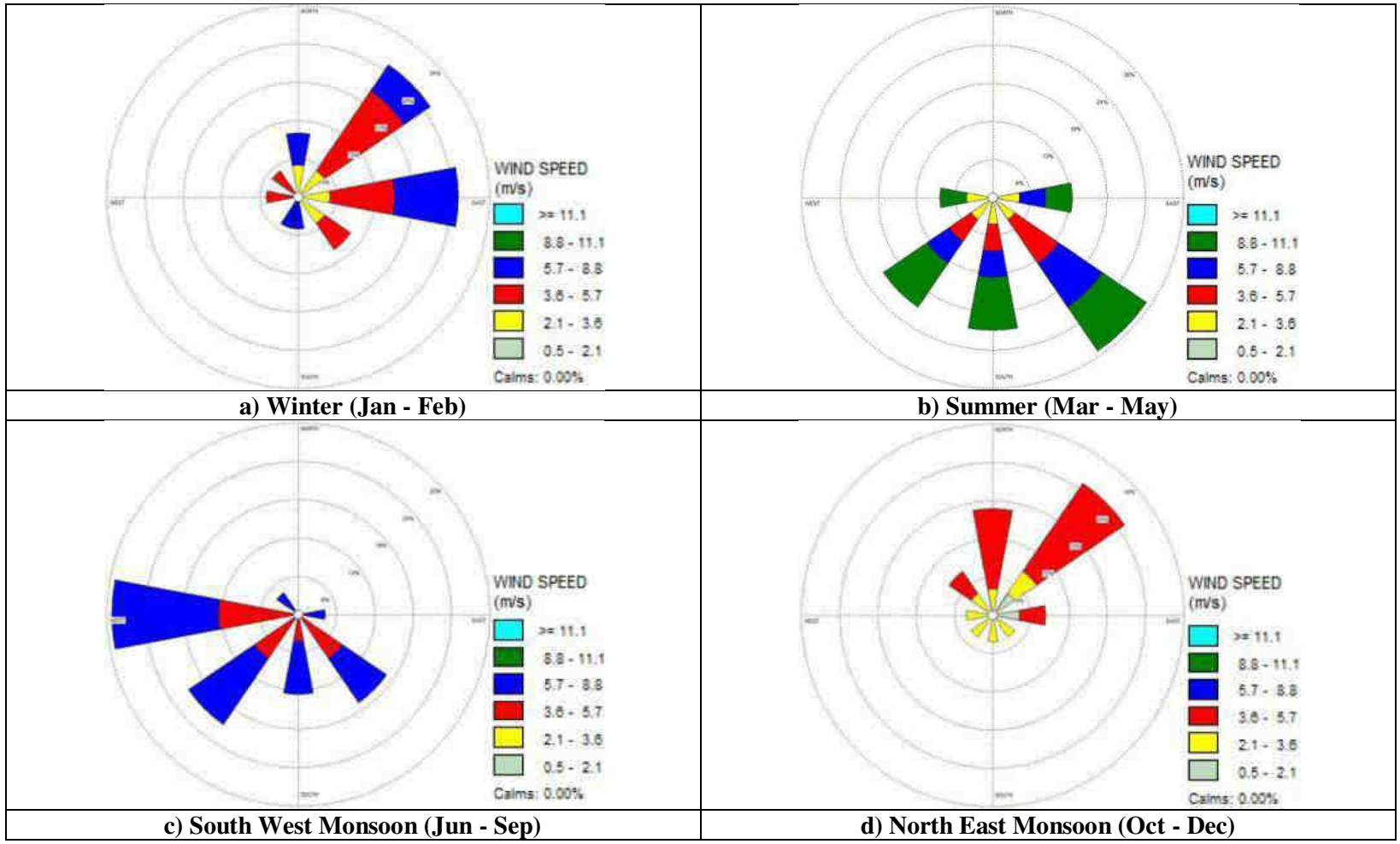
a) Winter(Jan - Feb)

b) Summer (Mar - May)

c) South West Monsoon (Jun - Sep)

d) North-East Monsoon (Oct - Dec)

Figure 4-5 Windrose plot of the nearest IMD Station (IMD-Chennai)[9]



a) Winter (Jan - Feb)

b) Summer (Mar - May)

c) South West Monsoon (Jun - Sep)

d) North East Monsoon (Oct - Dec)

[9] Climatological Normals (1971-2000) issued by Office of the Additional Director General of Meteorology(Research)- Indian Meteorological Department

4.1.6.2 Boundary Condition

Boundary conditions at the surface include specification of fluxes of momentum, heat and salt. At the ocean bottom, a quadratic drag formulation is used for momentum and the normal fluxes of heat and salt are typically set to zero. At closed lateral boundaries, the normal fluxes of heat and salt are also assumed to vanish. The seaward boundary tidal condition is the Astronomic constituents for water level and the lateral boundary tidal condition is the Neumann's time series.

4.1.7 Hydrodynamic Results

4.1.7.1 Ocean Currents

Ocean Current is a continuous, directed movement of seawater generated by forces acting upon this mean flow such as breaking waves, wind, the Coriolis Effect, temperature and salinity differences. Bathymetry, shoreline configurations and interactions with other currents influence a current's direction and strength. Ocean Currents play a major role in determining the climate of the region through which they travel.

The circulation features have been studied along the study area using initial, lateral and surface boundary conditions of the atmosphere and ocean parameters such as wind speed, sea temperature and salinity.

It has been observed that the study area has two major Currents. During winter and North-East monsoon the current flows from north-east to south-west with an average speed of 0.08m/s whereas in summer and south-west monsoon, the current gets reversed and flows from south-west to north-east with an average speed of 0.085m/s. The maximum current speed of 0.1m/s is recorded in summer which flows from South-West to North-East. **Table 4-3**gives the details of the current pattern in the Study area.

Table 4-3 Current Pattern in the Study Area

Season	Current Speed (m/s)		Current Direction	
	Maximum	Minimum	From	To
Winter	0.090	0.075	North-East	South-West
Summer	0.100	0.072	South-West	North-East
South West Monsoon	0.098	0.072	South-West	North-East
North East Monsoon	0.095	0.080	North-East	South-West

Figure 4-6 Area plot of the Seasonal Currents

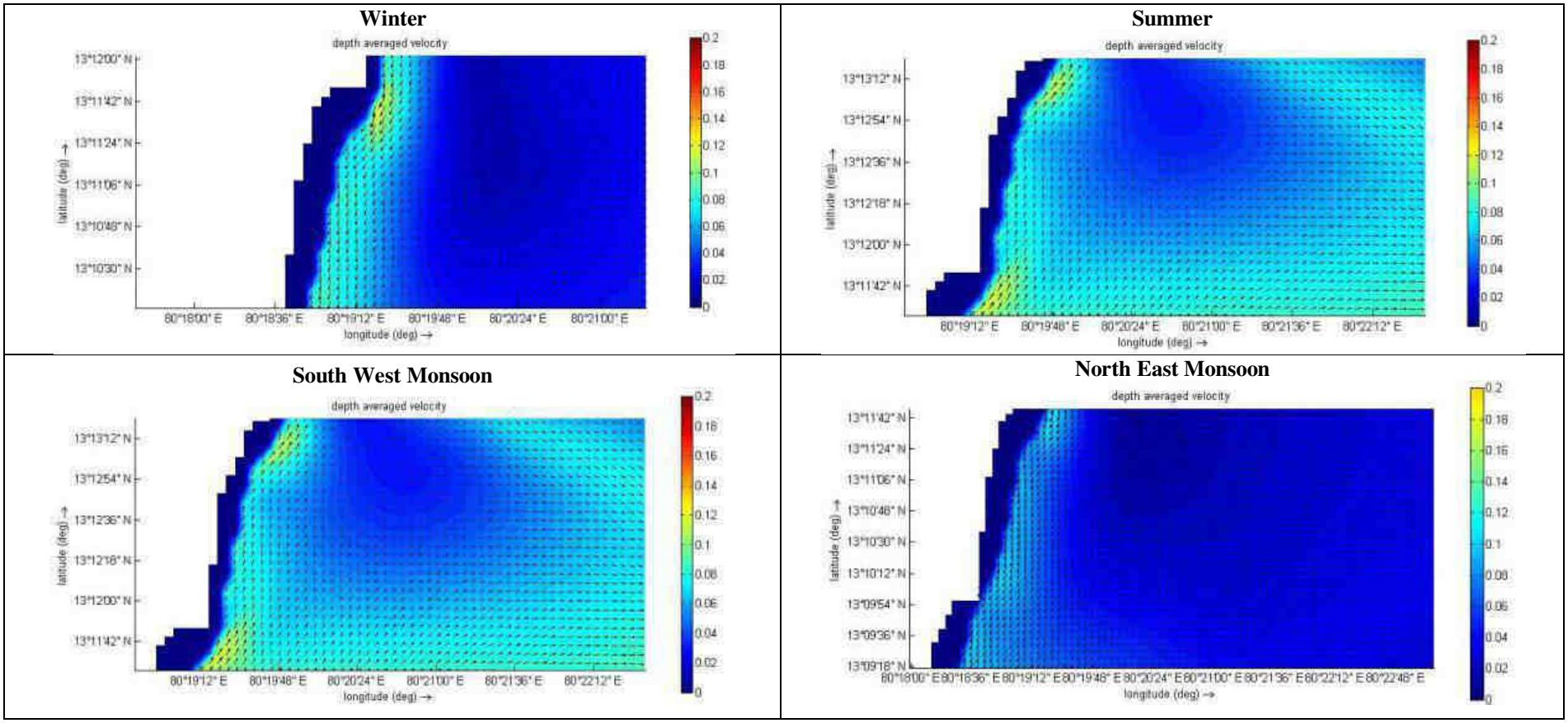
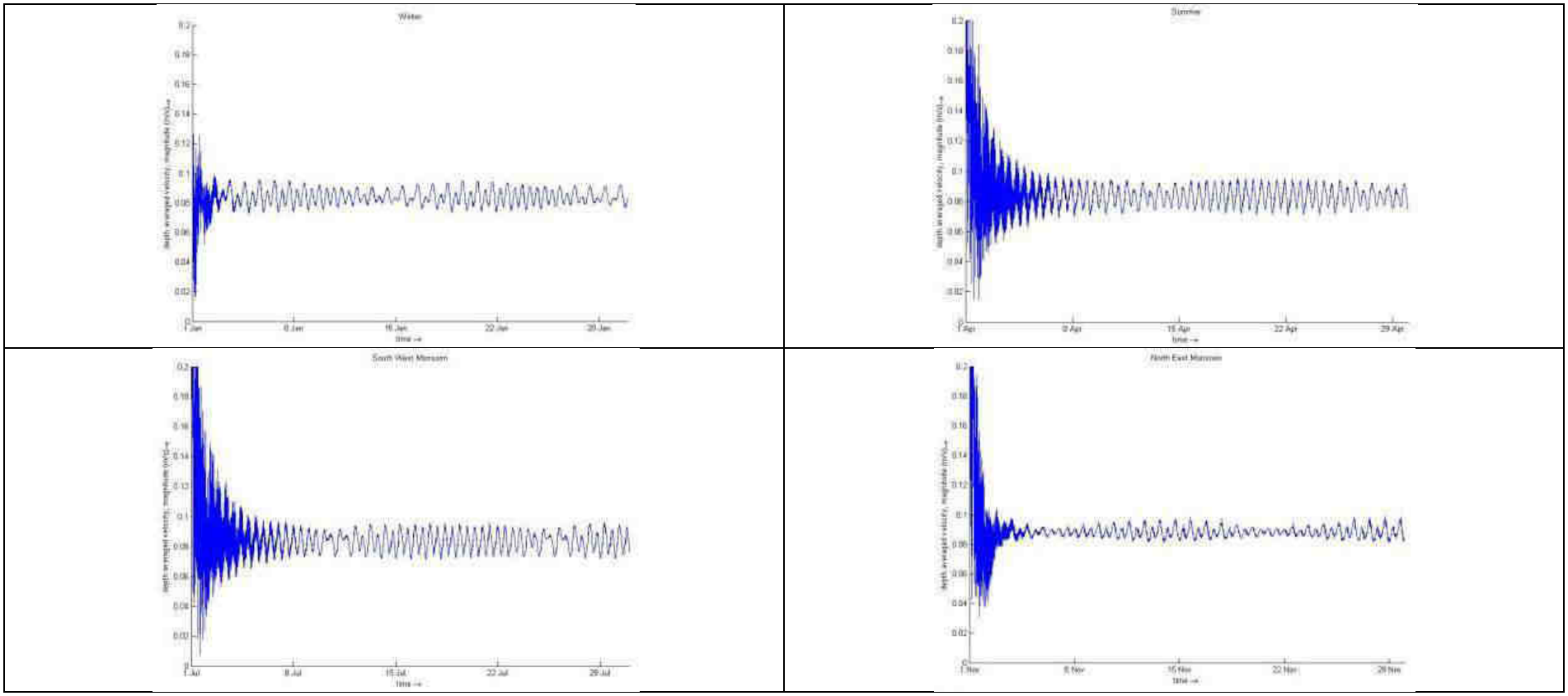


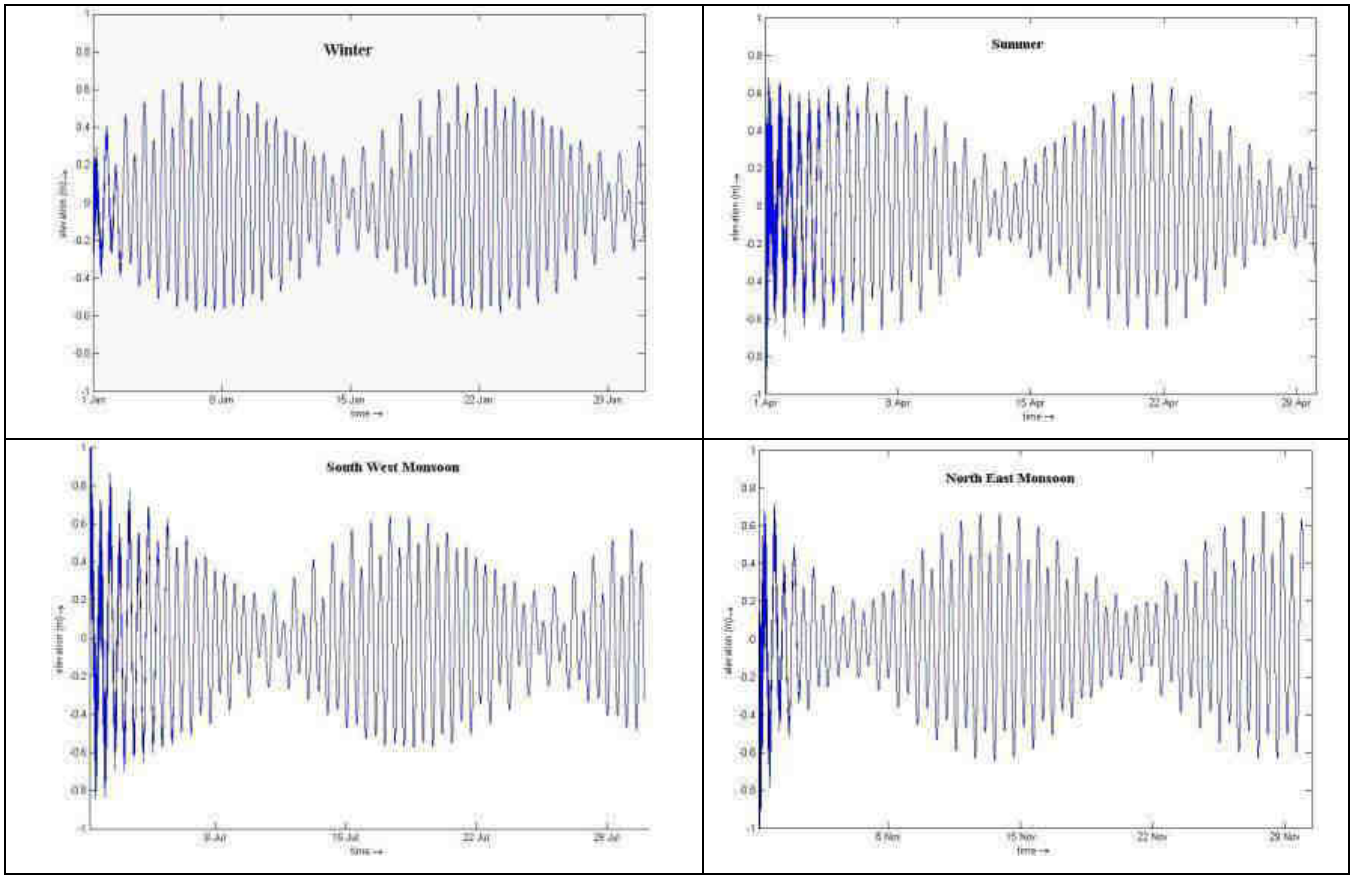
Figure 4-7 Time Series plot of the Seasonal Current



4.1.7.2 Tides

Tides are the rise and fall of sea levels caused by the combined effects of gravitational forces exerted by the Moon, Sun and Rotation of the Earth. The tidal pattern in the study area is semi-diurnal. Since it has two nearly equal high and low tides in a day. It is observed that the study area has a tidal variation of 0.8m to 1.2m.

Figure 4-8 Time Series plot of the Seasonal Tide



4.1.8 Dispersion Module Results

4.1.8.1 Temperature Dispersion

Advection Dispersion (AD) model study has been carried out for the combined sea water intake and outfall discharge of the 2x660MW (ETPS Expansion and Replacement Unit). The temperature dispersion pattern at the outfall points has been studied and presented below. **Table 4-4**presents the details of the Intake and Outfall.

Table 4-4 Details of Marine Intake and Outfall

Location	Marine Co-ordinates	Seasons	Temperature (°C)	Salinity (ppt)	Depth (m)	Distance from Shore (m)	Volume (m^3/hr)
Intake	13°12'7.72"N 80°19'37.96"E	Winter	28	33	8.2	650	24000
		Summer	31	36			
		SWM	30	35			
		NEM	30	35			
Outfall	13°11'41.53"N 80°19'19.70"E	Winter	33	51	5.4	250	16000
		Summer	36	54			
		SWM	35	53			
		NEM	35	53			

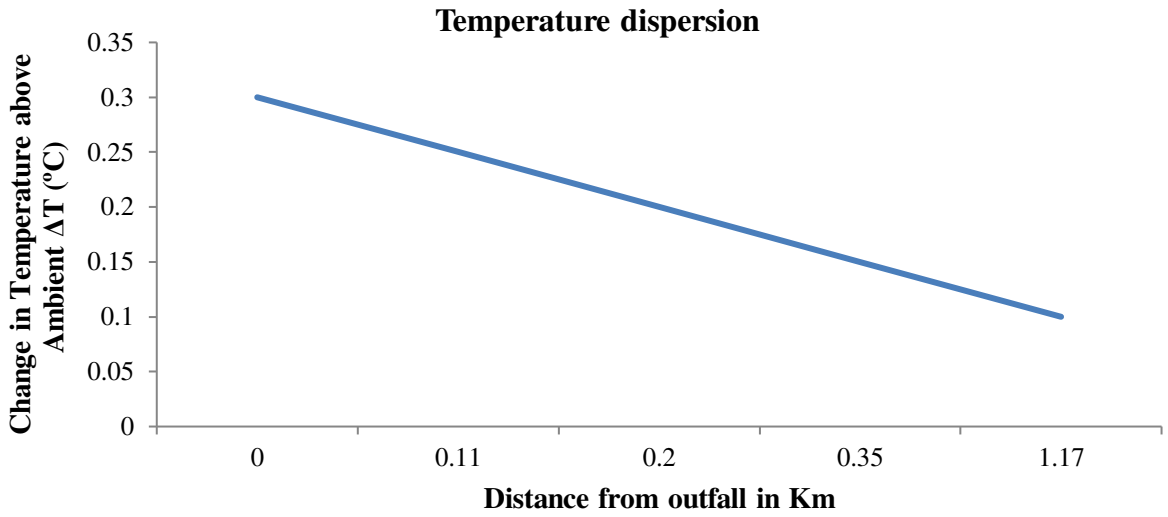
The model has been simulated for a period of thirty days in each season to view the pattern of thermal dispersion.

The maximum distance of thermal dispersion from the outfall location is around 1168m, beyond which the temperature drops less than 0.1°C from ambient temperature. The temperature variation at the intake location is insignificant throughout the year (all the season). The maximum variation of temperature at the intake point is 0.1°C from the ambient temperature which is observed at the intake point during summer and south-west monsoon. Hence there is no chance of recirculation of hot water. The maximum temperature variation of 0.2°C from ambient temperature is observed at the shore during the south-west monsoon.

Table 4-5 Summary of Temperature Dispersion

Seasons	Tidal Patterns		Distance of high concentration from outfall locations (m)	Temperature at Shore above ambient (℃)
Winter	Spring	Flood	720	0.11
		Ebb	1120	
	Neap	Flood	780	
		Ebb	920	
Summer	Spring	Flood	734	0.11
		Ebb	1105	
	Neap	Flood	794	
		Ebb	852	
South West Monsoon	Spring	Flood	730	0.23
		Ebb	1156	
	Neap	Flood	776	
		Ebb	831	
North East Monsoon	Spring	Flood	901	0.04
		Ebb	1168	
	Neap	Flood	919	
		Ebb	1084	

Figure 4-9 Graph showing the distance of temperature dispersion



The spatial plots of the temperature dispersion for three seasons are presented in **Figure 4-10,Figure 4-11, Figure 4-12 and Figure 4-13**.

Figure 4-10 Area plot for Season Temperature Dispersion – Spring Flood

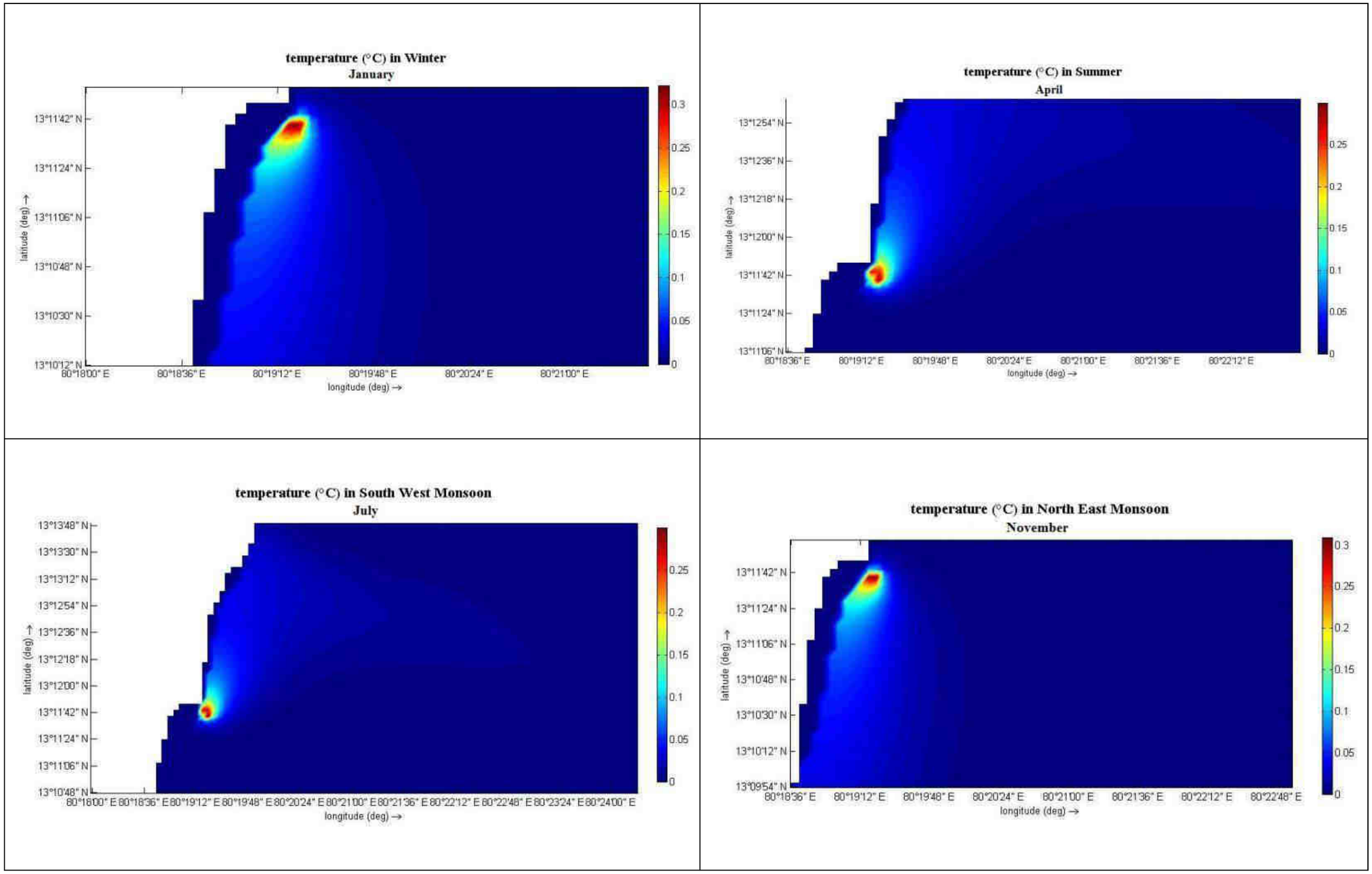


Figure 4-10shows the area plot of seasonal temperature dispersion during Spring-Flood. The distance of high temperature zone falling within 0.1ºC above ambient temperature for winter, Summer, South West Monsoon and North East Monsoon from the outfall location of the power plant are about 720m, 734m, 730m, &901m respectively.

Figure 4-11 Area plot for Seasonal Temperature Dispersion – Spring Ebb

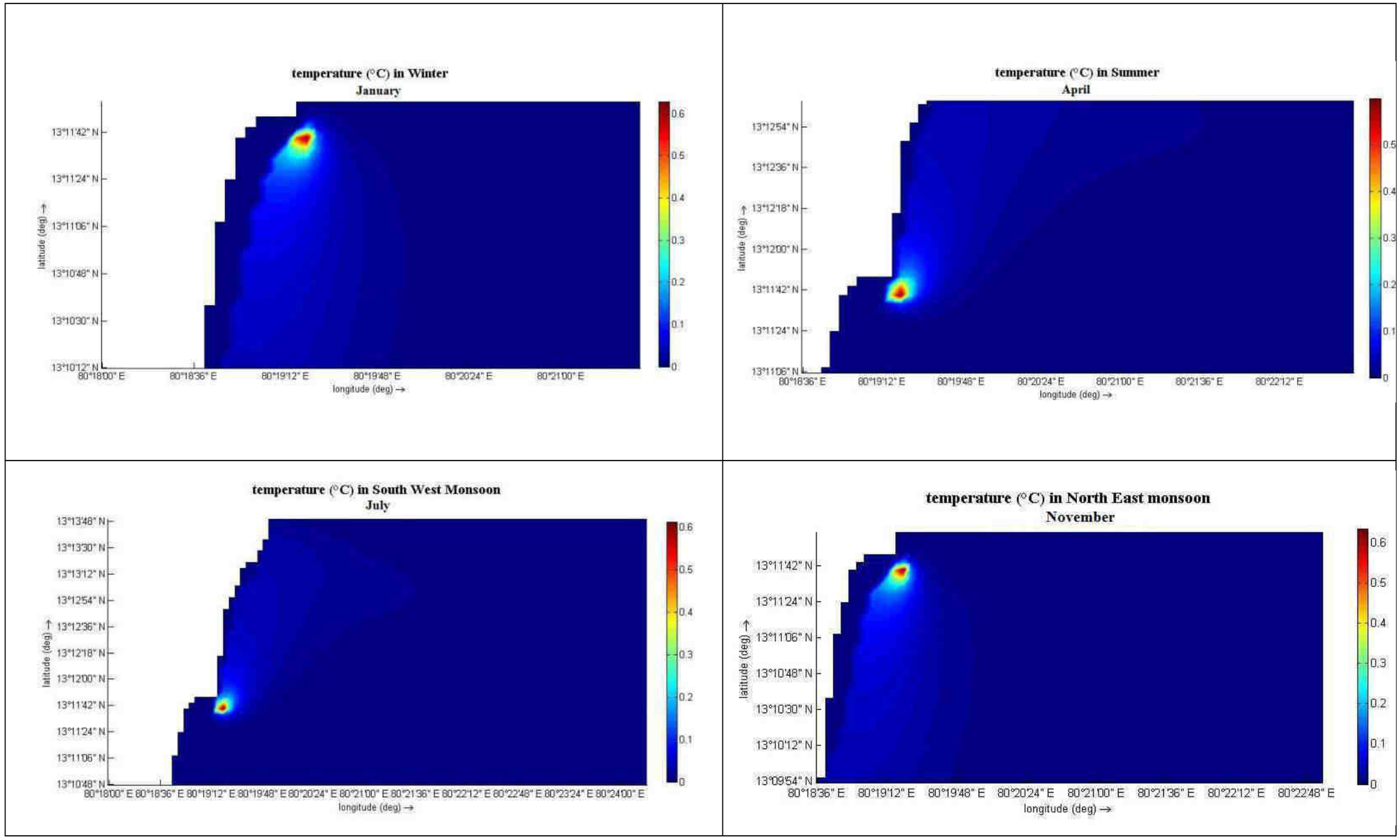
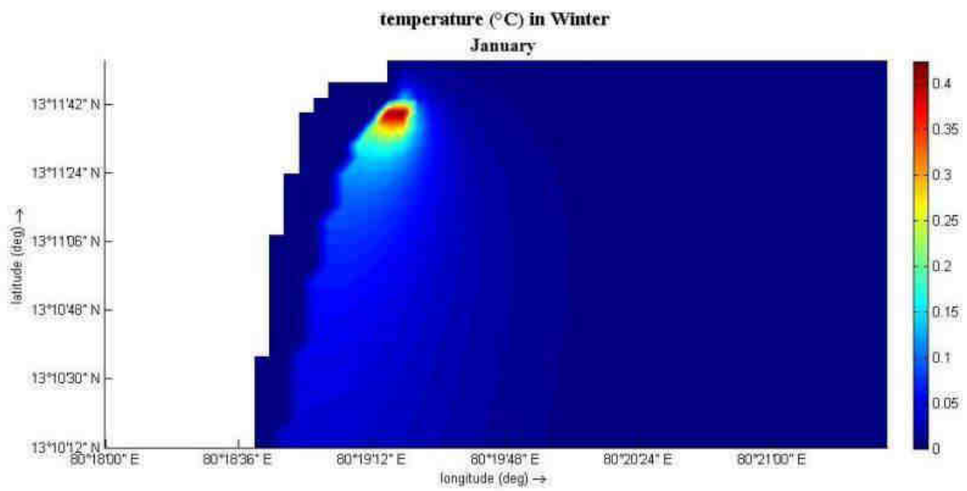
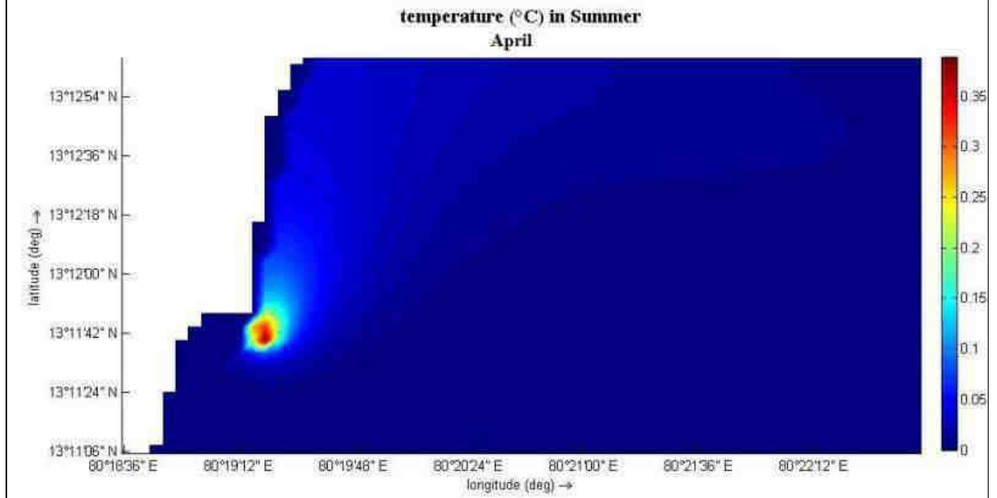
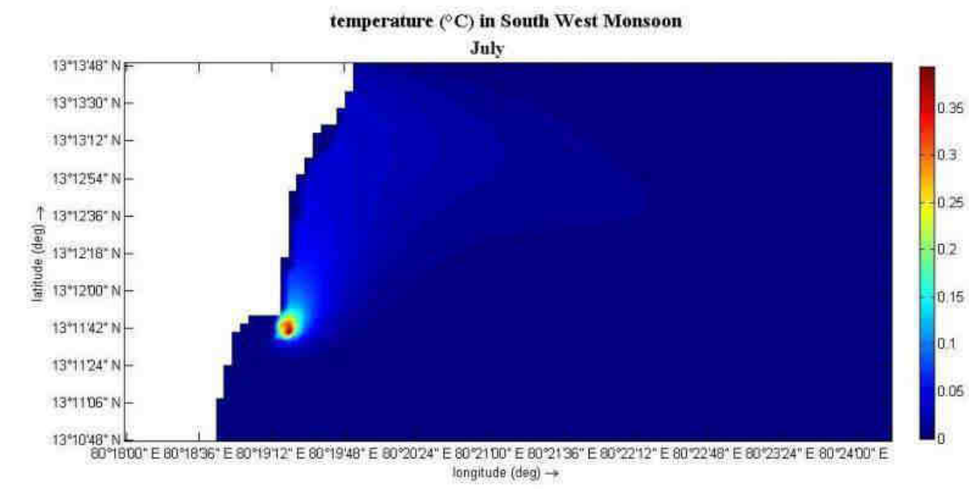


Figure 4-11shows the area plot of seasonal temperature dispersion during Spring-Ebb. The distance of high temperature zone falling within 0.1ºC above ambient temperature for winter, Summer, South West Monsoon and North East Monsoon from the outfall location of the power plant are about 1120m, 1105m, 1156m, and 1168m respectively.

Figure 4-12 Area plot for Seasonal Temperature Dispersion – Neap Flood







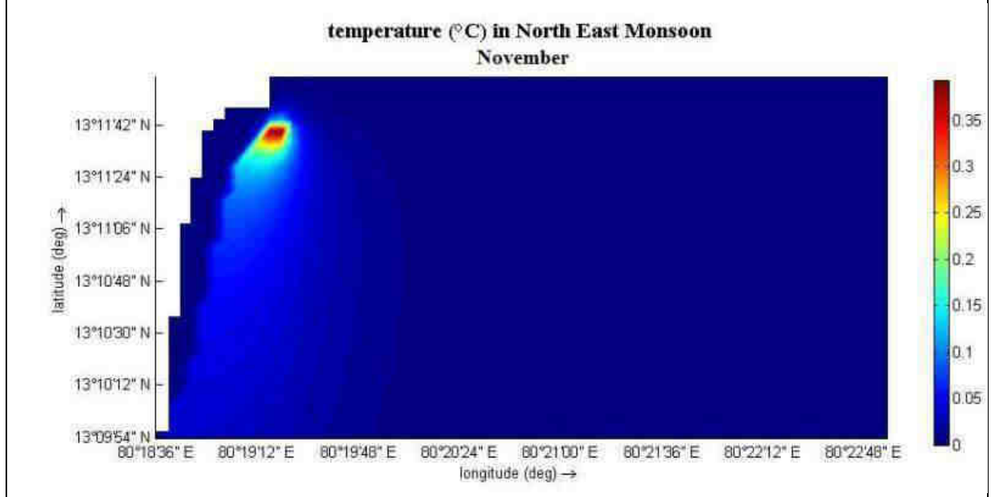
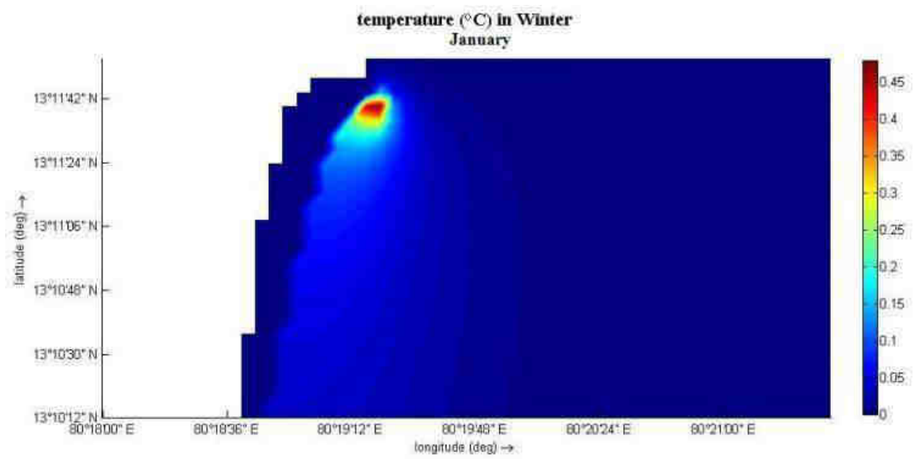
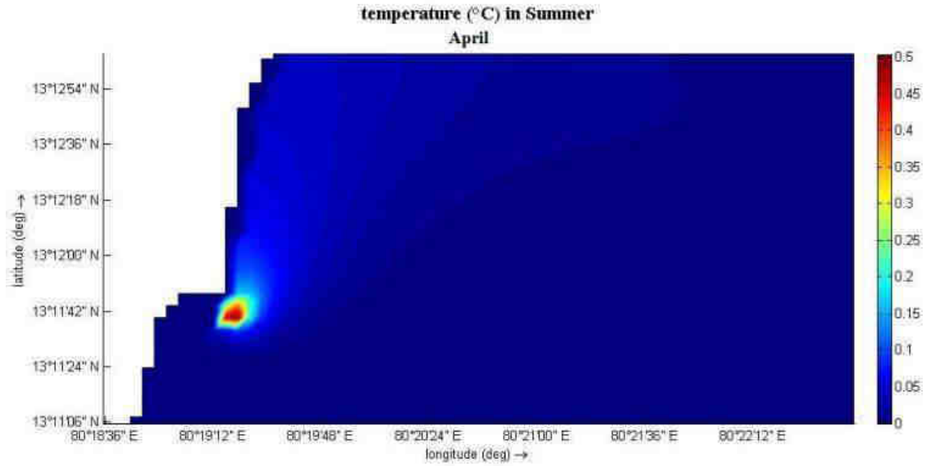
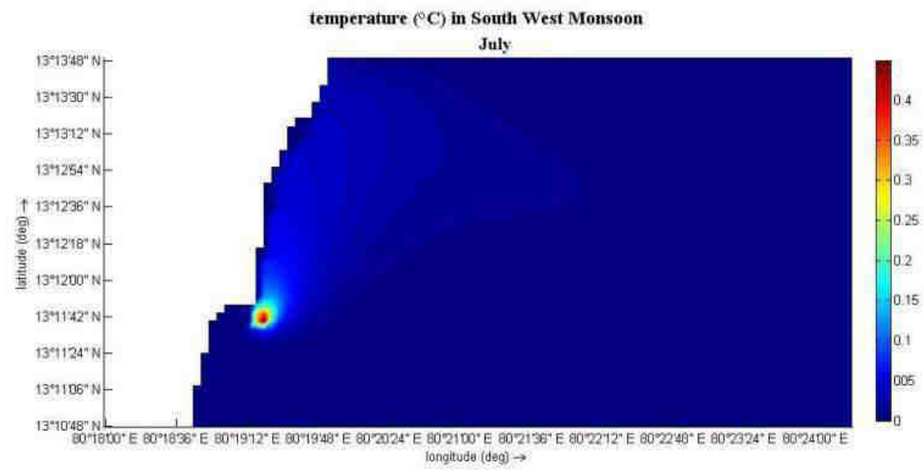


Figure 4-12shows the area plot of seasonal temperature dispersion during Neap-Flood. The distance of high temperature zone falling within 0.1ºC above ambient for winter, Summer, South West Monsoon and North East Monsoon from the outfall location of the power plant are about 780m, 794m, 776m, and 919m respectively.

Figure 4-13 Area plot for Seasonal Temperature Dispersion – Neap Ebb







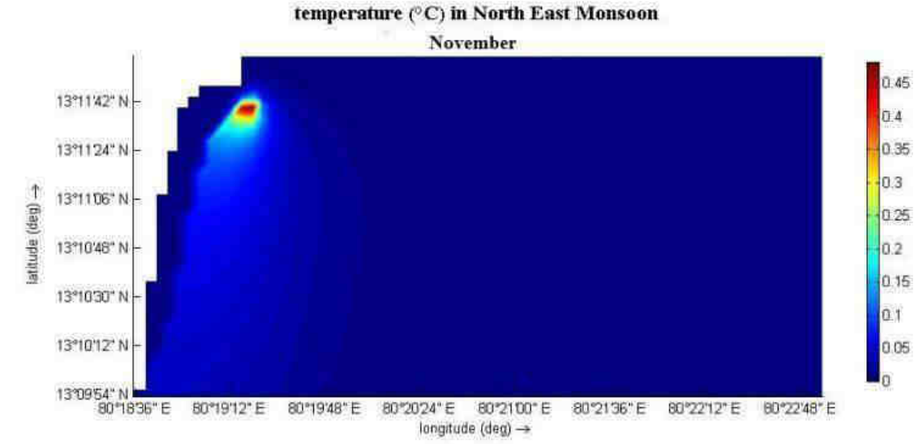


Figure 4-13shows the area plot of seasonal temperature dispersion during Neap-Ebb. The distance of high temperature zone falling within 0.1ºC above ambient for winter, Summer, South West Monsoon and North East Monsoon from the outfall location of the power plant are about 920m, 852m, 831m, and 1084m respectively.

4.1.9 Salinity Dispersion

The model has been simulated for a period of thirty days in each season to view the pattern of salinity dispersion. The below figure help in understand the scenario better.

The maximum distance of salinity dispersion from the outfall location is around 890m, beyond which the salinity level drops less than 0.5ppt from ambient salinity. The salinity variation at the intake location is insignificant throughout the year. The maximum variation of salinity at the intake location is 0.18ppt above ambient salinity. Hence there is no chance for recirculation of high saline water. The maximum salinity variation of 0.7ppt from ambient salinity is observed at shore during south west monsoon. The spatial plots of the salinity dispersion for three seasons are presented in **Figure 4-15, Figure 4-16, Figure 4-17 and Figure 4-18.**

Table 4-6 Summary of Salinity Dispersion

Seasons	Tidal Patterns		Distance of high concentration from outfall locations (m)	Salinity at Shore above ambient (˚ppt)
Winter	Spring	Flood	632	0.45
		Ebb	891	
	Neap	Flood	662	
		Ebb	735	
Summer	Spring	Flood	498	0.4
		Ebb	781	
	Neap	Flood	540	
		Ebb	614	
South West Monsoon	Spring	Flood	482	0.6
		Ebb	840	
	Neap	Flood	564	
		Ebb	740	
North East Monsoon	Spring	Flood	569	0.14
		Ebb	790	
	Neap	Flood	616	
		Ebb	755	

Figure 4-14 Graph showing the distance of salinity dispersion

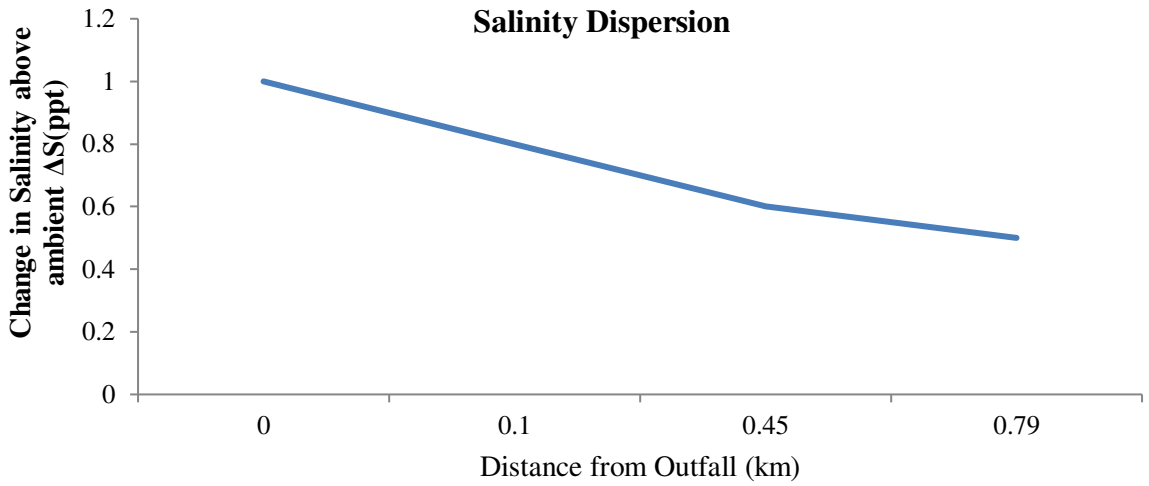


Figure 4-15 Area plot for Seasonal Salinity Dispersion during Spring flood

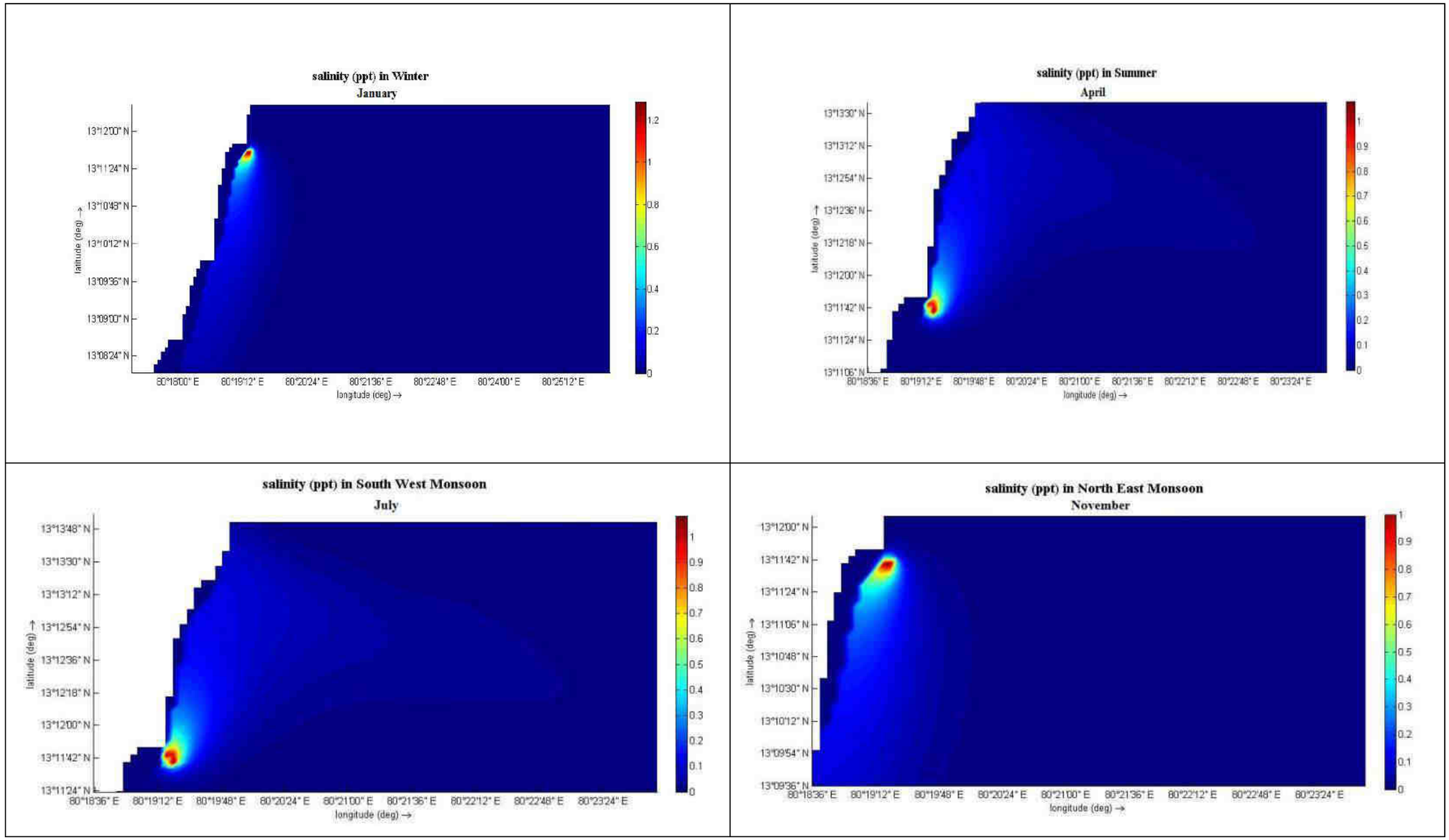
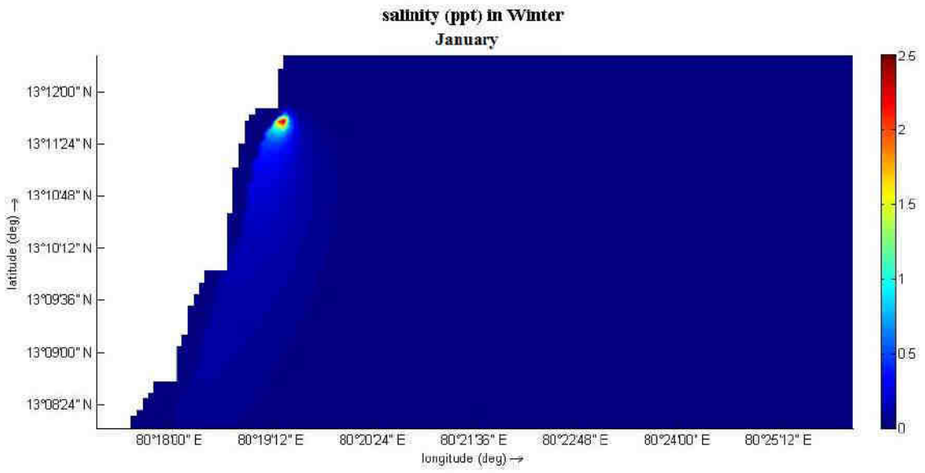
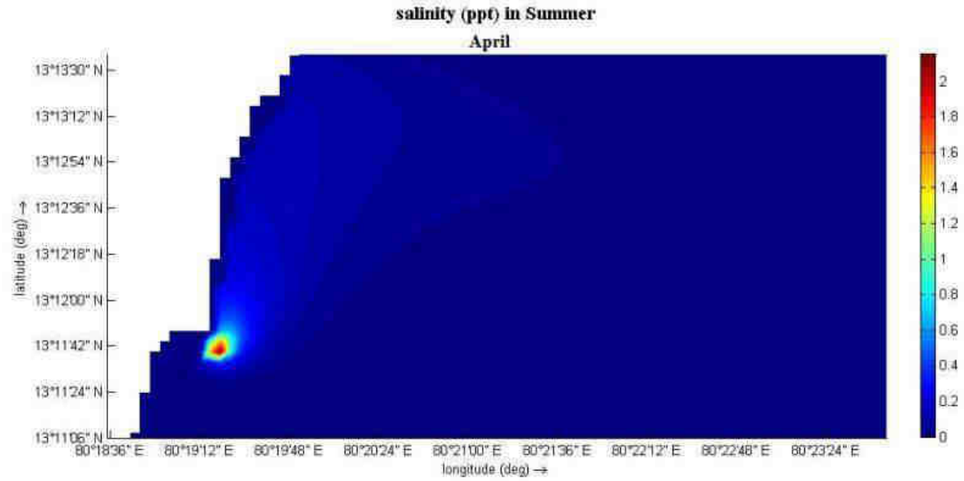
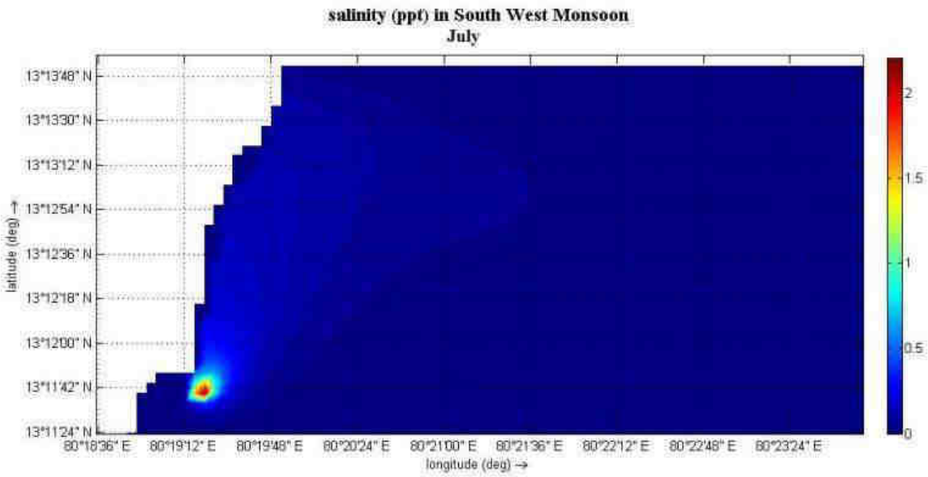


Figure 4-15shows the area plot of seasonal salinity dispersion during Spring-Flood. The distance of high salinity concentration falling within 0.5 ppt above ambient for winter, summer, South West monsoon and North East Monsoon from the outfall location of the power plant is about 632m, 498m, 482m, and 569m respectively.

Figure 4-16 Area Plot for seasonal salinity Dispersion during Spring-Ebb







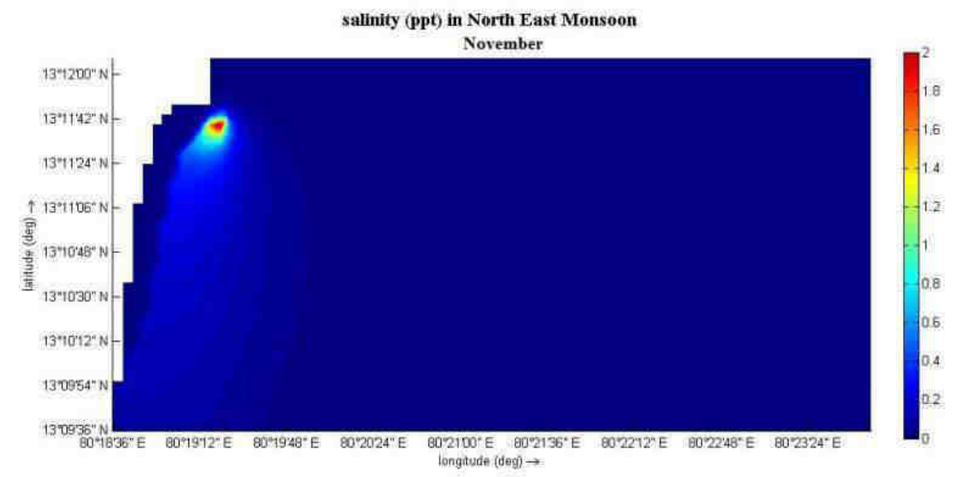
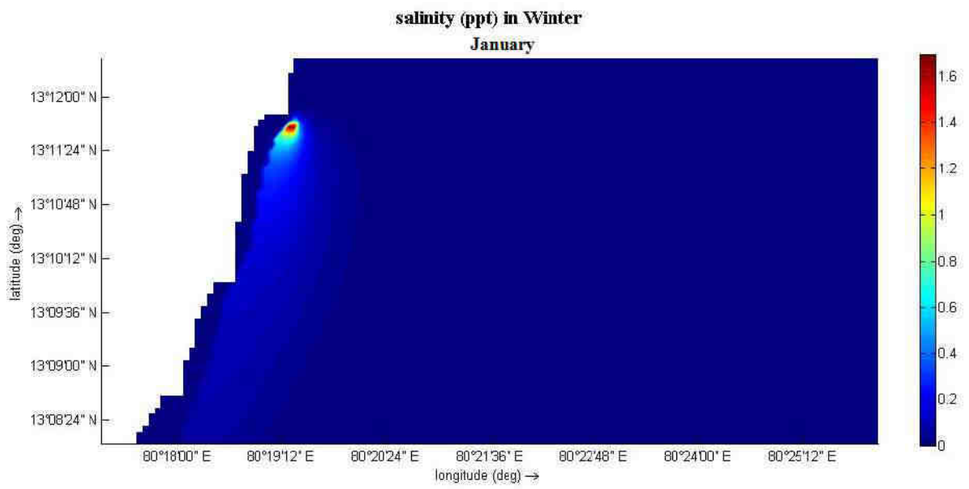
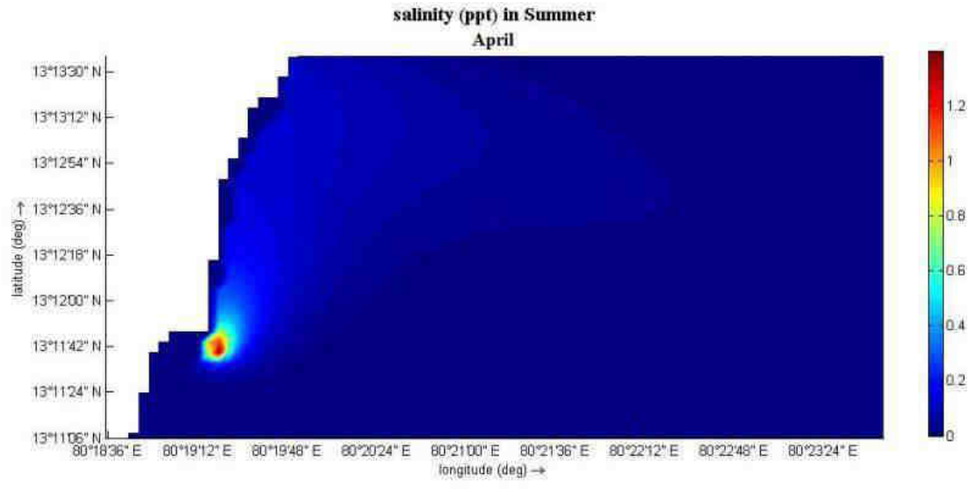
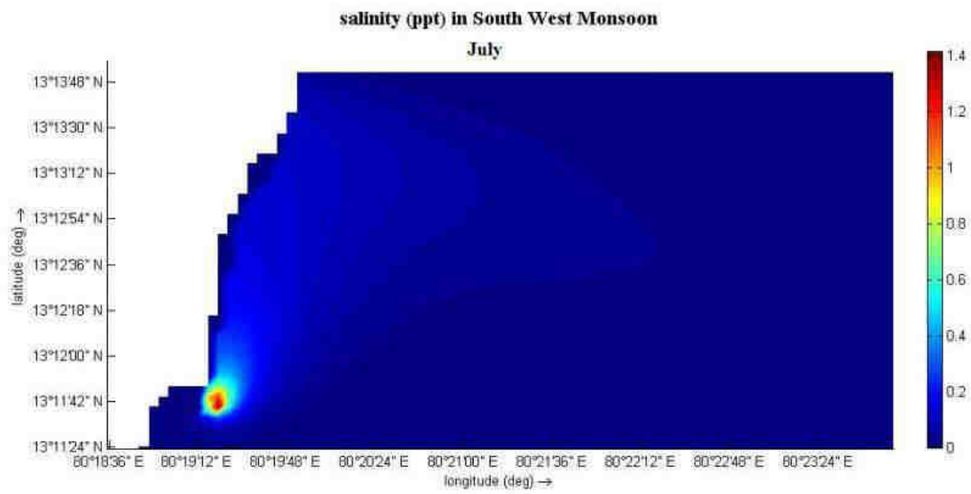


Figure 4-16shows the area plot of seasonal salinity dispersion during Spring-Ebb. The distance of high salinity concentration falling within 0.5 ppt above ambient for winter, summer, South West monsoon and North East Monsoon from the outfall location of the power plant is about 891m, 781m, 840m, and 790m respectively.

Figure 4-17 Area plot for Seasonal Salinity during Neap -Flood







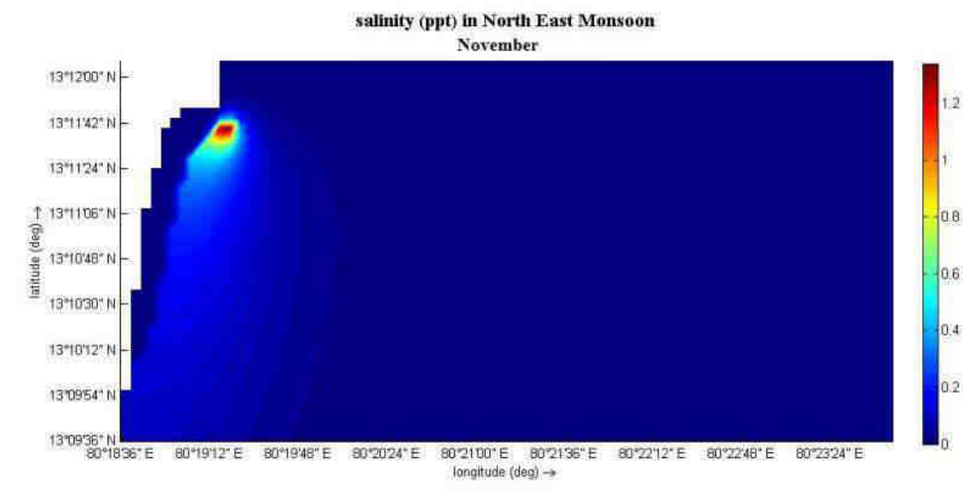
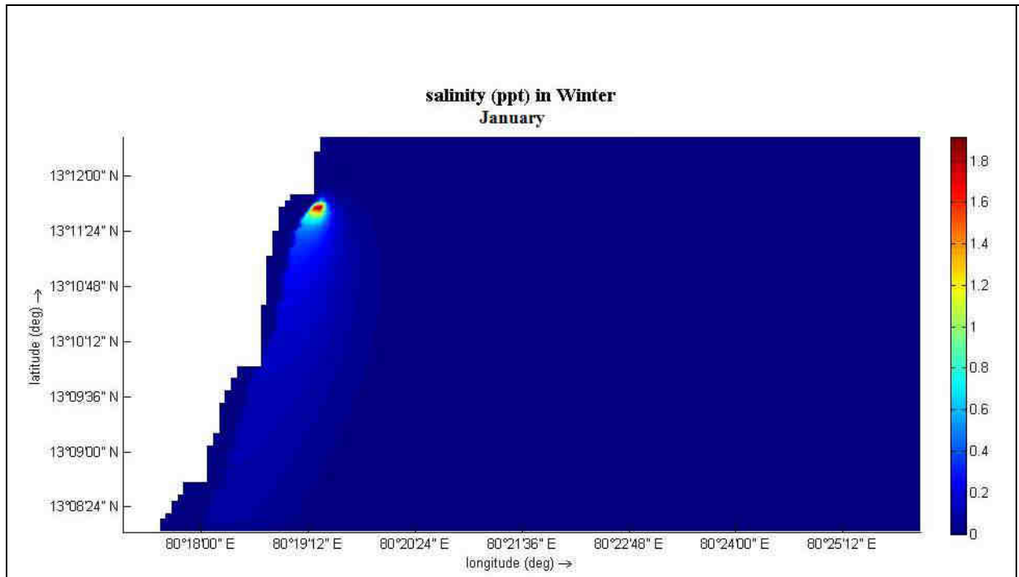
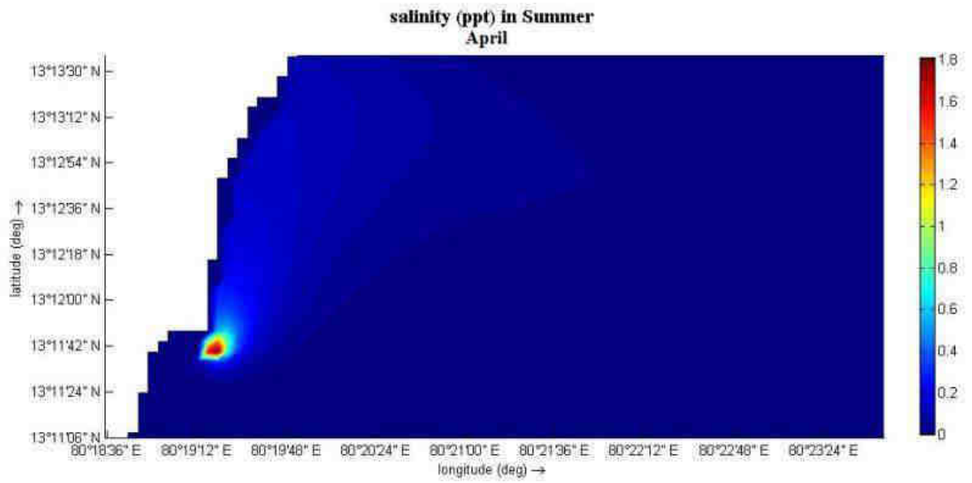
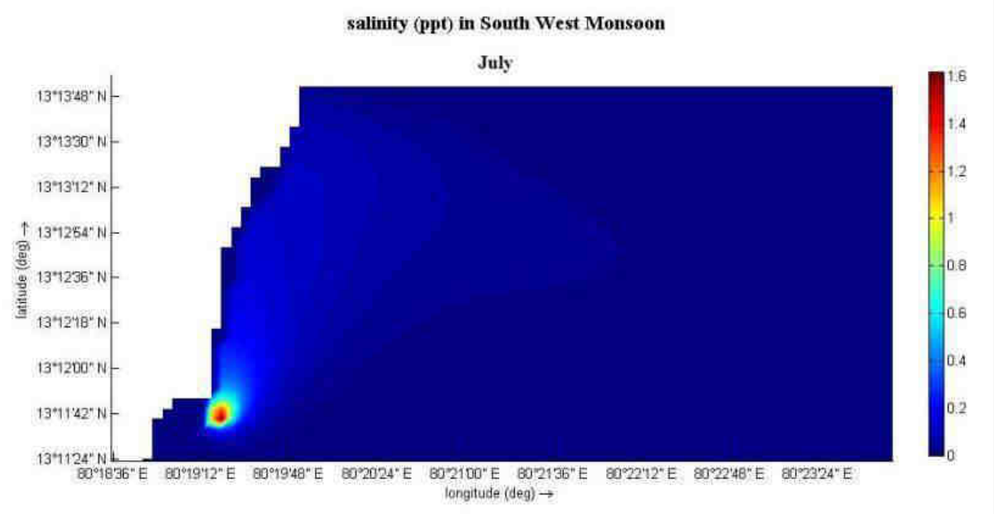


Figure 4-17shows the area plot of seasonal salinity dispersion during Neap-Flood. The distance of high salinity concentration falling within 0.5ppt above ambient for winter, summer, South West monsoon and North East Monsoon from the outfall location of the power plant is about 662m, 540m, 564m, and 616m respectively.

Figure 4-18 Area plot for seasonal Salinity Dispersion during Neap-Ebb







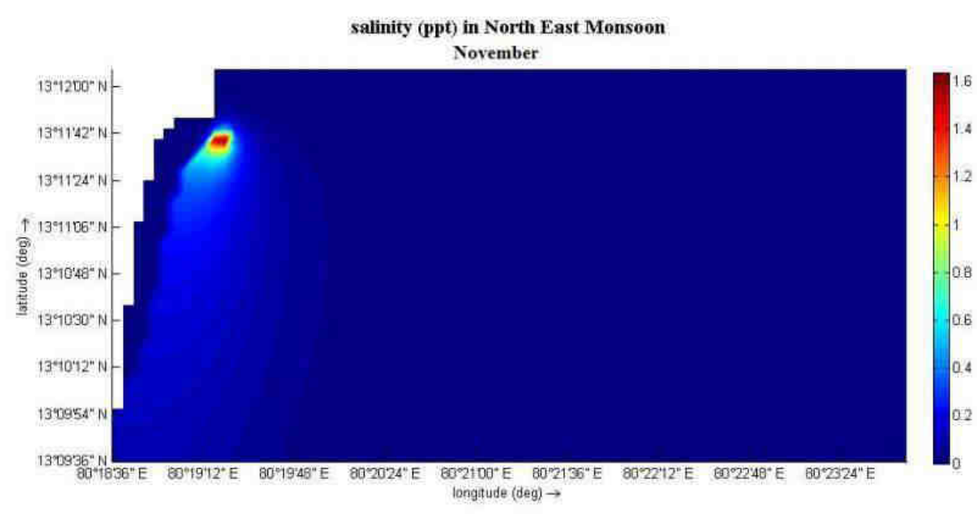


Figure 4-18shows the area plot of seasonal salinity dispersion during Neap-Ebb. The distance of high salinity concentration falling within 0.5ppt above ambient for winter, summer, South West monsoon and North East Monsoon from the outfall location of the power plant is about 735m, 614m, 740m, and 755m respectively.

4.2 Impacts of Outfall on Sea water Quality

The modelling studies for spatial distribution of temperature and salinity of the outfall from the power plant indicate no major increase in the concentration with respect to baseline value. However identifying and analyzing the possible impacts that may be caused due to the outfall on the marine environment shall aid in mitigating and neutralizing such impacts.

The discharge of coolant water into the sea will cause a thermal plume and increase the temperature of seawater. The dispersion of the plume shall vary based on the ocean currents and other parameters. Though the dilution factor of thermal outfall into seawater is high the concentration value at the point of outfall will be higher than the baseline values and will alter the sea water quality, making species sustainability difficult. Increase in temperature will lower the dissolved oxygen content of the receiving water and impact the marine species. Increased temperature changes the natural balance of sea water and directly affects the processes in water. Increased salinity concentration will increase the density of water affecting the sensitive benthic and plankton species. Higher salinity in seawater can benefit certain organisms such as shellfish but affect other species like, reduction in species growth survival at larval stage, shorter life expectancy, reduction in population density, breeding and reproductive activities.

To prevent the growth of organisms and waste build-up in the outfall pipeline anti-fouling agents will be applied; the interaction of thermal plant outfall along with these anti-fouling agents will affect the physic-chemical and biological quality of seawater, in turn affecting the species that inhabit the region. Chlorine is the major component in the anti-fouling agent and excess quantity of chlorine into the seawater will cause sweater toxicity and be harmful to the marine species. On analyzing the model results it can be concluded that no major variation can be observed the marine water quality with respect to temperature and salinity and the increase in baseline values due to coolant water outfall is very minimal and be neutralized hence, no major impacts shall be envisaged on the marine environment due to the proposed project activities.

4.3 Effects of Turbidity on Marine Ecosystems

Turbidity is an optical quality of water and describes how clear or transparent the water is. It describes the degree to which the water contains particles that cause cloudiness or muddiness

resulting in the disturbance of sunlight. Turbidity may be found in water bodies such as oceans, lakes and rivers. High turbidity may be caused by a high content of fine sediments or organic particles.The major source of turbidity is the phytoplankton.

According to the report by Aron Borok[10], turbidity affects the growth of macrophytes and eelgrass in lakes. Increased turbidity causes decrease benthic macrovertebrate abundance and diversity, as well as populations of zooplankton. Turbidity can affect these populations in 2 ways: 1) turbidity may reduce the primary production of phytoplankton thus affecting the primary consumers and 2) increased turbidity and suspended sediments may cause drift of macroinvertebrates due to clogging of benthic habitat. Turbidity also affects the behavioral effects of fish such as changes in territorial behaviour, avoidance of turbid water, increased blood sugar levels and change in visual effects of suspended sediment.

The suspension of fine sediments in the ocean waters may influence nutrient dynamics in estuaries, affect growth of primary producers and impair the performance of visual predators. The microphytobenthos is dependent on the natural turbidity and thus any change in that will affect this species. However, increased turbidity does not cause any significant effect on the productivity of micro-algae. Increased turbidity will cause a significant decrease in biomass and productivity of phytoplankton, zooplankton and filter-feeding benthos[11].

Light penetration in oceans is affected by the inorganic turbidity and thus decreasing the fraction of light absorbed by photosynthesizing organisms thereby reducing their density, growth rates and production of phytoplankton. The flagellates have greater motility and reduced sensitivity to flocculation. The phytoplankton density reduces when the algal cells sinks by adhering to clay particles in the turbid waters.

Turbid environment favours the young fish in terms of survival by reducing risk of predation by large predators. The feeding depends on the light as well as prey density. When there is high turbidity, the light is extinguished and the prey density could become important in influencing feeding success, growth and survival. The juveniles can consume the available

[10] Aron Borok (2014), Turbidity Technical Review, Water Quality standards published by Department of Enviornmental Quality, State of Oregon

[11] Essink, Karel(1999), Ecological effects of dumping of dredged sediments; options for management, Journal of coastal conservation 5: 69-80,1999

food in darkness and the prey concentration is maximum. Also, the juvenile fishes may be spatially separated from adult weakfish[12].

4.4 Effects of Salinity on Marine Ecosystems

Changes to salinity can play a significant role in the growth and size of aquatic life and the marine species disturbance. Changes in the salinity can play two opposite roles on the marine organisms' existence; it can be of benefit for some of these organisms such as shellfish and at the same time can have an adverse impact on other species.

The salinity observed in the project area ranges between 31 ppt to 33 ppt. The proposed outfall from the Thermal Power plant will be 5 ppt higher than the ambient salinity conditions. As per the modelling study, the salinity will get diluted to the ambient conditions within a radius of 300m. The impact on the receptors is mainly categorized into Plankton, Intertidal habitats, Fish and Fish larvae etc. the long-term average temperature increase assessed from modelling studies is 0.5° to 0.75°C above the ambient temperature at the outfall.

4.5 Effects of Temperature on Marine Ecosystems

Effect on plankton species have limited or less motility and their occurrence and distribution within a sea area is thus governed by external factors such as hydrodynamic regime, vertical mixing within the water column etc. As they do not have a selective avoidance mechanism of unfavourable conditions, they are susceptible to environmental changes both natural and anthropogenic, including the direct influence of thermal discharges.

There is a range of potential effects on planktonic communities that can result from increases in water temperature. Changes to the temperature regime of the water column in the receiving environment can have direct effects on planktonic species, as metabolic rates are dependent upon temperature.

Exposure to higher temperature in the order of 2° C usually leads to changes in the community structure. In the proposed project the temperature rise is 0.5 ° C to 0.75°C in a radius of 600m. So the effects resulting due to the temperature difference will be minimal.

[12] *Paul A. Grecay & Timothy E.Targett (1996), Effects of turbidity, light level and prey concentration on feeding of juvenile weakfish Cynoscion regalis, Marine ecology progress series, Vol. 131: 11-16,1996*

Further the modelling studies shows that the temperature gradient declines as it moves towards the seaward side. Hence no adverse impact is anticipated.

4.6 Effects of Antifouling Agent on Marine Ecosystems

There are potential operational issues caused by the growth or encrustation of marine organisms in pipes and inlet wells. Operationally, the colonization of marine organisms such as algae, bryozoans and molluscs within cooled water circuits could result in losses in thermal efficiency and reduced reliability of the system (including total shutdown).

To counteract settling and growth of marine organisms, cooled water circuits are typically dosed with chemicals (usually sodium hypochlorite). Such chemicals are known as antifoulants and they inhibit the growth of organisms within the circuit by creating unsuitable living conditions. A secondary consequence of this form of treatment is associated with the discharge of the treated seawater into the marine environment.

The concentration of chlorine in the inlet is 1ppm which is similar to that found in the cooling waters of power stations operating worldwide and is below the proposed power plant discharge limits. Concentrations of residual chlorine have been shown to diminish rapidly with time and distance from the discharge point(Mattice & Zittel, 1976).

The concentration in the outfall shall not exceed 0.5mg L-1 which is acceptable as per EPA guidelines. Consequentially, significant impacts to fisheries resources as a result of the discharge of chlorinated water are not expected to occur. As per literature review, it is observed that residual chlorine at a concentration of 0.5mg/L on the hatching of fish larvae was found to have no significant impact.

5 MARINE ENVIRONMENT MANAGEMENT PLAN

This chapter presents the tool for effective sustenance and management of the marine environment from any potential impacts that may affect the ambient condition of the surrounding environment – in this case the Ennore Thermal Power Station, Tamil Nadu. The effectiveness of Environment Management Plan (EMP) shall be assessed by developing a post project monitoring program (PPMP), which has been presented in Chapter 6. Upon successful implementation of EMP and by adopting good engineering and operational practices, the traces from the construction and operation phase of the ETPS will have minimal impact on the marine environment, which can otherwise be considered as insignificant. The following section describes EMP developed for construction and operation phase of the project.

5.1 Construction Phase

The construction phase involves the laying of pipelines for the intake of seawater and outlet of the used water into the sea. The management plan pertains to the ancillary infrastructure that are being constructed/developed in the coastal / marine environment, as part of the ETPS expansion.

5.1.1 Water Quality Management

The laying of the seawater intake pipeline, construction of intake terminal, and laying of outfall would foresee localized alteration of water quality due to disturbance to the sea bed. The intake and outfall pipeline would be laid below the seabed which involves digging of trenches. Considering the aforementioned and to reduce the effect on the water column the following recommendation are made.

1. Installation of silt screen shall be done to confine the suspended sediment to the project area.
2. Increased monitoring for turbidity to incorporate or re-orientate silt screens accordingly.
3. Decrease rate of dredging/excavation.
4. Select appropriate dredge method / technology for reduced impact of dredging on the surrounding environment.
5. Washing down of construction equipment is not permitted within 100m of the high water mark/high tide line

6. Monitoring sites shall be established to provide information on the sea water quality variation at the proposed Seawater Intake and Outfall Location

5.1.2 Fish and Marine Life Management

Fish management involves activities undertaken to protect and control fish and other marine species along the coastal stretch of Ennore. The stretch where he proposed intake and outfall pipelines are to be laid should be isolated for laying of pipelines. Any fish or other marine life that may be trapped within should be removed prior to the start of works. To perform that, an experienced professional need to be in place during the process of fish recovery from the construction site to avoid any loss of fish stock near the coast.

5.2 Operation Phase

The operation phase is the post development phase, once the installed supercritical thermal power unit has been put into operation. This phase would require intricate management of the marine environment due to the intake of seawater and outlet of the process water which would be of higher temperature as opposed to its intake temperature. The outlet of such water would collapse the biological diversity at the discharge point, for which necessary actions are to be taken.

5.2.1 Outfall Water Management

The water quality at the discharge point shall be analyzed for any change in the physicochemical as well as the biological parameters in the marine water. Besides the discharge point, the water quality shall be analyzed for the aforementioned parameters within the 5 km radius to assess for any effect on water quality due to the discharge of thermal/process water. Any change in the water quality observed shall be fixed by the ETPS in their process.

Accidental Oil Spill Management Plan

Though the proposed project is only for the intake and discharge of the seawater, there could be accidental oil spills in the marine environment due to the close proximity of the North Chennai Port. The following management measures are applicable in case of oil spill in the vicinity of the intake and the outfall structure:

- Notify the Indian Coast Guard in case of any oil spill noticed.

- The intake of water shall be suspended till oil spill is cleared as there is high chance of oil to be absorbed by the intake pipeline which would result in damage to the structures.
- The discharge of the water shall also be suspended since the discharge shall help in dispersion of the oil spill.

6 ENVIRONMENTAL MONITORING PLAN

An environmental monitoring programme is required to provide scientifically defensible information for determining the status of the environmental quality of the surrounding area of the intake and the outfall points of the Expansion project of ETPS and to ensure the outfall temperature is within the environmentally acceptable limit as per the Thermal Power Plant Standards. This will help to obtain an early warning of unacceptable environmental conditions so that control measures can be taken immediately. It also helps to determine in a timely fashion, changes in the local environmental quality.

Long term monitoring is proposed near the intake and outfall location especially to measure the temperature, salinity and biological parameters.

6.1 Water Quality Monitoring

The water quality monitoring programme consists of parameters monitoring prior to discharge, water quality monitoring near sea intake and outfall structure and nearby surface water.

Table 6-1 Water and Wastewater Monitoring Schedule- ETPS Expansion Unit

Waste Water Sources	Frequency of Analysis	Parameter of Examination
Boiler blow down	Monthly	Temperature suspended solids, oil & grease, dissolved solids, copper, iron etc.
Water treatment plant Effluent	Weekly	pH, suspended solids COD, BOD, dissolved solids
Ash Pond Effluent	Monthly	pH, suspended solids, oil & grease, dissolved solids, heavy metals like chromium, zinc, iron, manganese, aluminium, nickel etc.

The monitoring schedule for analysing the marine environmental quality parameters to be analyzed are shown in**Table 6-2.**

Table 6-2 Seawater Quality Monitoring Program- Construction Phase

Environmental Component to be monitored	Parameters to be monitored	Locations	Monitoring Frequency	Responsibility

Environmental Component to be monitored	Parameters to be monitored	Locations	Monitoring Frequency	Responsibility
Seawater Quality	Total Suspended solids, Total Dissolved Solids, Salinity, temperature, Chlorine, Heavy metals, BOD, Oil products, pH.	Seawater Intake and Discharge points	Every 15 days during the construction period	TANGEDCO
Sediment Quality	Trace metals, Nitrate-nitrogen, Phosphate-phosphorus.	Seawater Intake point, Discharge points, 100 m from the discharge point, creek	Every 15 days during the construction period	TANGEDCO
Marine biological environment	Phytoplankton, Zooplankton and Benthos	Seawater Intake point, Discharge points	Monthly	TANGEDCO
Marine Sediment	Benthic biomass and population	Seawater Intake point, Discharge points, creek	Monthly	TANGEDCO

Post Project Monitoring of Marine Environment

Post project monitoring for marine environment should be carried out in order to ensure that the environmental quality is maintained. Specially trained staff should be employed to undertake the monitoring work in a control laboratory of the plant or this work could be assigned to any research Institute/NABL accredited Laboratory having expertise in collection and analysis of sea water and sediment samples in offshore and intertidal region.

Table 6-3 Seawater Quality Monitoring Program- Operation Phase

Environmental Component to be monitored	Parameters to be monitored	Locations	Monitoring Frequency	Responsibility

Environmental Component to be monitored	Parameters to be monitored	Locations	Monitoring Frequency	Responsibility
Seawater Quality	Total Suspended solids, Total Dissolved Solids, Salinity, temperature, Chlorine, Heavy metals, BOD, DO, Oil products, pH, Conductivity and Total Residual Chlorine. (Temperature increase at discharge should be within 5°C).	Seawater Intake point, Discharge points, 100 m from the discharge point, creek	Monthly	TANGEDCO
Sediment Quality	Trace metals, Nitrate-nitrogen, Phosphate-phosphorus.	Seawater Intake point, Discharge points, 100 m from the discharge point, creek	Monthly	TANGEDCO
Marine biological environment	Phytoplankton, Zooplankton and Benthos	Seawater Intake point, Discharge points, 100 m from the discharge point, creek	Monthly	TANGEDCO
Marine Ecology	Marine organisms trapped in the pipe intake and outfall structure	Intake and outfall structure	Once in 15 days	TANGEDCO
Marine Sediment	Benthic biomass and population	Seawater Intake point, Discharge points, 100 m from the discharge point, creek	Monthly	TANGEDCO

Environmental Component to be monitored	Parameters to be monitored	Locations	Monitoring Frequency	Responsibility
Intertidal Coastal environment	Beach profile, Intertidal habitats	Intertidal region near to the intake and outfall points and along the pipeline route	Annually	TANGEDCO
Shoreline	Erosion and Accretion	2 km on either side of the intake and outfall points	Annually	TANGEDCO
Physical Process and Seafloor	Currents, waves, Tides and Bathymetry	Along the pipeline route of intake and outfall	Annually	TANGEDCO

7 SUMMARY AND CONCLUSION

Ennore Thermal Power Station (ETPS)is a coal fired power station located in Ernavur village, Thiruvottiyur Taluk in Tiruvallur district, Tamil Nadu, India. ETPS is owned and operated by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO), a subsidiary of the Tamil Nadu Electricity Board (TNEB).The existing ETPS was of 450 MW capacity which was in operation from 1975. The facility has been dismantled on 31st March 2019 and is proposed to be replaced with a 1x660 MW unit within the same facility. It has been also proposed that to expand the ETPS by an additional 1x660 MW super-critical technology.

The proposal for expansion would improve the capacity of the power generation by ETPS and the environmental clearance for the expansion of ETPS has been obtained in the year 2009. The validity of the clearance was upto 2nd June 2019. But the works relating to the construction of the facility has not been completed. Since the maximum validity of the clearance has been obtained. A fresh proposal has been submitted by TANGEDCO and ToR has been accorded by MoEF&CC for which the marine EIA study has been entrusted to Cholamandalam MS Risk Services Ltd, Chennai.

The proposed expansion facility will use super-critical technology. The water requirement will be met by Bay of Bengal. The outfall and the intake locations have been located as per the detailed study by NIO, Goa. The intake pipeline and the outfall pipeline has been provided at a distance of 650m and 250m respectively from the shore. The intake and the outfall are provided at different directions from each other to avoid mixing of water. The total quantity of intake for the Replacement unit and the Expansion unit is 25000 m^3/hr and the total quantity of discharge is 16000 m^3/hr.

The baseline monitoring has been carried out for the proposed facility for one season. The water and sediment samples have been collected from the offshore locations (inclusive of intake and outfall) and the creek. The creek samples have been analysed since the coal conveyor belt is proposed across the creek. The water and sediment samples have been analysed for the physio-chemical parameters and biological parameters. The results have shown a few traces of contamination in the creek. The offshore samples have shown diversified phytoplankton, zooplankton and benthos. Since the nature of the ocean is dynamic, the pollutants, if present, shall get dissipated in no time.

The thermal and salinity dispersion modelling has been conducted for a combined intake and outfall for the replacement unit as well as expansion unit which accounts to 2x660 MW capacity. The temperature and salinity at the intake and the outfall locations have been considered for the modelling study. The outcome has revealed that the temperature and salinity at the discharge location has been dissipated to a distance within 1 km for spring and neap tides for the ebb and flood conditions irrespective of the seasons.

The impacts of the temperature and salinity dispersion on the ecology and the marine environment has been analysed. Since the temperature and salinity at the discharge point diffuses and disperses within a short span of time, there will not be major impacts on the marine environment as well as ecology. Furthermore, the effect of anti-fouling agents on the marine ecosystem has also been discussed. It is mentioned that the levels of chlorine in discharge has to be limited so that it will not affect the marine ecology and environment.

The environmental management plan has been discussed to mitigate the impacts at the construction and the operation phase of the project. The management of the water quality in the marine environment is addressed with respect to the discharge characteristics of the outfall water from the Thermal Power Plant. The precautionary measures taken for the laying of pipeline and the measures to manage the ecology in the marine environment during the construction and the operation phase has been addressed in the respective sections.

Environmental Monitoring Program is provided to ensure that the surrounding environment is stable and not affected by the proposed project. It is also helpful to monitor and maintain the temperature of discharge within the standards set for Thermal Power Plants. Similar to the Environment Management Plan, Environmental monitoring plan is also devised for the construction and the operation phases of the project.

So, the overall outcome of the study reveals that the impacts of thermal and salinity dispersion of the discharge waters on the marine environment is negligible. Since the dispersion is fast and does not travel longer distances to match the ambient conditions, the proposed project is acceptable.

SOCIO ECONOMIC STUDY REPORT ON THE ONGOING ETPS EXPANSION THERMAL POWER PROJECT (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

STUDY COMMISSIONED BY

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD (TANGEDCO)

MAY - 2019

FINAL REPORT

VOLUME - I

MADRAS SCHOOL OF SOCIAL WORK

CHENNAI 600008

SOCIO ECONOMIC STUDY REPORT ON THE EXPANSION THERMAL POWER PROJECT (ETPS) (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

VOLUME - I

SOCIO ECONOMIC STUDY REPORT ON THE ONGOING ETPS EXPANSION THERMAL POWER PROJECT (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

ACKNOWLEDGEMENT

This report has been prepared by the consultancy team of the Madras School of Social work. The study highlights the socio economic status and future needs of the thirteen areas located around ETPS, Ennore, Thiruvallur District, Tamil Nadu.

The task of completing the study in a very short duration was made possible with the strategic back up support of the officials of TANGEDCO, Chennai. We thank Mr. K. Subash Chandra Bose, Chief Engineer/ Projects - I, Mr.D.Sundar Superintending Engineer, Ms.Munavar Sultana, Executive Engineer, Projects, Mr.N.Srinivasan, Executive Engineer, Projects and Mr.Balaji, Assistant Executive Engineer for giving us an opportunity for conducting the study and guiding the team in assessment and furnishing the relevant data and contact details.

We also acknowledge the support received from the other departments relating to this study. Our special thanks is due to Health Department, Heads of Educational Institutions, Project Officer, ICDS, Chennai District, Assistant Engineer, Corporation of Chennai, Division 4, Non-Governmental Organisations, Anganwadi Workers, Presidents of Village Panchayats, Local Youth Association and Self Help Group members as the Key Informants for this study. We owe our thanks to the Self Help Group Members and Panchayat Level Federation Members for supporting in village household survey.

At the field level, we remember with thanks the respondents of the survey, the Key Informants, FGD members and all others who have helped us in conducting this study. I thank the management of Madras School of Social Work for the support extended to the study as part of MSSW's Consultancy activities and the valuable back end support rendered towards the same.

The Study Team comprised of Dr. S.Raja Samuel, Principal Consultant, Dr. C.J.Paul, Team leader and Social Development Consultant, Dr.Prema P, Gender and Environment Consultant, Mr.M.S.Palanikumar, Study Coordinator, Dr.K.N.Vijayanthi, Documentation Expert, Mr.V.T.Ranganathan, Associate Consultant, Mr.D.Rajendran, Associate Consultant, Mr.Krishna Kumar, Mr.Muralidaran, Field Investigators, Mr. Jerald Robinson, Mr. Praveen Field Coordinator and Mr.V.Purushothaman, Office Administration.

Dr. S. Raja Samuel,
Principal,
Madras School of Social Work, Chennai

ABBREVIATIONS

ANC	Ante Natal Care
AD	Assistant Director
ANM	Auxiliary Nurse Midwifery
BC	Backward class
BLS	Base Line Survey
BPL	Below Poverty Line
CBO	Community Based Organization
CAN	Community Needs Assessment
CIFNET	Central Institute of Fisheries Nautical and Engineering Training
CMFRI	Central Marine Fisheries Research Institute
CSR	Corporate Social Responsibility
DFR	Draft Final Report
EDP	Entrepreneurial Development Programme
FC	Forward Caste
FGD	Focus Group Discussion
GCC	Greater Chennai Corporation
GoI	Government of India
GoTN	Government of Tamil Nadu
GP	Gram Panchayat
HIG	High Income Group
ICDS	Integrated Child Development Scheme
ISC	Integrated Sanitary Complex
ITI	Industrial Training Institute.
IWSC	Integrated Women Sanitary Complex
JD	Joint Director
KII	Key Informants Interview
KM	Kilo Meter
LIG	Lower Income Group
MIG	Middle Income Group
MGREGA	Mahatma Gandhi Rural Employment Guarantee Act
MSSW	Madras School of Social Work.
NHAI	National Highways Authority India
OHT	Over Head Tank
PDS	Public Distribution System
PIU	Project Implementation Unit
PHC	Primary Health Centre.
PNC	Post Natal Care
PO	Project Officer
PTA	Parent Teachers Association
PWD	Public works Department.
SC	Scheduled Caste
SHG	Self Help Group
ST	Scheduled Tribe
VLFP	Village Level Framework Plan
VTC	Vocational Training Centre
VHN	Village Health Nurse

SOCIO ECONOMIC STUDY REPORT ON THE ONGOING ETPS EXPANSION THERMAL POWER PROJECT (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

EXECUTIVE SUMMARY

1.CSR activities of Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)

Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) is a unit of TNEB takes care of the infrastructure relating to the power generation and distribution of power to the state.

Established in 1957, Tamil Nadu Electricity Board (TNEB) is now the largest vertically integrated power utility in the country with an installed generating capacity of 10,098 MW. TNEB ranks No.1 in India and 4th globally in wind power generation. It is also one of the best performing power utilities in the country with lowest AT&C losses of 18% and the highest revenue collection of 99%. Celebrating its Golden jubilee, TNEB is poised towards a powerful future.

Tamil Nadu is also blessed with many partnerships in power generation with the private and Central Public Sector Units. TANGEDCO's collaboration with many CPSU is expected to meet the additional energy requirements to meet the ongoing and upcoming industrial requirements.

TANGEDCO owns and operates a number of thermal power stations in the state of Tamil Nadu now proposes to expand Ennore Thermal Power Station (1x660 MW) within the existing Ennore Thermal Power Station Complex of TANGEDCO in Tiruvottiyur Taluk, Thiruvallur district of Tamilnadu. Total land area required for the power plant is available at Ernavoor Village, Tiruvottiyur Taluk, Thiruvallur District within the existing Ennore Thermal Power Station Complex of TANGEDCO in Tiruvottiyur Taluk, Thiruvallur district of Tamil Nadu. The identified land for the power plant is free from resettlement and rehabilitation issues since it is expansion of existing plant.

As part of Corporate Social Responsibility, Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) has also intended to identify the needs of the communities living near the project site and to support them through a series of socio economic and infrastructure projects.

The Madras School of Social Work has been assigned with the task of carrying out a socio economic study and community needs assessment around 10 km radius from the plant area to arrive at the CSR plan for the Thermal Power Project.

2. Research methodology of the study

2.1 Objectives of the study

The main objective of the Socio Economic and Community Needs Assessment Study in the project area was to support the efforts of TANGEDCO in designing the Corporate Social Responsibility framework and socio economic programs in the study areas.

2.2 Focus of the Socio Economic Study

A Socio Economic Study was conducted covering 500 families for eliciting the socio economic status of the communities living in the villages and settlements within 10 kms radius of the plant site.

2.3 Focus of the Community Needs Assessment (CNA) Study

As part of the Socio Economic Study, a Community Needs Assessment (CNA) was conducted in the study areas. The Community Needs Assessment started at the grassroot with the maximum involvement of the local communities and groups. This process involved considerable time to arrive at a well-defined plan. It focused on the Community Action Plan preparation which was incorporated as part of the Village Level Framework Plan.

A CNA is an approach followed for collecting the data on the infrastructure, socio economic status of the communities and deficiencies in the services to formulate strategies to eliminate or considerably reduce it.

2.4 The purpose of the CNA study

- To collect first-hand information on the prevailing social situation in the project areas.
- To collect the perceptions on various dimensions of community needs by the primary as well as secondary stakeholders through Focus Group Discussions and individual interactions.
- Identify areas for capacity enhancement.
- To create a local level networking system for post- project management (Village level working group).

- To identify and interact with all stakeholders related to the users and service providers and related individuals/institutions.
- To enhance coordinated approaches to poverty reduction through converging Government and Civil Society Organizations.
- To generate information for TANGEDCO CSR partnerships and identify micro level interventions based on the prioritized activities.
- To strengthen the community's involvement and participation for better delivery mechanisms.

2.5 Objectives of Village Level Framework Plan (VLFP)

The primary objective of the Village Level Framework Plan is a bottom up roadmap focusing on the physical, social and economic requirements of the backward strata population living in rural and urban communities which require CSR interventions to improve their quality of life. Village Level Framework Plan will serve as a blueprint in convergent based delivery of services to the communities. Some of the key objectives of the plan are:

i To involve the local people in the preparation of a plan
ii To identify and prepare activities to address the issues and findings from CNA
iii To facilitate convergence of resources within and outside the Villages
iv To sensitize and enhancing the capacity of people through strategic planning
v To promote decentralized planning and make the plans relevant to local needs

2.6 Sampling selected for the study

[vii]

The sample size including the household interviews have been limited to 500 families. In addition to the households study, Key Informants interviews, field level focus group discussions, case studies and transect walks have been organized to get additional information to supplement the quality and quantity data on the community needs

3. Socio economic status of the respondents of project areas (Findings based on the sample household survey):

3.1 FISHERMEN AREAS

- The study revealed that 25.5% of the families represented Tiruvottiyur Kuppam followed by 20.3% of the families from AIR Colony and Ernavoor Kuppam, 13.5% of

families from K.V.K. Kuppam and 6.8% families each from Kattu Kuppam, Thazhan Kuppam and Mugathuvara Kuppam.

- 50% of the respondents belonged to Most Backward community, followed by 44.7 % of SC community.
- 59% of the households have a monthly family income from Rs.10001 to Rs.20000, followed by 30% up to Rs.10000 and 11% more than Rs.20000.
- It was inferred that 50% of the respondents had studied up to 10^{th} standard, 6% were illiterates, 26% up to 12^{th}Standard, 11% were Graduates, 3% were Post Graduates and 4% were ITI and Diploma holders.
- 75 per cent of the respondents were living in concrete houses (Pucca), 19% residing in Semi pucca houses and only 6% in kutcha houses
- It was established that 66% of the respondents lived in their own houses, 14% in rental houses and 20% in slum tenements.
- It was ascertained that 78% of the families were drawing water from Metro water (Lorries), 30% were using hand pumps and 2% had bore well facility.
- 86.4% of the respondents expressed that the water supply is inadequate and does not meet their demand and the remaining 13.4 % stated that it was adequate.
- Only 25.5% of the respondents expressed that the areas have adequate street lights and markets, followed by 94% with cemetery and burial ground, 91% with transportation, 82% with motorable roads, 40% with bus shelters and 60 % with community Hall.
- 52% of the respondents had availed loan from various sources. It was revealed that 48% had no debts. 12 % had availed loans for marriage purpose, 11.5% to meet medical expenses, 7% towards food expenditure, 7.5% for children's education, 6% for house construction and 3% to attend family rituals and festivals and 5% for other reasons.
- 48% of the respondents had not availed any loans. 20% had taken loans from SHGs and micro finance institutions, 15% borrowed from money lenders, 8% from relatives and friends, 4 % through private chits, 3% from Nationalised banks and 2% from private banks
- 49% of the respondents had no savings. 24% of the respondents saved through SHGs, 10% through Chit Fund, 8.6% were having postal savings and 8.4% through banks.
- It was found that 44% of the respondents in the study area are members of SHGs.

- It was ascertained that 100% of families were relying on Corporation Tricycles for solid waste disposal and management.
- 95% of the respondents' families own Fibre boats and 5% of them own trawlers.
- It was ascertained that 55.6% of the respondents face problems related to frequent damage to nets and hence unable to buy new nets due to financial constraints and 40.7% unable to bear the repairing and operation cost of equipment.
- Only 34% of the respondents have insured their fishing Equipment.
- Only 5% of the respondents have installed GPS in their Boats.
- 100% of the respondents are not satisfied with the dredging activities in the study area.
- 61% of the respondents listed fishing harbour as their priority need, followed by Jetty (24%) and Cold Storage (15%)
- For the employable skills 45.5% of the respondents (fisher youth -Men) are interested to undergo training in Assistant Vessel Driver course, followed by 28.5% for boat engine repairing, 15% for heavy vehicle driving and 10% for other employable skill development training courses.
- 32% of the respondents (Female members from fishing settlements) are interested to undergo training in online fish marketing, followed by Nursing (25%), Tailoring (21%), Catering & Hospitality (17%) and 5% in other job oriented training courses.

3.2 NON FISHERMEN AREAS

- The study revealed that 21.9% of the families are residing in AIR Nagar, 17% each from Raja Shanmugham Nagar and Ambedkar Nagar. 14.6% of families living in Nehru Nagar and 9.7% families each are residing in Thiruvallur Nagar, Annai Sivagami Nagar and Bharathiyar Nagar.
- 59% of the respondents belonged to Most Backward Community followed by SC with 24 %, 16% belongs to BC and FC 1%.
- It was found that 90.7% of the families were male headed and only 9.3% were female headed families.
- It was found that 19.5% of the households have a monthly family income up to Rs.10000, followed by 69.3% between Rs.10001 to Rs.20, 000 and 11.2% more than Rs.20, 000.
- 40% of the respondents had studied upto 10^{th} standard, 7% were illiterates, 14% upto 12^{th}Standard, 31% were Graduates, 6% Post Graduates and 2% were Diploma holders and I.T.I. course.

- 82% of the respondents were living in concrete houses and slum tenements, followed by 16% in semi pucca houses and only 2% in Katcha houses.
- 52% of the respondents were living in their own houses, 26% in rental houses and 22% in slum tenements.
- It was ascertained that 78% of the families were drawing water from Metro water, 30% were using hand pumps and 2% had bore well facility.
- 90% of the respondents expressed that the water supply is inadequate and does not meet their daily requirement and the remaining 10% stated that it was adequate.
- It was found that 58% of the respondents are not SHG members.42% of the respondents in the study area hold SHG Membership.
- 57% of the respondents had not availed any loans. 16% of them have borrowed from money lender, 12% from SHGs and micro finance institutions, 7% from relatives and friends, 5 % through private chits and 3% from banks.
- 69% of the respondents do not have the habit of savings. 12% of them save money through Chit Funds, 8% through SHG, 6% through postal savings and 5% through banks.
- 75.2 % of the respondents had not taken any insurance against Life and health coverage.
- It was ascertained that 100% of families were disposing solid waste through Corporation Tricycles.

4. Findings based on the stakeholder consultations:

Out of the 13 study areas, 7 are fishermen habitations. One of the study areas is Mugathuvara Kuppam is located on the Creek. The community during the Focus Group discussion felt that the carrying capacity of the river has reduced and it cannot perform it complete draining action, which means the area around would be waterlogged during the monsoon., they also added that their boats which is their main source of livelihood were drastically affected since the depth of the river has been reduced to minimum of 1 feet. It was also scientifically proved that the fish caught around Ennore contain toxic elements due to effluents released from adjacent factories, making the fish unfit for consumption.

They suggested that job oriented skill development training for the youth in vessel navigation and ornamental fish culture may be provided as an alternate livelihood options. They also requested the corporates to provide engines, and netting materials to the small fishermen in enhancing their livelihood. They also expressed that any further expansion or development of

factories surrounding the creek will endanger the aquatic species which will have a direct impact on the livelihood of fishermen community.

Some of the respondents from Thazhan Kuppam suggested that frequent dredging should be done to facilitate the boat movement and also installing boulders to prevent sea erosion. They were also of the opinion that the Ennore Coast may be developed as a tourism centre due to its unique features and the existing harbour may generate more employment opportunities for the fishermen who have seasonal employment. The Fishing community also felt that the local youth and eligible persons may be provided with jobs and other opportunities in industries and factories located in and around Ennore and also in upcoming industries.

They also expressed that the occurrence of regular oil spill has affected their livelihood to a great extent. Therefore such incidents should be prevented by the Government and industries in future by taking necessary precautions.

It is heartening to know that women of the fishing community are undergoing training in online marketing to cope up with the technology development in the marketing field.

Tamilnadu Slum Clearance Board has allotted 200 tenements to the transgender in AIR colony. During the discussion, it was expressed that they are still discriminated and not accepted by the neighbourhood community. They requested that special clinics exclusively for their gender may be run by Urban Health Centre once in a week.

The community requested for a Police outpost to handle the menace of drug trafficking which is affecting the youth and children.

Earlier, the fishing community used to venture into fishing everyday but, at present they could go once in 2 days due to depleted catch and dead fish. The attributed this situation due to release of effluents from industries and factories located in Ennore.

The local fishing community felt that consortium of industries in Ennore was conducting meetings to assess the livelihood needs of the fisherman community. At present, this activity has been ceased to exist. It has been also expressed by the Senior Scientist, (Centre for Marine Fishing Research Institute) Ennore coast is the most polluted, which affect the fish biological Resource enhancement. The Joint Director, Department of Fisheries, Government of Tamilnadu, expressed that there is an increase in the fishing vessels from 1000 to 2000 nos. in Chennai region in recent times and 40,000 households are depending on fishing for their livelihood.

Keeping the future vision of livelihood options, the women desired to acquire alternative skill development training courses in Tailoring and Embroidery, Beautician, Car Driving, Mobile servicing, Computer Training and Nurse aid.

The children of non-fishermen community belong to the under privileged category. It is viewed that scholarships may be provided to them to pursue their school education, impart job oriented skill development training and on the job training for them to work in the field which they desire.

5. Activities identified for the CSR projects in the study areas:

Village Level Framework plans were based on focus group discussions, community meetings and transect walks.

The Qualitative study and survey findings brought out the genuine needs of the selected villages as mentioned below in the study area by TANGEDCO. Details of area, sector- wise needs, required interventions a long term with budget and implementing mechanism are spelt out in the report.

The Study suggests the following sector wise interventions for implementing the CSR initiatives. Suitable modifications may be made by the TANGEDCO based on further consultation if it is required.

Sector wise budget for next five years:

S.N	Sector	Budget (in Rs)
1	Infrastructure	3,53,90,000
2	Livelihood	1,58,30,000
3	Skill Detraining	36,00,000
4	Education	10,00,000
5	Health	35,00,000
6	Environment	7,00,000
7	NGO interventions support	3,00,000
Total		**6,03,20,000**

6. Suggestions

i. Specialized agencies such as CMFRI, CIFNET, MSSRF and Department of Fisheries may collaborate to have special plans for enhancing the livelihood of fishing community in the Ennore coast by implementing innovative self-employment schemes and to cope up with the latest technology (Deep sea fishing, usage of electronic gadgets etc.)

ii. To install artificial reef in Ennore coast to increase fish breeding and catch.

iii. The district administration may take necessary steps by arranging interface session between fishing community and PSU of Ennore coast to review the environmental issues at frequent intervals.

iv. One of the headmistress of a nearby school suggested that vocational training can also be imparted to the school children, to compete in the job market in future. This need a serious consideration.

v. Most of the respondents of the non-fishing area expressed their views that infrastructure up gradation may be addressed on priority basis to enable them to have a quality living and reduce risk factors related to socio economic and environmental degradation.

vi. It is necessary to supplement and support for ensuring adequate quantity and quality of drinking water supply in all the study areas.

vii. TANGEDCO through its CSR monitoring cell suggested facilitate and coordinate with various Government Departments, Educational institutions and Non-Governmental Organizations to impart skill training courses in all the study areas.

viii. To create awareness and support in conservation of water and also the importance of rain water harvesting among the community.

ix. It is also suggested that TANGEDCO may establish a special out sourced cell to conduct Pre Funding appraisals, stakeholders' involvement in CSR interventions, monitor the CSR initiatives, and act as a link between the community and TANGEDCO for fulfilling the objectives of CSR initiatives. This proposed CSR cell would help the interventions and enhance the branding of TANGEDCOs CSR interventions.

7. Conclusion

Ennore and its neighbourhood areas are surrounded by several of Public Sector Undertakings and Private Industrial Units. PSUs like NTPL, NPCL, KPL, IOC (bottling unit), Balmier &Laurie and CPCL have been initiating CSR activities by assessing community needs and implementing CSR interventions under various sectors such as water and sanitation, infrastructure to the Educational Institution and community, Women's Empowerment Environment /Green Cover Development and Sustainable Livelihood by spending huge funds.

Ashok Leyland, a private industrial unit also initiated CSR projects in Ennore neighbourhood. Inspite of the above CSR interventions, fishing community in and around Ennore is affected severely due to increased release of effluents resulted in the depletion of fish resource. Hence they are forced for to look for alternative source of livelihood. They also felt that steps may be taken to protect the environment at Ennore by regulating industrial pollution and control, infrastructure development for sustainable livelihood of fishermen, which has been followed for generation as a traditional occupation.

TANGEDCO through the commissioning of the power project must address the water issue in Ennore. TANGEDCO may also take steps to protect the environment in the Ennore coast by prioritising greenery initiatives. One of the major grievances of the inhabitants of Ennore coast is that TANGEDCO may consider sustainable development goals which will have a visible impact in the sectors of Water, Sanitation, Environment Protection and Livelihood support.

It is also suggested that TANGEDCO may establish a special cell to monitor the CSR initiatives and act as a link between the community and TANGEDCO for fulfilling the objectives of CSR initiatives and mutual benefits.

****

Chapter-1

General Overview of CSR activities in India and in Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)

1. CSR in India

CSR in India has traditionally been seen as a philanthropic activity. And in keeping with the Indian tradition, it was an activity that was performed, but not deliberated. As a result, there is limited documentation on specific activities related to this concept. However, what was clearly evident is that, much of this had a national character encapsulated within it, by endowing institutions to actively participating in India's freedom movement, and embedded in the idea of trusteeship.

The practice of CSR in India still remains within the philanthropic space, but has moved from institutional building (Educational, Research and Cultural) to community development through various global influences and with communities becoming more active and demanding. While CSR remains largely restricted to community development, it is getting more strategic in nature (that is, getting linked with business) than philanthropic, and a large number of companies are reporting the activities in their Official Websites, Annual Reports and publishing CSR activities in leading Journals.

The Companies Act, 2013 has introduced the idea of CSR to the forefront and is promoting greater transparency and disclosure. Schedule VII of the Act, which lists out the CSR activities suggests communities to be the focal point. On the other hand, by discussing a company's relationship to its stakeholders and integrating CSR into its core operations, the draft rules suggest that CSR needs to go beyond communities and beyond the concept of philanthropy. It will be interesting to observe the ways in which this will translate into action at the ground level, and how the understanding of CSR is set to undergo a change. The new guidelines, which have replaced two existing separate guidelines on CSR and Sustainable Development, issued in 2010 and 2011 respectively, mentions the following: "Since Corporate Social Responsibility and Sustainability are so closely entwined, it can be said that Corporate Social Responsibility and Sustainability is a company's commitment to

its stakeholders to conduct business in an economically, socially and environmentally sustainable manner that is transparent and ethical."

1.1 CSR and Sustainability

CSR in India tends to focus on what is done with profits after they are made. On the other hand, sustainability is about factoring the social and environmental impacts of conducting business, that is, how profits are made. Hence, much of the Indian practice of CSR is an important component of sustainability or responsible business, which is a larger idea, a fact that is evident from various sustainability frameworks. The Act encourages companies to spend at least 2% of their average net profit in the previous three years on CSR activities. The Act lists out the following activities viz., I. Promotion of education, ii. Eradication of extreme hunger and poverty iii. Reducing child mortality and improving maternal morbidity, iv. Gender equity and women empowerment v. Combating HIV/AIDs, malaria and other diseases vi. Environmental Sustainability vii. Social Business projects viii. Employment enhancing vocational training ix. Contributions to PM's relief funds etc are eligible under CSR, taking the local conditions under consideration after the approval of the Board.

1.2 Benefits of a robust CSR programme

As the business environment gets increasingly complex and stakeholders become vocal About their expectations, best CSR practices can bring in greater benefits, viz;
i. Communities provide the license to operate ii. Attracting the retaining employees and iii. Communities as suppliers.

1.3 Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO)

Established in 1957, Tamil Nadu Electricity Board (TNEB) is now the largest vertically integrated power utility in the country with an installed generating capacity of 10,098 MW. TNEB ranks No.1 in India and 4th globally in wind power generation. It is also one of the best performing power utilities in the country with lowest AT&C losses of 18% and the highest revenue collection of 99%.Celebrating its Golden jubilee, TNEB is poised towards a powerful future.

Thus Tamil Nadu is blessed with many partnerships in power generation with the private, Central Public Sector units and TANGEDCO, which would turn the wheels of many industries which are power starved today due to frequent power cuts. Tamil Nadu Generation

and Distribution Corporation Ltd (TANGEDCO) is a unit of TNEB takes care of the infrastructure relating to the power generation and distribution of power to the state.

TANGEDCO owns and operates a number of thermal power stations in the state of Tamil Nadu now proposes to set up a coal based thermal station within the existing ETPS power station complex of TANGEDCO in Tiruvottiyur Taluk, Thiruvallur district of Tamilnadu. Tot al land area required for the Thermal Power Plant is available at Ernavoor Village, Tiruvottiyur Taluk, Thiruvallur District within the existing Ennore Thermal Power Station Complex of TANGEDCO in Tiruvottiyur Taluk Thiruvallur district of Tamil Nadu. The Identified land for the power plant is free from resettlement a rehabilitation issues since it is e xpansion of existing plant. As part of Corporate Social Responsibility Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) has also intended to identify the needs of the communities living near the project site and to support them through a series of Socio economic and infrastructure projects.

The Madras School of Social Work has been assigned with the task of carrying out a socio economic study and community needs assessment around 10 km radius from the plant area to arrive at the CSR plan for the Thermal Power Project.

2.1 Madras School of Social Work

The Madras School of Social Work was founded in 1952 by Mary Clubwala Jadhav, under the auspices of Madras State Branch of the Indian Conference of Social Work (later renamed as Indian Council of Social Welfare) and the Guild of Service (Central). The College is run under the aegis of the Society for Social Education and Research.

It is a member of the Association of Schools of Social Work in India and the Asian Pacific Association of Social Work Education and is also an affiliate of International Association of Schools of Social Work. Madras School of Social Work is an autonomous college affiliated to the University of Madras. The School offers various Under-graduates, Post Graduate courses and Doctoral degrees.

2.1.1 Consultancy Division

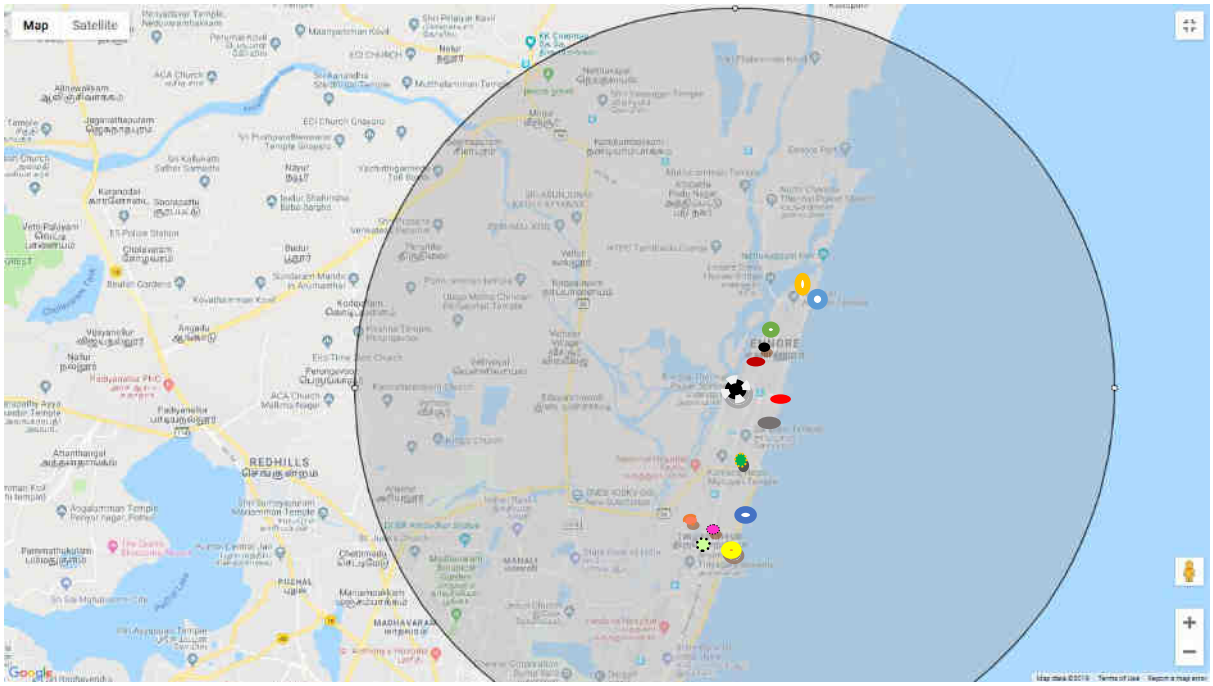
MSSW has established an exclusive Division for extending Consultancy services to Government Departments, Public and Private sector undertakings and Non-Governmental and International NGOs. The specific assignments include evaluation studies, monitoring, CSR investment plans, needs assessment and other institution based tasks on the social and environmental issues. The Consultancy Division has a core team of professionals representing the specialised areas viz., social, environmental, management, and training and research fields. The Institution has adequate infrastructure to carry out the consultancy projects.

****

CHAPTER– II

METHODOLOGY ADOPTED FOR CONDUCTING THE SOCIO ECONOMIC STUDY FOR ON-GOING ETPS EXPANSION THERMAL POWER PROJECT (1*660MW)

The ETPS Expansion TPP (1x 660 MW) site comes under the revenue administration of Tiruvottiyur Taluk of Thiruvallur district.



SN	Area Name
1	Ennore Thermal Power Station
2	Tiruvottiyur Kuppam
3	Kattu Kuppam
4	Thazan Kuppam
5	Mugadhuvara Kuppam
6	K.V. Kuppam
7	AIR Colony
8	Ernavoor Kuppam
9	Nehru Nagar
10	Annai Sivagami Nagar
11	Raja Shanmugam Nagar
12	Bharathiyar Nagar
13	Ambedkar Nagar
14	Thiruvallur Nagar

2. TANGEDCO and CSR focus for the present study

2.1 The objectives of the study

The main objective of the Socio Economic and Community Needs Assessment Study in the project area was to support the efforts of TANGEDCO in designing the Corporate Social Responsibility framework and socio economic programs in the study areas comprising of 10 km radius from the plant site surrounding the Thermal Power Project at Tiruvottiyur Taluk, (now under Tiruvottiyur), Thiruvallur District.

Community Needs Assessment Study was proposed in the following three stages:

i Socio Economic survey of the study areas.
ii Community Needs Assessment
iii Preparation of Corporate Social Responsibility Plan.

2.2 Focus of the Socio Economic Study

A Socio Economic Study was conducted covering 500 families for eliciting the socio economic status of the communities living in the villages and settlements within 10 km. radius of the plant site.

2.3 Focus of the Community Needs Assessment (CNA) Study

As part of the Socio Economic Study, a Community Needs Assessment (CNA) was conducted in the study areas. The Community Needs Assessment started at the grassroot with the maximum involvement of the local communities and groups. This process involved considerable time to arrive at a well-defined plan. It focused on the Community Action Plan preparation which was incorporated as part of the Village Level Framework Plan.

A CNA is an approach followed for collecting the data on the infrastructure, socio economic status of the communities and deficiencies in the services to formulate strategies to eliminate or considerably reduce it. The CNA explored the following areas:

- Poverty, vulnerability and relative well-being in rural poor communities.
- Livelihood strategies of the poor.
- Gender dimensions in the community.
- What people in poor communities see as the most important problems and concerns in their lives at present, how these have changed over the past few years, and expectations for change in the future.(Timeline analysis)

- Access to, quality and relevance of services (health, education, water/sanitation, housing, transport, agricultural support, justice and information.
- Local governance structures and strategies for supplementing the service delivery.
- Awareness levels among secondary stakeholders – Government, NGOs and other CBOs about key needs and interests of the poor and assessment of mechanisms to address them.

2.4 The purpose of the CNA study

- To collect first-hand information on the prevailing social situation in the project areas.
- To collect the perceptions on various dimensions of community needs by the primary as well as secondary stakeholders through Focus Group Discussions and individual interactions.
- Identify areas for capacity enhancement.
- To create a local level networking system for post- project management (Village level working group).
- To identify and interact with all stakeholders related to the users and service providers and related individuals/institutions.
- To enhance coordinated approaches to poverty reduction through converging Government and Civil Society Organizations.
- To generate information for TANGEDCO CSR partnerships and identify micro level interventions based on the prioritized activities.
- To strengthen the community's involvement and participation for better delivery mechanisms.

2.5 Sources of Data

The primary data included the responses from the beneficiaries and secondary stakeholders elicited through quantitative and qualitative methods referred above. Secondary data consists of the reports and documents pertaining to the community, socio economic indicators and the Government's interventions.

2.6 Sampling selected for the study

The study area comprises of 10 km radius from the plant site surrounding the Thermal Power Project at Tiruvottiyur Taluk, Thiruvallur District.

i. The sample size including the household interviews have been limited to 600 families. In addition to the households study, Key Informants interviews, field level focus group discussions, case studies and transect walks have been organized to get additional information to supplement the quality and quantity data on the community needs.

ii. A sample of 500 household interview schedules in the surrounding villages has been covered to assess their socio economic situation.

iii. Key informants Interview guide: 30 Key Informants interviews used to elicit information from NGOs, officials from Urban and Rural Local Bodies and elected representatives, Presidents of the SHGs, President of the Village level association, BDO, President GP, Ward member GP, ICDS Teacher, School Headmaster/Head mistress. This would facilitate in analysing needs of the communities.

iv. Focus Group Discussion: FGD were conducted with Women, Self Help Groups, Village level committee, School children and Residents Welfare Associations in the study areas (20 Nos).

v. Case Studies: A total of 10 case studies of people's endeavours contributing towards improving the quality of life have been presented.

vi. Transect walk: Transect walk and mapping exercise have been undertaken by the research team to highlight the water bodies, health, educational and community infrastructure facilities.

2.7 Samples covered for the CNA Study

S.N	Application of Tools	Samples
1	Household interview schedule	500
2	Key informants Interview guide	40
3	Focus Group Discussion	22
4	Case Studies	4
5	Transect walk	Each study site

S.N	Area wise Household interviews	
	Area	**Sample Size**
1	Tiruvottiyur Kuppam	75
2	Kattu Kuppam	20
3	Thazan Kuppam	20
4	Mugadhuvara Kuppam	20
5	K. V. Kuppam	40
6	AIR Colony	105
7	Ernavoor Kuppam	60
8	Nehru Nagar	30
9	Annai Sivagami Nagar	20
10	Raja Shanmugam Nagar	35
11	Bharathiyar Nagar	20
12	Ambedkar Nagar	35
13	Thiruvallur Nagar	20
Total		**500**

2.8 Study process

The study team received orientation and training in the research methodology, tools and techniques and Community Needs Assessment (CNA) and reporting formats with specific reference to Thermal Power Project.

The primary data, analysis of villagers' well-being, priorities and problems, issues of poverty and vulnerability, gender relations, social and physical infrastructure, livelihood, institutions' role, direct impact of the project on the community, families and persons were carried out by the team involving the Community Animators and Field Investigators.

2.9 Village Level Framework Plan

The Village Level Framework Plan (VLFP) is a comprehensive plan for the social and human development of rural and urban areas that has to be resolved through appropriate intervention strategies. The Village Level Framework Plan has been prepared based on the Socio Economic study, outcome of Community Needs Assessment, related research works, studies and data available from secondary sources.

2.9.1 Objectives of Village Level Framework Plan (VLFP)

The primary objective of the Village Level Framework Plan is a bottom up roadmap focussing on the physical, social and economic requirements of the backward strata population living in rural and urban communities which require CSR interventions to improve their quality of life. Some of the key objectives of the plan are:

viii To involve the local people in the preparation of a plan
ix To identify and prepare activities to address the issues and findings from CNA
x To facilitate convergence of resources within and outside the Villages
xi To sensitize and enhancing the capacity of people through strategic planning
xii To promote decentralized planning and make the plans relevant to local needs

Reduction in poverty and vulnerability of the rural poor cannot be reduced by provision of environmental infrastructure. Social and economic inputs are the key factors to reduce their high risk factors which are hindrance for their development. Thus Village Level Framework Plan will serve as a blueprint in convergent based delivery of services to the communities.

2.10 Thematic areas studied for the Village Level Framework Plan

The following thematic areas have been studied in each village to prepare the Village Level Framework Plan.

i. Family profile, Socio economic dimensions and Vulnerability.
ii. Housing and household infrastructure facilities with special reference to electricity, water and sanitation, roads etc.
iii. Public utility, community infrastructure for Education, Health Infrastructure and Livelihood.
iv. Cultural and recreational and environmental facilities such as avenue trees, parks, playground, temples etc.
v. Youth clubs, Village committees, CBOs, SHGs etc.
vi. Issues related to environment.

****

CHAPTER – III

PROFILE OF THE PROJECT AREAS

NON FISHING AREAS

3.1. All India Radio Nagar (Mixed – Fishing & Non Fishing Area)

AIR Nagar Scheme is one of the Resettlement and Rehabilitation schemes developed by Tamilnadu Slum Clearance Board. A total of 5996 Project Affected families have been rehabilitated by providing housing, infrastructure and socio economic facilities. The following basic infrastructure facilities have been provided.

S.N	Facility	No
i.	Urban Health Centre	1
ii.	Parks	14
iii.	Schools	2
iv.	Anganwadi Centres	9
v.	Community Centre	1
vi.	Petty shops provided by TNSCB	120

The inhabitants of this area belong to cross section of communities such as fishermen, Dalits, Muslims and Christians. Most of them work as casual and fishing labourers.

3.2 Annai Sivagami Nagar

Annai Sivagami Nagar is located between Ennore Beach Road and Bay of Bengal in Corporation division 5 of Zone 1. It is situated in north eastern direction of Ramakrishna Nagar in Tiruvottiyur. Indira Gandhi Kuppam is situated in the eastern side of Annai Sivagami Nagar.The residents of Annai Sivagami Nagar are mostly Burma repatriates with a total population of 10,902 persons. The basic infrastructure facilities available are

I. 5 ICDS Centres
II. Library

III. Market
IV. Community hall
V. Primary School
VI. Government High School &Sahaya Madha High School

The immediate need of the area is repairing and renovating of the existing Government High School.

3.3 Bharathiyar Nagar

Bharathiyar Nagar is located on the western side of Ennore Beach road and Tiruvottiyur flyover which leads to Manali. It is located in Corporation Division 5 of Zone I. It is situated on the Eastern side of AIR Resettlement and rehabilitation scheme developed by Tamil Nadu Slum Clearance Board. Two ICDS centres are functioning in this area. The total population is 1547 and people are engaged in multi various occupations. There are around 2000 non-fishing families in the Bharathiyar Nagar. The people living in this area belong mostly to the MBC community. Bharathiyar Nagar is comparatively well organised and maintained well than the other areas.

3.4 Thiruvallur Nagar

Thiruvallur Nagar has 200 to 250 families in which the people belong to the non-fishermen community. People living in Thiruvallur Nagar are mostly daily wage earners. Thiruvallur Nagar has 2 streets and it is well maintained and organised area which does not have major problems which requires immediate attention.

3.5 Ambedkar Nagar and Raja Shanmugam Nagar

Ambedkar Nagar and Raja Shanmugam Nagar are located in Zone 1 of GCC. There are 8 streets with 750 families. The inhabitants are living in this area nearly for 40 years and 70% of the families belong to dalit community. The local welfare association is very active and has taken various initiatives to provide and solve the issues relating to inhabitation viz., issue of drainage and drinking water supply.

3.6 Nehru Nagar

Nehru Nagar is a non fishermen area inhabited by 485 families belonging to MBC, SC and BC community are living pucca houses. There is an immediate need for Primary Health Centre caters to the health needs of the people.

II. FISHERMEN AREAS

3.7 Tiruvottiyur Kuppam

Tiruvottiyur Kuppam is situated in Ward No. 9. It has 1100 households. Most of the inhabitants belong to fishermen community. This area was affected by Tsunami and frequent occurrence of sea erosion. It has one primary school, 4 Anganwadi Centres and community hall built with the support of a corporate company.

3.8 Thazhan Kuppam

No .of households: 300

Type of houses: Huts, Tiled and thatched roof

The area is located in Ward No. 3 of Tiruvottiyur Corporation. Most of the inhabitants are fishermen. The basic infrastructure available is

1. The fish market has 37 retail shops.
2. Primary school with strength of 125 children
3. Anganwadi Centre with 25 children
4. Road facility are adequate and well connected by the share autos

The following community needs are needed to improve their quality of lives.

1. Public Toilet to be renovated.
2. Drinking water supply
3. Need Groynes to avoid sea erosion
4. Skill training for local youth

3.9 Mugathuvara Kuppam

No of households: 300

Type of houses: tiled and thatched roof (20 Nos)

The area is located in Ward No.3, Tiruvottiyur zone of Corporation and the inhabitants are fishermen. The existing basic facilities are

1. Primary school with strength of 75 children
2. Adequate Water supply
3. Road connectivity

The community needs the following to improve their quality of lives.

1. Public Toilet needs to be renovated.
2. New building for ICDS centre.
3. Desilting of river
4. Skill training for youth

3.10 Kasi Viswanathar Koil Kuppam

- City Corporation Ward 3, Tiruvottiyur Zone
- No .of households: 220
- Occupation: Fishing

19 Fishing vessels are owned by the people. Due to mechanized boats in operation and around the fishing area, the people using country boat fetch less fish, which has affected their livelihood. The community needs identified are drinking water, skill training and construction of household toilets.

3.11 Ernavoor Kuppam

The area has 200 families, who mostly belong to fishermen and the area has mixed caste population. The area has three streets (Amman Koil Street, Bhajanai Koil Street, and Periyamman Koil Street).The area's priority is drinking water supply. The ground water is salty in nature due to seas coast, which is used for other household chores. It was shared by the people that an industry located adjacent to the area has been tapping water from this area, resulting in scarcity to the families. The area has vacant sites which can be used for the construction of Primary Health Centre, since the people have to talk 5 kms to avail has to travel up to 5 km to visit a hospital.

3.12 Kattu Kuppam

The area is located in Zone 1 of GCC. Kattu Kuppam has 500 households. Their prime occupation is fishing. They work as labour in fishing boats. The ICDS centre needs renovation, skill training in Tailoring, Nursing Assistant, Boat engine repairing, Car driving for women and youth may be imparted.

****

CHAPTER IV

SOCIO ECONOMIC STATUS OF THE RESPONDENTS OF PROJECT AREAS

This chapter covers the Socio economic characteristics of sampled households and the physical infrastructural status of the area.

4. FISHERMEN AREAS

4.1.1 AREAWISE DISTRIBUTION OF HOUSEHOLDS

S.N	Area	Frequency	Percentage
1	Tiruvottiyur Kuppam	75	25.5
2	Kattu Kuppam	20	6.8
3	Thazhan Kuppam	20	6.8
4	Mugadhuvara Kuppam	20	6.8
5	K.V.K. Kuppam	40	13.5
6	AIR Colony	60	20.3
7	Ernavoor Kuppam	60	20.3
Total		**295**	**100**

The study revealed that 25.5% of the families represented Tiruvottiyur Kuppam followed by 20.3% of the families from AIR Colony and Ernavoor Kuppam, 13.5% of families from K.V.K. Kuppam and 6.8% families each from Kattu Kuppam, Thazhan Kuppam and Mugathuvara Kuppam.

4.1.2RELIGIONWISE DISTRIBUTION OF RESPONDENTS

Religion	Frequency	Percentage
Hindus	252	85.4
Christian	40	13.5
Others	3	1.1
Total	**295**	**100**

It was ascertained that majority of 85.4% of the respondents were Hindus, followed by Christians with 13.5% and others 1.1%

4.1.3 CASTEWISE DISTRIBUTION OF RESPONDENTS

Caste	Frequency	Percentage
BC	15	5.3
MBC	148	50
SC	132	44.7
Total	**295**	**100.0**

The above table shows that 50% of the respondents belonged to Most Backward community, followed by 44.7 % of SC community.

4.1.4 DISTRIBUTION OF SEXWISE HEAD OF THE HOUSEHOLD

Sex	Frequency	Percent
Female	40	13.5
Male	255	86.5
Total	**295**	**100.0**

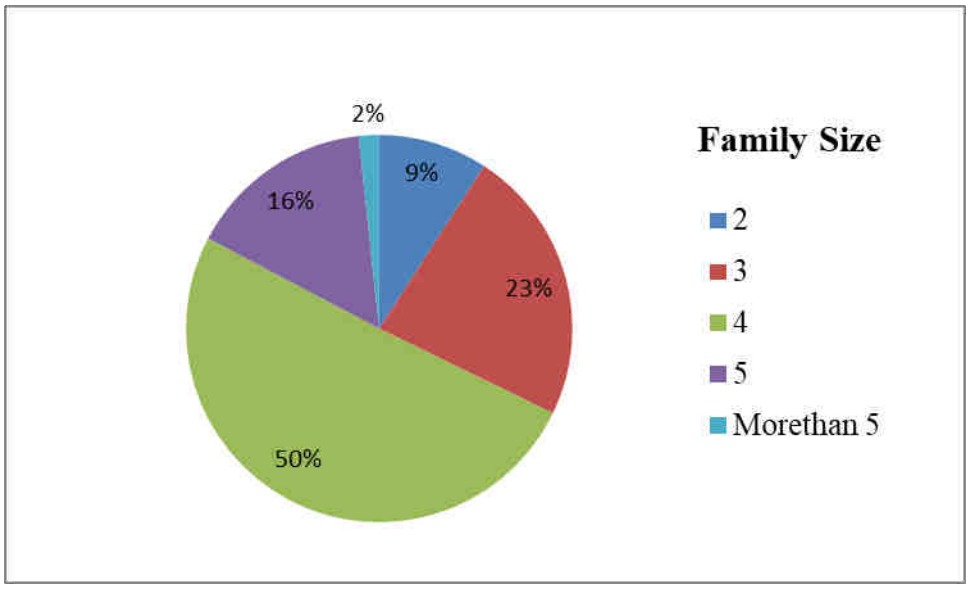
It was disclosed that majority of 86.5% of the families were male headed and 13.5% were female headed families.

4.1.5 DISTRIBUTION OF RESPONDENTS ACCORDING TO FAMILY INCOME

Family Income	Frequency	Percentage
Up to Rs.10000	88	30
Rs.10001 to 20000	175	59
More than Rs.20000	32	11
Total	**295**	**100**

It was found that 59% of the households have a monthly family income from Rs.10001 to Rs.20000, followed by 30% up to Rs.10000 and 11% more than Rs.20000 respectively.

4.1.6 DISTRIBUTION OF RESPONDENTS ACCORDING TO FAMILY SIZE

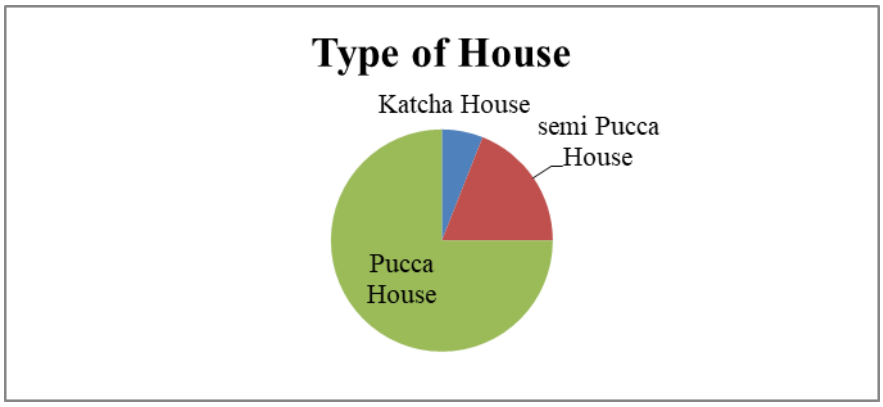


It was disclosed that 50% of the respondents had a family size of 4 members, followed by 23% with 3 members, 16% with 5 members, 9% with 2 members, and 2% with more than 5. From the above, it is concluded that the concept of larger family is on decline.

4.1.7 EDUCATIONAL STATUS OF THE RESPONDENTS

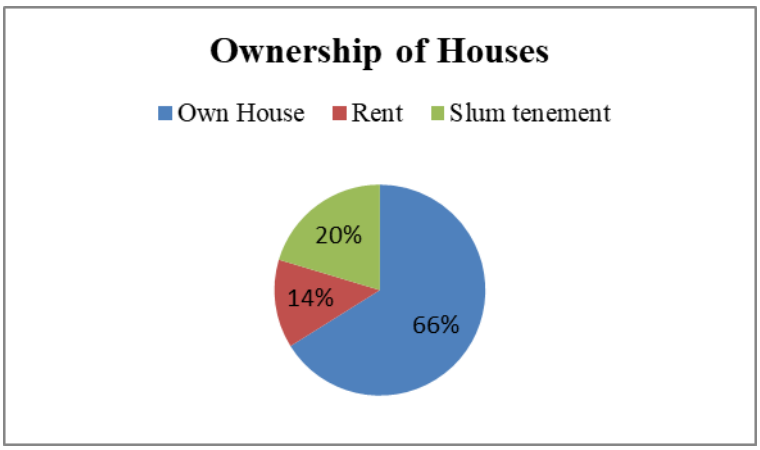
It was inferred that 50% of the respondents had studied up to 10th standard, 6% were illiterates, 26% upto 12thStandard, 11% were Graduates, 3% were Post Graduates and 4% were ITI and Diploma holders.

4.1.8 DISTRIBUTION OF RESPONDENTS ACCORDING TO THE TYPE OF HOUSING



A majority of 75 per cent of the respondents were living in concrete houses (Pucca), 19% residing in Semi Pucca houses and only 6% in Katcha houses.

4.1.9 DISTRIBUTION OF RESPONDENTS ACCORDING TO OWNERSHIP OF HOUSES



It was established that 66% of the respondents lived in their own houses, 14% in rental houses and 20% in slum tenements.

4.1.10 DISTRIBUTION OF RESPONDENTS WITH SOURCE OF WATER SUPPLY

It was ascertained that 78% of the families were drawing water from Metro water (Lorries), 30% were using hand pumps and 2% had bore well facility.

4.1.11 DISTRIBUTION OF RESPONDENTS ACCORDING TO ADEQUACY OF WATER SUPPLY

86.4% of the respondents expressed that the water supply is inadequate and does not meet their demand and the remaining 13.4 % stated that it was adequate.

4.1.12 AVAILABILITY OF BASIC INFRASTRUCTURE FACILITIES

Only 25.5% of the respondents expressed that the areas have adequate street lights and markets, followed by 94% with cemetery and burial ground, 91% with transportation, 82% with motorable roads, 40% with bus shelters and 60 % with community Hall.

4.1.13 DISTRIBUTION OF RESPONDENTS ACCORDING TO DEBT/LOAN

Response	Frequency	Percent
Yes	153	52
No	142	48
Total	**295**	**100**

52% of the respondents had availed loan from various sources.

4.1.14 DISTRIBUTION OF RESPONDENTS ACCORDING TO THE REASONS FOR AVAILING LOANS

Purpose of Loan	Frequency	Percentage
Food Expenses	20	7
Health	34	11.5
Children's Education	22	7.5
Marriage	36	12
House Construction	15	6
Festival/Social Functions	10	3
Others	16	5
No Debt	142	48
Total	**295**	**100**

It was revealed that 48% had no debts. 12 % had availed loans for marriage purpose, 11.5% to meet medical expenses, 7% towards food expenditure, 7.5% for children's education, 6% for house construction and 3% to attend family rituals and festivals and 5% for other reasons.

4.1.15DISTRIBUTION OF RESPONDENTS ACCORDING TO SOURCE OF LOAN

Source of loan availed	Frequency	Percentage
No loans availed	142	48
SHGs & Micro Finance institutions	58	20
Nationalised Banks	10	3
Money Lenders	45	15
Private Chit	12	4
Private Banks	5	2
Relatives and Friends	23	8
Total	**295**	**100**

48% of the respondents had not availed any loans. 20% had taken loans from SHGs and micro finance institutions, 15% borrowed from money lenders, 8% from relatives and friends, 4 % through private chits, 3% from Nationalised banks and 2% from private banks.

4.1.16 DISTRIBUTION OF RESPONDENTS ACCORDING TO SOURCE OF SAVINGS

Savings Source	Frequency	Percentage
Bank	25	8.4
SHG	70	24
Chit fund	30	10
Postal Saving	25	8.6
No saving	145	49
Total	**295**	**100**

49% of the respondents had no savings. 24% of the respondents saved through SHGs, 10% through Chit Fund, 8.6% were having postal savings and 8.4% through banks.

4.1.17 DISTRIBUTION OF RESPONDENTS ACCORDING TO INSURANCE COVERAGE

Insurance Coverage	Frequency	Percentage
Yes	37	12.5
No	258	87.5
Total	**295**	**100**

87.5% of the respondents had not taken any insurance against Life and health coverage.

4.1.18 DISTRIBUTION OF RESPONDENTS ACCORDING TO MEMBERSHIP IN SHGS

It was found that 44% of the respondents in the study area are members of SHGs.

4.1.19 DISTRIBUTION OF RESPONDENTS ACCORDING TO GARDENING

Gardening	Frequency	Percentage
Yes	15	5
No	280	95
Total	**295**	**100**

It was found that only 5% of the respondents are engaged gardening activities.

4.1.20 DISTRIBUTION OF RESPONDENTS ACCORDING TO AWARENESS LEVEL OF NON-CONVENTIONAL ENERGY SOURCES

Non-Conventional Energy Sources	Frequency	Percentage
Solar Energy for household purpose	50	17
Solar Energy for Street Light	245	83
Total	**295**	**100**

83% of the respondents were interested towards the use of non-conventional energy through solar streets lights.

4.1.21 DISTRIBUTION OF RESPONDENTS ACCORDING TO MODE OF DISPOSAL OF SOLID WASTE

Disposal of Solid Waste	Frequency	Percentage
Corporation Tricycle	295	100
Total	**295**	**100**

It was ascertained that 100% of families were relying on Corporation Tricycles for solid waste disposal and management.

4.1.22 DISTRIBUTION OF RESPONDENTS ACCORDING TO STATUS OF RAIN WATER HARVESTING

Status of Rain Water Harvesting	Frequency	Percentage
Yes	5	1.7
No	290	98.3
Total	**295**	**100**

The above table revealed that 98.3% of the respondents' houses do not have rain water harvesting facility.

4.1.23 AVAILABILITY OF BOATS

Availability of Boats	Frequency	Percentage
Vessel	15	5
Fibre Boats	280	95
Total	**295**	**100**

95% of the respondents' families own Fibre boats and 5% of them own trawlers.

4.1.24 USAGE OF EQUIPMENT

Usage of Equipment	Frequency	Percentage
Yes	160	54.3
No	135	45.7
Total	**295**	**100**

54.3% of the respondents are using fishing related equipments regularly.

4.1.25 REASON FOR NON-USAGE OF EQUIPMENT

Reason	Frequency	Percentage
Repairs	55	40.7
Unable to Maintain	5	3.7
Unable to replace nets	75	55.6
Total	**135**	**100**

It was ascertained that 55.6% of the respondents face problems related to frequent damage to nets and hence unable to buy new nets due to financial constraints and 40.7% unable to bear the repairing and operation cost of equipment.

4.1.26 INSURANCE OF FISHING EQUIPMENT

Insurance of Fishing Equipment	Frequency	Percentage
Yes	100	34
No	195	66
Total	**295**	**100**

The above table shows that only 34% of the respondents have insured their fishing Equipment.

4.1.27 GPS

GPS	Frequency	Percentage
Yes	15	5
No	280	95
Total	**295**	**100**

Only 5% of the respondents have installed GPS in their Boats.

4.1.28 DREDGING ACTIVITY

100% of the respondents are not satisfied with the dredging activities in the study area.

4.1.29 PRIORITY NEEDS OF FISHERMAN

Fishermen Needs	Frequency	Percentage
Jetty	70	24
Fishing Harbour	180	61
Cold Storage	45	15
Total	**295**	**100**

61% of the respondents listed fishing harbour as their priority need, followed by Jetty (24%) and Cold Storage (15%)

4.1.30 SKILL DEVELOPMENT TRAINING FOR MEN

Skill Training for Men	Frequency	Percentage
Assistant Vessel Driver	134	45.5
Boat Engine Repair Training	84	28.5
Heavy Vehicle driving	45	15
Others	32	11
Total	**295**	**100**

The above table highlights the employable skills preferred by youth (Men). 45.5% of the respondents are interested to undergo training in Assistant Vessel Driver course, followed by 28.5% for boat engine repairing, 15% for heavy vehicle driving and10% for other employable skill development training courses.

4.1.31SKILL TRAINING FOR (WOMEN)

Skill Training for youth (women)	Frequency	Percentage
Online Fish Marketing	93	32
Tailoring	63	21
Catering &Hospitality	51	17
Nursing	74	25
Others	14	5
Total	**295**	**100**

32% of the respondents are interested to undergo training in online fish marketing, followed by Nursing (25%), Tailoring (21%), Catering & Hospitality (17%) and 5% in other job oriented training courses.

4.2 NON FISHERMEN

4.2.1 AREA WISE DISTRIBUTION OF HOUSEHOLDS

S.N	Area	Frequency	Percentage
1	Nehru Nagar	30	14.6
2	Annai Sivagami Nagar	20	9.7
3	AIR Nagar	45	21.9
4	Raja Shanmugam Nagar	35	17
5	Bharathiyar Nagar	20	9.7
6	Ambedkar Nagar	35	17
7	Thiruvallur Nagar	20	9.7
Total		**205**	**100**

The study revealed that 21.9% of the families are residing in AIR Nagar, 17% each from Raja Shanmugham Nagar and Ambedkar Nagar. 14.6% of families living in Nehru Nagar and 9.7% families each are residing in Thiruvallur Nagar, Annai Sivagami Nagar and Bharathiyar Nagar.

4.2.2 RELIGIONWISE DISTRIBUTION OF RESPONDENTS

Religion	Frequency	Percentage
Hindu	165	80
Christian	28	14
Others	12	6
Total	**205**	**100**

It was revealed that 80% of the respondents were Hindus, 14% Christians and others 6%

4.2.3 CASTEWISE DISTRIBUTION OF RESPONDENTS

Caste	Frequency	Percentage
FC	3	1
BC	33	16
MBC	120	59
SC	49	24
Total	**205**	**100**

The above table that 59% of the respondents belonged to Most Backward Community. Followed by SC with 24 %, 16% belongs to BC and FC 1%.

4.2.4 DISTRIBUTION OF SEXWISE HEAD OF THE HOUSEHOLD

Head of the Household	Frequency	Percentage
Male	185	90.7
Female	20	9.3
Total	**205**	**100**

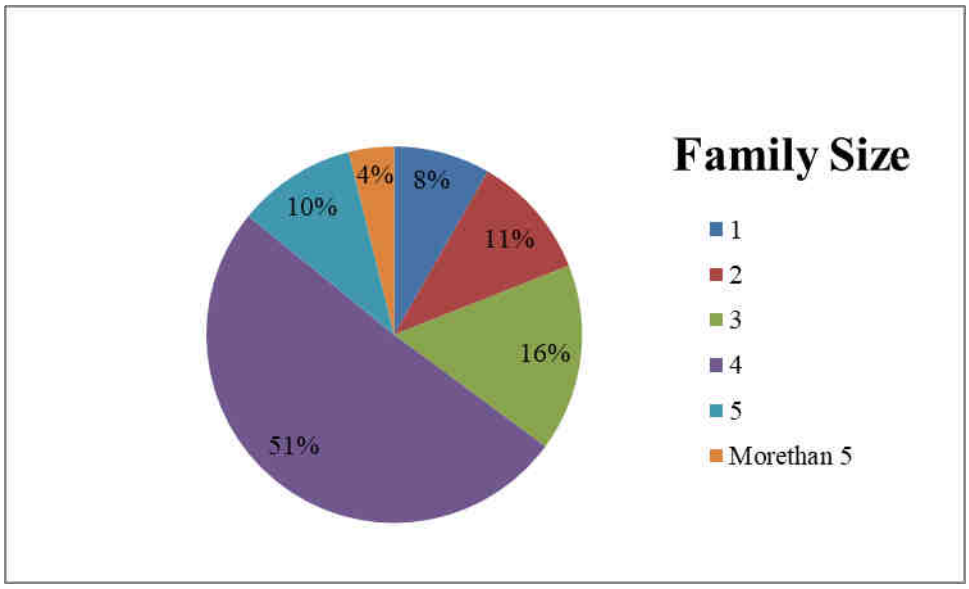
It was found that 90.7% of the families were male headed and only 9.3% were female headed families.

4.2.5 DISTRIBUTION OF RESPONDENTS ACCORDING TO FAMILY INCOME

Family Income	Frequency	Percentage
Upto Rs.10000	40	19.5
Rs.10001 to Rs.20000	142	69.3
More than Rs.20000	23	11.2
Total	**205**	**100**

It was found that 19.5% of the households have a monthly family income up to Rs.10000, followed by 69.3% between Rs.10001 to Rs.20, 000 and 11.2% more than Rs.20, 000.

4.2.6 DISTRIBUTION OF RESPONDENTS ACCORDING TO FAMILY SIZE

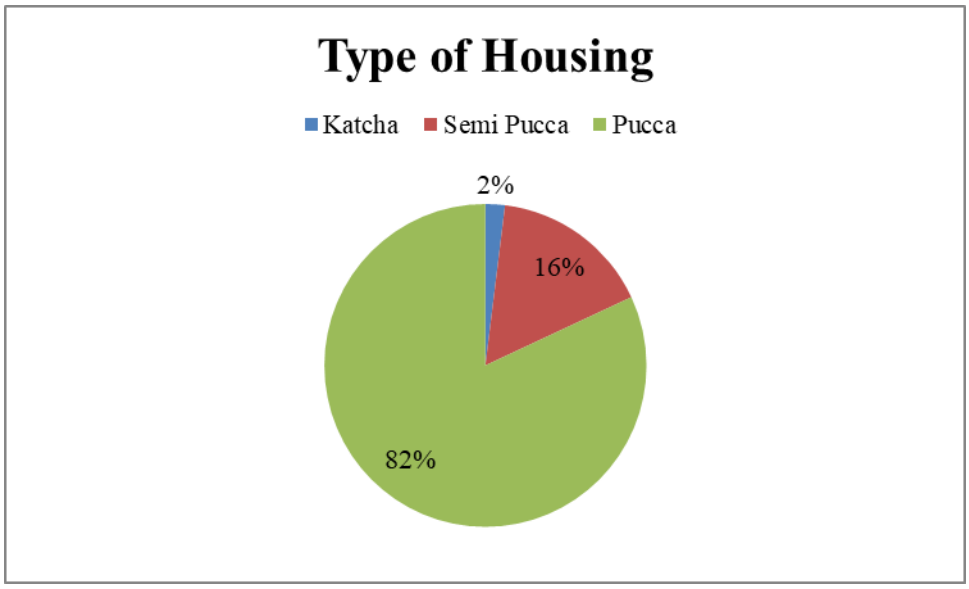


It was disclosed that 51% of the respondents had a family size of 4 members, followed by 16% with 3 members, 8% with 1 member, 10% with 5 members, 11% with 2 members, and 4% with more than 5.

4.2.7 EDUCATIONAL STATUS OF THE RESPONDENTS

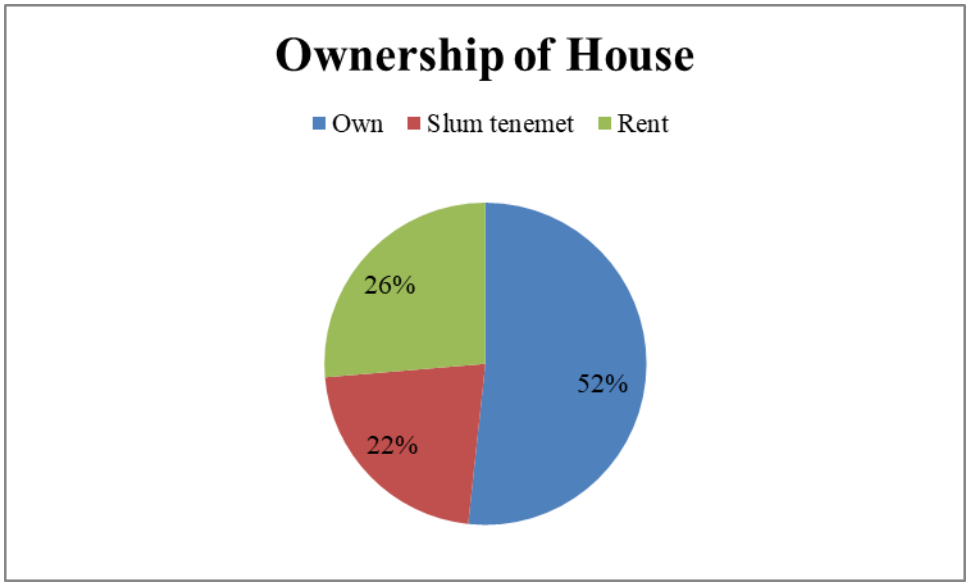
It was inferred that 40% of the respondents had studied upto 10^{th} standard, 7% were illiterates, 14% upto 12^{th}Standard, 31% were Graduates, 6% Post Graduates and 2% were Diploma holders and I.T.I. course.

4.2.8 DISTRIBUTION OF RESPONDENTS ACCORDING TO TYPE OF HOUSING



82% of the respondents were living in concrete houses and slum tenements, followed by 16% in semi pucca houses and only 2% in Katcha houses.

4.2.9 DISTRIBUTION OF RESPONDENTS ACCORDING TO OWNERSHIP OF HOUSES



It was revealed that 52% of the respondents were living in their own houses, 26% in rental houses and 22% in slum tenements.

4.2.10 – DISTRIBUTION OF RESPONDENTS WITH SOURCE OF WATER SUPPLY

It was ascertained that 78% of the families were drawing water from Metro water, 30% were using hand pumps and 2% had borewell facility.

4.2.11 – DISTRIBUTION OF RESPONDENTS ACCORDING TO ADEQUACY OF WATER SUPPLY

90% of the respondents expressed that the water supply is inadequate and does not meet their daily requirement and the remaining 10% stated that it was adequate.

4.2.12 – AVAILABILITY OF BASIC INFRASTRUCTURE FACILITIES

Only 25.5% of the respondents expressed that the areas have adequate street lights and markets, followed by 94% with cemetry and burial ground, 91% with transportation, 82% with motorable roads, 40% with bus shelters and 60 % for community Hall.

4.2.13 – DISTRIBUTION OF RESPONDENTS ACCORDING TO MEMBERSHIP IN SHGS

It was found that 58% of the respondents are not SHG members.42% of the respondents in the study area hold SHG Membership.

4.2.14 – DISTRIBUTION OF RESPONDENTS ACCORDING TO DEBT/LOAN

Debt	Frequency	Percentage
Yes	88	43
No	117	57
Total	**205**	**100**

It was revealed that 57% had no debts .43% of the respondents had availed loan from various sources.

4.2.15 – DISTRIBUTION OF RESPONDENTS ACCORDING TO THE REASONS FOR AVAILING LOANS

Purpose	Frequency	Percentage
Health	8	3.9
Education	15	7.3
Marriage	10	4.8
Constructing House	8	3.9
Festival & Social Occasion	12	5.8
Other Reasons	35	17.07
No debt	117	57
Total	**205**	**100**

4.8% of the respondents had availed loans for marriage purpose, 3.9% to meet medical expenses, 7.3% for children's education, 3.9% for house construction and 5.8% to attend festivals and social occasions and 17.07% for other reasons.

4.2.16 DISTRIBUTION OF RESPONDENTS ACCORDING TO SOURCE OF LOAN

Source of loan availed	Frequency	Percentage
No loans availed	117	57
SHGs & Micro Finance institutions	25	12
Banks	7	3
Money Lenders	32	16
Private Chit	10	5
Relatives and Friends	14	7
Total	**205**	**100**

57% of the respondents had not availed any loans. 16% of them have borrowed from money lender, 12% from SHGs and micro finance institutions, 7% from relatives and friends, 5 % through private chits and 3% from banks.

4.2.17 – DISTRIBUTION OF RESPONDENTS ACCORDING TO SOURCE OF SAVINGS

Source of Savings	Frequency	Percentage
Postal Savings	12	6
Banks	10	5
Chit Funds	25	12
SHGs	17	8
No savings	141	69
Total	**205**	**100**

69% of the respondents do not have the habit of savings. 12% of them save money through Chit Funds, 8% through SHG, 6% through postal savings and 5% through banks.

4.2.18 – DISTRIBUTION OF RESPONDENTS ACCORDING TO INSURANCE COVERAGE

Insurance	Frequency	Percentage
Yes	51	24.8
No	154	75.2
Total	**205**	**100**

75.2 % of the respondents had not taken any insurance against Life and health coverage.

4.2.19 DISTRIBUTION OF RESPONDENTS ACCORDING TO GARDENING

Gardening	Frequency	Percentage
Yes	10	5
No	195	95
Total	**205**	**100**

It was found that only 5% of the respondents are engaged in gardening.

4.2.20 DISTRIBUTION OF RESPONDENTS ACCORDING LEVEL OF AWARENESS TOWARDS USAGE OF NON-CONVENTIONAL ENERGY SOURCES

Non-Conventional Energy Sources	Frequency	Percentage
Solar Energy for household purpose	35	17
Solar Energy for Street Lights	170	83
Total	**205**	**100**

83% of the respondents are interested in using non-conventional energy through solar streets lights.

4.2.21 DISTRIBUTION OF RESPONDENTS ACCORDING MODE OF SOLID WASTE DISPOSAL

Garbage Disposal System	Frequency	Percentage
Corporation Tricycle	205	100
Total	**205**	**100**

It was ascertained that 100% of families were disposing solid waste through Corporation Tricycles.

4.2.22 DISTRIBUTION OF RESPONDENTS ACCORDING TO STATUS of RAIN WATER HARVESTING

Installation of Rain Water Harvesting	Frequency	Percentage
Yes	5	2.4
No	200	97.6
Total	**205**	**100**

97.6% of the respondents' have not arranged rain water harvesting in their houses.

****

CHAPTER - 5

VILLAGE LEVEL FRAMEWORK PLAN (ACTIVITIES IDENTIFIED FOR THE CSR PROJECTS IN THE STUDY AREAS)

The Following Village Level Framework plans have been prepared based on the primary and secondary data sources. The community's needs were identified based on focus group discussions, community meetings and transect walks.

5.1 Phasing of Village Level Framework Plan

The Study suggests the following sector and village wise interventions for implementing the CSR initiatives. Suitable modifications may be made by the TANGEDCO based on further consultation if it is required.

5.2 Investment Matrix –Village Level Framework Plan for five years

The Qualitative study and survey findings brought out the genuine needs of the selected villages as mentioned below in the study area by TANGEDCO. Details of area, sector- wise needs, required interventions a long term with budget and implementing mechanism are detailed below.

Area	Sector wise community needs	Intervention Duration Short term/Medium term/Long term	Budget (in Rs)	Implementing agencies
AIR Nagar	1. Infrastructure – Construction of 2 ICDS centres	Short term	10,00,000	TNSCB/TANGEDCO
	2. Providing Ambulance to UPHC centre	Short term	10,00,000	TANGEDCO
	3. Skill training for transgender and Youth	Short term	5,00,000	TNSCB & Skill Corporation of Tamil Nadu
	4. Vocational Training for Class 9 & 10th Students	Short term	10,00,000	School Education Department
	5. Tractor for garbage clearance	Short term	7,00,000	GCC & TNSCB
	6. Bore well for schools	Short term	1,00,000	TNSCB
	7. Toilets for girl children in School	Short term	3,00,000	TANGEDCO
	Total		**46,00,000**	

Area	Sector wise community needs	Intervention Duration Short term/Medium term/Long term	Budget (in Rs)	Implementing agencies
Dr. Ambedkar Nagar	1. Renovation of existing community Hall	Short term	3,00,000	GCC
	2. Solar Street lights 10 (Nose)	Short term	2,50,000	GCC
	3. Library with E. service	Short term	5,00,000	TANGEDCO
	4. Skill training for youth	Short term	5,00,000	Department of Employment & Training
	5. Installation of water tanks (8 Streets 16 Tanks)	Short term	4,00,000	TANGEDCO
	Total		**19,50,000**	
Tiruvottiyur kuppam	1.Renovation of ICDS centre roof	Short term	4,00,000	TANGEDCO
	2. Solar streets near seashore	Short term	2,50,000	TANGEDCO
	3. Drainage facilities	Long term	5,00,000	CMWSB
	4. Skill Development Training for youth (Assistant Vessel Driver and online marketing) (For 60 persons)	Short term	6,00,000	CIFNET Chennai
	5. Compound wall for primary school	Short term	3,00,000	TANGEDCO
	6. Providing children's park	Long term	3,00,000	TANGEDCO
	7. Net Mending Centre	Short term	7,00,000	TANGEDCO
	8. Electronic Gadgets to fisherman (Occupation Related)	Short term	2,00,000	TANGEDCO
Tiruvottiyur kuppam	9. Portable desalination plant (3 units)	Short term	12,00,000	TANGEDCO
	10. Providing toilets in the existing community hall	Short term	5,00,000	TANGEDCO
	11. Providing engine and fishing accessories (10 nos. at the rate of 75,000)	Short term	7,50,000	TANGEDCO
	12. Computer with Xerox machine for community purpose	Short term	1,20,000	TANGEDCO

Area	Sector wise community needs	Intervention Duration Short term/Medium term/Long term	Budget (in Rs)	Implementing agencies
Tiruvottiyur kuppam	13. Ornamental fish training (Skill)	Short term	4,00,000	CMFRI
	14. Conducting job fair	Medium term	3,00,000	TANGEDCO
	Total		**65,20,000**	
KVK Kuppam	1. Bus shelter	Short term	5,00,000	TANGEDCO
	2. Park (Space Available)	Medium term	7,00,000	TANGEDCO
	3. Construction of Jetty	Long term	25,00,000	TANGEDCO
	4. Providing Storm water drains (Low Lying area)	Long term	25,00,000	TANGEDCO
	5. Electronic Gadgets to fisherman (Occupation Related)	Short term	2,00,000	TANGEDCO
	6. Boat Repairing yard	Long term	25,00,000	TANGEDCO
	7. Tools & Equipment for self employed women	Short term	2,00,000	TANGEDCO
	8. Providing engines and fishing accessories (10 Nos. at the rate of 75,000)	Short term	7,50,000	TANGEDCO
	9. Computer with Xerox machine for community purpose	Short term	1,20,000	TANGEDCO
	Total		**99,70,000**	
Mugathuvara Kuppam	1. Community Hall	Short term	7,00,000	TANGEDCO
	2. Skill training	Short term	4,00,000	TNSCB/ TANGEDCO
	3. Renovation of ICDS Building	Short term	1,00,000	TANGEDCO
	4. Electronic Gadgets to fisherman (Occupation Related)	Medium term	1,00,000	Fisheries Dept
	5. Dredging work	Medium term	10,00,000	PWD
	6. Solar Lights near Jetty	Short term	2,00,000	TANGEDCO

Area	Sector wise community needs	Intervention Duration Short term/Medium term/Long term	Budget (in Rs)	Implementing agencies
Mugathuvara Kuppam	7. Portable desalination plant	Short term	4,00,000	TANGEDCO
	8. Mobile bike library	Short term	3,00,000	Don Bosco Youth Centre
	9. Equipment for self employment	Short term	2,00,000	TANGEDCO
	10. Providing engine and fishing accessories (10 Nos. at the rate of 75,000)	Short term	7,50,000	Fisheries Dept
	11. Computer with Xerox machine for community purpose	Short term	1,20,000	TANGEDCO
	12. Ornamental fish training (Skill)	Medium term	400000	CMFRI
	Total		**46,70,000**	
Thazhan Kuppam	1. Renovation of existing fish market	Short term	5,00,000	Fisheries Dept
	2. Providing play equipment for primary school	Short term	50,000	TANGEDCO
	3. Periodical Dredging work	Medium term	10,00,000	PWD
	4. Providing Boulders to prevent Sea erosion	Long term	10,00,000	PWD
	5. Play equipment for ICDS centres	Short term	10,000	TANGEDCO
	6. Tools & Equipment for self employment	Short term	2,00,000	TANGEDCO
	7. Providing engine and fishing accessories (10 no's at the rate of 75,000)	Short term	7,50,000	Fisheries Dept
	8. Computer with Xerox machine for community purpose	Short term	1,20,000	TANGEDCO
	9. Ornamental fish training (Skill)	Short term	4,00,000	CMFRI
	10. Artificial reef	Long term	75,00,000	CMFRI
	Total		**1,15,30,000**	

Area	Sector wise community needs	Intervention Duration Short term/Medium term/Long term	Budget (in Rs)	Implementing agencies
Ernavoor Kuppam	1. Skill training in Ornamental fish	Short term	4,00,000	CMFRI
	2. Developing Ennore fishing harbour as a tourist Coast	Long term	30,00,000	Fisheries Department
	3. Renovation of ICDS centre	Short term	10,00,000	TANGEDCO
	4. Construction of community hall	Short term	7,00,000	TANGEDCO
	5. Portable desalination plant (3units x 4,00,000)	Medium term	12,00,000	TANGEDCO
	6. Construction of Urban Health Centre	Short term	25,00,000	TANGEDCO
	7. Tools & Equipment for self employment for women(fishing related activities) 2500x 50 Nos.	Short term	2,00,000	TANGEDCO
	8. Mini truck (insulated) to transport fish catch from shore to main market	Short term	7,50,000	TANGEDCO
	9. Computer with Xerox machine for community purpose	Short term	1,20,000	TANGEDCO
	10. Construction of market and tenements	Long term	100,00,000	TNSCB
	11. Construction of Bus shelter	Short term	5,00,000	TANGEDCO
	Total		**2,03,70,000**	
Bharathiyar Nagar	Construction of bus shelters	Medium term	2,00,000	TANGEDCO
	Play and other equipment for ICDS centre	Short term	10,000	TANGEDCO
	Total		**2,10,000**	
Kattu Kuppam	Renovation of ICDS building	Short term	5,00,000	TANGEDCO
	Total		**5,00,000**	
	Grand Total		**6,03,20,000**	

Sector wise budget:

S.N	Sector	Budget (in Rs)
1	Infrastructure	3,53,90,000
2	Livelihood	1,58,30,000
3	Skill Detraining	36,00,000
4	Education	10,00,000
5	Health	35,00,000
6	Environment	7,00,000
7	NGO	3,00,000
Total		**6,03,20,000**

5.3 Avenues identified for routing the support

There are three avenues identified for routing the support. They are:

i. The individual/Group support through income generation activities through SHGs. This individual/group needs to be supported with training, technical knowledge, tool kits and financial support if required to start the income generating venture.

ii. The RWA/NGO/CBO/PTA/SHG Federation/ Training institutes are based on the initiatives identified by these agencies to transform the areas. For this avenue TANGEDCO may design a Grant Scheme.

iii. TANGEDCO direct implementation or implement through collaborative venture with the District Administration or Local bodies/ Panchayats

All TANGEDCO project funding activities to be properly contracted with clear TOR/Contract/MOU fixing the responsibility and accountability on the implementing agencies.

5.4 Ranking of Settlement for priority of CSR initiative based on the vulnerability status

The thirteen study areas were analysed based on the following vulnerability criteria and rated for the selection on priority basis.

A. Socio economic indicators:

- SC Community inhabitants
- Economically backward inhabitants

- Prevalence of alcoholism among male
- Women headed families

B. Physical infrastructure availability: (High/Medium/Low)

C. Educational infrastructure availability: (High/Medium/Low)

This is only an indicative guide to be used when there is a resource crunch for CSR investments or to assess the community contribution for the projects which require community contribution.

Based on the above, the Vulnerability Ranking was rated on the following three scale matrix (I -Highly vulnerable, II - Medium Vulnerability and III - less vulnerable in the study areas. The inhabitations which were studied are ranked as High, Medium and Low vulnerable categories.

S.N	Name of the Area	Sector	Highly vulnerable	Medium vulnerable	Less vulnerable
1	**AIR Colony**	**Physical & other infrastructure**	Water	Solid Waste Management	Requirements for street lights
			Livelihood	Skill Training for livelihood	-
			Women related issues	Awareness and education	-
			Environmental issues	-	-
			Socio economic status	-	-
2	**Ernavoor Kuppam**	**Physical & other infrastructure**	Water scarcity	Housing	-
			Livelihood	Skill training for livelihood	-
			Health care services	Construction of community hall.	-
			Transportation	Socio economic status	-
3	**Thazhan Kuppam**		Livelihood	Skill training for livelihood for women	-
			-	Socio economic status	-

4	**Mughadhuvara Kuppam**		Social	Awareness and education	Skill training programmes
			Livelihood	Installation of ATM	-
			Environmental issues	Socio economic status	-
			Water	-	-
5	**Annai Sivagami Nagar**		Water	-	-
			Livelihood	Socio economic status	-
			Environmental issues	-	-
6	**Nehru Nagar**		Health care services	Installation of hand pumps.	-
			Livelihood	Socio economic status	-
7	**Raja Shanmugam Nagar**		Water	Transportation	Upgradation of infrastructure (Roads)
			Livelihood	-	-
			Socio economic status	-	-
8	**Ambedkar Nagar**		Renovation of community hall (pump house)	Skill training for livelihood	-
			Water	Installation of solar street lights.	-
			Socio economic status	-	-
9	**Bharathiyar Nagar**		Environmental Issues	Formation of SHG	-
			-	Socio economic status	-
10	**Thiruvallur Nagar**		Environmental Issues	Socio economic status	-
			Water	-	-

11	**Tiruvottiyur Kuppam**		-	Solar lights near the seashore	-
			Children's park	Construction of toilet in the community hall	-
			Skill training for livelihood	Awareness for enrolment in primary school	-
			-	Socio economic status	-
12	**K.V.K.Kuppam**		Storm water drains	Bus shelter	-
			Skill Development training	Socio economic status	-
			Children's park	-	-
			Jetty	-	
13	**Kattu Kuppam**		Social issues (Alcoholism)	Awareness and education	Skill training programmes
			Livelihood	Socio economic status	-
			Environmental issues (Sea Storm)	-	-
			Water	-	-

5.5 Sector wise expected outcome from CSR Intervention

S.No.	Sector	Sector wise	Expected outcome from CSR Interventions
1	**Education**	a. Toilet units for girl students	a. To facilitate personal hygiene and ensure environment sanitation.
		b. Compound wall	b. Ensure the security of the students especially girl students.
		c. Soft skill training	c. Enhancing communication skills and self confidence and increasing career competence.
		d. Vocational training	d. To compete in the job market in future by acquiring a new skill.
2	**Livelihood**	a. Ornamental fish culture	a. Self employment venture to increase economic status.
		b. Artificial reef installation	B. To enhance quantity and quality fish species.
		c. Dredging work	c. To prevent soil erosion and facilitating boat movements.
3	**Livelihood - Equipment**	a. Boat engine and nets	Livelihood support for enhancing economic status and marketing avenues.
		b. Providing mini trucks	-
4	**Street lights**	Solar	Promotion of renewable energy and also safety and security to the community.
5	**Health**	a. Construction of urban health centre	a. Quality health care at free of cost
		b. Providing ambulance	b. Life saving during the time of emergency
6	**Skill Development and enhancement**	Skill Development Training	To equip as well as enhance employable skills among women and youth as an alternative source of livelihood.
7	**Environment**	Tree planting	Improve ecology / greenery environment in the study areas.
8	**Community hall**	Construction of Community Hall	It facilitates village people to arrange functions within their area at nominal cost. Besides it has multi-purpose social utility.

The community in the project areas especially youth and women are eager to participate in the development of the self, families and community for holistic development through suggested strategies and needs. As the project period planned is for five years, it is suggested that a full time Community Development Specialist may be appointed to coordinate with

community, TANGEDCO and Government Departments for the sustainability of CSR projects. TANGEDCO's CSR initiatives in these villages are expected to transform the lives of these communities especially the women, youth and children. Further these CSR initiatives expected to give a greater acceptance of TANGEDCO as a model corporate.

****

Chapter – VI

FINDINGS, SUGGESTIONS AND CONCLUSION

6.1 Findings

Out of the 13 study areas, 7 are fishermen habitations. One of the study areas is Mugathuvara Kuppam is located on the Creek. The community during the Focus Group discussion felt that the carrying capacity of the river has reduced and it cannot perform it complete draining action, which means the area around would be waterlogged during the monsoon., they also added that their boats which is their main source of livelihood were drastically affected since the depth of the river has been reduced to minimum of 1 feet. It was also scientifically proved that the fish caught around Ennore contain toxic elements due to effluents released from adjacent factories, making the fish unfit for consumption.

They suggested that job oriented skill development training for the youth in vessel navigation and ornamental fish culture may be provided as an alternate livelihood options. They also requested the corporates to provide engines, and netting materials to the small fishermen in enhancing their livelihood. They also expressed that any further expansion or development of factories surrounding the creek will endanger the aquatic species which will have a direct impact on the livelihood of fishermen community.

Some of the respondents from Thazhan Kuppam suggested that frequent dredging should be done to facilitate the boat movement and also installing boulders to prevent sea erosion. They were also of the opinion that the Ennore Coast may be developed as a tourism centre due to its unique features and the existing harbour may generate more employment opportunities for the fishermen who have seasonal employment. The Fishing community also felt that the local youth and eligible persons may be provided with jobs and other opportunities in industries and factories located in and around Ennore and also in upcoming industries.

They also expressed that the occurrence of regular oil spill has affected their livelihood to a great extent. Therefore such incidents should be prevented by the Government and industries in future by taking necessary precautions.

It is heartening to know that women of the fishing community are undergoing training in online marketing to cope up with the technology development in the marketing field.

Tamilnadu Slum Clearance Board has allotted 200 tenements to the transgender in AIR colony. During the discussion, it was expressed that they are still discriminated and not accepted by the neighbourhood community. They requested that special clinics exclusively for their gender may be run by Urban Health Centre once in a week.

The community requested for a Police outpost to handle the menace of drug trafficking which is affecting the youth and children.

Earlier, the fishing community used to venture into fishing everyday but, at present they could go once in 2 days due to depleted catch and dead fish. The attributed this situation due to release of effluents from industries and factories located in Ennore.

The local fishing community felt that consortium of industries in Ennore was conducting meetings to assess the livelihood needs of the fisherman community. At present, this activity has been ceased to exist. It has been also expressed by the Senior Scientist, (Centre for Marine Fishing Research Institute) Ennore coast is the most polluted, which affect the fish biological Resource enhancement. The Joint Director, Department of Fisheries, Government of Tamilnadu, expressed that there is an increase in the fishing vessels from 1000 to 2000 nos. in Chennai region in recent times and 40,000 households are depending on fishing for their livelihood.

Keeping the future vision of livelihood options, the women desired to acquire alternative skill development training courses in Tailoring and Embroidery, Beautician, Car Driving, Mobile servicing, Computer Training and Nurse aid.

The children of non-fishermen community belong to the under privileged category. It is viewed that scholarships may be provided to them to pursue their school education, impart job oriented skill development training and on the job training for them to work in the field which they desire.

6.2 Suggestions

i Specialized agencies such as CMFRI, CIFNET, MSSRF and Department of Fisheries may collaborate to have special plans for enhancing the livelihood of fishing community in the Ennore coast by implementing innovative self employment schemes and to cope up with the latest technology (Deep sea fishing, usage of electronic gadgets etc.)

ii To install artificial reef in Ennore coast to increase fish breeding and catch.

iii The district administration may necessary take steps by arranging interface session between fishing community and PSU of Ennore coast to review the environmental issues at frequent intervals.

iv One of the headmistress of a nearby school suggested that vocational training can also be imparted to the school children, to compete in the job market in future.

v Most of the respondents of the non fishing area expressed their views that infrastructure up gradation may be addressed on priority basis to enable them to have a quality living and reduce risk factors related to socio economic and environmental degradation.

vi To ensure drinking water supply and maintain quantity and quality in all the study areas.

vii To impart skill training courses in all the study areas through coordinating with various Government Departments, Educational institutions and Non-Governmental Organizations.

viii To create awareness about conservation of water and also the importance of rain water harvesting among the community.

ix It is also suggested that TANGEDCO may establish a special out sourced cell to conduct Pre Funding appraisals, stakeholders' involvement in CSR interventions, monitor the CSR initiatives, and act as a link between the community and TANGEDCO for fulfilling the objectives of CSR initiatives. This proposed CSR cell would help the interventions and enhance the branding of TANGEDCOs CSR interventions.

6.3 Conclusion

Ennore and its neighbourhood areas are surrounded by several of Public Sector Undertakings and Private Industrial Units. PSUs like NTPL, NPCL, KPL, IOC (bottling unit), Balmier &Laurie and CPCL, have been initiating CSR activities by assessing community needs and implementing CSR interventions under various sectors such as water and sanitation, infrastructure to the Educational Institution and community, Women's Empowerment Environment /Green Cover Development and Sustainable Livelihood by spending huge funds.

Ashok Leyland, a private industrial unit also initiated CSR projects in Ennore neighbourhood. Inspite of the above CSR interventions, fishing community in and around Ennore is affected severely due to increased release of effluents resulted in the depletion of fish resource. Hence they are forced for to look for alternative source of livelihood. They also felt that steps may be taken to protect the environment at Ennore by regulating industrial pollution and control, infrastructure development for sustainable livelihood of fishermen, which has been followed for generation as a traditional occupation.

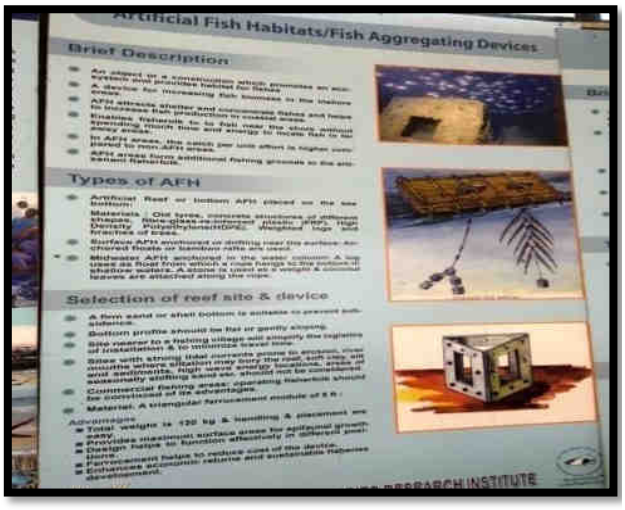
TANGEDCO through the commissioning of the power project must address the water issue in Ennore. TANGEDCO may also take steps to protect the environment in the Ennore coast by prioritising greenery initiatives. One of the major grievances of the inhabitants of Ennore coast is that TANGEDCO may consider sustainable development goals which will have a visible impact in the sectors of Water, Sanitation, Environment Protection and Livelihood support.

****

SOCIO ECONOMIC STUDY REPORT ON THE ONGOING ETPS EXPANSION THERMAL POWER PROJECT (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

STUDY COMMISSIONED BY

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD (TANGEDCO)



MAY - 2019

FINAL REPORT

VOLUME - II

MADRAS SCHOOL OF SOCIAL WORK

CHENNAI 600008

SOCIO ECONOMIC STUDY REPORT ON THE EXPANSION THERMAL POWER PROJECT (ETPS) (1X660MW) ENNORE, THIRUVALLUR DISTRICT, TAMIL NADU

VOLUME - II

Annexure: 1
TOOLS
Socio Economic Survey *(1.1)*

Ennore

1. **Name of the respondent:** Mobile No:

2. **Address:**

3. **Place:**_____ Ward No:_____ Zone_____

4. **Religion:**

    1. Hindu
    2. Christian
    3. Muslim
    4. Others

5. **Community:**

    1. FC
    2. BC
    3. MBC
    4. SC
    5. ST

6. **Type of the family:**

    a) Nuclear family b) Joint family

7. **Family particulars:**

S.No	Name	Age	Sex (M/F)	Relationship to the head of the household	Marital status	Education	Occupation	Monthly income	Vulnerability
1									
2									
3									
4									
5									

Coding:

Sex: 1. Male 2. Female

Vulnerability: 1.widow 2.orphan 3. Physically/Mentally Challenged 4.Alcoholic 5.Chronically ill 6. Senior citizen

Education: 1. Illiterate 2. Primary 3.Secondary 4.Graduate 5. Post graduate 6.professional (Teacher, Advocate, Engineer, Doctor, etc.)

Occupation: 1. None 2. Daily wages 3. Government service 4. Small business (self-employed) 5. Professional practice (Doctor, Engineer, Teacher, etc.) 6. Artisans
7. Private sector 8. Fishing

8. Gender of the head of house hold: 1. Male 2. Female

From the family particulars table fill up the following details:

9. Total family income _____

10. Family size_____

11. Highest education level in the family_____

12. Type of house

1. Thatched roof/ mud walls (Kutcha)
2. Thatched roof, stone/ brick- cement walls (Semi- pucca)
3. RCC roof, with brick- cement wall (Pucca)

13. Are the following facilities available within the house?

1. Toilet facility 1.Yes 2. No
2. Water supply 1.Yes 2. No
3. Electricity 1.Yes 2. No

14. Ownership of house:

1) Own 2) Rented / Lease 3) Slum Tenement

15. Build- up area of the house in Sq.ft _____

16. Primary drinking water source:

1) Well 2) Hand Pump 3) Bore well 4) Metro water, 5) Any other_____

17. Distance to the water source (in meters):_____

18. Adequacy of water supply

a) Quantity:1) Adequate 2) Inadequate

b) Quality:1) Portable 2) Saline

19. Do you have water scarcity at any period in a year: 1) Yes 2) No?

20. If yes, number of months with water scarcity _____

21. Do you have the following possessions?

S.No	Asset	1. YES	2. NO
1.	Colour TV		
2	Fridge		
3.	Telephone/ mobile		
4.	Bicycle		
5	Two wheeler		
6.	Car/ three wheeler		
7.	Computer		
8.	Any other		

22. How is your satisfaction level of services relating to the following?

S.No	Services	1. Adequate 2. Inadequate	Satisfaction level of the current infrastructure/ services 1. Very good 2. Good 3. Poor 4. Very poor
1.	Roads "kucha" roads or "pucca"		
2.	a) Water for drinking purpose		
	b) Water for other purpose		
3.	Bus facility		
4.	Bus shelter		
5.	Local markets		
6.	Street lighting		
7.	Primary Health Centre		
8.	Government Hospital		
9.	Private Clinic		
10.	Balwadi		
11.	Primary school		
12.	High school		
13.	Higher secondary school		
14.	Community Hall		
15.	Public Library		
16.	Cremation ground		

23. Give your detailed monthly expenses (from last month expenses)

S.No	Detail	Average expenses per month
1.	Food	
2.	Clothing	
3.	Transportation	
4.	Education	
5.	Cooking fuel	
6.	Electricity	
7.	Entertainment	
8.	Rent/ Housing Loan payments	
9.	Telephone	
10.	Water	
11.	Medical	
12	House hold articles	
13.	Others	
Total		

24. Do you have debt?

1) Yes 2) No

25. If yes, how much_____

26. For what purpose do you have availed loan?

1) To meet food expenses, 2) Health, 3) Children's Education, 4) Marriage
5) Construction of House, 6) Festival/ Social functions.

27. Source of Loan:

1) Nationalised banks, 2) Private bank, 3) Money lender, 4) Relatives / friends
5) SHG

28. Where do you save money?

1) Nationalised Banks, 2) Private Bank, 3) SHG, 4) Chit fund,
5) Postal savings, 6) No savings.

29. Do you have any Life/ Health insurance policy?

1) Yes 2) No

30. How many in your family are members of SHG _____ (Put 0 if no one)

31. Are you taking part in the gardening activities?

1) Yes 2) No

32. If yes, where?

1) Houses 2) Common place

33. Fuel of cooking in your home?

1. Gas
2. Kerosene
3. Wood
4. Others_____

34. Are you interested in use of non-conventional energy sources? (Tick more than one)

1. Solar energy for household purpose.
2. Solar energy for street light

35. What method of garbage disposal system:

1. Corporation tricycle
2. Burning
3. Composting

36. Have you installed rain water harvesting in your house 1. Yes 2. No

37. Do your family members consult you on the following decisions?

1.	Livelihood decisions	1. Yes 2. No
2.	Financial	1. Yes 2. No
3.	Marriage of girl child	1. Yes 2. No
4.	Education of children, particularly girl child, choice of school/ college	1. Yes 2. No
5.	Health care of yourself and your children	1. Yes 2. No

38. How far do women in the household experience the following:

S.No	**Factors**	**1. To a great extent 2. To small extent 3. Not at all**
1	Improved confidence	
2	Reduced violence at home	
3	Ability to voice concerns at Gram Sabha	
4	Communication skills	
5	Reduced alcohol consumption by husband	
6	Ability to put my groups concerns in the micro plan	
7	A sense of security	
8	Increased role in decision making	
9	Ability to educate community on environmental sanitation and keep their surroundings clean	
10	Sense of civic responsibility	

39. Is any member of the family holding / or had ever held any positions in the Panchayat/ local association/ political party

1. Yes 2. No

Name and signature of the investigator/ field supervisor
Date:

4. FISH CATCHING:

S.No.	Type of boat / Machine available	Average Distance for Fish Catching	No. of workers	Avg. fish catch /month (Kg)	Avg. income /month (Rs.)	Avg. Exp / Month (Rs.)	Net Income (Rs.)

a. Type: Catamarans (1) Vallams (2) FRP Boat (3) Mech. boats (4) Equipments (5), others _____ Specify (6)

b. Distance for Fish Catching: 0 to 3 Kms (1), 3 to 10 Kms (2), 10 to 20 Kms (3), 21 to 50 Kms (4), More than 50 Kms (5)

2. A Season and Fishing Variety

S.No	Season1.Month_____to_____		Season2.Month_____to_____		Season3.Month_____to___	
1	Fish Type	Price Per Kg	Fish Type	Price Per Kg	Fish Type	Price Per Kg
2						
3						
4						
5						

5. B. BOAT AVAILABILITY AND USAGE

5.1. Whether the boat / equipments are used Yes (1) / No (2)

5.2. If No, reason _____ Repair (1), Unable to Maintain (2), Non-availability of Proper Net (3), Changed Occupation (4) Rented out (5), Leased out (6), Mortgaged (3), Sold out (7), Theft (8), Other _____(9)

5.3. Whether the fishing equipment is insured? Yes (1) / No (2)

6. Navigation infrastructure facility:

6.1 GPS -1(Yes) 2(No)

6.2 Communication gadgets – 1(Yes) 2(No)
6.3 Life saving equipments – 1(Yes) 2 (No)
6.4 Knowledge about marine fishing -1 (Yes) 2(No)
6.5 Training on vessel navigation - 1(Yes) 2 (No)
6.6 Whether the dredging activity is satisfied: Yes (1)/No (2)/ NA (3)\
6.7 Who did the dredging activity? Government (1) NGO (2) others _____
6.8 Maintaining navigation by: Fishing society (1), Fisheries Dept. (2), Maritime Board (3) Others ------- (4) NA (5)

7. Felt needs of the fishermen communities:

1. Facilities for fish landing platforms / fishing harbour / cold storage
2. Relief in case of emergency: to provide relief in case of emergency situations such as missing of fishermen on duty due to rough seas
3. Any other felt need

8. Skill training for youth

1. Computer 2. Marine related livelihood training (specify) 3. Tailoring for women
4. Welding/ Plumbing 5. Heavy vehicle training 6. Nursing 7.marketing based training
8. Catering & hospitality 9. Using of gadgets (fishing related)

8. Opinion on fish harvesting

S.No	Year	Fish harvest
1	1995-1999	
2	2000-2004	
3	2005-2009	
4	2010-2014	
5	2015-2019	

(1) High (2) Medium (3) Low

****

Annexure - 1.2

COMMUNITY NEEDS ASSESSMENT STUDY AS A PART OF CORPORATE SOCIAL RESPONSIBILITY PROGRAMME

Guideline for Transect walk

Transect walk to contain following areas:

A rough sketch of the name of the area surveyed with serial number and where the investigator undertook the inspection walks mainly focusing on the condition of drainage, water stagnation, solid waste management and sanitary conditions, the status of the road and other infrastructure such as school, health post, park etc. will be observed. Apart from the above, analysis and current status of the following will be recorded.

1. Educational and vocational training
2. Health care
3. Infrastructure and civic amenities
4. Training and Income Generation Programme
5. Environmental and Green Initiatives
6. Disaster Relief and Rehabilitation
7. Water supply
8. Solid Waste Management:
9. Sanitary conditions
10. Roads and safety
11. Health post
12. Parks
13. Backward area in the village
14. Awareness levels
15. Any other observations

Date:

Signature of the interviewer:

Attach: a rough sketch of the area and the infrastructure facilities available and needed:

Annexure 1.3

COMMUNITY NEEDS ASSESSMENT STUDY AS A PART OF CORPORATE SOCIAL RESPONSIBILITY PROGRAMME

Guidelines for Case study

Case studies should highlight the following areas.

Earlier initiatives of the stakeholders (Government Departments, elected representatives, NGOs, Women's Groups, Residents Welfare Associations, etc) relating to village development initiatives to improve the quality of the residents. Conditions like economic deprivation, social protection and social safety required by certain sections of village population as a special initiative.

1. Case study number
2. Village
3. Name of the respondents/ agency/ group
4. Address
5. Analysis of the situation which forced for the initiative
6. Date of initiating project
7. Partners in the initiative
8. Nature of partnership (Money, labour, awareness, monitoring and collaboration)
9. Process followed
10. Management of the initiative
11. Result of the initiative
12. Is it still in force or no more?
13. Do the initiative need any support
14. How the initiative is sustained

Date:

Signature of the interviewer:

Comment of the supervisor on the case study:

Suggestions to scale up the effectiveness of the Case/support required:

Annexure – 2
List of Key Informants and Stakeholders

S.No	Name	Designation	Contact number
1	Mrs.Karpagam	ICDS Teacher, AIR Nagar	9094816622
2	Mrs.Geetha	Pharmacist in Primary Health Centre, AIR Nagar	9444465072
3	Mr.Desappan	CI in EB, AIR Nagar	9382800694
4	Mrs.Devaki	PDS Centre Distributor, AIR Nagar	9941813843
5	Mr.Babu	CI in Corporation Office, AIR Nagar	9500153976
6	Mrs.Sarulatha	Headmistress in AIR Nagar School	9962662174
7	FGD with the women from non-fishermen community		
8	FGD with the women from fishermen community		
9	Mr.Arunkumar	Joint Secretary ,Nehru Nagar,Grama Sangam	7010774525
10	FGD with the non fishermen community in Nehru Nagar		
11	Mr.Pushpalingam	President of Fishermen Cooperative Society, Thazhan Kuppam	9677293061
12	FGD with the Fishermen Panchayat members Thazhan Kuppam		
13	Mrs.Nirmala	ICDS teacher Annai Sivagami Nagar	9710264740
14	FGD with the women group members in Bharathiyar Nagar		
15	Mrs.Pichianandhi	ICDS teacher, Ernavoor Kuppam	6384407299
16	Mr.Selvam	Panchayat leader, Ernavoor Kuppam	9840012492
17	FGD with the fishermen community Ernavoor Kuppam		
18	Mrs.Rathi	Fisher Women Cooperative Society member Tiruvottiyur Kuppam	9952356916

19	Mrs.Mekala	ICDS Teacher	9884536999
20	Mrs.Deepa		9962276032
21	Mr.Sudhakar	Youth leader in Tiruvottiyur Kuppam	955177939
22	Mrs.Dhanalakshmi	Headmistress in Primary School	9626538501
23	FGD with Women's Group Tiruvottiyur Kuppam (15 members)		
24	FGD with the self employed women (7 members) Tiruvottiyur Kuppam		
25	FGD with the youth (7 members) Tiruvottiyur Kuppam		
26	Mrs.Poongudi	SHG leader AIR Nagar	9884536999
27	Mrs.Kanchana	School Counsellor, AIR Nagar	9962276032
28	Ms.Banupriya	Transgender community, AIR Nagar	
29	FGD with youth, K.V.K. Kuppam (10 members)		
30	FGD with fishermen Panchayat (7 members) K.V.K. Kuppam		
31	Mr. K.P.P. Shankar	Ex-Ward Councillor	
32	Mrs.Vinodha	SHG member, K.V.K.Kuppam	9884122375
33	Mrs. Marie	SHG member K.V.K.Kuppam	9176363064
34	Mr.Das	Local leader Welfare Society Dr. Ambedkar Nagar	9444168224
35	FGD with the local association members (10 members) Dr. Ambedkar Nagar		
36	Mrs. Kamala	Headmistress Kathivakam Government High School	9444521433
37	FGD with girl students, Kathivakkam		
38	Mrs.Amudha	ICDS centre Bharathiyar Nagar	9840404772

39	Mr.Bharathi	Community Leader, Mughadhuvara Kuppam	9941185652
40	Mr.Meganathan	Community Leader, Mughadhuvara Kuppam	996224116
41	Mr.Dhanasundar	Community Leader, Mughadhuvara Kuppam	
42	Mr.Pugazh	Community Leader, Mughadhuvara Kuppam	
43	Mr.Premkumar	Community Leader, Mughadhuvara Kuppam	
44	Mr.Vinodh	Community Leader, Mughadhuvara Kuppam	
45	Mr.Kumaresan	Community leader(Thaazhankuppam)	8015761215
46	Mrs.Vijaya	SHG Leader, Kattu Kuppam	9444030921
47	Mr.Seenu	Fishermen Cooperative Society, Kattu Kuppam	9884280891

Annexure - 3
Case study

Case Study 3.1 - NO ALMS NEED RESPECT - A Transgender Aspirations

Suguna (name changed) has been deserted by her family for no fault of hers as she was a transgender. Her +2 mark sheets were destroyed by her parents. She was supported by her peer group. Thanks to the State Government initiative, as she could own a house in AIR Nagar under special allotment under transgender category. But she could not get access to the community life. She has to face the wrath of the society including personal security. She expressed that exclusion of transgender from the community is the major cause of concern to them, as there is no way for livelihood. She cited that they were not given admission in the tailoring course conducted at AIR Nagar with the support of Government. She suggested that separate classes in job oriented trades could be organized exclusively for transgender in the area by state Government. She expressed that their plight was worse in the Urban Health Centre while providing treatment meted out to them by the common public. She suggested a separate weekly clinic for them in the local Urban Health Centre to meet their medical needs. She said that Transgender community wishes to be integrated into the mainstream of the society. This could be possible, only if the community hold hand with them and treat them with dignity and paving a way for socio-economic development of transgender Community.

Case Study 3.2 – A Teacher's Worry-Students used in Drug Trafficking

This Government Higher Secondary School for boys and girls has strength of more than 1600 students catering to the educational needs of students belonging to the marginalized and fishermen community. Teachers put their heart and soul to enhance the students' academic performance for their better future. One day one of teachers had the shock of the day. Police officials entered the school campus asking for the names of few boys. The teacher refused permission to the police for taking the students out. Police officials informed the teacher that the some students are involved in drug trafficking and this was confirmed by the drug peddlers. The teacher requested for her presence during the enquiry of the students. The students informed that some strangers had given some packets from the other side of the compound wall of the school and asked them to deliver in the addresses enclosed. They assured them that they would be paid heavily. Hence, they kept the packets with them for delivery after the school hours. The teacher advised them not to involve in such activities and requested the police officials to take away the pockets and leave the students keeping in

mind of their future. Accordingly police warned the students to keep away from such practices in future.

Case Study – 3. 3 A Teachers Dilemma

A primary school conducted by Chennai Corporation in Tiruvottiyur Kuppam has strength of 25 children with 2 teachers. The headmistress of the school has taken all efforts to increase the enrolment of students. The neighbourhood has 6 Balwadis with strength of around 100 children. But the parents prefer to put the children in unrecognized private schools by paying huge fees in spite of their financial constraints. The Headmistress of the school has even sent a proposal for the starting an English Medium section from this academic year. She feels that the parents should understand the value of the Government run schools with quality educational approach.

Case Study3. 4: The Headmistress & Team of school teachers strive hard to enhance the learning outcome of the students

AIR Nagar has more than 6000 tenements accommodating people with cross section of society. AIR Nagar has one Middle school which has strength of 550 students. The Headmistress and team of school of teachers strive hard to enhance the learning outcome of the students. She coordinates with Corporates to provide quality infrastructure in the school premises under CSR such as making the toilets functional with hiring care takers, involving the parents in the prevention of absenteeism of the students, providing counselling with the help of NGO to slow learners and promoting awareness on greenery. It is no wonder that parents opt for the admission of their children in this school rather than several private schools situated adjacent to the area.

****

Annexure - 4

Vocational training for school children – A Guide

Sarva Shiksha Abhiyan (SSA) is a flagship programme for achievement of Universalization of Elementary Education (UEE) in a time bound manner, as mandated by 86th Amendment to the Constitution of India making free and Compulsory Education to the Children of 6-14 years age group, a Fundamental Right. However critical lacunae in the system act against children emerging as productive workers. As per the 2015, NCERT National achievement survey, less than half of the children met the bench mark for their age in reading comprehension and Mathematics. The key issue across all levels of education is quality. With regard to skill development, the Government is yet to concentrate on vocational based education system at school level.

A system that integrates formal education and skill development go a long way in ensuring youth to face challenges in future employment market and to pursue their career and livelihood. The skill development training in various trades should be imparted as a subject who should lay a foundation for the students to take up specialized field in their future higher education or get equipped to take up self employment on completion of higher secondary school, based on the family's economic needs. The immediate need is in the introduction of educational reforms for meeting the demand in manufacturing and service trades. This innovative approach may be adopted in a block to study the impact of the interventions and replicate to other areas on success

Duration	Program	Remark
First 3 months of academic year	Bridge course syllabus of 9th class	To enhance subject wise knowledge
One hour / day for 3 months	Basic operation in computers	Gaining computer knowledge
Life skill (One hour / day for 3 months)	Communication Skill & Personality Development	Self confidence
Tailoring for girls (One hour / day for 3 months)	Skill	Acquiring skill
Mobile Service and Domestic Wiring (One hour / day for 3 months)	Skill	Acquiring skill
Sports, Cultural & Yoga activities	Skill	Enhancement of socio economic status.
Special coaching classes in subject like Maths and English	Enhancing learning outcome	Emerging as productive work force.
Solar Panel Technician Course	Skill	Enhancement of socio economic status

Annexure - 5
List of Training Institutions

S. No	College Name	Address	Contact Information	Email / Website
1	Advanced Training Institute – ATI, Chennai	C.T.I. Campus, Guindy, Chennai, Tamil Nadu – 600032	(044)22501460, 22500252, 22501211	E-MAIL atichn@vsnl.com
2	Arignar Anna I.T.I.	School Road, Ambattur, Chennai, Tamil Nadu – 600053	(044)24767228	
3	Government Industrial Training Institute (I.T.I.)	ITI, (BTC), Ambattur, Chennai, Tamil Nadu – 60098	(044)26252453	
4	Chanakya Academy for Diploma in Solar & Electrical	No 6, Camp Road, Selaiyur, Chennai - 600073,	(91)-44-39613904	www.chanakya-education.org
5	Mother Teresa Industrial Training Institute	No. 12, Kamaraj Nagar Main Road, Avadi, Chennai, Tamil Nadu – 600071	(044)26550800	
6	Sarvodaya Industrial Training Institute	No. 28, V.V.K. St, M.K.B. Nagar, Pattabiram, Chennai, Tamil Nadu	(044)26850231, 011 2280 0322	sarvodayainstitute@yahoo.in / www.sarvodayainstitute.com/contact-us.php
7	Swamy Vivekananda Industrial Training Institute	No 18, Near Theradi, Motilal Street Tiruvallur, Chennai, Tamil Nadu – 602001	(044)27645171	
8	Vivekananda ITI	No 102/3, Bricklin Road, Purasawalkam, Chennai - 600084, Near MekalaTheatre Church	91)-44-39611268, 044 2662 2733	www.vivekanandaiti.com
9	Madras Vocational Training Institute	Plot No 7, 19 A Cross Street, Ambattur, Chennai - 600053, Lenin Nagar, Rakki Theatre & Lenin Nagar Park	(91)-44-33892141	
10	Government Industrial Training Institute	Alandur Road, Guindy, Chennai - 600032,	(91)-44-22501530, 22501538, +(91)-44-22501530	
11	Rajalakshmi Institutions (Admin Office)	No 69, New Avadi Road, Kilpauk, Chennai - 600010	(91)-44-26442472, 26461316, 26460124	hr@rajalakshmi.edu.in / www.rajalakshmi.org
12	Hi Mark Educational Institute	No 31/15, Kambar Street, Alandur,St.Thomas Mount, Chennai – 600016	(91)-9786511555	www.himark.net

13	Central Training Institute	10, Alandur Road, Thiru-vi-ka Industrial Estate, Guindy Institutional Area, SIDCO Industrial Estate, Guindy, Chennai - 600032	044 2250 0437	www.dget.nic.in
14	Madras Industrial Training Institute	Madras I.T.I, No.2, 7th Main Rd, Umayalpuram, New Colony, Chromepet, Chennai - 600044	044 2241 1255	
15	Brilliant ITI	No 50/145, Mount Road, Little Mount, Saidapet, Chennai – 600015	(91)-44-22351582, 42118554, +(91)-9445210155	
16	SAM ITI	No 49, Police Commissioner Office Rd, Egmore, Chennai - 600008,	(91)-44-39614892	
17	Kumaran ITI	No 15/19 B, Ist Main St, Kumaran Nagar, Tiruvottiyur, Chennai - 600019, Opposite Odiyanmani Theatre	91-44-25991145, +(91)-9841420143	
18	Mother Theresa ITI	No 12, Kamaraj Nagar Main Road, Avadi, Chennai – 600054	(91)-44-26550800, 42847090, +(91)-9566217438	www.factum.in
19	Annai Technical Institute	No 44, Mookkathal Street, Purasawalkam, Chennai – 600084	(91)-44-26431405, 098413 64530	
20	Kanchi ITI	No 11/1 Ground Floor, 2nd Cross Street, Velacheri, Chennai – 600042	(91)-44-22434096, 65436817, (91)-9566007945, 9444928278	
21	St John Bosco I T I	No 162 1st Floor, Redhills Road, Ambattur, Chennai – 600053	(91)-9444763515	
22	Dream India ITI	Chinna Ekkadu Road, Tiruvallur, Chennai – 602001	91-44-27645293, (91)-9600550555, 098944 40444	dreamindiaiti@yahoo.in / dreamindiaiti.in
23	TVS Training and Services Ltd. Technical Training Centre	Plot No: 7/9, ABC MTH Road,, Ambattur Industrial Estate, Chennai – 600 058	----	----
24	Director of Employment and Training Government of TN	Guindy	------	------
25	MRF Driving Institute	Vadakarai, Red hills	------	------

****

Annexure – 6

Soft skill training and Mobile Library - Objective and Impact
(Don Bosco Youth Animation Centre, Ennore)

TRAINING IN COMMUNICATIVE ENGLISH AND EMPLOYABILITY SKILLS FOR POOR COLLEGE STUDENTS

English language has been the lingua franca of the world for more than 2 centuries. India has been a major beneficiary with the advent of the English language. Great scholars, scientists, computer wizards and motivational speakers have prospered because of their proficiency in the English language. Indians are prospering all over the world, thanks to their knowledge and motivation to learn the language. Therefore, English both literary and communicative style is very essential for our young generation.

Ennore is no different from the rest of India. More importantly, most of the youth are first generation college students. On a negative note, Ennore has a high percentage of youngsters dropping out of education after high school and higher secondary levels. About 5 years ago, hardly 25% had enrolled themselves in colleges. Though the situation is slowly changing, there are girls who are kept from studying in colleges and married off too early in life.

Don Bosco Evening school has done yeomen service in this regard for the past 20 years. Their efforts have begun to bear fruit in terms of the rising number of students entering colleges. There is a welcome change today as at least 60% of the youngsters enrol in college and technical institutions.

The lack of knowledge in Communicative English is identified as a serious block to pursue their higher education. Hence, the Don Bosco Centre organizes classes in Communicative English for the youth from economically backward families.

Specific methodology used is; latest methods of English teaching with Language Lab, Audio-video inputs, role plays and skits in English, watching programmes and videos in English, campus culture of only English during training hours, hands-on experience and practice with professionals and experts.

IMPACT OF THE PROGRAMME:

1. Proficiency in English language and capacity in communicative English will help Young people to move ahead in life.
2. Better job opportunities and job placement is guaranteed.
3. Create more self-confidence and self-esteem in the young people.
4. They can become leaders and great organizers with proficiency in English.

LIBRARY FOR THE STUDENTS AND MOBILE LIBRARY SERVICES

In this modern world of technology wherein touch phones, social networking media like Whats app, Facebook have made young people 'net-addicts', it is important that young people are reintroduced to the importance of reading.

To enable this noble cause, Don Bosco has set up a simple but functional Library in the Don Bosco campus. The students and young people will be encouraged to read books of different genres and fields, viz., Science and Arts, lives of great men, inspirational books, spiritual and value based books on personality development and General Knowledge. They will be asked to read at least one book in 2 weeks and once in a while conduct a study group circle meetings.

A novel idea that we are daring to pursue is to commission young people to involve in 'Books on Wheels' Programme. With this method, young people will take books on their motor bikes and distribute to different homes for a nominal fee of Rs.10 per book. After a week, the books will be collected back and distributed to others. In this way, we hope to create a reading culture among the adults, youth and children of Ennore.

IMPACT OF THE PROGRAMME:

1. Reading culture in the general public of Ennore will be created.
2. Children and youth will decrease the using of mobiles and social networking sites and get into a habit of reading.
3. Lives of great men and great nations will instil greater motivation and goals.
4. Young people will participate in helping Ennore people to become reading literates.
5. Scholarship programme can be linked with mobile library programme.

****

Annexure - 7
Photo Gallery Snap Shots

1. KVK Kuppam:






2. AIR Colony:




3. Tiruvottiyur Kuppam:


Annexure - 8
KII and Focus Group Discussions

1. KII - Karpagam, ICDS teacher, AIR Nagar, Tiruvottiyur, 9094816622

She stated that 25 children have been enrolled in the ICDS Centre. The teacher informed that the centre requires RO water plant for the children to get drinking water, playing materials, Kids chairs, tables and desks, teachers table and chairs and Kitchen platform for cooking purpose.

2. KII with the pharmacist of the primary health centre - Mrs. Geetha, Ernavoor, Urban Primary Health Centre, 9444465072

Ms. Geetha informed that around 200 patients visit the health care centre for treatment, in a month which includes around 75 children. The Urban Health Centre provides pre-natal and anti-natal check up and also specialized clinics for 'Hypertension' and 'Diabetics'. She expressed that large number of patients come for treatment of diseases like cough, respiratory

complaints and ailments related due to environmental pollution. She also informed that the hospital needs the following materials.

i BP Apparatus
ii ECG(computerized) 1 No
iii Furniture for patients in waiting room

3. KII - A.Desappan, Conservancy Inspector, Electricity Board, 9382800694

He informed that water facility in the AIR Nagar has to be improved with provision of street taps and installation of hand pumps in some of the areas as per the people's requirement. He disclosed that collection and disposal of solid waste is one of the challenges faced by the residents. He has requested TNSCB & GCC to take necessary action to handle this issue by periodical clearance of garbage to prevent diseases and ensures public health.

4. KII - Devaki. J, Ration Distributor in AIR Nagar, 9941813843, Shop no: HEO90

The informant mentioned that there are 1706 family cards in the AIR Nagar, and informed that the stock has been regularly supplied to the people living in the area. The ration shop need extension of AC sheets for people to wait in the queue to get their ration supplies.

5. KII - Babu. K, CI, GCC, Ramakrishna Nagar, 9500153976

Mr.Babu informed that 82 contract labours and employees and 21 regular staff are working in the Corporation Division for collection, disposal and segregation of solid waste. He stated that 21 new tricycles and hand gloves are required for the collection of garbage for the Division to maintain environmental hygiene.

6. KII - S. Sarulatha, Headmistress in Corporation Middle School, AIR Nagar, 9962662174

The Headmistress informed that the school has a students' strength of 502, of which boys are 252 and girls 250. She requested TANGEDCO for supply of 16 tables and 25 chairs for higher class, 100 Kids chairs and 20 round tables, construction of toilets for boys and girls, construction of 6 additional classrooms to accommodate more children.

7. FGD with the non-fisherman community AIR Nagar, Ernavoor

The Consultants had discussion with non-fisherman community in the AIR Nagar, Ernavoor to identify the community needs and other issues that require interventions from Government. Women Self Help group with 9 members lead by Poongodai were present for the meeting. The women expressed that they need employment opportunities, skill development training and formation of additional women self help groups. The women also requested for provision of additional hand pumps to augment water supply and organising job fair for youth to explore livelihood opportunities.

8. FGD with the fishermen group in AIR Nagar

The Consultants had discussion with the fishermen community in AIR Nagar to identify the area's needs. The fishermen community headed by B.Selvi (7358583467) with 15 members participated and shared that their immediate priority is solid waste disposal which is affected them to a great extent. The members informed that water scarcity is one of the issues consuming their time and energy and requested the Government to replace the old pipelines with the new connections. They also suggested that the electricity meter board has been damaged causing safety concern to the public and it needs to be replaced with the new covered boxes. Furthermore they requested employment opportunities for the women groups.

9. KII - B. Arunkumar, Joint Secretary (7010774525), Nehru Nagar, Grama Sangam

The informant stated that the area needs health centre with ambulance facility to cater to the medical needs of Nehru Nagar, as the adjacent health centre functioning in AIR colony, is not accessible by public transport system. The informant also suggested that a job fair may be conducted in this village for creating employment opportunities and additional hand pumps have to be provided in the streets to access water supply to the convenience of the public.

10. Focused Group Discussion with the non-fishermen community in Nehru Nagar

The Consultants had discussion with the 11 members of Nehru Nagar Grama Sangam. The group disclosed that 4850 families are residing in Nehru Nagar, of which 80% of the population belong to Dalit community. The group listed the needs like employment opportunities for the youth, health centre with ambulance, revamping of SHGs and provision of sewing machines for the trained women in tailoring for the development of the families and area.

11. FGD - with the fishermen community in the Nettu Kuppam and Thazhan Kuppam

The Consultants had a discussion with the fishermen community lead by C.Pushpalingam (9677293061) with 22 members. The group requested that the sand in the river threshold has to be removed periodically since it is affecting the fishermen's livelihood. They prioritised the immediate needs like employment opportunities for the youth in the area, fishing net repairing centre and job opportunities in the Government for the qualified tailors.

12. KII with the President of Fishermen Cooperative Society - C.Pushpalingam, (9677293061)

The informant requested that the sand in the river threshold has to be cleared, since it is affecting fishermen's livelihood, construction of yard for storing fishing nets and job fair for creating employment opportunities for youth.

13. Focus Group Discussion with the women's group in Bharathiyar Nagar

The group was headed by Priyadarshni, (9840451726) SHG leader with 9 members from Bharathiyar Nagar. They listed provision for bus shelter, community hall and a public library as their immediate needs under CSR initiative.

14. KII -T. Nirmala, ICDS Teacher, (9710264740)

It was ascertained that the Anganwadi is functioning with the total strength of 30 children (15 girls and 15 boys). The teacher informed that the centre requires steel container to store food materials, 7 desks and benches for children to sit comfortably, Television for entertainment, RO plant for drinking water and table and chair for the teacher to maintain records.

15. KII - Pichianandhi, ICDS Teacher, 6384407299, Ernavoor Kuppam

The teacher informed that the ICDS is functioning with a total strength of 25 children. (14 boys and 11 girls). The teacher requested for the provision of play materials, 3 chairs and round tables for the children and table and chair for teacher for effective functioning of the centre.

16.KII - R.Selvam, Panchayat President, Ernavoor Kuppam, (984001249)

It was ascertained that 200 families are living in Ernavoor Kuppam, and Selvam has been the Panchayat President for the past 10 years. The president shared that Ernavoor is one of the oldest settlements, but lack basic facilities. The water supply is one of the issues affecting the people, since the adjacent industries exploit ground water from this area, resulting in water scarcity to the population. The Government is building pucca houses in the adjacent areas, but the scheme has not been extended to Ernavoor Kuppam. Hence he requested the Government to improve and provide proper roads, construction of houses and market by

Tamilnadu Slum Clearance Board in the vacant 7 acres of Government land, community hall, bus shelter, development of play ground for youth, since most of them are sportspersons.

17. KII: Ms.LaxmiLatha, Principal Scientist, CMFRI

During the discussion, the Principal Scientist informed that the training in ornamental fish culture to the women members of SHG of the coast will be one of the alternative livelihood options with long term sustainable benefits. She also added that Ennore coast has been found to be polluted to a larger extent due to release of effluents from nearby industries, which has seriously affecting fishermen. She expressed that training in value added fish product could also be imparted in the training to increase the income levels of fishermen. She expressed that after extensive study, deployment of artificial reef can be taken in Ennore coast.

18. Focus Group Discussion with the community at Ernavoor Kuppam

A discussion with Mr. Vinayagamoorthi, President of the Fishermen Cooperative Society (9600123407), Ernavoor Kuppam along with 11 members was conducted to list out their immediate needs. The group listed drinking water supply, community hall, renovation of ICDS Centre, mini load van for transportation of fish to market, skill development training and shoes for the physically challenged youth for their mobility.

19. FGD with the SHG members, Tiruvottiyur Kuppam

The members disclosed that Tiruvottiyur Kuppam is one of the largest fishermen hamlets with 1000 population in Ennore coast. They expressed that the ICDS centres need renovation with replacement of roof immediately. The members are satisfied with solid waste management by GCC (Greater Chennai Corporation). However they need drainage connection to prevent mosquito menace and public health hazards. In the recent past, one of

the corporates imparted skill development training in tailoring under CSR initiative benefitting 50 women. They listed the following facilities for the improvement of their area.

1. Solar lights near coastal area
2. Net vending hall
3. Compound wall for the school
4. Toilet and water connection to the community hall with a compound wall.

20. FGD with the self employed women in Thiruvottiyur Kuppam

The members expressed that they are selling fish in the nearby market and majority of them are widows. They added that they need equipment and ice box to store fish. They also felt that there is a need for awareness on evils of alcoholism.

21. FGD with youth of Tiruvottiyur Kuppam

The members felt that there is a need for skill training for the youth in trades such as Assistant Vessel drivers, Boat engine repairing, Car driving and Welding as they are demand trades in the market. They also stressed the need for providing employment on priority basis to the local youth in the adjacent companies. Women may be imparted skill development training in Tailoring, Embroidery, Nursing Assistant, Mobile servicing etc. There is a need for conducting job fair, to facilitate employment opportunities to the local youth.

22. FGD with local fishermen Panchayat, K.V.K. Kuppam

The members felt that the area will be water logged during rain and the inhabitants have to use boat to rescue themselves. This is due to the construction of private company adjacent to the inhabitation which blocked the way for the rain water to drain. They also need a children's park in a vacant site, to protect from encroachment. The president requested for provision for bus shelter in the main road to board buses to different locations, jetty to keep their boats, since they share Kasimedu fishing harbour which is located far off from their location.

23. FGD with the youth, K.V.K. Kappa

The youth acknowledged the needs expressed by the village committee and in addition to that the youth felt the need for preference in employment to the local youth in the industries and companies located in their neighbourhood.

24. FGD with Welfare Association Dr. Ambedkar Nagar

The members during the discussion expressed that the area always face inadequacy of water supply. The area is situated near railway track. Since the street lights are dim, there is frequent incidence of thefts. The association has taken efforts to impart skill training in tailoring to women, with the support of a Non Governmental Organisation. As the courses are conducted inside a pump room, the space is very limited. Hence, an alternate place is needed. Some of the immediate requirements are

i Installation of solar lights in the area as well as in road leading to railway station
ii Renovation of pump room
iii To ensure water supply through street tanks.

25. KII – District Environmental Engineer, Ambattur, Chennai , Tamil nadu pollution control board, Contact 044-26880130

The informant suggested some of the mitigation process to reduce pollution such as increasing the green belt around the industrial site minimum of 25% and maximum of 33%. The informant also stated that the basic mitigation process to reduce the air and water pollution and these standards have been instructed to the thermal power plants before the installation of the thermal power plants. The informant also mentioned other mitigation process which includes planting different trees in the areas near the power plant which could reduce the carbon di oxide. The informant also suggested that the fly ash from the power plant can be given to the cement production factories at free of cost which could reduce the pollution created by fly ash.

Annexure - 9
Marine Fish Production for Tiruvallur and Chennai Districts

SN	Year	Tiruvallur	Chennai
1	2008-2009	9011	32087
2	2009-2010	9101.39	32407.52
3	2010-2011	9643.83	34283.11
4	2011-2012	9686.9	34437.38
5	2012-2013	9752.86	34671.86
6	2013-2014	9812.35	34886.36
7	2014-2015	10384.14	36919.28
8	2015-2016	14799	34217
9	2016-2017	16425	28941.53
10	2017-2018	19499.54	32378.38

*Source - Directorate of Fisheries, Chennai – 600018.

****