DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

EXPANSION OF BULK DRUGS MANUFACTURING FACILITY FOR CHANGE IN PRODUCTION CAPACITY FROM 4800 TPA TO 9156 TPA

AT

R. S Nos. 30, 32, 33, 34, 35, 36 etc.

VILLAGE: PERIYAKALAPET, MATHUR ROAD
TEHSIL: PUDUCHERRY
STATE: PUDUCHERRY

BY:

M/s. Strides Shasun Limited

Project termed under schedule 5(f): Category 'A' Synthetic Organic Chemicals, ToR *vide* file no. J-11011/211/20l7-1A. II (I), dated: 16th August, 2017.

Report Prepared by:

(NABET Accredited vide Certificate No. NABET/EIA/1618/SA0015 &
MoEF Recognized Lab vide F. No. Q-15018/29/2007-CPW)
HUBERT ENVIRO CARE SYSTEMS (P) LTD, CHENNAI

DECEMBER, 2017

ACKNOWLEDGEMENT

The following personnel are gratefully acknowledged for their fullest support in collection, compilation of needful data regarding the project and kind cooperation in fulfilling the report on Environmental Impact Assessment (EIA) of M/s. Strides Shasun Limited, Puducherry.

Strides Shasun Limited,

Mr. B. Sreenivasa Reddy – COO (Chief Operating Officer)

Mr. E. Kannapiran – Vice President, Operations

Mr. Ramesh Ramasamy – DGM, EHS

Mr. Yuvaraj Kumar – Senior Group Leader, Tech Service

Declaration by the Head of the Accredited Consultant Organisation

I, Dr. J.R. Moses, hereby confirm that the above mentioned experts prepared the EIA/EMP for "**EXPANSION OF BULK DRUGS MANUFACTURING FACILITY FOR CHANGE IN PRODUCTION CAPACITY FROM 4800 TPA TO 9156 TPA"** by M/s Strides Shasun Ltd in existing facility at Periakalapet Village, Mathur Road, Puducherry Tehsil, Puducherry District, Puducherry UT. I also confirm that I shall be fully accountable for any misleading information mentioned in this statement.

Signature:

Date: 16/12/2017

Name: Dr. J.R. Moses

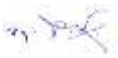
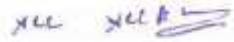
Designation: Chief Executive Officer

Name of the EIA Consultant Organisation: Hubert Enviro Care Systems (P) Ltd, Chennai

NABET Certificate No & Validity: NABET/EIA/1618/SA 0015 & 13.04.2018

Declaration of Experts contributing to the EIA

I, hereby certify that the above mentioned experts prepared the EIA/EMP for "**EXPANSION OF BULK DRUGS MANUFACTURING FACILITY FOR CHANGE IN PRODUCTION CAPACITY FROM 4800 TPA TO 9156 TPA" by M/s. Strides Shasun Limited at Plot R. S Nos. 30, 32, 33, 34, 35, 36, Periakalapet, Mathur Road, Puducherry.** I was a part of the EIA team in the following capacity that developed the above EIA with the support of the following Team Member.

EIA Coordinator:	Team Member:
Name: Mr. N. Vamsee Krishna	Name: Abhishek Moses
Signature: 	Signature: 
Date: 16/12/2017	Date: 16/12/2017
Period of Involvement: July 2017 –Till Date	Period of Involvement: July 2017 –Till Date

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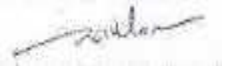
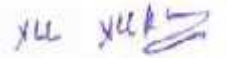
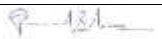
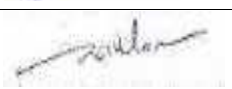
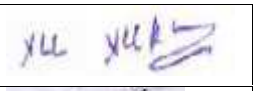
1	AP	FAE Dr. J.R Moses	July 2017 –Till Date	
		TM Mr. Abishek Moses Mr. B. Tamil Selvan Mr. Harsha Vardhan	July 2017 –Till Date	
			July 2017 –Till Date	
			July 2017 –Till Date	
		FAA Ms. Dhanya M	July 2017 –Till Date	
2	AQ	FAE Dr. J.R Moses	July 2017 –Till Date	

		TM Mr. Abishek Moses Mr. B. Harsha Vardhan Mr. B. Tamil Selvan	July 2017 –Till Date	
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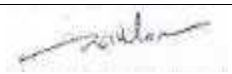
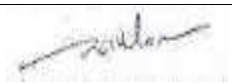
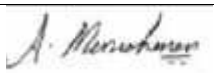
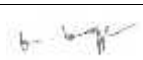
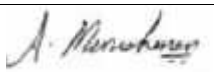
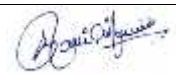
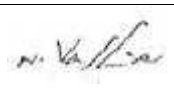
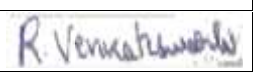
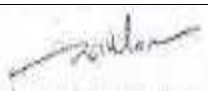
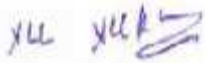
3	WP	FAE Dr. J.R Moses	July 2017 –Till Date	
		TM Mr. Vamsee Krishna Navooru Mr. Abhishek Moses Mr. Chengalvarayan Mr. A.K Natarajan	July 2017 –Till Date	
			July 2017 –Till Date	
			July 2017 –Till Date	
			July–Sep 2017	
		FAA Ms. Dhanya M	July 2017 –Till Date	
4	SHW	FAE Mr. A. Manoharan	July 2017 –Till Date	
		TM Mr. Vamsee Krishna Navooru Dr. K. Karupaiyan	July 2017 –Till Date	
			Aug 2017 –Till Date	
5	SE	FAE V. Dhivakar	July 2017 –Till Date	
6	EB	FAE Mr. A. Manoharan	July- Sep 2017	
		TM Dr. Rajkumar Samuel Mr. Tamil Selvan	July 2017 –Till Date	
			July 2017 –Till Date	
7	HG	FAE B. Mallikarjuna Rao	July- Sep 2017	
8	NV	FAE Mr.Brijesh Kumar	July- Sep 2017	
		TM: Mr. N. Varadharajan	July 2017 –Till Date	
9	LU	FAE	July- Sep 2017	

		Mr. R.Venkateswarlu		
		TM: Mr. N. Varadharajan	July 2017 –Till Date	
10	RH	FAE Dr. J.R Moses	July 2017 –Till Date	
		FAA Mr. Abhishek Moses	July 2017 –Till Date	
		Mr. Harsha Vardhan B	July 2017 –Till Date	

HECS

Hubert Enviro Care Systems (P)Ltd.

Client:	**M/s. Strides Shasun Limited** **Periyakalapet Village, Puducherry**		
Project :	**EXPANSION OF BULK DRUGS MANUFACTURING FACILITY FOR CHANGE IN PRODUCTION CAPACITY FROM 4800 TPA TO 9156 TPA**	**Project No.:** **HECS/CONS/MKTG/17-18/107**	
Title:	EIA/EMP Report	**Document No.:** RP002	**Rev.:** A

Revision Details:

A	08.12.2017	Draft R3 – After revision of details	Dr. Thomas		For JRM review			
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A	10.10.2017	Draft R1 – After client corrections	Dhanya/Kavya		For JRM review			
0	30.09.2017	Draft R0 – For client review	Dhanya/ Harsha Vardhan/Tamil Selvan/ Varadharajan		For NVK review			
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Rev	**Date**	**Details**	**Init.**	**Sign**	**Init.**	**Sign.**	**Init.**	**Sign.**
			Prepared		**Checked**		**Approved**	

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LIST OF ACRONYMS

AAQ	Ambient Air Quality
AAQM	Ambient Air Quality Monitoring
ACGIH	American Conference of Governmental Industrial Hygienists
API	Active Pharmaceutical Ingredients
ATFD	Agitated Thin Film Drier
BDL	Below detectable limit
BIS	Bureau of Indian Standards
CBL	Convective Boundary Layer
CC & A	Consolidated Consents & Authorization
CEC	Cation Exchange Capacity
CGWB	Central Groundwater Board
ChERA	Chemical Exposure Risk Assessment
CO	Carbon Monoxide
CPCB	Central Pollution Control Board
CREP	Corporate Responsibility for Environmental Protection
CRZ	Coastal Regulation Zone
CSR	Corporate Social Responsibility
CTE	Consent to Establish
CTO	Consent to Operate
dB(A)	decibels - A weighted
DG	Diesel Generator
DGMS	Director General of Mines Safety
DL	Detectable limit
DMP	Disaster Management Plan
EAC	Expert Appraisal Committee
EC	Environmental Clearance

EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMC	Environmental Management Cell
EMP	Environmental Management Plan
EMS	Environmental Management System
ETP	Effluent Treatment Plant
GLC	Ground Level Concentration
GW	Groundwater
Ha	Hectares
HC	Hydrocarbons
HECS	Hubert Enviro Care Systems (P) Ltd
HPS	High Polluted Stream
HSD	High Speed Diesel
HVAC	Heating, Ventilation and Air Conditioning
IEMC	Independent Environmental Monitoring Consultant
IH	Industrial Hygiene
IIR	Incident Investigation and Reporting
IMD	Indian Meteorological Department
IMS	Integrated Management System
IS	Indian Standards
ISO	International Organization for Standardisation
Kcal	Kilo calories
Kg	Kilogram
KLD	Kilo Litre per Day
kVA	Kilo Volt Ampere
kWh	Kilowatt per hour
L_d	day equivalent noise levels
LDAR	Leak Detection and Repair
Leq	Equivalent noise level
L_n	night equivalent noise levels
LPS	Low Polluted Stream
LULC	Land Use Land Cover
MACT	Maximum Achievable Control Technology
MEE	Multiple Effect Evaporator

MoEF &CC	Ministry of Environment, Forests and Climate Change
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
MSW	Municipal Solid Waste
NAAQ	National Ambient Air Quality
NAAQS	National Ambient Air Quality Standards
NABET	National Accreditation Board for Education and Training
NABL	National Accreditation Board for Testing and Calibration Laboratories
NEM	North East Monsoon
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NH	National Highway
NIC	National Informatics Centre
NNE	North North East
NNW	North North West
NO_2	Nitrogen Dioxide
NSPS	New Source Performance Standards
NTFP	Non Timber Forest Produce
OH	Occupational Health
OHS	Occupational Health and safety
OHSAS	Occupational Health and Safety Assessment Standards
PCB	Pollution Control Board
PEL	Permissible Exposure Limit
PHA	Process Hazard Analysis
PIA	Project Influence Area
PID	Process & Instrumentation Diagram
PIMS	Puducherry Institute of Medical Sciences
PM_{10}	Particulate Matter less than 10µ size
$PM_{2.5}$	Particulate Matter less than 2.5µ size
PPCC	Puducherry Pollution Control Committee
PPE	Personal Protective Equipment
PWD	Public Works Department
R & D	Research & Development
R&R	Resettlement and Rehabilitation
RCC	Reinforced Cement Concrete
RO	Reverse Osmosis

SBL	Stable Boundary Layer
SO_2	Sulphur Dioxide
SOP	Standard Operating Procedure
SSE	South South East
SSW	South South West
STP	Sewage Treatment Plant
SW	Surface Water
TDS	Total Dissolved Solids
TFH	Thermic Fluid Heater
THF	Tetrahydrofuran
TLV	Threshold Limit Value
ToR	Terms of Reference
TPA	Tonnes per Annum
TPH	Tonnes per Hour
TPM	Tonnes per Month
TSDF	Treatment, Storage and Disposal Facilities
VOC	Volatile Organic Compound
ZLD	Zero Liquid Discharge

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

I. Background

Strides Shasun Limited, an integrated, leading global supplier for development and manufacturing services of Bulk drugs, intermediates, API (Active Pharmaceutical Ingredients) and Formulations to the Pharmaceutical Industry, holding a Consent to Operate (CTO) for the existing facility with the manufacturing capacity of 4800 TPA for 5 products, proposes an "expansion of bulk drugs manufacturing facility with change in capacity from the existing 4800 TPA (5 products) to 9156 TPA (8 products)" at Plot No. R.S Nos. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Periakalapet, Mathur Road, Puducherry. Strides Shasun proposes to expand the above bulk drugs facility due to market demand.

II. Management Commitment

The company assigns prime importance for environmental protection. Zero Liquid Discharge concepts have already been implemented by the company and it complies with all the stipulated environmental regulations. The company has recently purchased additional 1 acre of land for maintaining the adequate greenery within the facility. Water conservation measures will be implemented which include the existing freshwater consumption of 45 KLD currently utilized by boilers will be replaced with recycled water in the proposed expansion and is also committed to follow all the environmental statutory regulations and requirements in future.

III. Environmental Sensitive Areas

As seen in **Table-I** below, the environmentally protected areas within 15 km from project boundary include Ousteri Wetland & National Park (≈ 13.7 Km ≈ SW), Bird Sanctuary (≈ 13.39 Km ≈ NNE) and Botanical Garden, Puducherry (≈12.6 Km ≈S). The project site is located at Periakalapet, Mathur Road, Puducherry within 5km of the Tamilnadu – Puducherry interstate boundary.

The Environmentally Sensitive Areas within 15 km from Project Boundary is provided in **Table-1.**

Table-1 Environmentally Sensitive Areas within 15 km from Project Boundary

Project site is S. No	Areas	Proposed project location boundary (approximate aerial distance)
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	• Auroville ≈ 5 Km ≈ SW • Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW Botanical Garden, Puducherry ≈12.6 Km ≈S
2	Areas which are important or sensitive for ecological reasons – Wetlands, Water courses or other water bodies, coastal zone, biospheres, mountains, forests	• Bay of Bengal ≈ 1.82 Km ≈ E • Kaliveli Lake ≈ 2.89 Km ≈ N • Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW • Bird Sanctuary ≈ 13.39 Km ≈ NNE • Kumalumpattu R.F≈ 13.7 Km ≈ NW • Mangroves Back Water ≈ 13.1 Km ≈ S • Thengaithittu Estuary ≈ 14.3 Km ≈ S
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	• Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW • Kaliveli Lake ≈ 2.89 Km ≈ N • Bird Sanctuary ≈ 13.39 Km ≈ NNE
4	Inland, coastal, marine or underground waters	• Bay ofBengal ≈ 1.82 Km≈ E • Kaliveli Lake ≈ 2.89 Km ≈ N • Mangrooves Back Water ≈ 13.1 Km ≈ S • Thengaithittu Estuary ≈ 14.3 Km ≈ S
5	State, National boundaries	Tamilnadu –Puducherry Interstate Boundary 1.02 Km ≈ N
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	• Auroville ≈ 5 Km ≈ SW • Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW • Botanical Garden, Puducherry≈ 12.6 Km ≈ S • Bird Sanctuary ≈ 13.39 Km ≈ NNE
7	Defence installations	Nil
8	Densely populated or built-up area (Nearest Town,City,District)	Puducherry Town at 14.4 Km

9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	Schools & Colleges • Navodaya Vidhyalaya ≈ 0.1 Km≈ SSE • Study International School ≈ 0.47 Km ≈ WNW • Govt. Law College≈ 0.32 Km≈ SE • Puducherry Institute of medical science (PIMS) ≈ 0.68 Km≈ N • Puducherry University≈ 1.77 Km≈ SE • Puducherry Engineering College ≈ 2.94 Km≈ SSE Religious Places • Manakular Vinayagar temple≈ 11.53 Km≈ W • Murugan Temple, perampai road≈ 13.75 Km≈ SW Hospital • Puducherry Institute of medical science (PIMS≈ 0.68 Km≈ N Tourist Places • Auroville≈ 5.66 Km≈ SSW • Botanical Garden, Puducherry≈ 12.6 Km≈ S Others • Police station, Kalapet≈ 2.1 Km≈ E • Fire station, Periyakalpet≈ 2.1 Km≈ E • Puducherry Central Jail≈ 0.33 Km≈ SW • Puducherry Airport ≈ 8.40 Km≈ SSW
10	Areas containing important, high quality or scarce resources, (groundwater resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	• Bay of Bengal ≈ 1.82 Km≈ E • Auroville ≈ 5 Km ≈ SW
11	Areas already subjected to pollution or environmental damage (those where existing legal environmental standards are exceeded)	No Notified/Recognized polluted area within 15Km distance.
12	Areas susceptible to natural hazard which could cause the project to present environmental problems, (earthquakes, subsidence, landslides, erosion or extreme or adverse climatic conditions)	This area is generally plain not prone to any natural disasters. The study area falls under study in Zone-II, according to the Indian Standard Seismic Zoning Map.

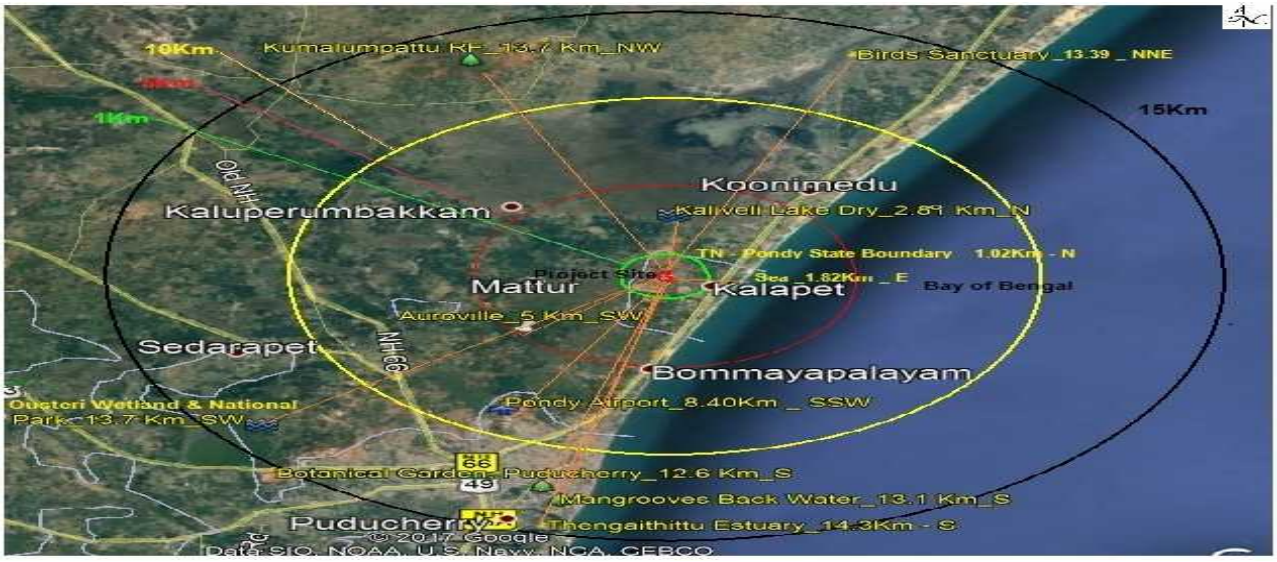


Figure-1 Environmentally Sensitive Areas Covered within 15 Km from Project Boundary

IV. Products Details

The products categories are bulk drugs and the project, located at Periakalapet, Mathur Road, Puducherry is categorized under Schedule 5 (f), Category A, Synthetic Organic Chemicals. Strides Shasun proposes to expand the bulk drug unit with change in capacity from the existing 4800 TPA (5 products) to 9156 TPA (8 products). Existing and Proposed products details are provided in **Table-2.**

Table-2 Existing and Proposed Products with Capacity

S. No	Existing		New Addition		S. No	Proposed	
	Product Name	Quantity TPA	Product Name	Quantity TPA		Product Name	Quantity TPA
1	Ibuprofen	4308	Ibuprofen	2892	1	Ibuprofen	7200
2	Ibuprofen DC	240	Ibuprofen DC	960	2	Ibuprofen DC	1200
3	Ibuprofen Lysinate Ibuprofen Sodium& S+ Ibuprofen	240	Ibuprofen Lysinate , Ibuprofen Sodium& S+ Ibuprofen	300	3	Ibuprofen Lysine, Ibuprofen Sodium& S+ Ibuprofen	540
4	Carisoprodol	12	Carisoprodol	0	4	Carisoprodol	12
5	Pilot Scale Operations for R&D	-	Pilot Scale Operations for R&D	-	5	Pilot Scale Operations for R&D	-

			Pilot Plant Small Scale Volume Products	12	6	Pilot Plant Small Scale Volume Products	12
			Pregabalin	180	7	Pregabalin	180
			Sapropetrein	12	8	Sapropetrein	12
Total		4800		4356			9156

V. Categorization

The proposed project is termed under Schedule 5 (f), Category A, Bulk Drugs and Intermediates as per the EIA Notification 2006 and its Amendments requiring EIA studies of the project. As the project site is located at Periakalapet, Mathur Road, Puducherry within 5 km of the Tamilnadu – Puducherry interstate boundary, the facility attracts general conditions and hence it requires prior Environmental Clearance from Expert Appraisal Committee (EAC) at the Ministry of Environment, Forest and Climate Change (MoEF&CC) before commencing onsite activities, i.e., Category A. As per EIA Notification, 2006 in para 7 (i), sub section III it attracts public hearing for expansion or modernization or change of product mix in existing projects as it attracts specific condition. There are no interlinked projects. The company holds a CTO for the existing facility with the manufacturing capacity of 4800 TPA for 5 products.

The proposal was appraised in the 24th EAC meeting held on 14th June 2017 and was issued the Terms of Reference (ToR) for preparing Environmental Impact Assessment (EIA) Report vide Letter No. IA-J-11011/211/2017-IA-II (I) dated 16/08/2017. The total project cost is Rs.125 Crores.

VI. Land Requirement

The plant facilities are spread over 105155.54 sq.m (25.99 Acres). The proposed expansion is within the existing facility only. In addition to the existing greenbelt area of 7.39 acres, 1 acre of land has been purchased for maintaining a greenbelt area which comprises 35.37% of the total land area of 25.99 acres. The land use pattern is provided in **Table-3** overleaf.

Table-3 Land Use Pattern

Sl. No.	Description	Existing			Proposed		Total Area (After Expansion)		
		Area in (Sq.m)	Area in (Acres)	Area in (%)	Area in (Sq.m)	Area in (Acres)	Area in (Sq.m)	Area in (Acres)	Area in (%)
1	Green Belt	29919	7.39	28.45	7,274.44	1.80	37,193.29	9.19	35.37
2	Roads & Other Area	51688	12.78	49.15	- 9,135.71	-2.26	42,551.98	10.52	40.47
3	Build up Area	23549	5.82	22.39	1,861.27	0.46	25,410.27	6.28	24.16
Total Land Area		105156	25.99	100	0	0	105155.54	25.99	100

VII. Water Requirement

The total water requirement after expansion will be 2315 KLD. The freshwater consumption will be 498 KLD sourced from inhouse bore wells. 1817 KLD of recycled water will be obtained from expanded ZLD plant.

The external sources water consumption is detailed in **Table-4.**

Table-4 Water consumption from external sources

S. No	Description	Existing in KLD	Proposed in KLD	Total After Expansion in KLD
1	Freshwater requirement	110	388	498
2	Treated sewage water from PWD, MGMC& PIMS etc.,	440	150	590
3.	Treated sewage water and process effluent from Strides Shasun – Formulation division (non EC category)	199	0	199
Total		749	451	1287

The water requirement break-up details are given in **Table-5.**

Table-5 Water Requirement Break-Up Details

Requirement	Freshwater consumption in KLD			Recycled water consumption in KLD			Total (KLD)		
	Existing	Additional	Total Proposed	Existing	Additional	Total Proposed	Existing	Additional	Total Proposed
Process water	60	393	453	0	0	0	60	393	453
Boilers	45*	0	0	251	67	318	251	67	318
Cooling tower	0	0	0	522	654	1176	522	654	1176
Green Belt	0	0	0	30	20	50	30	20	50
Washings & cleaning	0	0	0	50	25	75	50	25	75
Domestic	5	40	45	0	0	0	5	40	45
TW to formulation unit**	0	0	0	198	0	198	198	0	198
Total	110	433	498*	1051	766	1817	1116	1199	2315

Note:

* Existing Freshwater of 45 KLD utilized for Boilers will be replaced with recycled water in the proposed expansion.

**Recycled water is supplied to Formulation unit (non EC Category) for their utility application and again taken as sewage water of 156 KLD and effluent of 43 KLD (over and above PWD, PIMS, MGMC etc).

VIII. Wastewater Generation

The expansion facility will generate 45 KLD of wastewater from domestic activities. The effluent generated from manufacturing process (550 KLD) will be sent to the MEE followed by Biological Treatment and RO along with sewage water sourced from PWD (Public Works Department), Mahatma Gandhi Medical College, PIMS which will be used in the process/non process application. Zero Liquid Discharge (ZLD) system already exists and ZLD is also proposed for expansion. The existing and total water balance quantity charts are shown in **Figures-2 & 3.**

High pollutant stream is treated in Stripper and MEE. The condensate is sent to Biological treatment followed by RO plant for usage in Process/Non process area.

Less pollutant stream along with externally procured treated sewage is sent to Biological treatment followed by RO for using in Process/Non process area. Marine outfall has been discontinued in October 2017.

Concentrate from Multiple Effect Evaporator (MEE) is treated in Agitated Thin Film Drier (ATFD) and the sludge generated from biological treatment system and ATFD salts are currently stored inhouse and procedures to dispose them to nearby TSDF sites/Co processor will be established.

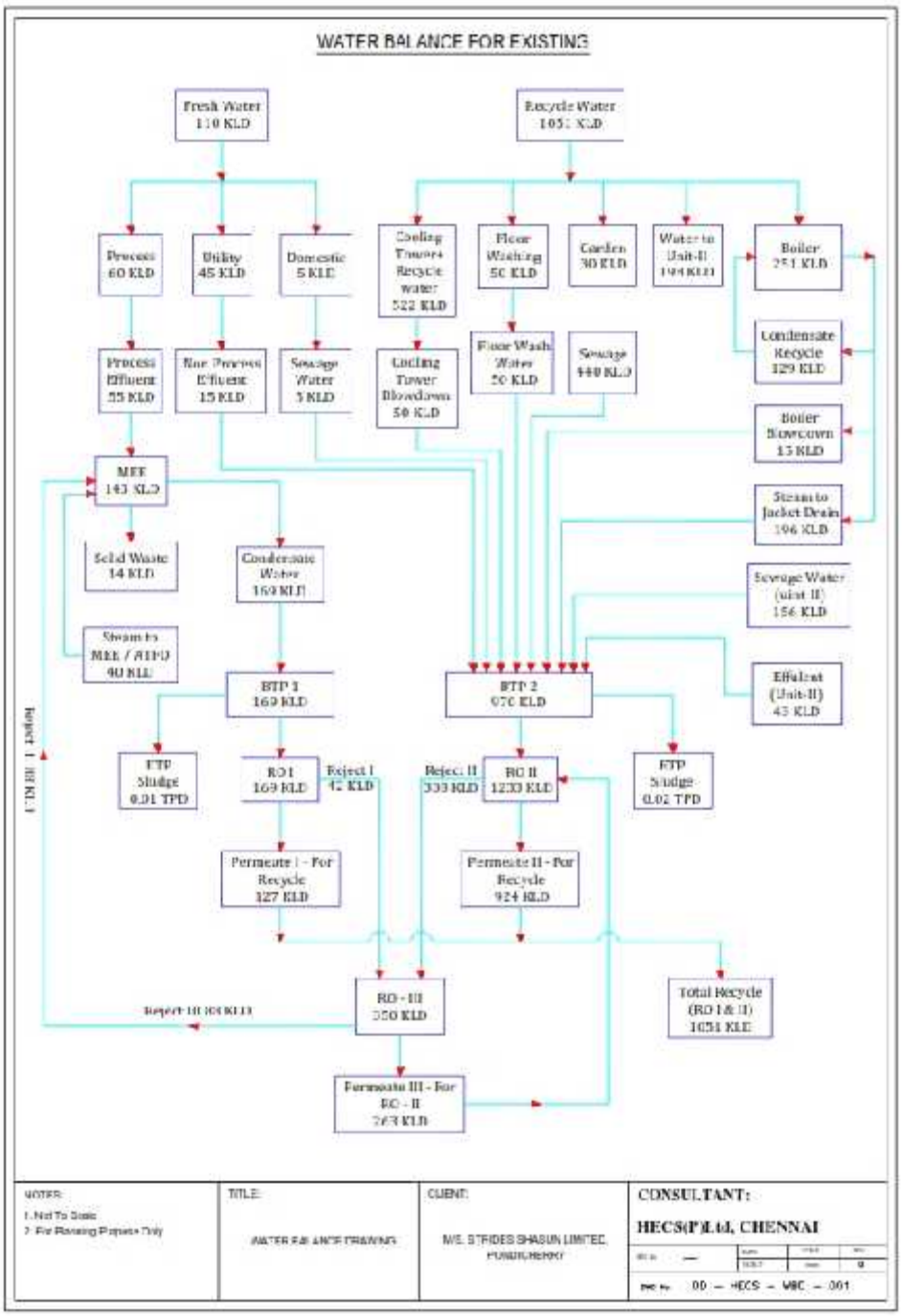


Figure-2 Existing Water Balance Chart

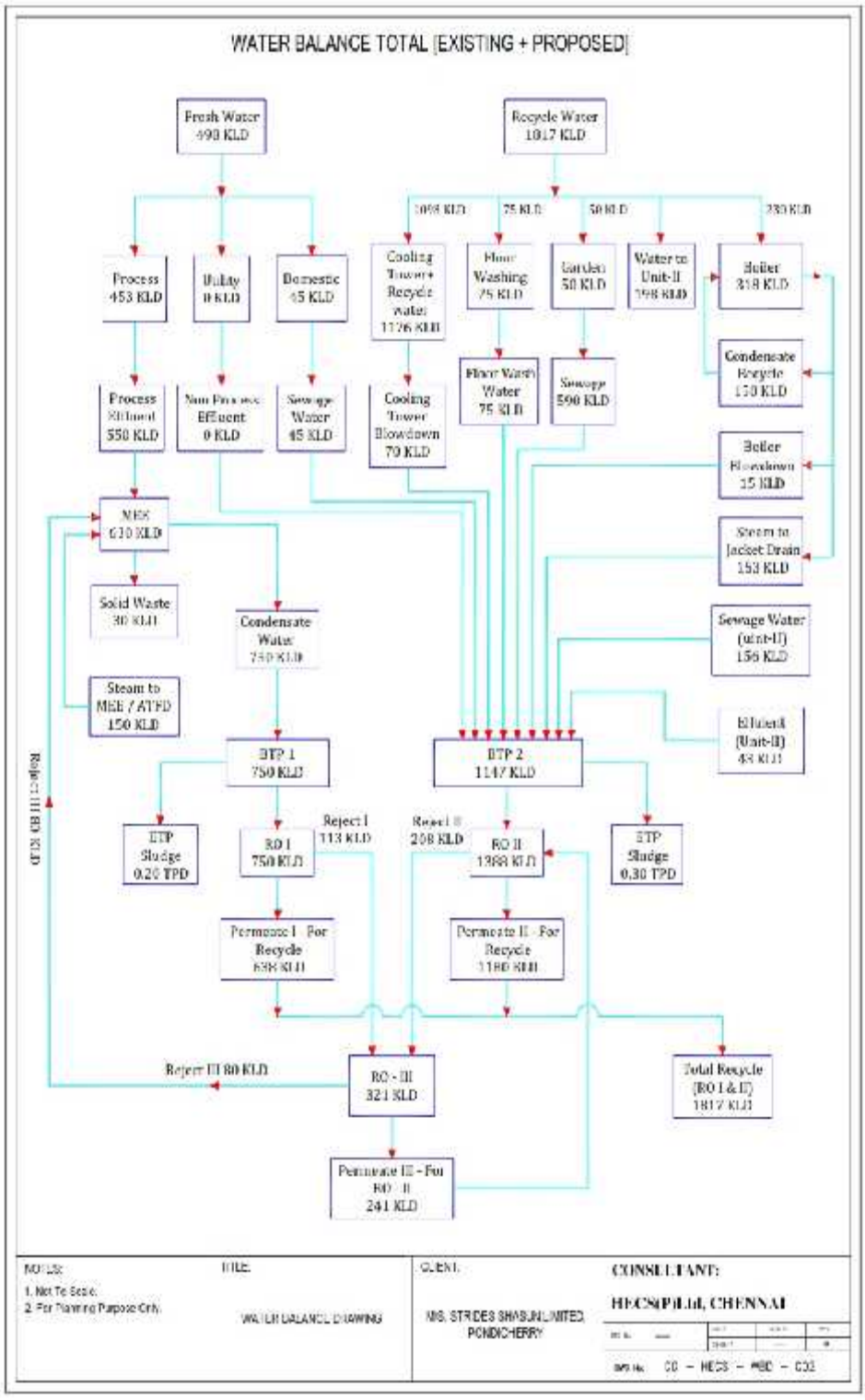


Figure-3 Total Water Balance Chart

IX. Power Requirement

The power required for the project will be sourced from Puducherry Electricity Board. 6 DG sets (3 nos. of 1000 kVA and 3 nos. of 1500 kVA) will be used as backup facilities in case of power failure.1 no. of 16 TPH boiler will be used for production and another of the same capacity will be used as standby. The power requirement details and backup power facilities are provided in **Table-6.**

Table-6 Power Requirement and and backup power facilities

Details	Existing	Proposed	After expansion
Power Requirement Soure: Puducherry Electricity Board	3860 KVA	2000 KVA	5860 KVA
Power Back Up through DGs	2 x 1500 KVA	1 x 1500 KVA	3 x 1500 KVA
	2 x 1000 KVA	1 x 1000 KVA	3 x 1000 KVA
Boiler-bio-Briquettes	1 x 16TPH	1 x 16 TPH	1 x 16 TPH
	1 x 3.5 TPH (S.B)	1 X 15 Lac Kcal/hr Thermic Fluid Heater	1 X 15 Lac Kcal/hr Thermic Fluid Heater
	2 x 4.5 TPH (S.B)		1 x 3.5 TPH
			2 x 4.5 TPH (S. B) 1 x 16 TPH (S. B)

S.B = standby boiler

Note: 1 no. of 3.5 TPH Boiler acting as standby in the present unit will be running after expansion. 2 Nos of 4.5 TPH boilers from existing unit will be retained as standby after proposed expansion.

Boilers and thermic fluid heaters: One 16 TPH boiler backed up by one 3.5 TPH and two 4.5 TPH boilers are being operated in the existing facility. One 16 TPH boiler in the existing facility will be used in the proposed facility. One 3.5 TPH existing standby boiler becomes operational during expansion. Two 4.5 TPH and one 16 TPH boilers will be standby during expansion. In addition to this, one Thermic Fluid Heater (TFH) of 15 Lac K Cal capacity powered by Bio-briquettes is also proposed.

X. Manpower

The manpower requirement including both technical and non-technical personnel is given in **Table-7.**

Table-7 Manpower Requirement

S.No	Manpower	Existing	Additional	Total after Expansion
1	Employees	640	50	690
2	Contract labourers	210	0	210
	Total	850	50	900

XI. Solid Waste

MSW in operation phase will be treated in Organic Waste Convertor. 60 TPA of organic waste will be generated in operation phase from canteen and STP. The source of municipal solid waste in the industry is domestic use. Inorganic waste will be disposed to PPCC authorized recycling agency. Municipal Waste Management details are given in **Table-8.**

Table-8 Municipal Solid Waste Quantities

Sl. No.	Description	Quantity (TPA)			Method of Collection	Method of Disposal
		Existing	Additional	Total Proposed		
1	Food waste	35	30	60	Manual	Converted to manure in Organic convertor

XII. Hazardous Waste Management

The hazardous wastes will be stored in an isolated area above concrete platform under roof shed. These wastes will be segregated, stored and will be disposed to MoEF&CC/PPCC authorized TSDF operators within a stipulated period of time (90 days).

The hazardous wastes will be disposed as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and subsequent amendments. ATFD salts are currently stored inhouse and procedures to dispose to nearby TSDF sites/Co processor will be established. Hazardous Waste Generation details are given in **Table-9.**

Table-9 Hazardous Waste Management

Sl.No	Schedule No	Name of the Hazardous Waste	Existing Quantity KLA/TPA	Additional Quantity KLA/TPA	Total Quantity KLA/TPA	Method of Stage / Disposal
1	Class A of Schedule II	Waste Sodium Dichromate Solution	22000	13000	35000	Dispose to PPCC Authorized Vendor
2	34.3 Schedule I	ETP Sludge	3	5	8	Sent to Coprocessing in Cement Industries/ GEPIL
3	5.1 Schedule I	Spent Lubricating Oil	4	6	10	Dispose to PPCC Authorized Vendor
4	5.2 Schedule I	Waste / Residue containing Oil	150	150	300	Dispose to PPCC Authorized Vendor
5	20.2 Schedule I	Spent Solvent	900	680	1580	Dispose to PPCC Authorized Vendor
6	20.3 Schedule I	Distillation Residue	48	48	96	Dispose to PPCC Authorized Vendor
7	28.1 Schedule I	Process Residue / Waste	720	620	1340	Dispose to PPCC Authorized Vendor
8	28.2 Schedule II	Spent Catalyst / Spent Carbon	54	20	74	Dispose to PPCC Authorized Vendor
9	28.3 Schedule II	Off Specification Product	1	4	5	Dispose to PPCC Authorized Vendor
10	28.4 Schedule II	Date Expired / Discarded Off Specification drugs / Medicines	1	2	3	Bio Medical waste Treatment Facility
11	28.5 Schedule II	Spent Organic Solvent	36	50	86	Dispose to PPCC Authorized Vendor
12	33.2 Schedule I	Sludge from Treatment of Waste water arising out of cleaning / disposal of Barrels / containers	20	10	30	Dispose to PPCC Authorized Vendor

Sl.No	Schedule No	Name of the Hazardous Waste	Existing Quantity KLA/TPA	Additional Quantity KLA/TPA	Total Quantity KLA/TPA	Method of Stage / Disposal
13	33.3 Schedule I	Discarded Containers / Barrels / Liners , Contaminated with Hazardous waste Chemicals	250	180	430	Dispose to PPCC Authorized Vendor
14	35.1 Schedule I	Chemical Sludge from Waste water treatment	4800	6180	10980	ATFD salts are currently stored inhouse and options to dispose to nearby TSDF sites/Co processor
15	34.4 Schedule I	Oil and Grease Skimming Residues	1	1	2	Dispose to PPCC Authorized Vendor
16	35.2 Schedule I	Spent Catalyst	1	1	2	Dispose to PPCC Authorized Vendor
17	35.3 Schedule I	Spent Carbon	90	50	140	Dispose to PPCC Authorized Vendor

XIII. Analysis of Alternatives Considered

Since the land adjacent to existing facility is only used for the expansion with change in production capacity, no alternate sites are considered as stated in **Chapter 5 & Section 5.2**.

XIV. Project Cost

The total capital investment of the expansion project is INR 125 crores, the details of which are provided in **Table-10.**

Table-10 Project cost Breakup

Sl. No.	Description	Cost In INR Lacs
1	Civil	980.00
2	Equipment Cost	5,750.00
3	Mechanical	1,470.00
4	Electrical	980.00
5	Instrumentation	1,300.00
6	HVAC	670.00
7	EHS	1,250.00
8	Consultancy	100.00
	Grand Total	12,500.00

XV. Baseline Study

Meteorological Environment

The micro-meteorological conditions during the study period (July – September 2017) for hourly data of wind speed, wind direction and temperature were recorded at the project site. As per the Indian Meteorological Department (IMD) located at Puducherry provided Climatological data, the annually determined wind direction is South East.

Annual total total rainfall was 1354 mm. Maximum and minimum rainfall of 132.8 mm and 89.5 mm was recorded in the months of July and September respectively. In the site specific meteorological data of study period (July – September 2017), an average wind speed of 2.9 m/s. average temperature of 33.1°C and relative humidity of 73% were recorded. Map showing the air monitoring locations is given in **Figure-4.** Air, Noise, SW, GW & Soil Quality Monitoring Locations are provided in **Table-11.**

Table-11 Monitoring Locations

Station Code	Location	Type of Wind	Geographical Coordinates	Distance (Km) from Project boundary	Azimuth Directions
A1	Project Site	-	12° 2'19.87"N 79°51'10.63"E	Within Site	
A2	Manjakuppam	d/w	12° 6'9.14"N 79°54'3.35"E	3.9	NE
A3	Sertinagar	d/w	12° 4'2.21"N	8.7	NE

Station Code	Location	Type of Wind	Geographical Coordinates	Distance (Km) from Project boundary	Azimuth Directions
			79°52'47.28"E		
A4	Chinna Kalapettai	c/w	12° 1'49.31"N 79°51'46.44"E	2.0	SE
A5	Kottaikuppam	c/w	11°57'55.50"N 79°50'23.44"E	8.6	S
A6	Idayanchavadi	u/w	11°57'50.90"N 79°46'32.54"E	7.2	SW
A7	Royapudupakkam	c/w	12° 1'52.17"N 79°47'35.02"E	6.15	W
A8	Nesal	c/w	12° 3'21.71"N 79°48'44.83"E	7.94	WNW

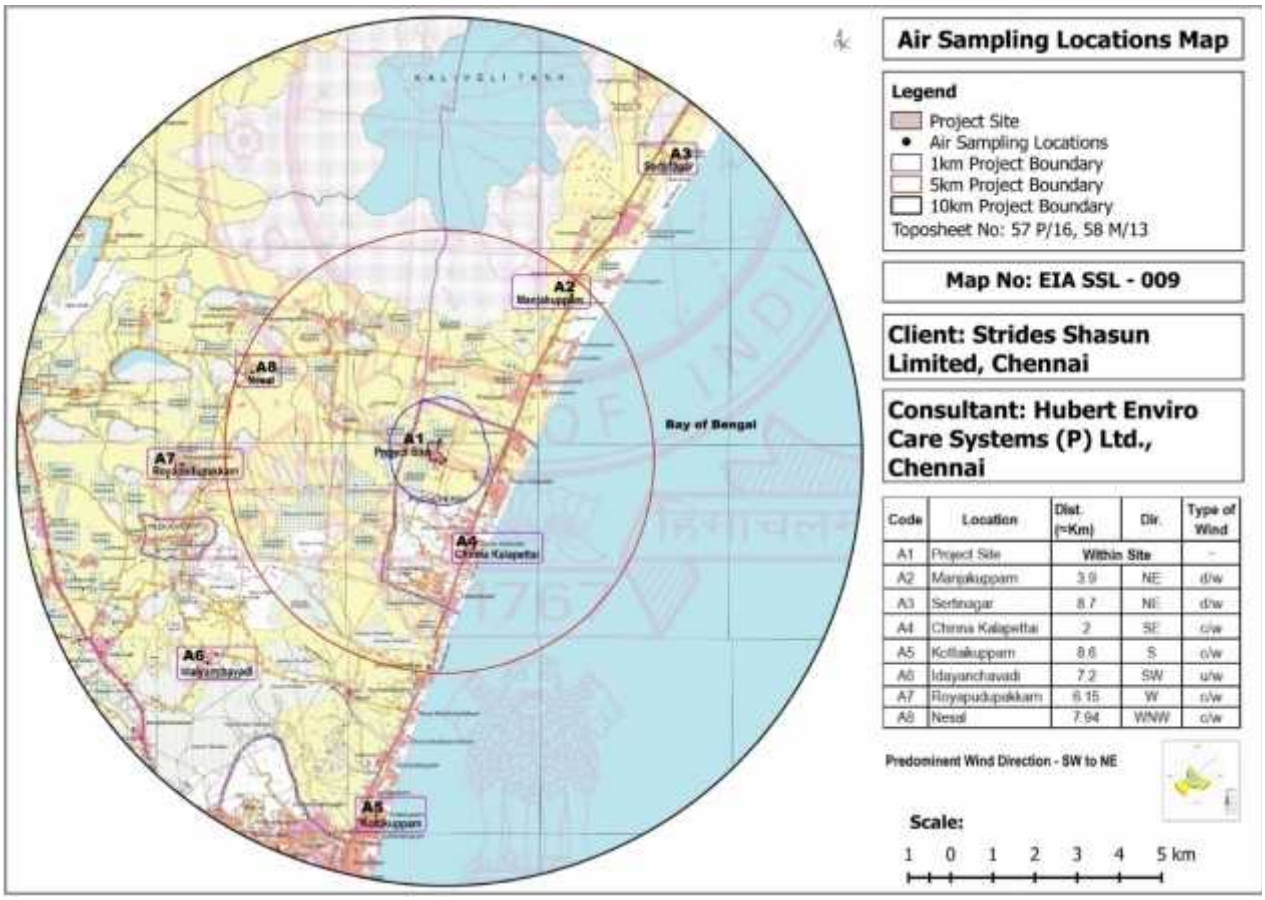


Figure-4 Map showing the Air, Noise, SW, GW &Soil Quality Monitoring Locations

Ambient Air Quality

The ambient air quality has been monitored at 8 locations for 12 parameters as per NAAQS, 2009 within the study area. The baseline levels of PM_{10} (48.5 – 60.8 µg/m³), $PM_{2.5}$ (18.1 – 25.0 µg/m³), SO_2 (10.8 – 13.8 µg/m³), NO_2 (18.2 – 21.5) and CO (0.01 - 0.91 mg/m^3), all the parameters are well within the National Ambient Air Quality Standards for Industrial, Commercial and Residential areas at all monitoring locations during the study period from July to September 2017.

Noise Environment

The existing ambient noise levels were monitored using precision noise level meter in and around the project site at 10 km radius at 8 locations during July - Sept 2017. During the study period in industrial area day time noise levels were about 59.4 dB(A) and 60.8 dB(A), which are within prescribed limit by MoEF&CC (75 dB(A) Day time & 70 dB(A) Night time). During night time noise levels of 50.1 dB (A) and 55.2 dB (A) were recorded, which are within prescribed limit by MoEF&CC (75 dB(A) Day time and 70 dB(A) Night time). In residential sector, daytime Leq values were in the ranges of (51.1 – 60.2) dB(A), and the nighttime Leq values varied in the range of (44.3 – 50.8) dB(A).

Water Environment

There are two kajor water bodies within the study area: Kaliveli Lake, 8.1 Km towards North and Bay of Bengal 1.72 Km in East direction from the project site. The prevailing status of water quality at 8 sampling locations for surface water and 8 sampling locations for groundwater have been assessed from July to Sept 2017. The standard methods prescribed in IS were followed for sample collection, preservation and analysis in the laboratory for various physiochemical parameters.

Surface water quality

The values range pH: 7.14 – 8.01, TDS: 238 mg/l – 35329 mg/l, Total Hardness: 70 mg/l – 8200 mg/l, Chloride content: 42.552 mg/l – 19750 mg/l. Sulphate content: 34 mg/l – 2530 mg/l. Fluoride 0.21 mg/l - 1.0 mg/l and Dissolved Oxygen 5.5 mg/l – 6.5 mg/l

Groundwater Quality

The values ranges pH: 6.98 - 7.74, TDS: 442 mg/l – 1180 mg/l, Total Hardness: 123 mg/l – 501 mg/l, Chloride content 136 mg/l – 289 mg/l and Sulphate content: 58 mg/l – 157 mg/l. Fluorides were observed between 0.44 mg/l and 1.0 mg/l.

Soil sampling was carried out at eight (8) locations in the study area. It is observed that,

- The pH of the soil samples ranged between 6.90 – 8.15; indicating that the soils are almost neutral in nature.
- Conductivity of the soil samples ranged from 100.5 – 714 µS/cm. As the EC values are less than 2000 µS/cm, the soil is found to be non-saline in nature.
- The water holding capacity of the soil samples varied from 19.6 - 28.6 (%).
- Nitrogen content ranged from 67 kg/ha to 188 kg/ha.
- Phosphorous ranged from 47 kg/ha to 106 kg/ha.
- Potassium content ranged from 60 to 154 kg/ha.

Biological Environment

The sensitive places in the study area are provided in **Table 3-1**. The species observed in the study area are mostly commercial crops and plantation crops and breaks are also observed throughout the semi-evergreen and moist deciduous forest types. The main trees which are grown in this region such as Eucalyptus supply firewood. There are two wildlife refuges in Puducherry with a great variety of birds. There is no extinct flora and fauna species found in the study area. The biodiversity richness map of study area is provided in **Figure-5.**

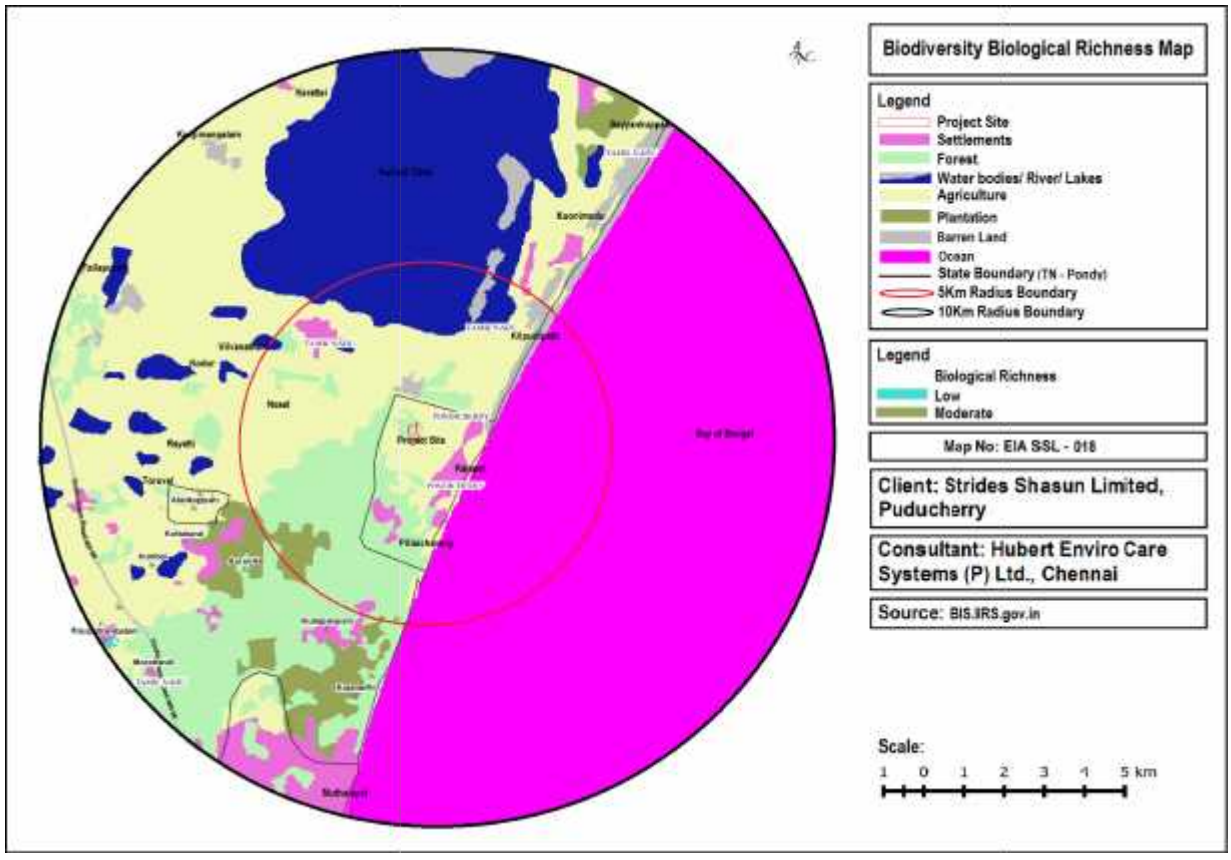


Figure-5 Biodiversity Richness Map

Socio Economic Environment

A socio-economic study was undertaken in assessing aspects which are dealing with social and cultural conditions, and economic status in the study area. The study provides information such as demographic structure, population dynamics, infrastructure resources, and the status of human health and economic attributes like employment, per-capita income, agriculture, trade, and industrial development in the study area. The study of these characteristic helps in identification, prediction and evaluation of impacts on socio-economic and parameters of human interest due to proposed project developments. The parameters are:

- Demographic structure
- Infrastructure Facility
- Economic Status
- Health status
- Cultural attributes

Agriculture is the main occupation of the district, but the district is being close to Chennai and Cuddalore and the fast industrialization in the district, there is shift in the occupation pattern. The main workers of the study area constitute 84.94% i.e a person who has worked for major part of the reference period (i.e. six months or more during the last one year in any economically productive activity is termed as 'Main worker)'. Those who involved in the agriculture are 18.21% and other workers are 79.89%. The socio-economic status of the district and study area are provided in the **Chapter 3, Section 3.11.**

The project area is in Periakalapet Village, Puducherry Tehsil of Union Territory of Puducherry located at Latitude: 12° 2'20.58"N and Longitude: 79°51'9.96"E

XVI. Anticipated Environmental Impacts

Water Environment

The freshwater requirement for proposed expansion phase will be 498 KLD to be sourced from inhouse bore wells/ externally procured treated sewage, PIMS, MGMC, PWD etc. The certificate for registration of existing inhouse borewell is attached as **Annexure 22**. Application has been submitted to Puducherry Groundwater Authority for renewal of Groundwater usage certificate for inhouse borewell and acknowledgement of the same is attached as **Annexure 23**.

The total water requirement for Operation Phase after expansion will be 2315 KLD (freshwater 498 KLD and treated water 1817 KLD). Out of 1817 KLD of recycled water consumed, 590 KLD of treated sewage is sourced from PIMS, MGMC, PWD etc.

Industrial effluent will be treated in a dedicated ETP. Treated wastewater will be used within the plant and Zero Liquid Discharge concept will be maintained. Thus there will be no outfall of

effluent to outside and hence there are no adverse impacts due to the proposed project on water environment.

As the proposed expansion will draw groundwater from the site, the following measures are proposed as a part of development to improve the groundwater scenario and also to ensure that groundwater is not contaminated.

- Rainwater is captured from the roof catchments with closed pipe system (without mixing surface water to avoid the spillage contamination) into the recharge pits and excess water is stored in the rain water storage tank/sumps. Strides Shasun has developed rainwater harvesting structures to harvest the runoff water from the rooftops and stormwater drainage system for recharge of groundwater.
- Rooftop harvesting is practiced for non process areas (Admin Building and Canteen) from where the water collected is used for groundwater recharge.

Air Environment

The baseline levels of PM_{10} (48.5 – 60.8 µg/m³), $PM_{2.5}$ (18.1 – 25.0 µg/m³), SO_2 (10.8 – 13.8 µg/m³), NO_2 (18.2 – 21.5) and CO (0.01 - 0.91 mg/m^3), all the parameters are well within the permissible limits as prescribed by National Ambient Air Quality Standards. The main sources of emissions will be from the D.G sets, Reactors, Boilers and Thermic Fluid Heater stacks.

Air pollution control measures following will be adopted:

1. All process vents will be connected to scrubbers and let out through at 3 m stack located above roof level.

2. Utilities stack will be provided with adequate height for DG Sets 20 m & TFH 30 m respectively.

3. After expansion, 16.58 Acres (35.371% of total area of 25.99 Acres) of greenbelt cover will attenuate the air pollutants.

As GLC indicates maximum concentration observed due to proposed expansion for PM, SO_2 and NOx are 0.39 µg/m^3, 0.22 µg/m^3 and 6.13 µg/m^3 (scenario 1) and 3.35µg/m^3, 1.01 µg/m^3 and 18.29 µg/m^3 (scenario 2) respectively. So it can be concluded that even after the expansion of the plant the impact envisaged is minimum.

Noise Environment

During the study period in industrial area day time noise levels were about 59.4 dB(A) and 60.8 dB(A), which are within prescribed limit by MoEF&CC (75 dB(A) Day time & 70 dB(A) Night time). During night time noise levels of 50.1 dB (A) and 55.2 dB (A) were recorded, which are within prescribed limit by MoEF&CC (75 dB(A) Day time and 70 dB(A) Night time). In residential

sector, daytime Leq values were in the ranges of (51.1 – 60.2) dB(A), and the nighttime Leq values varied in the range of (44.3 – 50.8) dB(A).

As a preventive measure for the noise reduction the following will be adopted:

1. Acoustic measure for all the rotary equipment.
2. All the equipment will be housed in civil sheds.
3. Greenbelt development and maintenance will attenuate the noise levels.
4. The designed equipment with noise levels not exceeding beyond the requirements of Occupational Health and Safety Administration Standard will be employed.

Land Use

The present land is being used for industrial use from 1986. The proposed project is an expansion within the existing facility. Hence no change in land use is envisaged due to this project.

XVII. Environmental Monitoring Program

A monitoring schedule with respect to Ambient Air Quality, Water & Wastewater Quality and Noise as per CPCB/MoEF&CC shall be maintained.

XVIII. Pollution Control Measures

The Air emissions from Thermic Fluid Heaters and D.G sets will be mitigated by providing adequate stack heights. The reactors will be connected to scrubbers, which are attached to individual stacks.

Municipal Solid Waste comprises of food, packing material etc. MSW including food waste will be treated in Organic Waste Convertor. Packing material is sold to PPCC. Boiler ash is distributed to local farmers for agricultural purposes.

The hazardous waste will be stored separately in hazardous waste storage areas and disposed to MoEF & PPCC/CPCB authorized TSDF sites within the stipulated period of time. Hazardous waste materials will be properly disposed as per the Hazardous and other Wastes (Management and trans-boundary Movement) Rules 2016 and subsequent amendments

The expansion facility will generate 45 KLD of sewage from domestic activities and 550 KLD effluents from industrial processes. The effluents will be treated in Combined Effluent Treatment Plant (ZLD system). There will be no discharge to land environment. ZLD system has been installed and commissioned in September 2017. ATFD salts are currently stored inhouse and procedures to dispose to nearby TSDF sites/Co processor will be established. (Refer PPCC NOC and Agreement with TSDF as **Annexure 23**).

XIX. Greenbelt Development

The total existing land area is 105156 Sq. m (25.99 Acres). Total greenbelt area after expansion will be 37,193.29 Sq.m (16.58 Acres) for maintaining 35.37 % greenbelt.

XX. Risk Analysis

Summary of results and observations

- As per the NFPA rating, the fire hazard is observed in chemicals such as Acetone, Toluene, Hexane, Iso-propanol and Methanol. All the chemical are stored underground tank where the impacts are negligible and even risk contours maps are not generated.
- Risk assessment is done for day storages tanks and pipelines with max. capacity and length only.
- The Consequence analysis study has been carried out for Acetone, Toluene, Hexane, Iso-propanol and Methanol storage tank and pipelines.
- All the hazards are observed in North-East direction due to the wind, which is blowing from South-West direction.
- It is observed for IPA, Methanol, Toulene, Acetone, Hexane storage tanks in the catastrophic rupture scenario, the estimated distance for Explosion are 793.71m, 110.21m, 793.71m, 292.62m and 981.246m at wind speed of 1.5 m/s and stability class F, at the pressure of 0.02068 bar.
- It is observed for Hexane, IPA, , Methanol storage tank pipeline in the rupture scenario, the estimated distance for Explosion are 90.56m, 42.64m, 32m at wind speed of 1.5 m/s and stability class F, at the pressure of 0.02068 bar. Acetone Toluene storage tank pipeline in the rupture scenario the estimated distance for explosion are 71.75m, and 72.5m at wind speed of 1.5 m/s and stability class D, at the pressure of 0.02068 bar.
- Mitigative measures for storage tanks are proposed to avoid hazards.

XXI. Disaster Management Plan

The salient features of Disaster Management Plan include:

- Emergency shutdown procedure
- Electrical Power Failure & Key Utility failures
- Fire protection system
- Emergency safety equipment & reporting and response to emergency
- Emergency help from nearby industries and tie up with nearby industries

- Emergency control room - is the focal point in case of an emergency from where the operations to handle the emergency are directed and coordinated. It will be equipped with Internal and P & T telephones, Paging system and Emergency siren.

Major hazards from the hazardous material storage have been identified and evaluated using PHAST software. Impacts due to accidental releases of flammable, explosive and toxic chemicals from the storage tank pipelines are discussed. The consequence analysis is conducted to assess the level of impacts associated with storage and handling of hazardous chemicals. The storage tanks are located within Strides Shasun, Pondicherry boundary and the surroundings are ideal without external interface.

On-Site Emergency Plan

An on-site emergency plan is established to deal with emergencies and prevent disasters:

- To provide effective planning, communication and to ensure discipline while mitigating identified emergencies at the earliest utilising available resources, safety gadgets and systems.
- Synchronized action from all the internal and external agencies at the earliest to initiate corrective and preventive action.
- To minimize the human injury and illness during emergency mitigation, priority will be given to rescue of incident victim/s, rendering them first aid onsite and if required providing further medical services at the earliest, which will be available nearest to our plant.
- To minimize damage to property, general environment or work environment.
- To effectively refer and utilize the revised onsite emergency plan while conducting on site emergency and preparedness response drills and also during real emergencies.
- To identify any deviations during the above drills and real situations to ensure any identified and recorded observations for continual corrective actions and preventive actions.

XXII. Benefits of the Proposed Project

Though there are minor pollution impacts, the project will be beneficial in the following aspects:

1. As seen above there is no marginal impacts on air, noise, water & soil environments.
2. The proposed greenbelt will enhance the green coverage in the area and aesthetics.
3. Rainwater collection and storage systems will enhance the water conservation.
4. An additional employment generation of 50 numbers.

5. Fulfill the market requirement and play a vital role in the manufacture of pharmaceutical bulk drug production sector which thereby reduce imports and address the market demand and social and health benefits. The products manufactured within these facilities will be exported which will aid in adding foreign exchange to the nation.

6. Production of effective drugs to treat life threatening diseases, which will save millions of lives.

7. The existing freshwater consumption of 45 KLD by boilers is planned to be replaced with recycled water during expansion to conserve freshwater use.

8. The image of India will be better positioned as we enter into partnership to deliver products which are being developed by major pharma companies to treat life threatening diseases such as neuro disorders. Strides Shasun will be one among the few companies in the world to produce such complex molecules.

9. Various skill development, education, health care programmes & infrastructure developments are proposed as CSR, through which many villages around will be benefitted.

10. Also by this project the socio economic development of Pondicherry gets projected by means of creating more job opportunities for transport, supplementary supplies, and employees of Shasun living around the facility will create the development.

CHAPTER – 1

INTRODUCTION

1. Introduction

1.1 Project Background

Strides Shasun Ltd., (SSL) A globally leading Pharmaceutical company, is an integrated, developer, manufacturer and supplier of services for Bulk drugs, intermediates, Active Pharmaceutical Ingredients (API) and Formulations to pharmaceutical industries. Strides Shasun Limited – Puducherry (formerly known as Shasun Pharmaceutical Ltd) was established in 1986 with headquarters in Bengaluru, India.

The State of the art Multi Product Manufacturing facility of Strides Shasun Limited is located at Plot no. R.S No. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Periakalapet, Mathur Road, Puducherry. Due to increased market demand for API and intermediates in domestic and international markets, Strides Shasun Limited Puducherry proposes expansion of its Bulk Drugs Manufacturing Facility from the existing capacity of 4800 TPA with 5 products to capacity of 9156TPA with 8 products. Strides Shasun has obtained CTO for the existing facility for the manufacturing capacity of 4800 TPA with 5 nos. products (Attached as **Annexure 3**).

The Proposed Project termed under Schedule 5 (f), Category A, Synthetic Organic Chemicals as per the EIA Notification 2006.Tamil Nadu – Puducherry Interstate Boundary is crossing within 5 Km radius of Project Study Area and hence the general condition is also applicable, requiring appraisal of the project at MoEF&CC, i.e, Category A.

1.2 Project Proponent

M/s. Strides Shasun Limited

Corporate Office: Strides House, Bilekahalli, Bannerghatta Road, Bengaluru-560 076

Contact Persons: -

1. Mr. E. Kannapiran – Vice President, Operations
2. Mr. Ramesh Ramasamy – DGM, EHS
3. Mr. Yuvarajkumar – Senior Group Leader, Technical Service

1.3 Proposed Project

Strides Shasun Limited proposes Expansion of Bulk Drugs manufacturing from existing capacity of 4800 TPA with 5 products to 9156 TPA with 8 products at the existing facility at Periyakalapet, Puducherry.

1.4 Justification & Need for the Project

Due to increased market demand of Active Pharmaceutical Ingredients (API) and Intermediates in domestic and international markets, Strides Shasun Limited proposes to increase the existing capacity and addition of products in bulk drugs manufacturing facility at Puducherry, which will also house a state of the art QC/QA/R&D & EHS to cater the advanced technological and market requirement.

1.5 Location of the project site

The facility is proposed within its 25.99 Acres of land located at Mathur Road, Periakalapet Village, Puducherry Tehsil, Union Territory of Puducherry. On the East side is the State Highway 49 (Puducherry – Chennai East Coast Road) which connects Chennai and Puducherry. Puducherry, which is a Union Territory and U.T Capital, is well connected by Rail and road. The National Highway is situated at about 25 kms away. There is no additional land is required for this expansion project.

Salient features of the project site and its Environs are given in **Table 1-1.** Location map of Strides Shasun Limited is given in **Figure 1-1.**

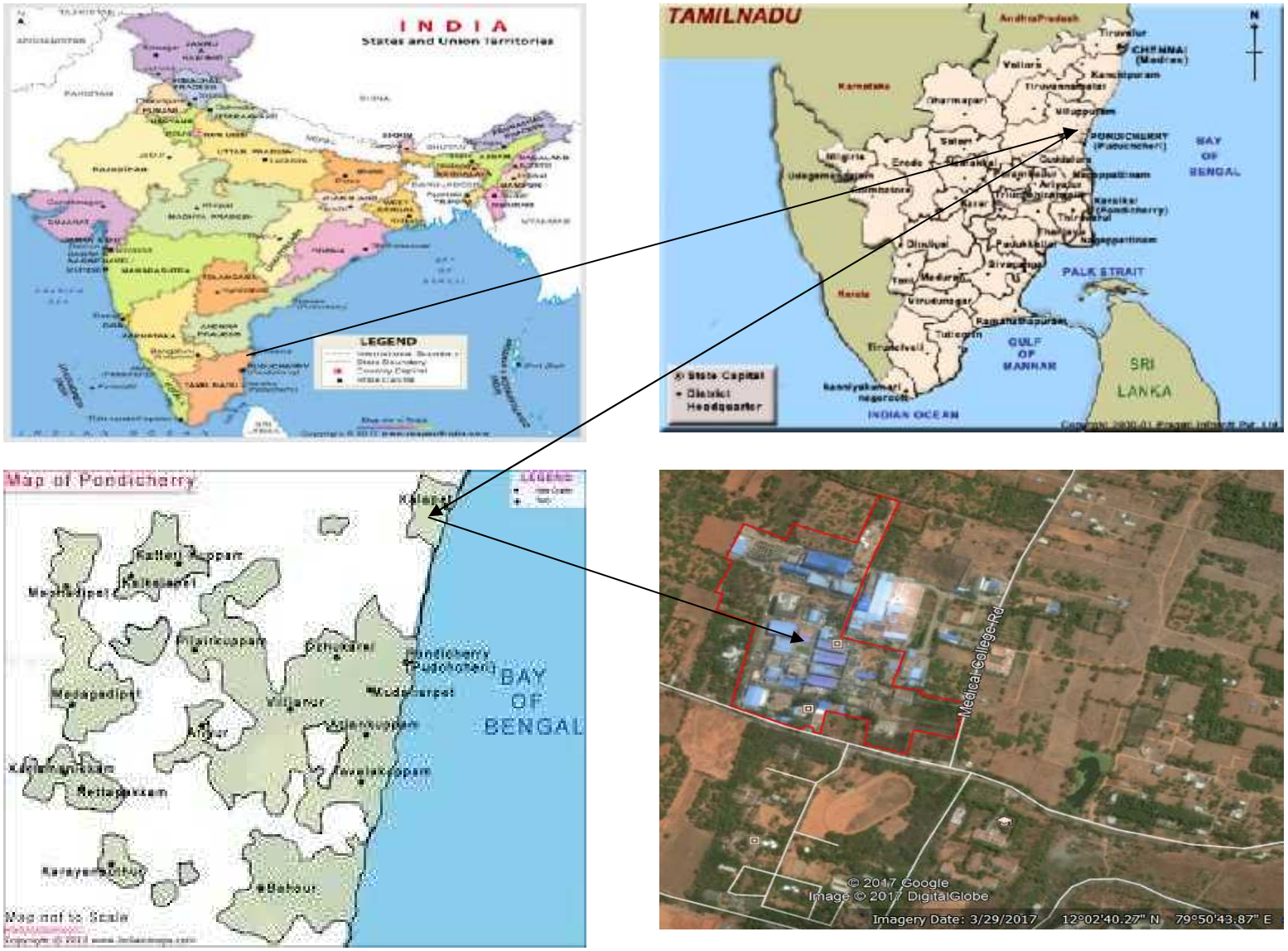


Figure 1-1 Location map of the Strides Shasun facility- Puducherry

Table 1-1Salient Features of the project site and its environs (Refer Chapter 3)

S. No.	Particulars	Details within 10Km radius from Proposed project
1	Location:-	Plot no. R.S No. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5
	Village	Periakalapet, Mathur Road,
	Taluk (Mandal)	Puducherry (Puducherry)
	District	Puducherry (Puducherry)
	State	Puducherry (Puducherry)
2	Latitude	12° 2'20.58"N
3	Longitude	79°51'9.96"E
4	Elevation above Mean Sea Level (MSL)	35m
5	Climatic condition as per IMD	Average Max. Temp: 35.7°C Annual Min. Temp: 20.9°C Annual Total Rainfall: 1240 mm
6	Present land use at the proposed site	Notified Special Hazardous Industrial Use Zone
7	Nearest Highway/Road	NH-45A (Viluppuram - Nagapattinam)
8	Defence installations	Nil within 10 Km radius
9	Nearest railway station	Puducherry Railway station ≈13Km Towards SSW
10	Nearest airport/air strip	Puducherry Airport –≈8.9 Km, SSW
11	Nearest village	Kalapet Village – ≈1 Km, ESE
12	Nearest town	Puducherry Town - ≈13 Km
13	Nearest river	Nil within 10 Km radius
14	Archaeologically important places	Nil within 10 Km radius

S. No.	Particulars	Details within 10Km radius from Proposed project
15	Nearest place of Tourist/Religious importance	Auroville 5.60 Km SW
16	Ecologically sensitive areas (National Parks/Wildlife sanctuaries/bio-sphere reserves)	• Kaliveli Lake _8.1 Km_N • Ousteri Wetland & National Park_13.7 Km_SW • Kumalumpattu_13.7 Km_NW
17	Reserved/Protected forests within 10 km radius	Nil within 10 km radius
18	Type of soil	Red ferrallite, and black clay

1.5.1 Sites considered for the project location

As discussed in earlier section. The site for the proposed project is situated at Plot No. R.S No. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9,34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Periakalapet, Mathur Road, Puducherry.

No alternate sites are considered as the project is expansion within the existing facility with increase in production capacity. The land document is enclosed as **Annexure 4**.

1.6 Need for the EIA Study

According to the Environmental Impact Assessment (EIA) Notification, 2006 issued by Ministry of Environment, Forests& Climate Change (MoEF&CC) under Environmental Protection Act, the project falls in synthetic organic chemical based units located inside the notified industrial area/estate are listed in schedule no. 5(f) under Category ' B'. If the project is coming outside the industrial area/estate then it will be treated as Category-A project. Since the proposed project is located outside the industrial estate /park it is categorised as Category A project. Also, general condition is applicable to this project, as the Tamil Nadu – Puducherry Interstate Boundary is falling within 5 Km radius from the project site. Hence the project is treated as Category "A" and to be appraised at MoEF & CC, New Delhi.

1.6.1 Project Screening and ToR

The proponent has obtained ToR from MoEF & CC as vide as letter no. IA-J-11011/211/2017-

IA-II(I) dated 16/08/2017 (Attached as **Annexure-1**). The consolidated compliance against ToR points is enclosed in the report as **Annexure-2**. With a view to evaluate likely impacts/ risks associated with the proposed projects on various components of the environment and propose appropriate management and monitoring plan, M/s. Strides Shasun Limited took services of NABET Certified EIA Consultant, Hubert Enviro Care System Pvt. Ltd.Chennai, Tamil Nadu.

1.6.2 EIA Study

The EIA study was undertaken covering all the aspects of the specific conditions mentioned in the terms of reference issued by EAC. This EIA study was undertaken by M/s Hubert Enviro Care Systems (P) Ltd (HECS), Chennai, a NABET accredited EIA consulting organisation, with specific project related inputs required for undertaking the EIA studies from M/s. Strides Shasun Limited, Puducherry.

M/s. Hubert Enviro Care Systems (P) Ltd is authorized to undertake EIA studies for 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) as per the NABET accreditation scheme.

1.6.3 EIA Cost

EIA study was undertaken by HECS for an amount of **Rs. 25,20,000/- (Twenty Five lakhs Twenty Thousand only).**

1.7 Overview of the Methodology of the EIA Study

The Environmental Impact Assessment (EIA) report has been prepared based on the methods and guidelines suggested by MoEF&CC to address all the specific conditions stipulated in the Terms of Reference issued by MoEF & CC.

The EIA study team, headed by an accredited EIA Coordinator, along with the approved Functional Area Experts, undertook detailed baseline studies as per the ToR, between July to September 2017.

Micro-meteorological data comprising hourly readings of wind speed, wind direction, dry bulb temperature, relative humidity and rainfall were measured by installing an onsite meteorological station near the Project site. Hourly readings were collected for a period of three (03) months.

Micro-meteorological data was adopted for generating wind rose diagrams and also to predict the ground level concentrations due to release of emissions from the proposed project.

Ambient Air Quality (AAQ) was measured at 8 locations in the study area as per the methods and procedures recommended by Central Pollution Control Board (CPCB). Air quality sampling was undertaken for a period of 12 weeks with a total of 24 samples per site were taken as per the MoEF&CC guidelines. Stipulated criteria pollutants such as particulate matter size less than 10 microns (PM_{10}), Particulate matter size less than 2.5 microns ($PM_{2.5}$), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon monoxide (CO), Hydrocarbons (HC) and Ozone (O_3) were analysed at all the locations. The measured background air quality data was compared with that of the prevailing National Ambient Air Quality Standards and this will also form the basis for predicting the cumulative air quality scenario due to the operation of the proposed facility.

Hydro-geological status was studied based on the secondary published long-term data. Data on sub-surface soil profile and also bore-log data in the study area was obtained. In additional, a preliminary study on the regional and local aquifer status was studied based on primary and secondary data.

Ground water samples from 8 locations were analysed as per the terms of reference for all the designated parameters. The measured values were compared with drinking water standards. Secondary data on the regional ground water status was also collected from the Central Ground Water Board and the State Ground Water Board.

There are no major perennial rivers flowing within the study area. However, surface water samples from eight (08) locations were analysed as per the terms of reference for all the designated parameters. All seasonal streams, rivers and water bodies located within the study area were mapped through latest remote sensing data under land use and land cover study. Walk through surveys were also undertaken to assess the current status of the water resources. Details about the major cropping pattern and irrigation methods etc were collected from local village offices and also published district census data. Details of the surface water quality in the study area were also collected and analysed for designated physicochemical, elemental and biological parameters.

Land use and land cover was mapped using remote sensing satellite imagery. The data was processed using applicable software models and level 2 land use classification within the study area was developed. A walk through survey was undertaken near the forest boundaries, major settlements and plantation area to verify the land use as a part of the ground truth survey procedures.

Soil samples were also collected at 8 locations and all relevant parameters such as texture, nutrients, heavy metals and other parameters were analysed in the soil samples.

Flora and Fauna survey was undertaken in the study area and all spotted ecological and biological aspects were mapped based on grid sampling method. Bio-diversity density and abundance were estimated. Walk through surveys near forest area and its environs were also undertaken to assess the ecology around the forest areas and dependency of the local people on the forest produce.

Primary socio-economic survey was undertaken in the study area to capture the socio-economic conditions, major occupation of the people, drinking water and sanitation facilities, transportation and other amenities in the study area, with a specific reference to the villages located within five (5) km radius (Category-I) of the project site and villages located within 5 to 10 Km radius (Category-II) of the project site.

In addition to the above, district level census data published by National Informatics Centre (NIC) was also collected for a detailed analysis on the socio-economic aspects. Based on the socioeconomic survey, a need based Community Development Plan under Coroporate Social Responsibility (CSR) was suggested. Since, there are no settlements at the proposed Project site, detailed Rehabilitation and Resettlement studies are not envisaged under this study; however, the indirect impacts on the local and regional community due to land acquisition were studied.

A typical review on the various industrial units, various pollution control systems proposed details of wastes and discharges that are envisaged from the proposed project were also undertaken. Such inputs are adopted while predicting various environmental impacts due to operation of the facility and also to suggest an appropriate environmental management plan and environmental monitoring plan.

As a part of the environmental impact assessment study, an attempt was made to predict the possible and likely impacts on background environment. Likely air quality impacts due to release of emissions within the stacks were modelled using AERMOD model.

Ground Level Concentration of criteria pollutants such as Particulate Matter, Sulphur Dioxide, and Oxides of Nitrogen were estimated using MoEF&CC approved AERMOD model. Hourly meteorological data collected from IMD data Periyakalapet, at the Project was adapted to assess ground level concentrations. Maximum ground level concentrations were predicted and concentration isopleths of the above mentioned pollutants were plotted.

The predicted ground level concentrations of the respective pollutants were added to the prevailing baseline concentrations of the designated pollutants to assess the likely cumulative post project scenario and such values were compared with the National Ambient Air Quality Standards.

Noise generating sources and the expected noise levels were estimated. Impacts due to utilisation of treated wastewater for greenbelt/utilities applications were also studied. Since the proposed project will not discharge any treated wastewater into surface water bodies (Ponds, Rivers and Canals), no further environmental modelling studies related to river water quality modelling were considered under this study.

In addition to the above aspects, the positive environmental benefits arising from community development plans under CSR programme, ecological and biodiversity enhancement aspects due to development of plantation and green-cover development in the project site were also studied.

Based on a detailed environmental impact assessment study, a comprehensive report on the environmental management plan was developed covering the following aspects: air quality management plan, noise and water quality management plan, wastewater treatment, reuse, recycling and disposal programme, rainwater harvesting plan, socioeconomic and community development plan and ecological and biodiversity enhancement plan. An outline of the proposed environmental management systems, environmental cell and environmental monitoring programme were also presented in this report.

Although the proposed project utilises the limited quantities of flammable and combustible materials within threshold levels below the stipulated quantities under Hazardous Materials

Handling Rules, a preliminary risk assessment study and Disaster Management study, was undertaken to assess the residual risks, if any, due to storage and handling of diesel and other combustible material. Wherever applicable, quantitative methods were adopted to establish the heat radiation levels due to accidental fires at storage facilities.

CPCB guidelines on risk assessment methods were adopted and CPR 18E guidelines were used for estimating the consequences of fire accidents. Based on the risk assessment study, a preliminary fire safety and occupational health management plan was suggested. A road map for onsite emergency and disaster management plan was suggested based on the preliminary information available at this stage.

1.8 Structure of the EIA Study

This EIA report is structured into eleven chapters as below.

Chapter 1 – Introduction presents details of project background, justification and need for the project, screening and scoping studies etc.,

Chapter 2 – (Project Description) presents details of the proposed project, land requirement and details of various supporting facilities required for the project.

Chapter 3 - (Description of Environment) presents a comprehensive description of the baseline environmental conditions of the study area. This includes the data obtained from primary surveys and also secondary published data from various authentic sources.

Chapter 4 – (Anticipated Environmental Impacts and Mitigation Measures) presents the environmental aspects associated with the proposed project, envisaged emissions and discharges from the facility, an overview of various pollution control systems proposed under project planning activities in the detailed project report and construction and operational phase environmental impacts.

Chapter 5 – (Analysis of Alternative Sites & Technology) presents alternative sites if any considered for the project and alternative Technologies considered for this project.

Chapter 6 – (Environmental Monitoring Programme) depicts the summary of proposed environmental management plan.

Chapter 7 – (Additional Studies) presents the findings of the risk assessment study, risk mitigation plan, a preliminary onsite emergency and disaster management plan.

Chapter 8– (Project Benefits) presents the benefits of the project.

Chapter 9 – (Environmental Management Plan) depicts the summary of proposed environmental management plan.

Chapter 10 – Presents the (Summary and Conclusion) of EIA report.

Chapter 11 – Disclosure of Consultant Engaged presents the declaration by the EIA consultant organisation as per the NABET requirements.

CHAPTER – 2

PROJECT DESCRIPTION

2. PROJECT DESCRIPTION

2.1 Type of Project

The State of the art Multi Product Manufacturing facility of Strides Shasun Limited is located at Plot no. R.S No. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Periakalapet, Mathur Road, Puducherry. Strides Shasun Limited Puducherry proposes expansion of Bulk Drugs manufacturing Facility from existing capacity of 4800 TPA with 5 products to 9156TPA with 8 products. Strides Shasun has CTO for the existing unit (Attached as **Annexure 3**).

The Proposed Project is termed under Schedule 5 (f), Category A, Synthetic Organic Chemicals as per the EIA Notification 2006as the project site is located outside the industrial area/Park/Estate. Also the project site is located within 5 Km of Tamilnadu – Puducherry Interstate boundary, general conditions apply. Hence the proposal shall be appraised by MoEF & CC, New Delhi. As per EIA Notification, 2006 in para 7 (i), sub section III it attracts public hearing for expansion or modernization or change of product mix in existing projects as it attracts specific condition.

The proposed site falls in the Latitude: 11°41’5.80"N and Longitude: 79°45’19.60"E. Site coordinates are given in below **Table 2-1**and habitat profile in **Table 2-2 .**

Table 2-1Site coordinates

Project Site Coordinates					
Site Corner	Latitude	Longitude	Site Corner	Latitude	Longitude
C1	12° 2’31.87"N	79°51’13.36"E	C14	12° 2’15.31"N	79°51’10.73"E
C2	12° 2’31.48"N	79°51’14.49"E	C15	12° 2’17.18"N	79°51’5.90"E
C3	12° 2’22.09"N	79°51’11.79"E	C16	12° 2’22.76"N	79°51’6.96"E
C4	12° 2’21.29"N	79°51’15.03"E	C17	12° 2’23.56"N	79°51’4.81"E
C5	12° 2’18.82"N	79°51’14.52"E	C18	12° 2’24.76"N	79°51’5.17"E
C6	12° 2’18.56"N	79°51’16.11"E	C19	12° 2’24.97"N	79°51’4.72"E
C7	12° 2’17.74"N	79°51’18.43"E	C20	12° 2’27.18"N	79°51’5.46"E
C8	12° 2’15.41"N	79°51’18.04"E	C21	12° 2’27.35"N	79°51’5.05"E
C9	12° 2’15.83"N	79°51’15.71"E	C22	12° 2’29.65"N	79°51’6.01"E
C10	12° 2’14.29"N	79°51’15.46"E	C23	12° 2’28.63"N	79°51’8.33"E
C11	12° 2’14.82"N	79°51’13.10"E	C24	12° 2’29.68"N	79°51’8.73"E
C12	12° 2’16.48"N	79°51’13.34"E	C25	12° 2’28.49"N	79°51’12.23"E
C13	12° 2’17.05"N	79°51’11.00"E			

Table 2-2 Nearest Habitat Profile from the project site

Sl.No	Villages	Distance in km	Direction	Population
1	Kalapet	1KM	ESE	9226

The satellite image showing the project site and the Google maps indicating the proposed site covering 10 Km, 5 Km and1 km radius from the project area is given **in Figure 2-1**, **Figure 2-2** and **Figure 2-3** respectively. Site layout & Site photos are represented in **Figure 2-4** & **Figure 2-5** respectively and site layout enclosed as **Annexure 5.** Industries within10 Km radius of project site is given in **Table 2-3** .

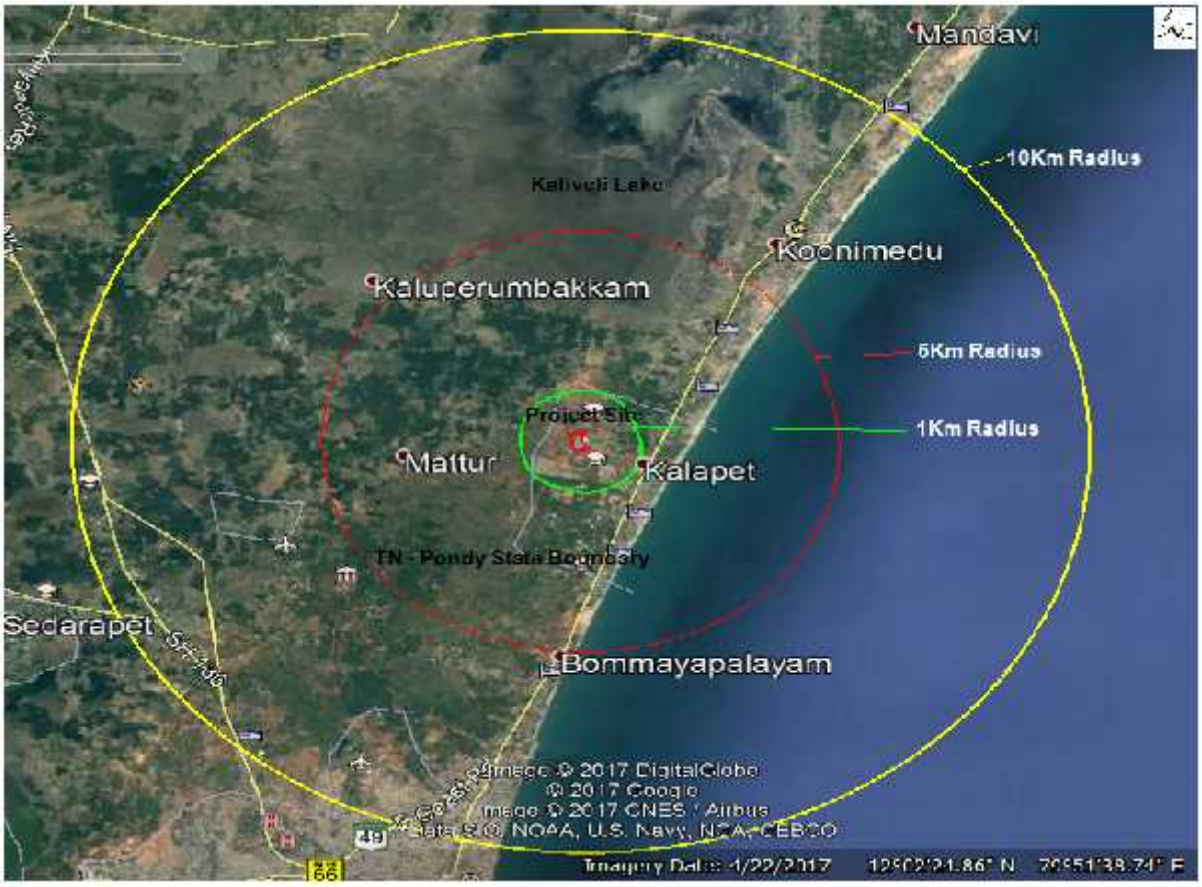


Figure 2-1Google view of the Project Site (10 Km Radius)

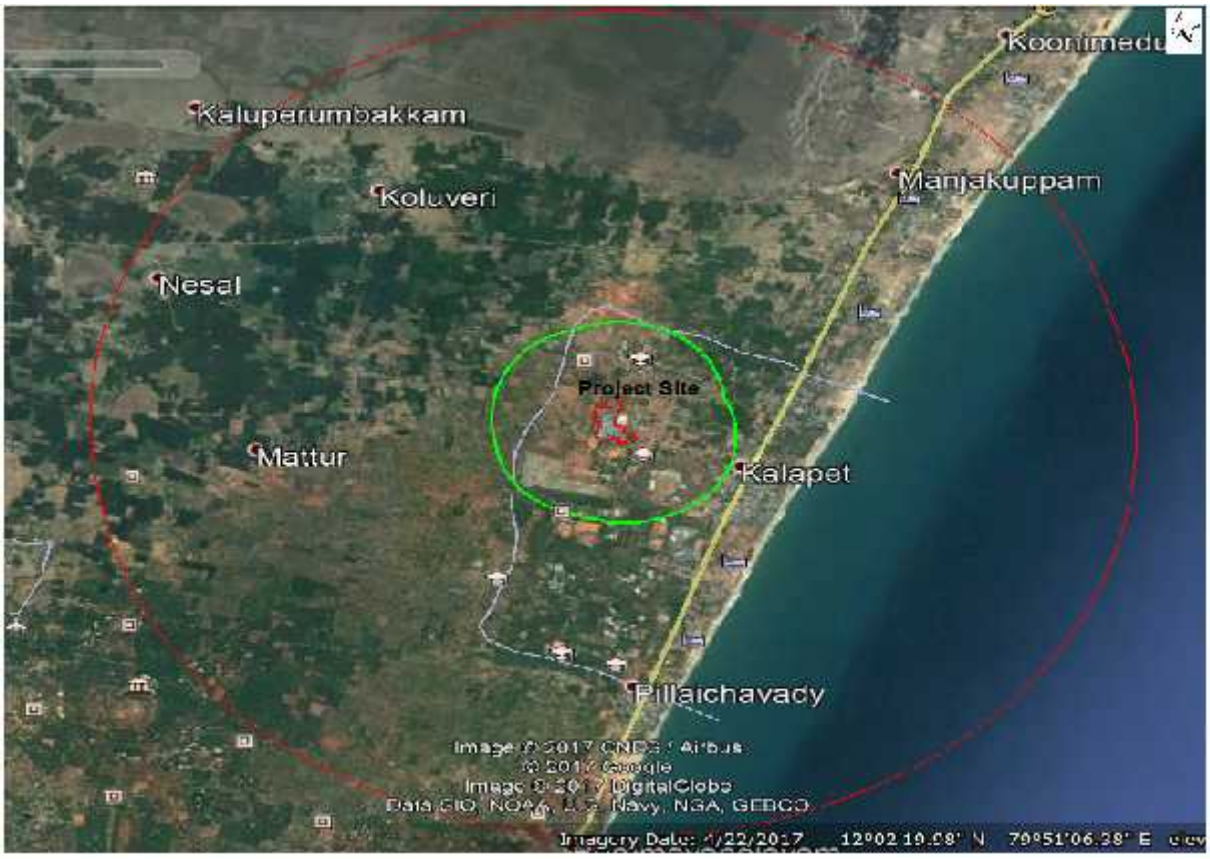


Figure 2-2 Google Satellite Image of the Project Site (5 Km Radius)

Figure 2-3Google Satellite Image of the Project Site (1 Km Radius)

Table 2-3 Industries within 10 Km of project site

S.No.	Name	Product	Distance from site (Km)	Direction
1	M/s. Strides Shasun Ltd – Formulation Unit	Bulk drugs	Adjacent to existing unit	E
2	M/s NS Pet Industries	Plastic	1.55	SE
3	M/s. Steeltech Industries	Steel works	3.66	NE
4	M/s. Chemfab Alkalis Limited	Chemical	1.15	SE
5	M/s Palmetto Industries India (P) Ltd	Packaging	1.42	SE
6	M/s. UCAL Polymer Industries	Polymer	11.92	SWS

7	M/s. ACT Plastic (P) Ltd	Plastic	12.08	SWS
8	M/s. Sundaram Industries (P) Ltd	Iron Works	12.37	SWS
9	M/s. Foseco India Limited	Chemical	11.89	SWS
10	M/s. Chemin C&I (P) Ltd	Electrical	12.04	SWS
11	M/s. Britannia Industries Ltd	Food	9.19	SW
12	M/s. Fine Automotive & Industrial Radiators (P) Ltd	Spares & Products	11.67	SW
13	M/s. Crimson Metal Engg. Company	Metal	11.19	SW
14	M/s. Aparna Paper Processing Industry (P) Ltd.	Paper	11.27	SW
15	M/s. Pondy Agro Chemicals Ltd.	Agrochemicals	0.01	W

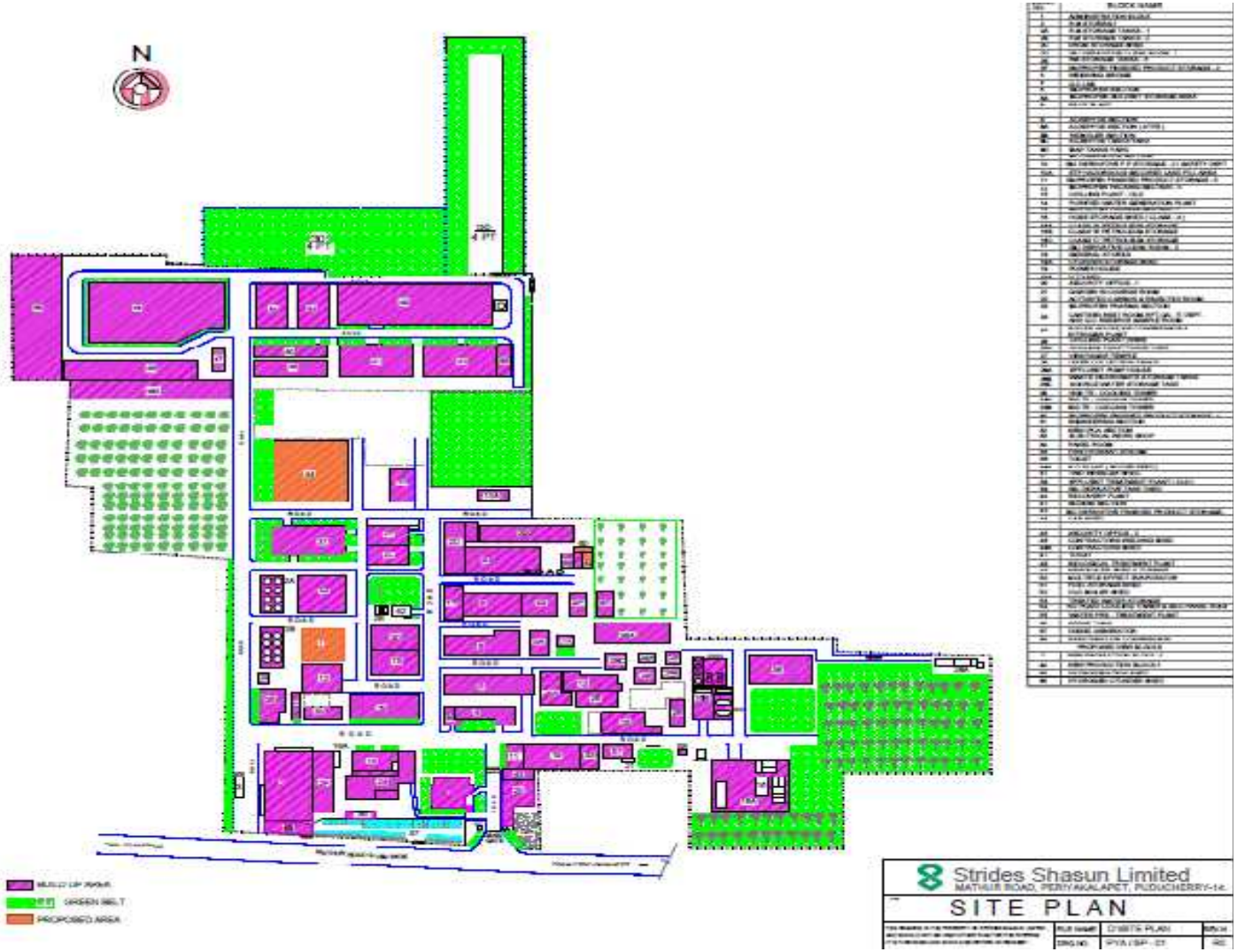


Figure 2-4 Site Master Plan – Strides Shasun Ltd, Puducherry

Site Administration block

Existing Production Block

Multiple Effect Evaporator

ZLD - BTP

Green belt area – Production

Green belt area – ETP

ETP Building

Boiler Stack

Figure 2-5Site Photographs

2.2 Size or Magnitude of operation

Strides Shasun Limited Puducherry was established in 1986 with valid CTO vide F.12/6(739)/86NOC /SOP/39. The product capacity was 1200 TPA in 1997 with 2 products with CTO vide PPCC/CON/OM/JE-II/96/349 increased upto the existing 5products of 4800 TPA through a series of 21 revisions in product mix/numbers till 2017. All the consent orders obtained by the facility from inception are attached as **Annexure 24.**

Table 2-4 Details of existing and proposed products and capacities

Sl. No.	Year	Products		EC No	CTE No	CTO No	Remarks
		Name	TPA				
1.	1986-1987			-	-	F.12/6(739)/86NOC/SOP/39	
2.	1987-1989			-	-	F.12/6(128)/87/CON/SOP/1462	
3.	1989-1991			-	-	F.12/6(128)/87/CON/SOP/-do-	
4.	1991-1992			-	-	F.12/6(128)/87/CON/SOP	
5.	1993-1994	Ibuprofen, PMP, Chloroheniramine Maleate,Pheiramine Maleate, Aluminum Chloride, Sodium Sulphate, Basic Chromium Sulphate		-	-	DSTE/CON/93-94/1369	
6.	1995-1995	Ibuprofen, Aluminum chloride, PMP, Chloroheniramine Maleate,Pheiramine maleate, Sodium sulphate, Basic chromium sulphate		-	-	DSTE/CON/JE-II/94-95/308	
7.	1997-1998	Ibuprofen 100 TPM, Semi finished organic chemicals	2800	-	-	PPCC/CON/OM/JE-II/96/349	

		- 140 TPM					
8.	1998-1999	Ibuprofen100 TPM,	1200	-	-	PPCC/CON/OM/JE-II/98/1175	
9.	1999-2000	Ibuprofen 100 TPM,	1200	-	-	PPCC/CON/OM/JE-II/99/1141	
10.	2001-2002	IIbuprofen100 TPM,	1200	-	-	PPCC/CON/OM/JE-II/2001/550	
11.	2002-2003	Ibuprofen100 TPM, Ibuprofen dc 20 TPM , S.Naproxen 20 TPM	1680	-	-	PPCC/CON/WTR/OM/EE/2002/2877	
12.	2004-2005	Ibuprofen 100 TPM, Ibuprofen dc-20 TPM S.Naproxen 20 TPM	1680	-	-	PPCC/CON/WTR/OM/JE-II/2004/2045	
13.	2005-2006	Ibuprofen 100 TPM, Ibuprofen dc-20 TPM, S.Naproxen 20 TPM,	1680	-	-	PPCC/CON/WTR/OM/JE-II/2004/3576	
14.	2006-2007	Ibuprofen 100 TPM, Ibuprofen dc-20TPM S.Naproxen 20 TPM	1680	-	-	PPCC/CON/WTR/OM/JE/2006/1690	
15	2009-2011	Ibuprofen 340 TPM, Ibuprofen dc-20 TPM , Ibuprofen derivative 20 TPM, Carisoprodol 20 TPM and Pilot scale operation for R&D	4800	-	-	9/PPCC/CON/WTR/OM/JE/2009/486	
16	2011-2012	Ibuprofen 340 TPM, Ibuprofen dc - 20 TPM	4800	-	-	9/PPCC/CON/WTR/OM/JE/2011/404	

		Ibuprofen derivative 20 TPM, Carisoprodol 20 TPM and Pilot scale operation for R&D					
17	2014-2016	Ibuprofen 340 TPM, Ibuprofen dc -20 TPM Ibuprofen derivative 20 TPM, Carisoprodol 20 TPM and Pilot scale operation for R&D	4800	-	-	9/PPCC/CON/WTR/OM/JE/2014/1003	
18	2017-2018	Ibuprofen 340 TPM, Ibuprofen dc -20 TPM Ibuprofen derivative 20 TPM, Carisoprodol 20 TPM and Pilot scale operation for R&D	4800	-		NO.7528/PPCC/CON/WTR/OM-KAL/JE-11/2017/1453 NO. 7528/PPCC/CON/AIR/OM-KAL/JE-11/2017/1454	
19	2017-2018	Ibuprofen 359 TPM, Ibuprofen dc 20 TPM, Ibuprofen derivative 20 TPM, Carisoprodol 1 TPM and Pilot scale operation for R&D	4800	-		No.7528/PPCC/CON/AIR/OM-KAL/JE-II/2017/1655 Dt: 23rd Mar 2017 No.7528/PPCC/CON/WTR/OM-KAL/JE-II/2017/1656 Dt: 23rd Mar 2017	
20	2017-2018	Ibuprofen 359 TPM, Ibuprofen dc 20 TPM, Ibuprofen derivative 20 TPM, Carisoprodol 1 TPM and Pilot scale operation for R&D	4800	-	No. 7528/PCC/NOC/OM/JE/2015/882	No.7528/PPCC/CON/AIR/OM-KAL/JE-II/2017/1699 Dt: 31 Mar 2017 No.7528/PPCC/CON/WTR/OM-KAL/JE-II/2017/1700 Dt:31 Mar 2017	
21	2017	Existing 5 no.s products After Change in product mix 8 no.s Products	4800 9156	Current Application	-	No.7528/PPCC/CON/AIR/OM-KAL/JE-II/2017/1699 Dt: 31 Mar 2017 No. 7528/PPCC/CON/WTR/OM-KAL/JE-II/2017/1700 Dt:31 Mar 2017	New addition: Existing 5 nos products retained - 4356 TPA New added 3 nos products

Now, Strides Shasun Ltd, Puducherry proposes expansion of Bulk Drugs Manufacturing Facility from existing capacity of 4800 TPA with 5 products to 9156 TPA with 8 products. The lists of existing and proposed raw materials are given in

Table 2-6 and also attached as **Annexure 26. Table 2-5** shows details of the existing and proposed products with capacities.

Table 2-5 Details of existing and proposed products and capacities

S. No	Existing		New Addition		S.No	Proposed	
	Product Name	Quantity TPA	Product Name	Quantity TPA		Product Name	Quantity TPA
1	Ibuprofen	4308	Ibuprofen	2892	1	Ibuprofen	7200
2	Ibuprofen DC	240	Ibuprofen DC	960	2	Ibuprofen DC	1200
3	Ibuprofen Lysinate Ibuprofen Sodium& S+ Ibuprofen	240	Ibuprofen Lysinate , Ibuprofen Sodium& S+ Ibuprofen	300	3	Ibuprofen Lysine, Ibuprofen Sodium& S+ Ibuprofen	540
4	Carisoprodol	12	Carisoprodol	0	4	Carisoprodol	12
5	Pilot Scale Operations for R&D	-	Pilot Scale Operations for R&D	-	5	Pilot Scale Operations for R&D	-
			Pilot Plant Small Scale Volume Products	12	6	Pilot Plant Small Scale Volume Products	12
			Pregabalin	180	7	Pregabalin	180
			Sapropetrein	12	8	Sapropetrein	12
Total		4800		4356			9156

2.3 Project Cost

The project cost (Without land cost) for the expansion project is Rs. 125 Crores.

2.4 Process Description

The overall process flow is given in **Figure 2-6** and process details of all the products are attached as **Annexure 7.**

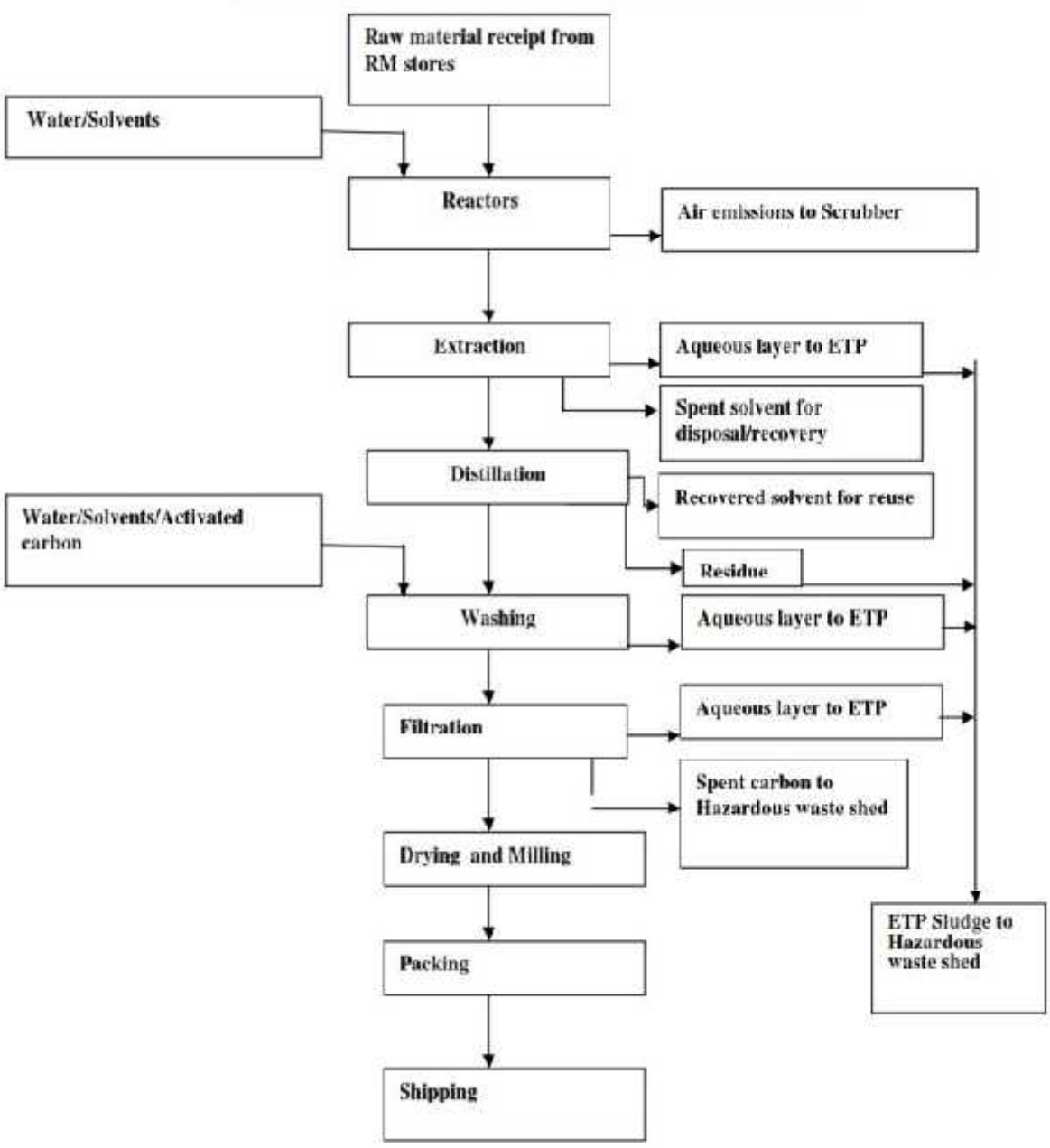

Raw material receipt from RM stores
Water/Solvents
Reactors
Air emissions to Scrubber
Extraction
Aqueous layer to ETP
Spent solvent for disposal/recovery
Distillation
Recovered solvent for reuse
Water/Solvents/Activated carbon
Residue
Washing
Aqueous layer to ETP
Filtration
Aqueous layer to ETP
Spent carbon to Hazardous waste shed
Drying and Milling
ETP Sludge to Hazardous waste shed
Packing
Shipping

Figure 2-6

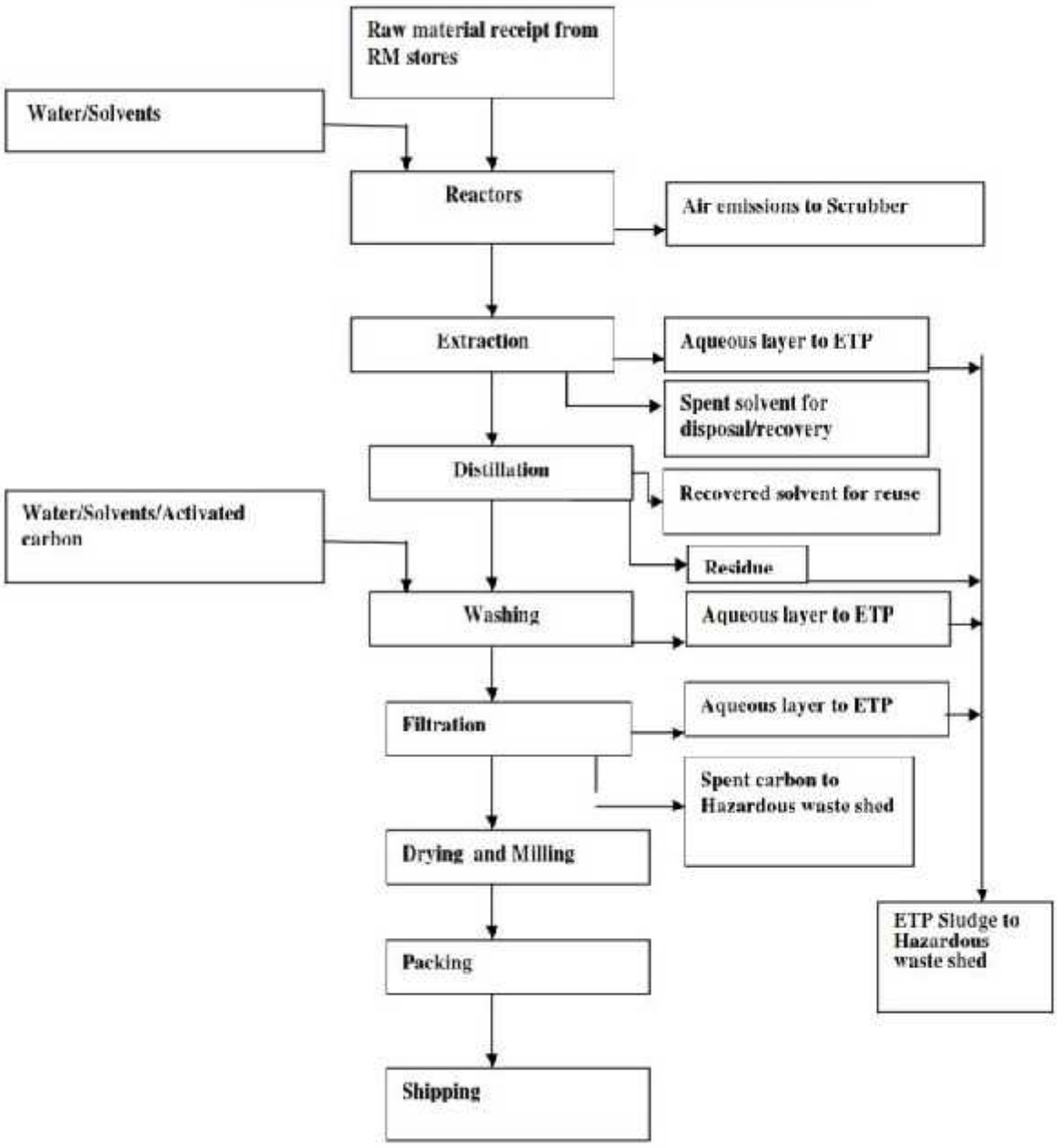


Figure 2-6 Process flow for production

2.5 Resource Requirements

2.5.1 Raw Materials

The list of raw materials given in

Table 2-6 and MSDS are provided as **Annexure 8.** The physical properties and details of transportation for raw materials are attached as **Annexure 25**. List of solvents and tank details are given in **Table 2-7.**

Table 2-6 List of Raw Materials & Quantity for Existing and Proposed Products

Ibuprofen				
S. no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Acetone	14.04	12.17	26.21
2	Activated Carbon	2.51	2.18	4.69
3	Aldehyde	427.88	371.05	798.93
4	Ammonium Bi Carbonate	6.69	5.80	12.48
5	Caustic Soda Flakes	148.57	128.84	277.41
6	Caustic Soda Lye	53.49	46.38	99.87
7	Dilute Sulphuric Acid	427.88	371.05	798.93
8	Ferric Chloride	0.06	0.05	0.11
10	Hexane	75.95	65.86	141.82
11	Hydrochloric Acid	512.79	444.68	957.47
12	Hydroxyl Ammonium Sulphate	5.99	5.19	11.18
13	Iso butyl aceto phenone	408.36	354.11	762.47
14	Isopropyl Alcohol (IPA)	79.38	68.83	148.21
15	isopropyl chloro acetate	466.93	404.91	871.85
16	Liquor Ammonia	4.79	4.15	8.94
17	Methanol	5.00	5.00	10.00
18	Mono Chloro Acetate (MCA)	353.74	306.75	660.49
20	Sodium Bicarbonate	67.21	58.28	125.49
21	Sodium Chloride	2.48	2.15	4.62
22	Sodium Dichromate	260.74	226.11	486.85
23	Sodium Hydroxide, 48 %	480.09	416.32	896.42
24	Sodium Metal	84.90	73.62	158.52
25	Sulphuric Acid	132.41	114.82	247.23
Total		4,021.88	3,488.31	7,510.18

Ibuprofen DC				
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Ibuprofen	18.02	72.07	90.09
2	Starch	1.44	5.77	7.21

3	Cellulose	0.54	2.16	2.70
Total		20.00	80.00	100.00
Ibuprofen Lysine				
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Ibuprofen	4.29	6.43	10.71
2	Isopropyl Alcohol (IPA)	5.69	8.54	14.23
3	DL. Lysine	5.73	8.59	14.31
Total		15.70	23.55	39.26
Ibuprofen Lysine				
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Ibuprofen	4.29	6.43	10.71
2	Isopropyl Alcohol (IPA)	5.69	8.54	14.23
3	DL. Lysine	5.73	8.59	14.31
Total		15.70	23.55	39.26
Ibuprofen Sodium				
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Ibuprofen	7.37	8.42	15.79
2	Toluene	3.26	3.73	6.99
3	Sodium Hydroxide	1.42	1.62	3.04
Total		12.05	13.77	25.82
S+ Ibuprofen				
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Activated Carbon	0.05	0.06	0.11
2	Benzyl Cyanide	1.67	1.91	3.57
3	Benzyl Tri Ethyl Amm. Chloride	0.04	0.05	0.09
4	Biphenyl	0.09	0.10	0.19
5	Caustic Soda Flakes	1.80	2.06	3.86
6	Caustic Soda Lye	38.92	44.48	83.40
7	Hexane	3.55	4.05	7.60
8	Hydro Chloric Acid	33.45	38.23	71.69
9	Hydrogen Gas	0.10	0.11	0.21
10	Ibuprofen	9.33	10.67	20.00
11	Isopropyl Alcohol	25.34	28.96	54.31
13	Isopropyl Bromide	2.37	2.71	5.07
14	Liquid Ammonia	1.13	1.30	2.43
15	Methanol	16.01	18.29	34.30
16	Rane Nickel	0.50	0.58	1.08
19	S+Ibuprofen	1.44	1.65	3.09
20	Sodium Metal	0.04	0.05	0.09
22	Tetrhydra Furan	0.22	0.25	0.46
23	Toluene	25.40	29.03	54.44
Total		161.46	184.53	345.99

				Carisoprodol
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	2 - Methyl - 2 - Propyl - 1,3 - Propane diol	0.85	-	0.85
2	Activated Carbon	0.03	-	0.03
3	Anhydrous HCl gas	0.96	-	0.96
4	Dimethyl Carbonate	0.70	-	0.70
5	Hyflo	0.05	-	0.05
6	Isopropyl amine	1.04	-	1.04
7	Methanol	3.03	-	3.03
8	Sodium bicarbonate	0.46	-	0.46
9	Sodium Cyanate	0.40	-	0.40
10	Sodium Methoxide	0.01	-	0.01
11	Toluene	9.38	-	9.38
Total		16.92	-	16.92
		Pregabalin		
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	3- (Carbamoylmethyl)-5-methylhexanoic acid	-	98.75	98.75
2	Activated Carbon	-	2.06	2.06
3	Caustic soda lye solution	-	64.72	64.72
4	Chloroform	-	65.72	65.72
5	Hydrochloride acid	-	122.31	122.31
6	D (+) - Phenylethylamine	-	28.75	28.75
7	Hyflo	-	3.09	3.09
8	Isopropyl alcohol	-	11.83	11.83
9	Methanol	-	36.50	36.50
10	Pregablin Stage I seeding material	-	0.06	0.06
11	p-Toluene sulphonic acid	-	1.38	1.38
12	Sodium Hypochlorite solution	-	100.54	100.54
13	Sodium Metabisulfite	-	0.07	0.07
14	Stage-1 and 2 ML material	-	1,030.00	1,030.00
15	Toluene	-	7.25	7.25
Total		-	1,573.03	1,573.03
		Sapropritean di hydrochloride		
S.no	Raw Material	Existing-TPM	Proposed-TPM	Total after expansion-TPM
1	Acetic acid	-	3.13	3.13
2	Acetic anhydride	-	27.00	27.00
3	Acetone	-	60.04	60.04
4	Acetonitrile	-	64.69	64.69
5	Activated carbon	-	2.79	2.79
6	Aqueous ammonia	-	12.50	12.50
7	Hydrchloric acid	-	85.76	85.76
8	Diisopropylether	-	335.42	335.42

9	DMAP	-	1.38	1.38
10	D-Ribose	-	20.83	20.83
11	Ethyl acetate	-	75.94	75.94
12	Hydrogen peroxide	-	12.50	12.50
13	Methanol	-	260.00	260.00
14	Methyl magnesium chloride	-	166.67	166.67
15	Phenyl hydrazine	-	16.52	16.52
16	Platinum IV oxide	-	0.08	0.08
17	Rectified spirit	-	41.60	41.60
18	Sodium bicarbonate	-	6.25	6.25
19	Sodium bicarbonate solution	-	31.25	31.25
20	Sodium carbonate	-	13.54	13.54
21	Sodium carbonate solution	-	25.00	25.00
22	Sodium dithionate	-	3.13	3.13
23	Sodium metaperiodate	-	25.42	25.42
24	TAP sulphate	-	11.25	11.25
25	Tetrahydrofuran	-	93.75	93.75
26	Toluene	-	88.54	88.54
27	Triethylamine	-	7.50	7.50
Total		-	1,492.45	1,492.45

Table 2-7 Solvents & Fuels Materials Tank Storage Details

S.No	Chemical	Existing					Proposed
		No. of Tanks	Volume in KL/tank	Internal		Mode of storage	
				Temperature in (^{0}C)	Pressure		
Petroleum Class A Storage							
1	Hexane	3	3 x 16	Ambient Temperature	Atmospheric	Under ground	No Change
2	Iso Propyl Alcohol	3	2 x 33 1 x 16				
3	Acetone	2	2 x 16				
4	Methanol	1	1 x 16				
5	Toluene	1	1 x 16				
Petroleum Class B Storage							
6	Diesel	2	2 x 24	Ambient Temperature	Atmospheric	Under ground	No Change

Class A/Class B Chemical Storage Permits are included in **Annexure 18.**

2.5.2 Land Details

The expansion is proposed within the premises of the existing facility spread over in 25.99 Acres of land located at Mathur Road Periakalapet Village, Puducherry Tehsil, Puducherry Union Territory (UT).The land is under industrial use from 1986. Land area break up is given in **Table2-8**.

Table2-8 Land use break up details

Sl. No.	Description	Existing			Proposed		Total Area (After Expansion)		
		Area in (Sq.m)	Area in (Acres)	Area in (%)	Area in (Sq.m)	Area in (Acres)	Area in (Sq.m)	Area in (Acres)	Area in (%)
1	Green Belt	29919	7.39	28.45	7,274.44	1.80	37,193.29	9.19	35.37
2	Roads& Other Area	51688	12.78	49.15	-9,135.71	-2.26	42,551.98	10.52	40.47
3	Build up Area	23549	5.82	22.39	1,861.27	0.46	25,410.27	6.28	24.16
Total Land Area		105156	25.99	100	0	0	105155.54	25.99	100

Existing Green belt area is 7.39 Acres and proposed additional green belt is 1.80 Acres. Total greenbelt area covered will be 9.19 Acres which is 35.37% of the total area of 25.99 acres.

2.5.3 Water Requirement

The total water requirement after proposed expansion will be 2315 KLD. The freshwater consumption will be 498 KLD sourced from inhouse borewells/externally procured treated sewage, PIMS, MGMC, PWD etc. The certificate for registration of existing inhouse borewell is attached as **Annexure 22**. Application has been submitted to Puducherry Groundwater Authority for renewal of Groundwater usage certificate for inhouse borewell and acknowledgement of the same is attached as **Annexure 23.** Recycled water of 1817 KLD will be consumed of which 590 KLD treated sewage is sourced from PIMS, MGMC, PWD etc. For greenbelt, treated water will be used. Detailed water requirement breakup is given in **Table2-9** and water sourced from external sources is separately tabulated in **Table2-10.**

Table2-9 Breakup of Water Consumption for the Project

Requirement	Fresh water consumption in KLD			Recycled water consumption in KLD			Total (KLD)		
	Existing	Additional	Total Proposed	Existing	Additional	Total Proposed	Existing	Additional	Total Proposed
Process water	60	393	453	0	0	0	60	393	453
DM Plants	45	0	0	0	0	0	45	0	0
Boilers	0	0	0	251	67	318	251	67	318
Cooling tower	0	0	0	522	654	1176	522	654	1176
Green Belt	0	0	0	30	20	50	30	20	50
Washings & cleaning of roads	0	0	0	50	25	75	50	25	75
Domestic	5	40	45	0	0	0	5	40	45
Treated water to Strides Shasun formulation unit	0	0	0	198	0	198	198	0	198
Total	**110**	**433**	**498**	**1051**	**766**	**1817**	**1161**	**1199**	**2315**

Table2-10 Water Consumption from external source

S. No	Description	Existing in KLD	Proposed in KLD	Total After Expansion in KLD
1	Fresh water requirement	110	388	498
2	Treated sewage water from PWD, MGMC& PIMS etc.,	440	150	590
3.	Treated sewage water and process effluent from Strides Shasun – Formulation division (non EC category)	199	0	199
Total		749	451	1287

The water requirement for expansion will be met by additional treated sewage from PIMS, MGMC, PWD etc as per PPCC consent conditions given for ZLD project operation.

Existing and total water balance charts for the facility are enclosed in **Annexure 9.**

2.5.4 Power Requirement

Power Requirement for the project after proposed expansion is 5860 KVA, which will be sourced from Puducherry Electricity Board. 6 DG sets (3 nos of 1000 kVA and 3 nos of 1500 kVA) will be used as backup facilities in case of power failure. 1 no. of 16 TPH boiler will be used for production and another of the same capacity will be used as standby. The details of power requirement are given in **Table2-11.**

Table2-11 Power and Energy Requirement

Details	Existing	Proposed	After expansion
Power Requirement Source: Puducherry Electricity Board	3860 KVA	2000 KVA	5860 KVA
Power Back Up through DGs	2 x 1500 KVA	1 x 1500 KVA	3 x 1500 KVA
	2 x 1000 KVA	1 x 1000 KVA	3 x 1000 KVA
Boiler-bio-Briquettes	1 x 16TPH	1 x 16 TPH 1 X 15 Lac Kcal/hr Thermic Fluid Heater	1 x 16 TPH
	1 x 3.5 TPH (S.B)		1 X 15 Lac Kcal/hr Thermic Fluid Heater
	2 x 4.5 TPH (S.B)		1 x 3.5 TPH
			2 x 4.5 TPH (S. B)
			1 x 16 TPH (S. B)

S.B = standby boiler

Note: 1 no. of 3.5 TPH Boiler acting as standby in the present unit will be running after proposed expansion. 2 Nos of 4.5 TPH boilers from existing unit will be retained as standby after proposed expansion.

2.5.5 Manpower Requirement

The total strength of the M/s. Strides Shasun Limited is 850 people (permanent & contractual), which is proposed to increase to 900 after expansion as given in **Table2-12**.

Table2-12 Manpower Requirement

S.No	Manpower	Existing	Additional	Total After Expansion
1	Employees	640	50	690
2	Contact labourers	210	0	210
	Total	850	50	900

2.6 Pollution Control Measures

2.6.1 Air Pollution & Fugitive Emission Control

The major air pollution sources from the industry are DG sets, boilers and scrubbers. The DG set and boiler sources are provided with stacks of adequate height so as to disperse the emanating flue gases containing suspended particulate matter, oxides of sulfur and nitrogen without affecting the ground level concentrations. The emissions generated from the reactors are scrubbed out by wet scrubbers. Bag filters are provided for all process stacks and multi cyclone dust collector for boiler stacks. The source of emission, capacity and the various Air Pollution Control (APC) measures taken are listed in **Table2-13.**

Table2-13Existing and Proposed Air Pollution Sources and Control Measures

Details	Air pollution source			No of stacks			APC Measures
	Existing	Proposed	After expansion	Existing	Proposed	Total	
Stack Process	IBU	-	IBU	1	1	2	Existing Wet Scrubber/ Proposed Bag filter
	S-IBU	-	S-IBU	0	1	1	Bag Filter
	IBU Lysine	-	IBU Lysine	0	1	1	Bag Filter
	-	IBU Sodium	IBU Sodium	0	1	1	Bag Filter
	-	DC-90	DC-90	0	1	1	Bag Filter
	-	Pilot Plant	Pilot Plant	0	1	1	Bag Filter
	-	Pregabalin	Pregabalin	0	1	1	Bag Filter
	-	Sapropetrin	Sapropetrin	0	1	1	Bag Filter
Stack – Non Process (DG)	2 x 1500 KVA 2 x 1000	1 x 1500 KVA 1 x 1000	3 x 1500 KVA 3 x 1000 KVA	4	2	6	Chimney 18 m height, AGL

	KVA	KVA					
Boiler –Bio Mass Briquette	1 x 16TPH 1 x 3.5 (standby boiler) & 2 x 4.5 TPH (standby boiler)	1 x 16TPH 1 X 15 Lac Kcal/hr Thermic Fluid Heater	2 x 16TPH (1 in Standby) 1 x 3.5 TPH 1 X 15 Lac Kcal/hr Thermic Fluid Heater 2 x 4.5 TPH (standby boiler)	2	0	2	Multi cyclone dust collector going in for bag filter and then to stack, 30 m AGL
Total No of Stacks				7	10	17	

2.6.2 Odour Control

Odour has been controlled with proper mitigative measures like wet scrubber.

2.6.3 Noise Pollution

The major source of noise pollution in the industry is DG sets, boilers and reactors. DG sets are provided with integral acoustic enclosures. Also the ambient noise levels are within the ambient standards by inbuilt design of mechanical equipment and buildings apart from vegetation along the periphery and at various locations within the industry premises. The plant will be specifically designed with due consideration on minimizing noise pollution. Higher noise levels will be felt only near the active working areas and therefore the workers are provided with personal protective equipment as a safety measure.

2.6.4 Wastewater Generation and Disposal Details

The proposed expansion facility will generate 45 KLD sewage from domestic activities and 550 KLD effluents from industrial operations/processes. Apart from the effluents and sewage of the API unit, the combined effluent plant also treats 43 KLD of process effluent and 156 KLD of sewage from the Strides Shasun Formulation Unit lying towards northeast and adjacent to the API unit. The combined wastewater treatment plant in the existing facility will be upgraded to handle the increased quantity of effluents after expansion. The existing ZLD system was commissioned in September 2017. ZLD adequacy report is attached as

Annexure 10 and wastewater treatment system specifications as **Annexure 11.** Water balance for existing facility is given in **Figure 2-7** and total water balance for proposed expansion is given in **Figure 2-8**

High pollutant stream is treated in Stripper and MEE. The condensate is sent to Biological treatment followed by RO plant for usage in Process/Non process area.

Less pollutant stream along with externally procured treated sewage is sent to Biological treatment followed by RO for using in Process/Non process area. Marine outfall has been discontinued in October 2017.

Concentrate from Multiple Effect Evaporator (MEE) is treated in Agitated Thin Film Drier (ATFD) and the sludge generated from biological treatment system and ATFD salts are currently stored inhouse and options to dispose to nearby TSDF sites/Co processor (Refer PPCC NOC and Agreement with TSDF as **Annexure 23**).

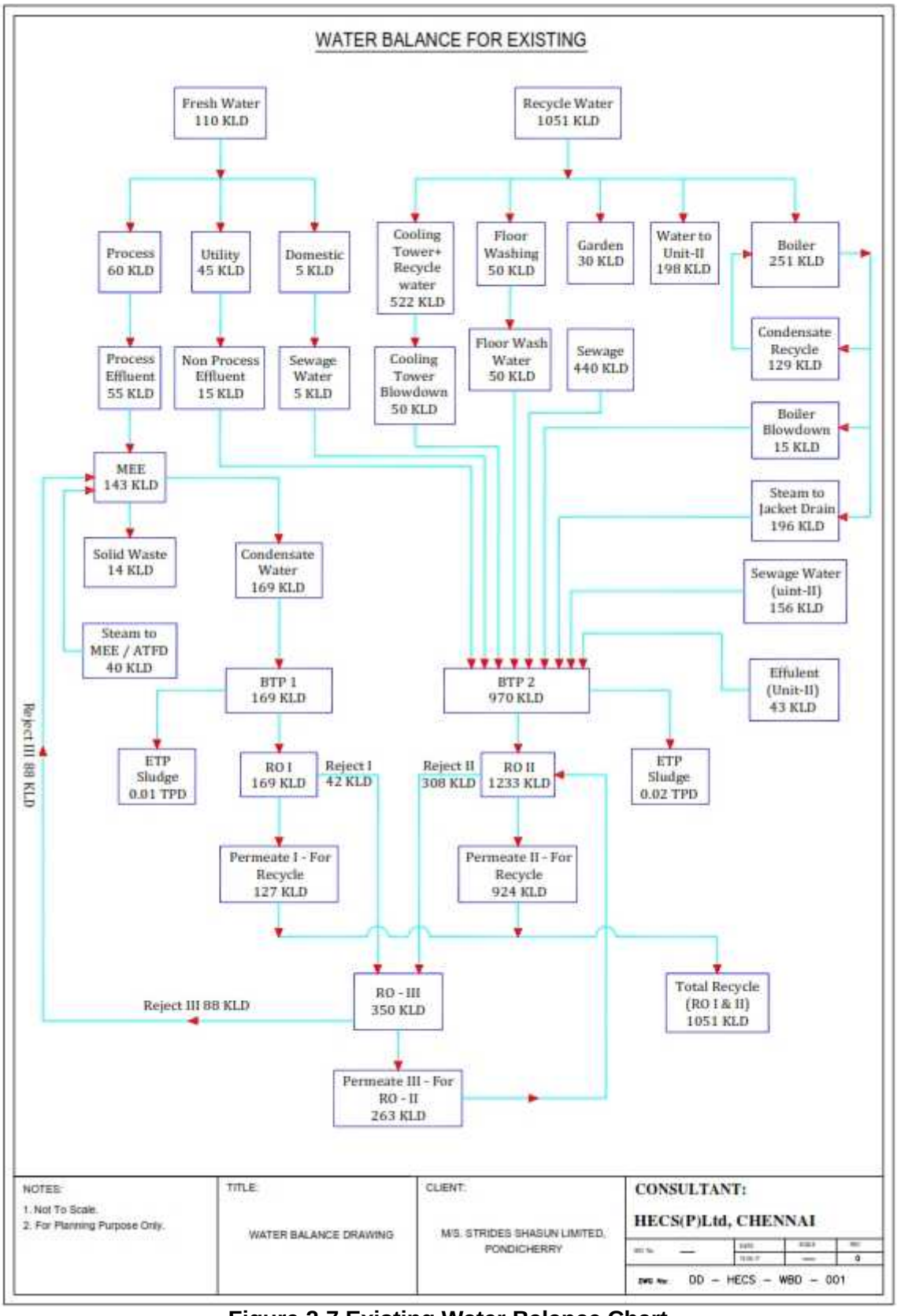


Figure 2-7 Existing Water Balance Chart

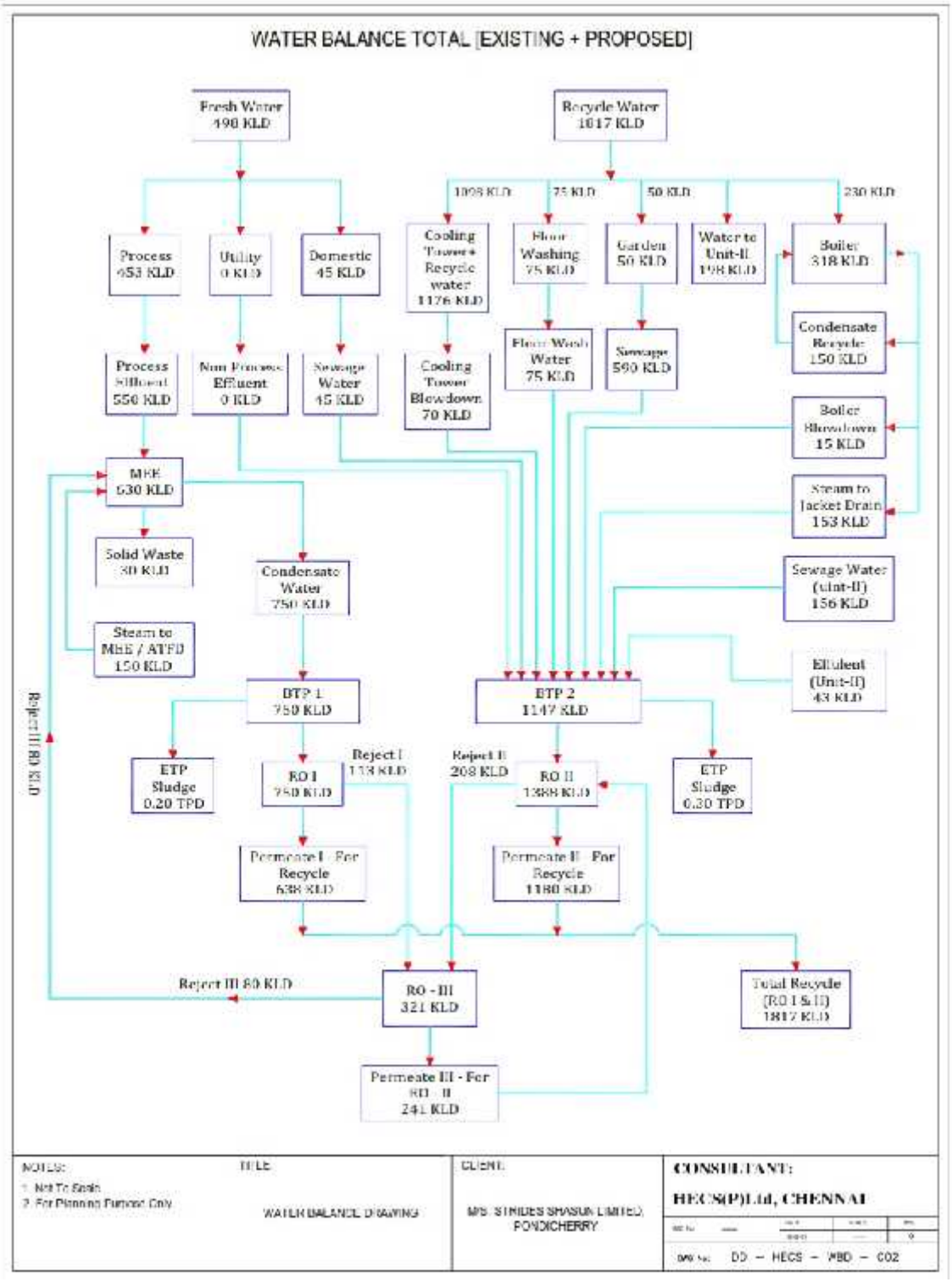


Figure 2-8 Total Water Balance Chart

2.6.5 Hazardous and Solid Waste Management

2.6.5.1 Solid waste management

The Municipal Solid Waste Generated during the operation phase will be treated in Organic Waste convertor. 60 TPA will be generated in operation phase from canteen and STP. The organic waste will be treated in Organic Waste convertor and inorganic waste will be disposed to authorized recycling agency. Details are as given in **Table 2-14** .

Table 2-14 Municipal Solid Waste details

Sl. No.	Description	Quantity (T/year)		Method of Collection	Method of Disposal
		Existing (TPA)	After Modification (TPA)		
1	Food waste	35	60	Manual	Composted in Organic waste convertor and used as manure

Note: As per CPCB guidelines: MSW per capita/day =0.45Kg

2.6.5.2 Hazardous waste Management

The various hazardous waste generated from the process is stored in a separate hazardous waste storage area and properly disposed as per the Hazardous and Other Wastes (Management and Trans boundary Movement) Amendment Rules, 2016. The type of hazardous waste and the quantity generated are detailed in **Table2-15 .** Hazardous waste authorization of Strides Shasun is enclosed as **Annexure 12**.

Table2-15 Hazardous waste details

Sl.No	Schedule No	Name of the Hazardous Waste	Existing Quantity KLA/TPA	Additional Quantity KLA/TPA	Total Quantity KLA/TPA	Method of Stage / Disposal
1	Class A of Schedule II	Waste Sodium Dichromate Solution	22000	13000	35000	Dispose to Authorized Vendor
2	34.3 Schedule I	ETP Sludge	3	5	8	Sent to Coprocessing in Cement Industries/ GEPIL
3	5.1 Schedule I	Spent Lubricating Oil	4	6	10	Dispose to Authorized Vendor
4	5.2 Schedule I	Waste / Residue containing Oil	150	150	300	Dispose to Authorized Vendor
5	20.2 Schedule I	Spent Solvent	900	680	1580	Dispose to Authorized Vendor
6	20.3 Schedule I	Distillation Residue	48	48	96	Dispose to Authorized Vendor
7	28.1 Schedule I	Process Residue / Waste	720	620	1340	Dispose to Authorized Vendor
8	28.2 Schedule II	Spent Catalyst / Spent Carbon	54	20	74	Dispose to Authorized Vendor
9	28.3 Schedule II	Off Specification Product	1	4	5	Dispose to Authorized Vendor
10	28.4 Schedule II	Date Expired / Discarded Off Specification drugs / Medicines	1	2	3	Bio Medical waste Treatment Facility
11	28.5 Schedule II	Spent Organic Solvent	36	50	86	Selling to Authorized Vendor
12	33.2 Schedule I	Sludge from Treatment of Waste water arising out of cleaning / disposal of Barrels / containers	20	10	30	Dispose to Authorized Vendor
13	33.3 Schedule I	Discarded Containers / Barrels / Liners , Contaminated with Hazardous	250	180	430	Dispose to Authorized Vendor

Sl.No	Schedule No	Name of the Hazardous Waste	Existing Quantity KLA/TPA	Additional Quantity KLA/TPA	Total Quantity KLA/TPA	Method of Stage / Disposal
		waste Chemicals				
14	35.3 Schedule I	Chemical Sludge from Waste water treatment	4800	6180	10980	ATFD salts are currently stored and options to dispose to nearby TSDF sites/Co processor
15	34.4 Schedule I	Oil and Grease Skimming Residues	1	1	2	Dispose to Authorized Vendor
16	35.2 Schedule I	Spent Catalyst	1	1	2	Dispose to Authorized Vendor
17	35.3 Schedule I	Spent Carbon	90	50	140	Dispose to Authorized Vendor

2.7 Existing Infrastructure Facilities

a. Land

The existing plant facilities are spread over 105155.54 sq.m,(25.99 acres/ 10.51 Ha), Land is owned by M/s. Strides Shasun Limited located at Plot no. R.S No. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Mathur Road Periakalapet Village, Puducherry,Union Territory of Puducherry.

b. Buildings

Total built up area is divided into various sections like Production Blocks, Engineering, Warehouses, Administration, Canteen, Toilets etc. There is adequate space & provision for operations.

c. Plant and Machinery & Utilities

The Plant facilities have been designed and set up with the objective to carry out almost all chemical reactions and processes. Details of plant and machinery and utility equipments used for the production are as below;

i. Process Equipments:

- Reactors
- Centrifuges
- Hydrogenator (Proposed)
- Heat exchangers and condensors
- ANFDs
- RCVD
- Jet Mill
- Multi Mill
- Sifter &Blender

ii. Machinery / Utility Equipments;

- Boilers
- Brine Chilling Plants
- Cooling towers
- DG sets
- Air compressors
- HVAC system (Heat, Ventilation and Air conditioning)
- Vacuum pumps
- Hot water systems
- Chilled water plant
- Dust collectors
- Scrubbers
- Nitrogen Plants
- Material Hoist
- Silo
- Granulator
- Blower

iii. Safety Equipments:

- Fire Hydrant System
- Fire Extinguishers
- Fire Alarm System
- Eye wash fountain / Safety Showers
- Emergency PPE cupboards
- Wind Sack

CHAPTER – 3

DESCRIPTION OF ENVIRONMENT

3. DESCRIPTION OF ENVIRONMENT

3.1 Preamble

This chapter depicts the existing environmental conditions in and around the proposed project with an area of 25.99 Acres (10.52 Hectare) located at Periakalapet, Mathur Road, Puducherry Tehsil, Puducherry District &Union Territory (UT). The primary baseline data monitored covered one complete season i.e., from **July – September 2017**, and secondary data was collected from Government and Semi-Government organisations. The primary baseline data has been generated by M/s. Hubert Enviro Care Systems (P) Ltd, Chennai, an MoEF&CC approved Environmental Testing Laboratory for the following Terrestrial environmental components.

- **Meteorology:** The Meteorological data such as Temperature, Relative Humidity, Rainfall, Wind Speed & Direction are depicted in **Section- 3.6.3.**
- **Ambient Air Quality:** Particulate matter <10 micron size (PM_{10}),Particulate matter <2.5 micron size ($PM_{2.5}$), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2),Carbon Monoxide (CO), Lead (Pb),Ozone (O_3), Benzene (C_6H_6), Benzo (a) pyrene ($C_{20}H_{12}$), Arsenic (As), Nickel (Ni), Ammonia (NH_3), Volatile Organic Compounds (VOC) and Total Hydrocarbon (THC) are depicted in **Section- 3.6.4.2.**
- **Ambient Noise Levels:** Day equivalent noise levels, Night equivalent noise levels are depicted in **Section- 3.7**
- **Inland Water Quality:** Inland Water Quality data such as Groundwater Quality, Surface Water Quality are depicted in **Section- 3.8**
- **Soil Quality:** Soil Quality data is depicted in **Section- 3.9**
- **Ecology:** Depicted in **Section- 3.10**
- **Social Economic Status:** Depicted in **Section- 3.11**

3.2 Study Area

A 10Km radial distance with the proposed project site as the epicentre has been identified as the General study area for assessing the baseline environmental status. The core study area is the project area and its immediate surroundings to the tune of 1.0 Km radius from the boundary. The project area is the land where the project is being developed. Further the Project Impact/Influence Area (PIA) is 10Km from the boundary of the core area covering Periakalapet Village, Puducherry Tehsil, Puducherry District & UT Puducherry state.

3.3 Description of the Study Area

As described in Chapter 1 Introduction **M/s. Strides Shasun Ltd.** Project site is located outside the Industrial Area. The site is located at approximately 14 Km from Puducherry. Tamil Nadu – Puducherry interstate Boundary is crossing within 5 Km radius of Project Study Area. An overall idea of the study area with reference to the physical conditions are presented for better understanding in the following sections before proceeding into the section on the prevailing environmental conditions of the study area. The map showing the satellite image study area of Project is given in and Topo Map of study area is given in **Figure 3-2.**

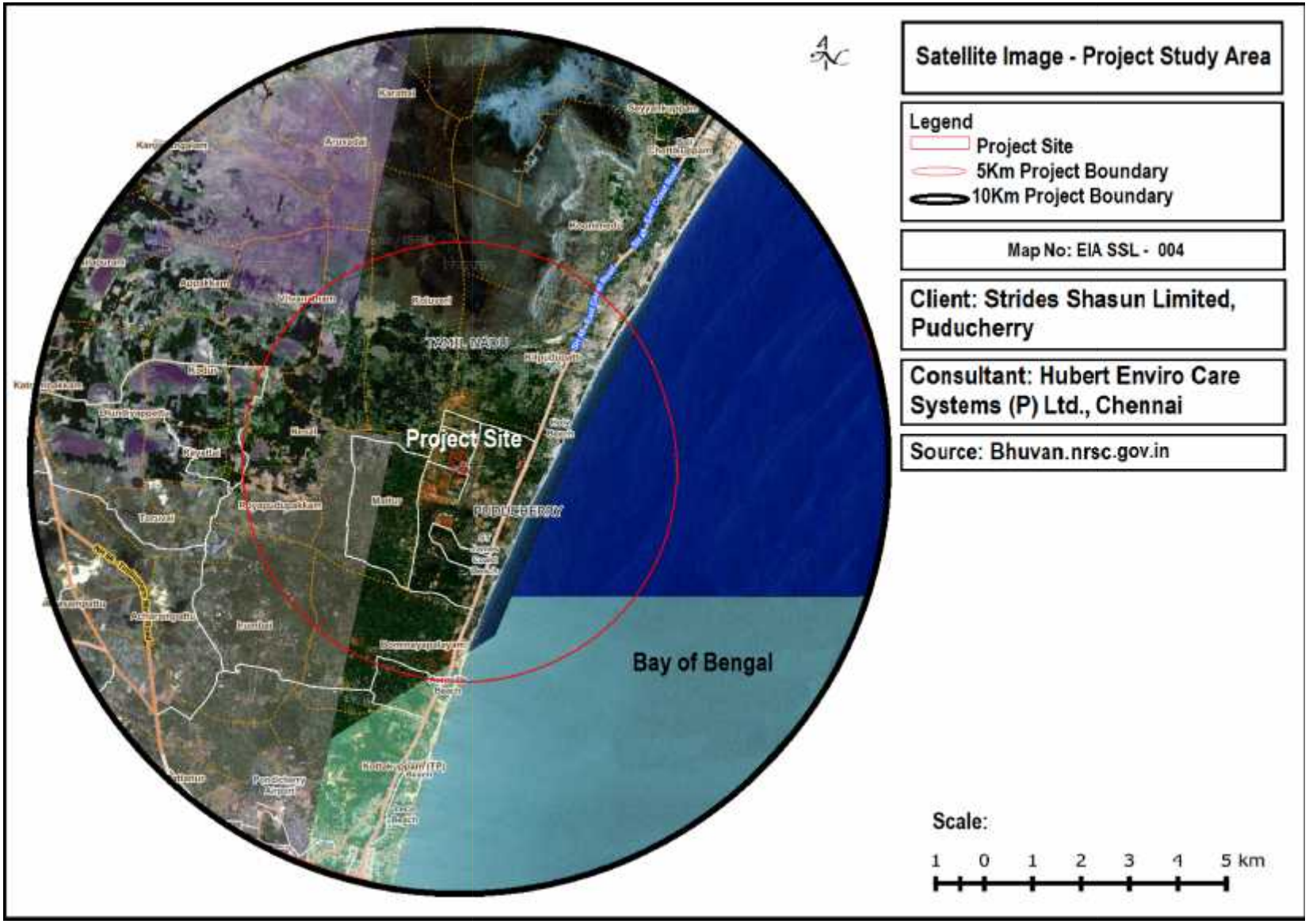


Figure 3-1 Map showing the satellite image study area

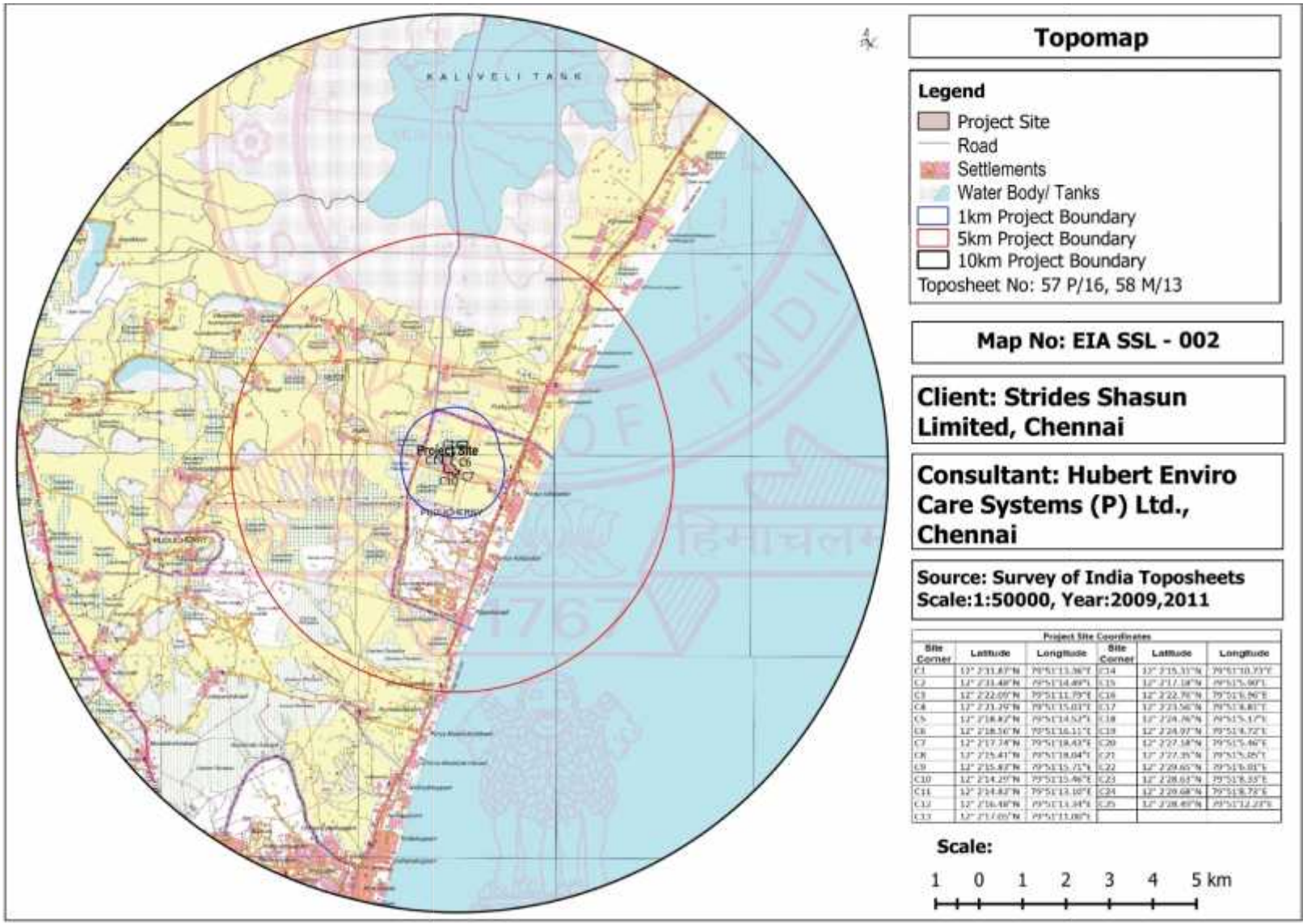


Figure 3-2 Topo Map of study area

3.4 Environmentally/Ecologically Sensitive Areas

The environmental sensitive areas covering an aerial distance of 15 km PIA from project boundary is given in **Table 3-1** and **Figure 3-3.**

Table 3-1 Environmentally Sensitive Areas within 15km from Project Boundary

S.No	Areas	Proposed project location boundary(approximate aerial distance)
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	• Auroville ≈ 5 Km ≈ SW • Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW Botanical Garden, Puducherry_12.6 Km_S
2	Areas which are important or sensitive for ecological reasons – Wetlands, Water courses or other water bodies, coastal zone, biospheres, mountains, forests	• Bay of Bengal ≈ 1.82 Km ≈ E • Kaliveli Lake ≈ 2.89 Km ≈ N • Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW • Bird Sanctuary ≈ 13.39 Km ≈ NNE • Kumalumpattu R.F≈ 13.7 Km ≈ NW • Mangroves Back Water ≈ 13.1 Km ≈ S • Thengaithittu Estuary ≈ 14.3 Km ≈ S
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	• Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW • Kaliveli Lake ≈ 2.89 Km ≈ N • Bird Sanctuary ≈ 13.39 Km ≈ NNE
4	Inland, coastal, marine or underground waters	• Bay ofBengal ≈ 1.82 Km≈ E • Kaliveli Lake ≈ 2.89 Km ≈ N • Mangrooves Back Water ≈ 13.1 Km ≈ S • Thengaithittu Estuary ≈ 14.3 Km ≈ S
5	State, National boundaries	Tamilnadu –Puducherry Interstate Boundary 1.02 Km ≈ N
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	• Auroville ≈ 5 Km ≈ SW • Ousteri Wetland & National Park ≈ 13.7 Km ≈ SW • Botanical Garden, Puducherry≈ 12.6 Km ≈ S • Bird Sanctuary ≈ 13.39 Km ≈ NNE
7	Defence installations	Nil

8	Densely populated or built-up area (Nearest Town, City, District)	Puducherry Town at 14.4 Km
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	Schools & Colleges • Navodaya Vidhyalaya ≈ 0.1 Km≈ SSE • Study International School ≈ 0.47 Km ≈ WNW • Govt. Law College≈ 0.32 Km≈ SE • Puducherry Institute of medical science (PIMS) ≈ 0.68 Km≈ N • Puducherry University≈ 1.77 Km≈ SE • Puducherry Engineering College ≈ 2.94 Km≈ SSE Religious Places • Manakular Vinayagar temple≈ 11.53 Km≈ W • Murugan Temple, perampai road≈ 13.75 Km≈ SW Hospital • Puducherry Institute of medical science (PIMS≈ 0.68 Km≈ N Tourist Places • Auroville≈ 5.66 Km≈ SSW • Botanical Garden, Puducherry≈ 12.6 Km≈ S Others • Police station, Kalapet≈ 2.1 Km≈ E • Fire station, Periyakalpet≈ 2.1 Km≈ E • Puducherry Central Jail≈ 0.33 Km≈ SW • Puducherry Airport ≈ 8.40 Km≈ SSW
10	Areas containing important, high quality or scarce resources, (groundwater resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	• Bay of Bengal ≈ 1.82 Km≈ E • Auroville ≈ 5 Km ≈ SW
11	Areas already subjected to pollution or environmental damage (those where existing legal environmental standards are exceeded)	No Notified/Recognized polluted area within 15Km distance.
12	Areas susceptible to natural hazard which could cause the project to present environmental problems, (earthquakes, subsidence, landslides, erosion or extreme or adverse climatic conditions)	This area is generally plain not prone to any natural disasters. The study area falls under study in Zone-II, according to the Indian Standard Seismic Zoning Map.

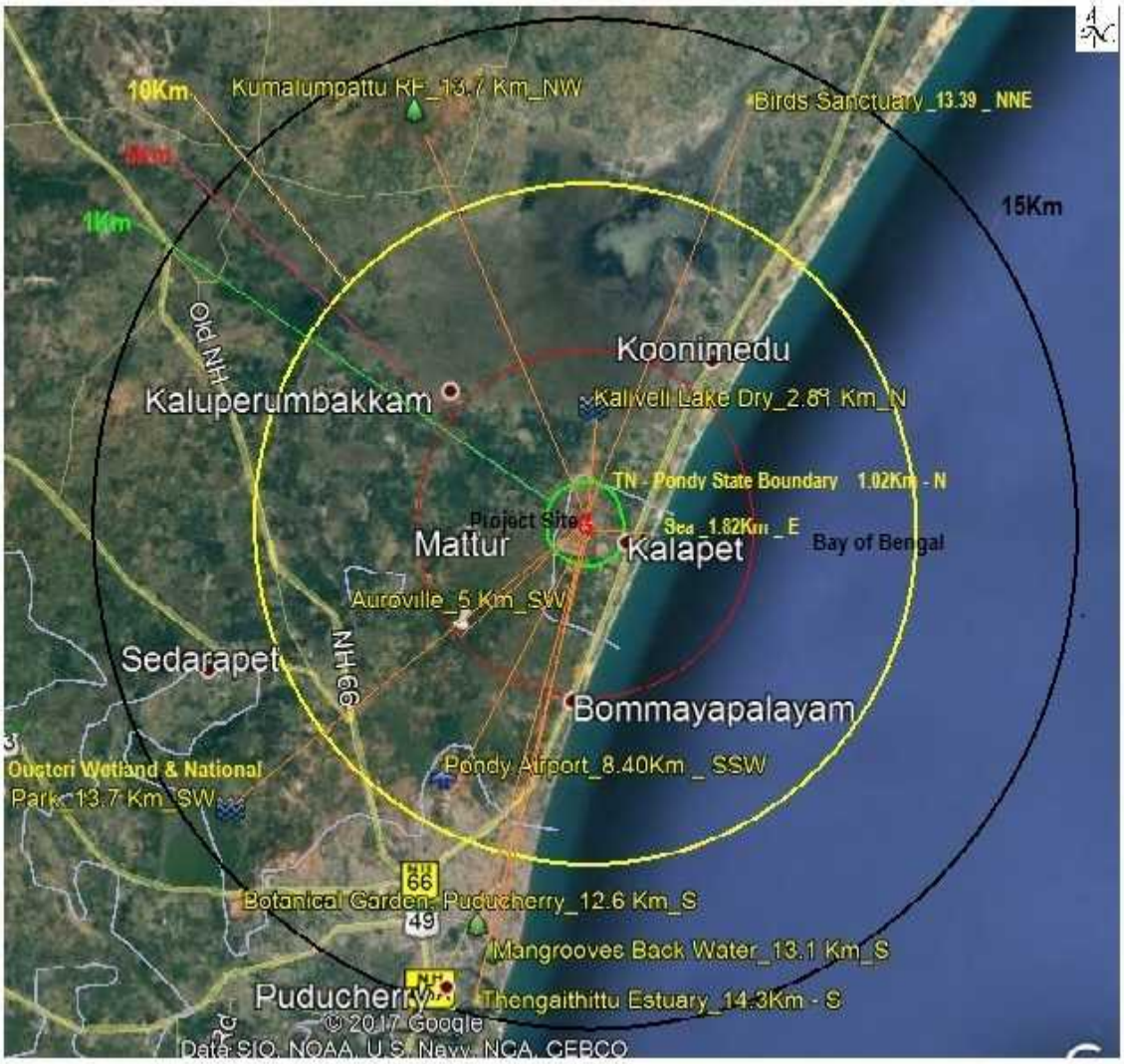


Figure 3-3 Environmental sensitive areas covering within 15 km from project boundary

3.5 Physical Conditions

In this section, the physical conditions of PIA district Puducherry are discussed in general and wherever possible references to the conditions prevailing in the study area in particular are also provided. The physical conditions are discussed as under:

- District profile
- Drainage, land use, geology, physiography
- Natural resources
- Climatic conditions, seismic zone characteristics and natural hazards

3.5.1 PIA District Profile

The Periyakalapet, Puducherry district lies on the east coast. It is bounded on the north by Villupuram district, on the south by Nagapattinam district, on the west by Perambalur and Villupuram districts and on the east by Bay of Bengal. The Southern boundary follows for the greater part of the length of two rivers - the Vellar and the Coleroon. The district lies between 78^0 38' and 80^0 East latitude and 5^o 5'/11^o 11' and 12^o 35' North longitude. The total geographical area of the district is about 3,678 Sq.Km. The district has 3 revenue divisions, 7 Taluks, 32 revenue Firkas and 873 revenue villages. With respect to local administrative bodies, there are 5 municipalities, 13 panchayat unions, 16 town Panchayats, 683 village Panchayats and 873 revenue villages. The district has a total population of twenty six Lakhs with 13,11,151 males and 12,89,729 females (2011 census).The sex ratio in Periyakalapet stood at 984 per 1000 males according to the 2011 census. Of the total population, 17, 18,249 (66.06%) persons live in rural areas and 8, 82,631 (33.94%) persons live in urban areas.

3.5.2 Climatic Conditions

Since Puducherry is located in coastal area the climate here is warm and humid all through the year. The summer temperature ranges between 21.7° to 38.9° centigrade with dry and clear blue sky. Generally the summer stays from March to July and it is the most predominant season. For tourism purpose, ideal season is March to October. Puducherry sees a very little monsoon which occurs between November to January and July to September. It sooths the heated days and makes the climate pleasant during this time. Winter in Puducherry is heavily influenced by the north-east monsoons. November to January can be said to experience winter but temperature never goes below 20°.

(Source: IMD_Puducherry 1971-2000)

3.5.3 Natural Resources

3.5.3.1 Flora & Fauna

Puducherry is covered with dry and evergreen species of vegetation typical in tropical regions. Main trees grown in this region are those which are a good supply of firewood. Eucalyptus is one example of this kind. You will find rows of tamarind tree along the roadside. Just like flora; Puducherry is equally rich in fauna as well. There are two wildlife refuges in Puducherry with a great variety of birds. The bogs, ponds and streams house many species. It is a natural habitat

for ducks like ring-necked, wood etc and animals like deers and rabbits. Flora and fauna of PIA are discussed in **section 3.11.**

3.5.3.2 Forest Resources

Union Territory of Puducherry does not have forest resources in abundance, in fact there are no recorded forests in the Union Territory. Puducherry presents more or less a flat land. There are no hills or forests. Therefore the activities of the department consist of afforestation by means of plantations in urban and rural areas, extension of technology and knowhow to farmers and other persons engaged in agro forestry practices and creating awareness about conservation of natural resources.

3.5.3.3 Irrigation

The entire irrigation is covered from ground water by means of tube wells which constitute 100 percent of the net area irrigated. Irrigation by tanks and other sources constitutes a meager part of the net area irrigated.

3.5.3.4 Agricultural Resources

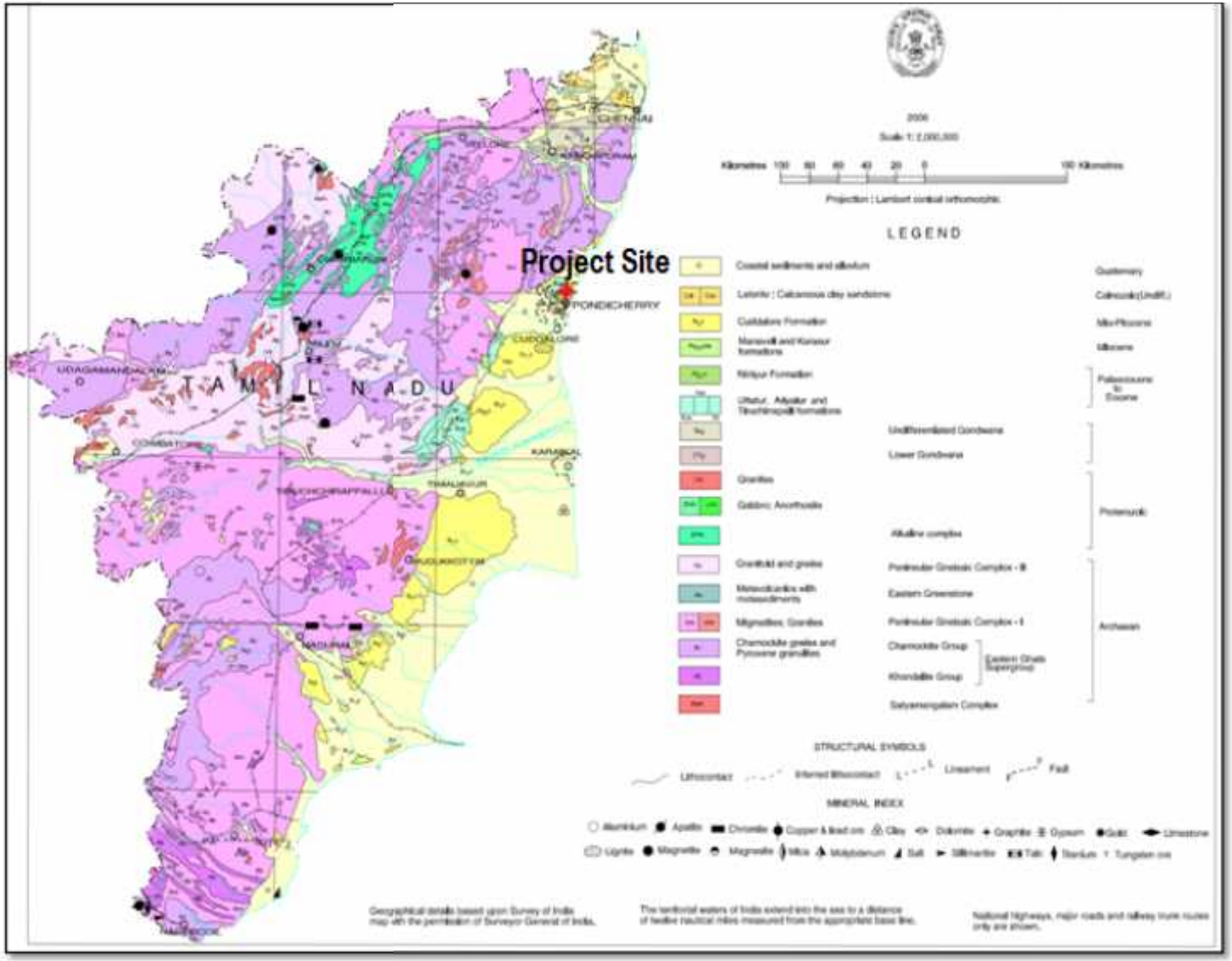
Cultivation is the main occupation of the rural population of the Puducherry district. The soil is most suitable for cultivation. The fertile land of the district contributes a lot for cultivation. The physiographical landscape of the district is almost plain. Rabi season is most suitable for good yield and most of the farmers cultivate 2 crops of Paddy in this season. During Kharif, Ragi and Cumbu are also cropped. The above mentioned crops are mostly grown in the southern part of the district while Cashew, Casuarina, Tapioca etc. are grown in the northern part of the district. Among various horticulture crops, mango, plantain, banana, chilly, onions are also grown in considerable areas in the district. The main agricultural crops are as below:

- **Major Field Crops cultivated:** Paddy, Sugarcane, Groundnut, Cumbu, Ragi, Blackgram, Greengram, Coconut, Plantain etc
- **Horticultural crops:** Mango, Guava and Vegetables
- **Livestock:** Non descriptive Cattle (local low yielding), Crossbreed cattle, Non descriptive Buffaloes (local low yielding), Graded Buffaloes, Goat, Sheep, Others (Camel, Pig, Yak etc.) Poultry.

3.5.3.5 Mineral Resources

Puducherry U.T. does not have any major mineral resources. Around 2.6 mi. tones of Cement grade limestone have been proven in Puducherry region. Ignite deposits have been recorded

near Bahour, Aranganur and Kanniakoil. 250 MT of graphite has been estimated in Puducherry region. Rare mineral resources like lignite are found to occur in the form of alluvial deposits in the coastal area of Karaikal. The Project area is covered by laterite. Geology & Minerals map of Tamil Nadu & Puducherry is given in **Figure 3-4.**



(Source: Dept of Mines and Geology)

Figure 3-4 Geology & Minerals Map of Tamil Nadu

3.5.4 Land Use & Land Cover

Total geographical area of Puducherry district is 293 Sq.Km. Built up-Urban area is 49.76 Sq.Km. Builtup, Rural 19.41 Sq.Km. Details of land use/land cover statistics for Puducherry given in **Table 3-2 & Figure 3-5.** Land Use map of Puducherry (2005) given in **Figure 3-6.**

Table 3-2 District land use/land cover statistics

S.No	Division of Land Use/Land Cover	Area in Sq.Km	Area in Acres	Area in Ha	Total Area %
Urban					
1.	Builtup,Mining	0.08	19.7684	8	0.03
2.	Barren/unculturable/ Wastelands, Salt Affected land	0.1	24.7105	10	0.03
3.	Forest,Deciduous	0.17	42.00785	17	0.06
4.	Wetlands/Water Bodies, Inland Wetland	0.86	212.5103	86	0.29
5.	Barren/unculturable/ Wastelands, Scrub land	3.73	921.7017	373	1.27
6.	Wetlands/Water Bodies, River/Stream/canals	7.25	1791.511	725	2.47
7.	Agriculture,Plantation	10.43	2577.305	1043	3.56
8.	Builtup,Urban	49.76	12295.94	4976	16.98
Rural					
9.	Forest,Forest Plantation	0.03	7.41315	3	0.01
10.	Barren/unculturable/ Wastelands, Gullied/Ravinous Land	0.04	9.8842	4	0.01
11.	Barren/unculturable/ Wastelands, Sandy area	2.43	600.4652	243	0.83
12.	Wetlands/Water Bodies, CoastalWetland	4.26	1052.667	426	1.45
13.	Wetlands/Water Bodies, Reservoir/Lakes/Ponds	16.55	4089.588	1655	5.65
14.	Builtup,Rural	19.41	4796.308	1941	6.62
15.	Agriculture,Fallow	28.37	7010.369	2837	9.68
16.	Agriculture,Crop land	149.53	36949.61	14953	51.03
	Total	293	72401.77	29300	100

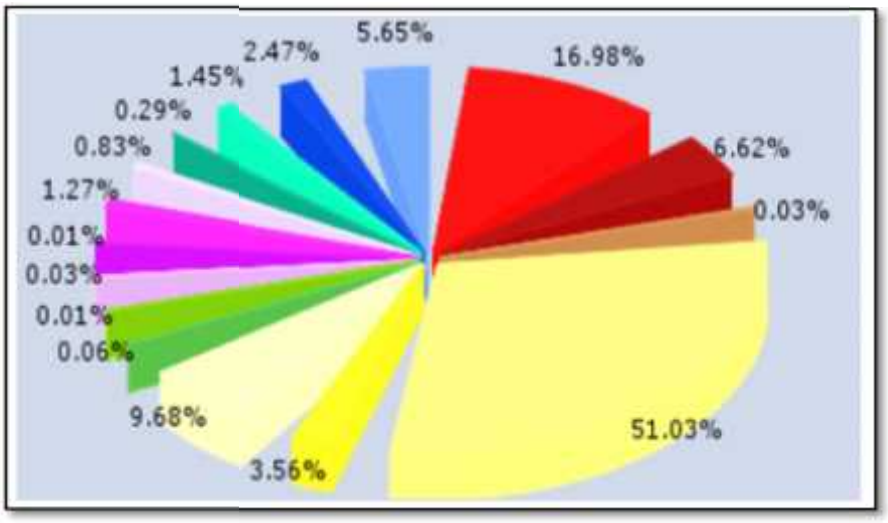
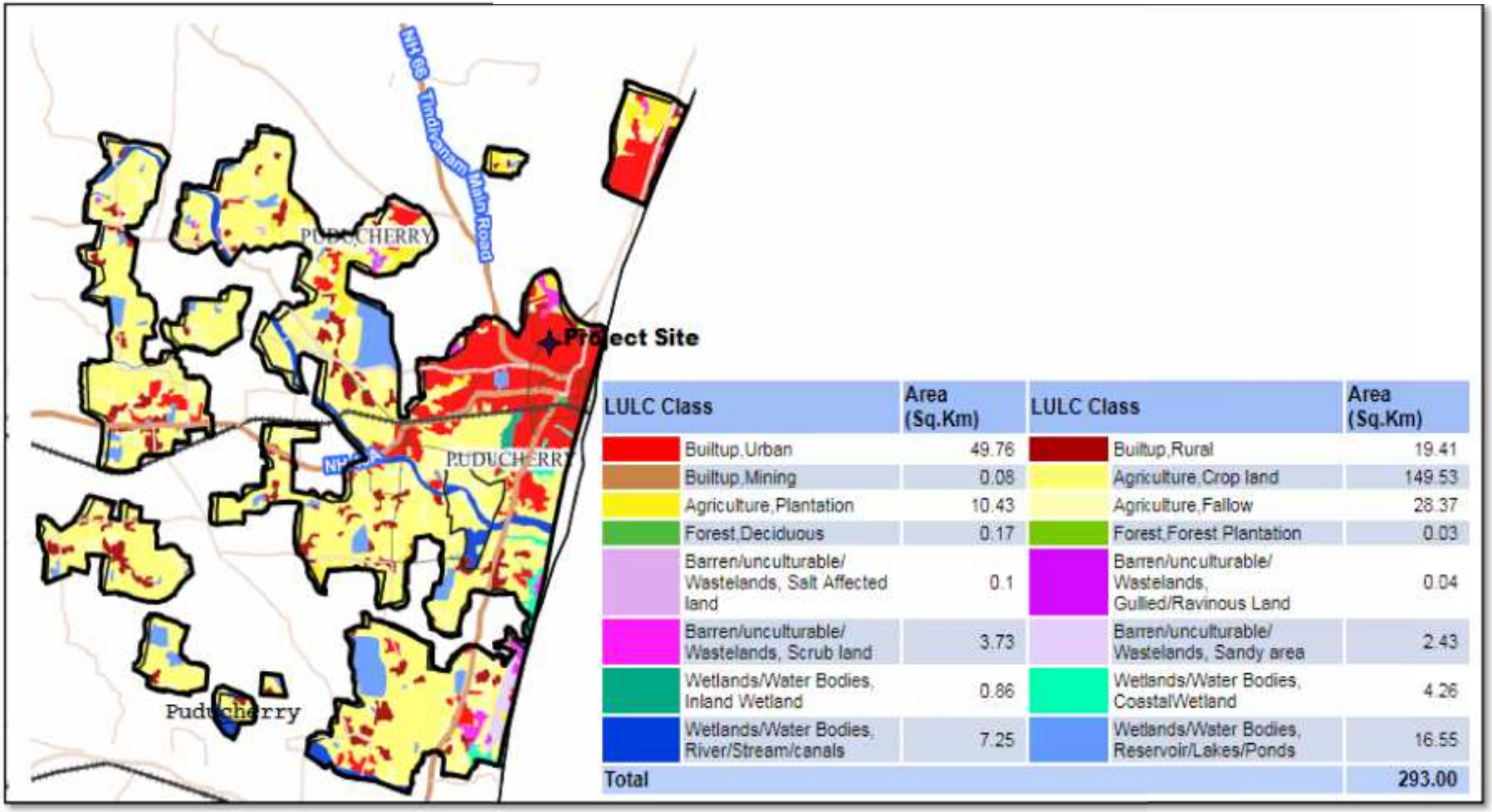


Figure 3-5 Land Use Pattern in the PIA District



LULC Class	Area (Sq.Km)	LULC Class	Area (Sq.Km)
Builtup,Urban	49.76	Builtup,Rural	19.41
Builtup,Mining	0.08	Agriculture,Crop land	149.53
Agriculture,Plantation	10.43	Agriculture,Fallow	28.37
Forest,Deciduous	0.17	Forest,Forest Plantation	0.03
Barren/unculturable/ Wastelands, Salt Affected land	0.1	Barren/unculturable/ Wastelands, Gullied/Ravinous Land	0.04
Barren/unculturable/ Wastelands, Scrub land	3.73	Barren/unculturable/ Wastelands, Sandy area	2.43
Wetlands/Water Bodies, Inland Wetland	0.86	Wetlands/Water Bodies, CoastalWetland	4.26
Wetlands/Water Bodies, River/Stream/canals	7.25	Wetlands/Water Bodies, Reservoir/Lakes/Ponds	16.55
Total			293.00

(Source: Bhuvan.gov.in)

Figure 3-6 Land Use Map of Puducherry

3.5.4.1 Land Use Pattern of the Study Area

Total Project Study Area: 327.83 Sq.Km. Land Use/Land Cover statistics of 10 Km radius of the study area is given in **Table 3-3.** Land Use pattern of the study area is given in **Figure 3-7**. LULC map of the Study area is given in **Figure 3-8.**

Table 3-3 Land Use/Land Cover statistics of 10 Km radius of the Study Area

S.No	Land Use	Area in Sq.Km	Area in Acres	Area in Ha	Area in Percentage
1.	Gullied/ Ravinous land	0.36	88.9578	36	0.109813
2.	Salt affected land	1.04	256.9892	104	0.317238
3.	Scrub land	1.67	412.6654	167	0.50941
4.	Rural	4.26	1052.667	426	1.299454
5.	Sandy Area	5.12	1265.178	512	1.561785
6.	Urban	14.12	3489.123	1412	4.30711
7.	Fallow land	21.98	5431.368	2198	6.704695
8.	Cropland	27.67	6837.395	2767	8.44035
9.	Reservoirs/ Lakes/ Ponds	60.81	15026.46	6081	18.54925
10.	Plantation	74.54	18419.21	7454	22.73739
11.	Ocean	116.26	28728.43	11626	35.4635
	Total	327.83	81008.43	32783	100

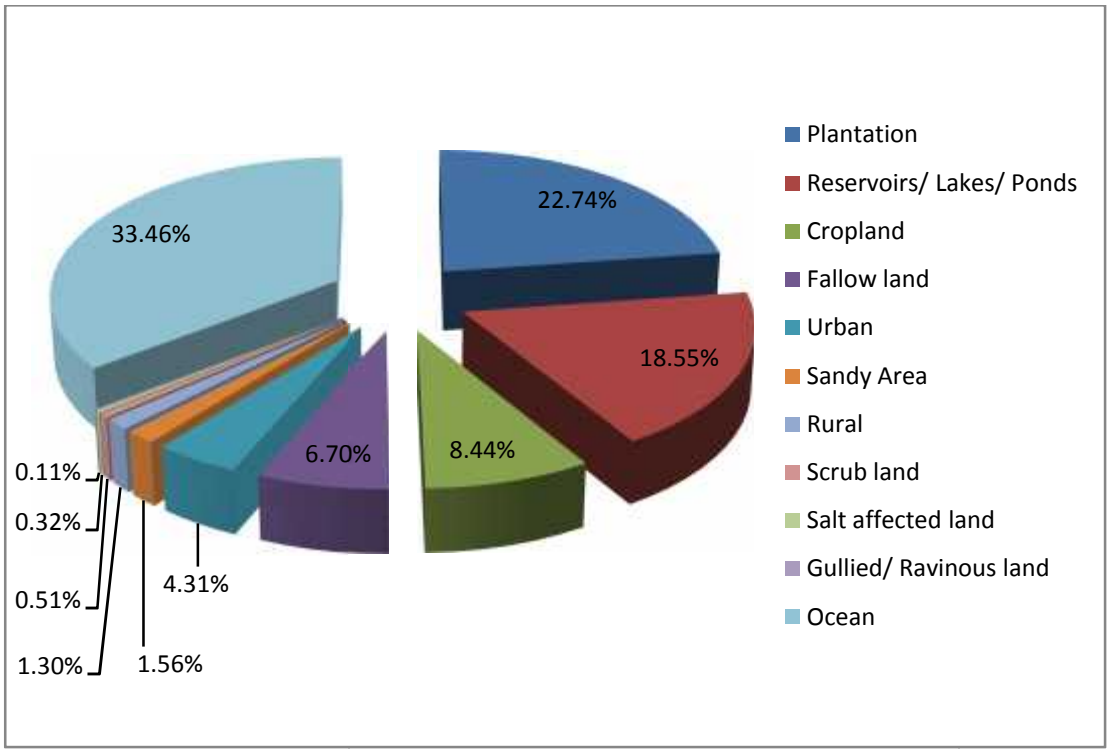


Figure 3-7 Land Use Pattern of the Study Area

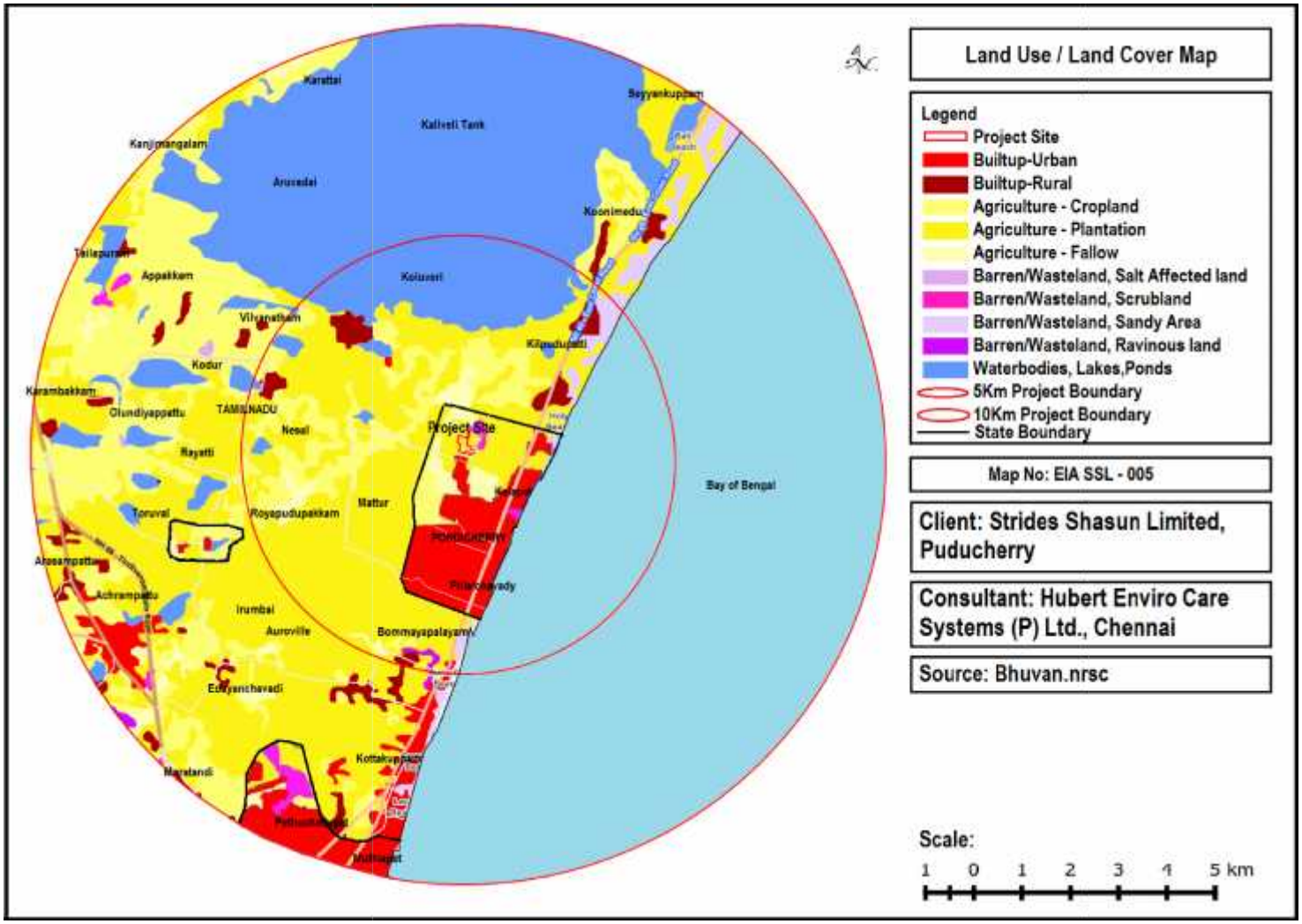


Figure 3-8 Land use/Land cover map of the Study Area

3.5.5 Topography

The region is a flat country of average elevation of about 15 metres above sea – level, intersected by the deltaic channels of River Gingee and the Ponnaiyar and other streams forming the main drainage basins, interspersed with lagoons, lakes and tanks. The Puducherry area is said to mark the northern limit of the sediments laid down during the great Cenomanian marine transgression along the east coast of South India. The coastal border has a length of 22Km, with a breadth ranging from four to six hundred metres. Superficially, the coast is flat and sandy. The project site fall under an elevation of 40m above the mean sea level and the study area contours vary from 20 m to 180 m above MSL. From the project site the high elevations were observed towards West North West direction. While the remaining areas showed variations with respect to contours. Contour map of the Study area is given in **Figure 3-9**.

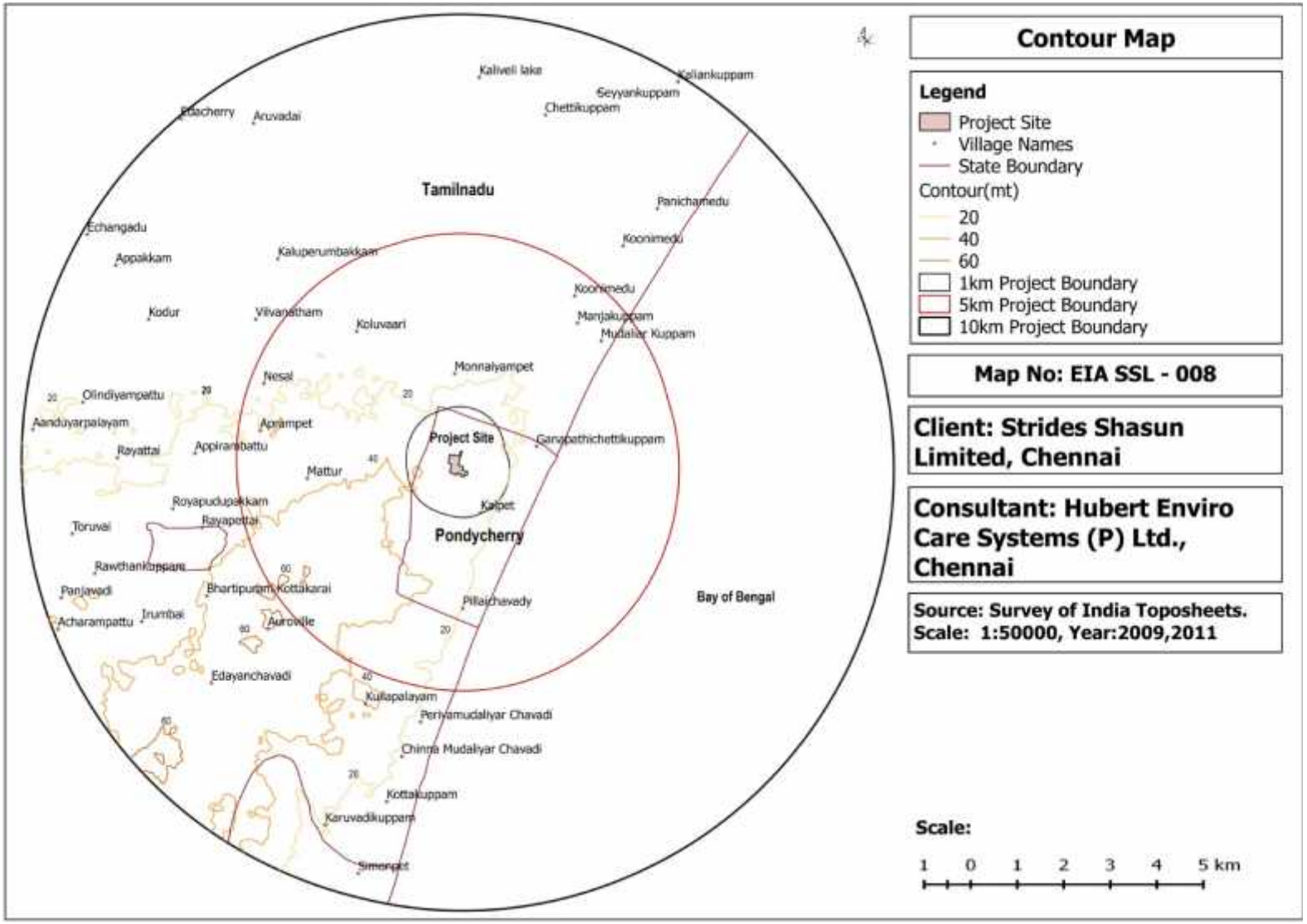


Figure 3-9 Contour map of Study Area

3.5.6 Geomorphology of Project Influence Area (PIA) District

The Puducherry region in general is a flat pen plain with an average elevation of 15m above mean sea level. The terrain becomes a little undulating with prominent high grounds varying from 30 to 100-m above mean sea level towards northwest and northeastern parts of the region. Three major physiographic units are generally observed, viz., (i) Coastal plain, (ii) Alluvial plain and (iii) Uplands.

The coastal plain extends as a narrow stretch for about 22 km and of four to six hundred meters width on the eastern part of the region along the Bay of Bengal. The major part of the coastal plain comprises gently sloping land with a chain of sand dunes extending all along the coast. Other physiographic units which are characteristic of the coastal plains such as spit bars, mud flats, lagoons and tidal inlets also occur. Geomorphology pattern of Study area, which shows that major part of the study area is covered by Denudational Origin - Pediment - Pediplain Complex 25.9%, Coastal Origin- Younger coastal plain19.8%, Fluvial origin - Older flood plain 0.20%, Water bodies 18.54 and Sea water 35.46% Shown in **Figure 3-10**. Geomorphology Map of study area given in **Figure 3-11.**

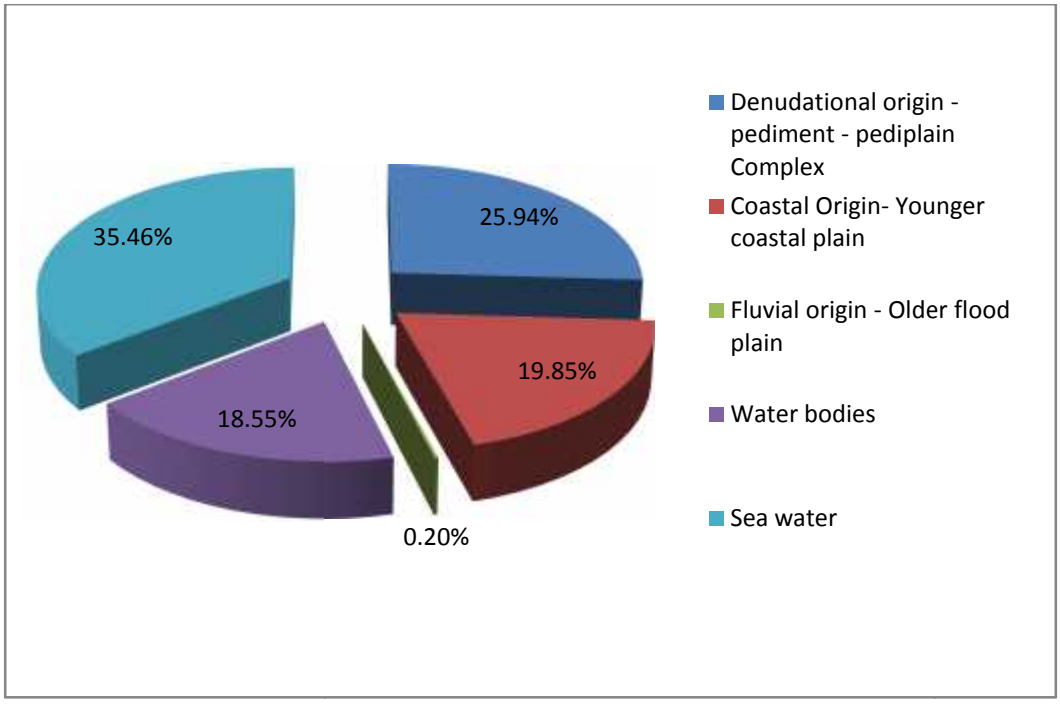


Figure 3-10 Geomorphology pattern of Study area

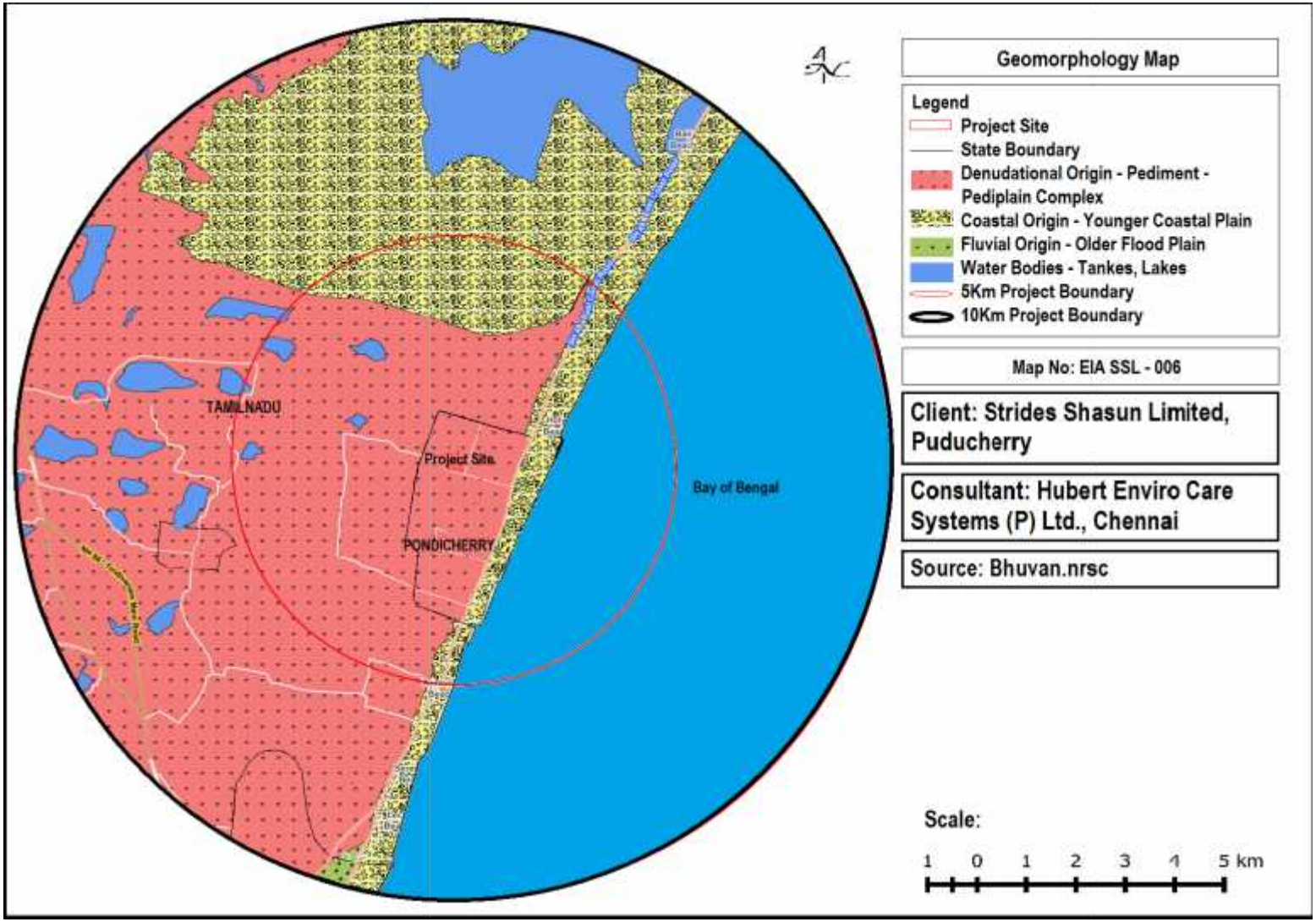
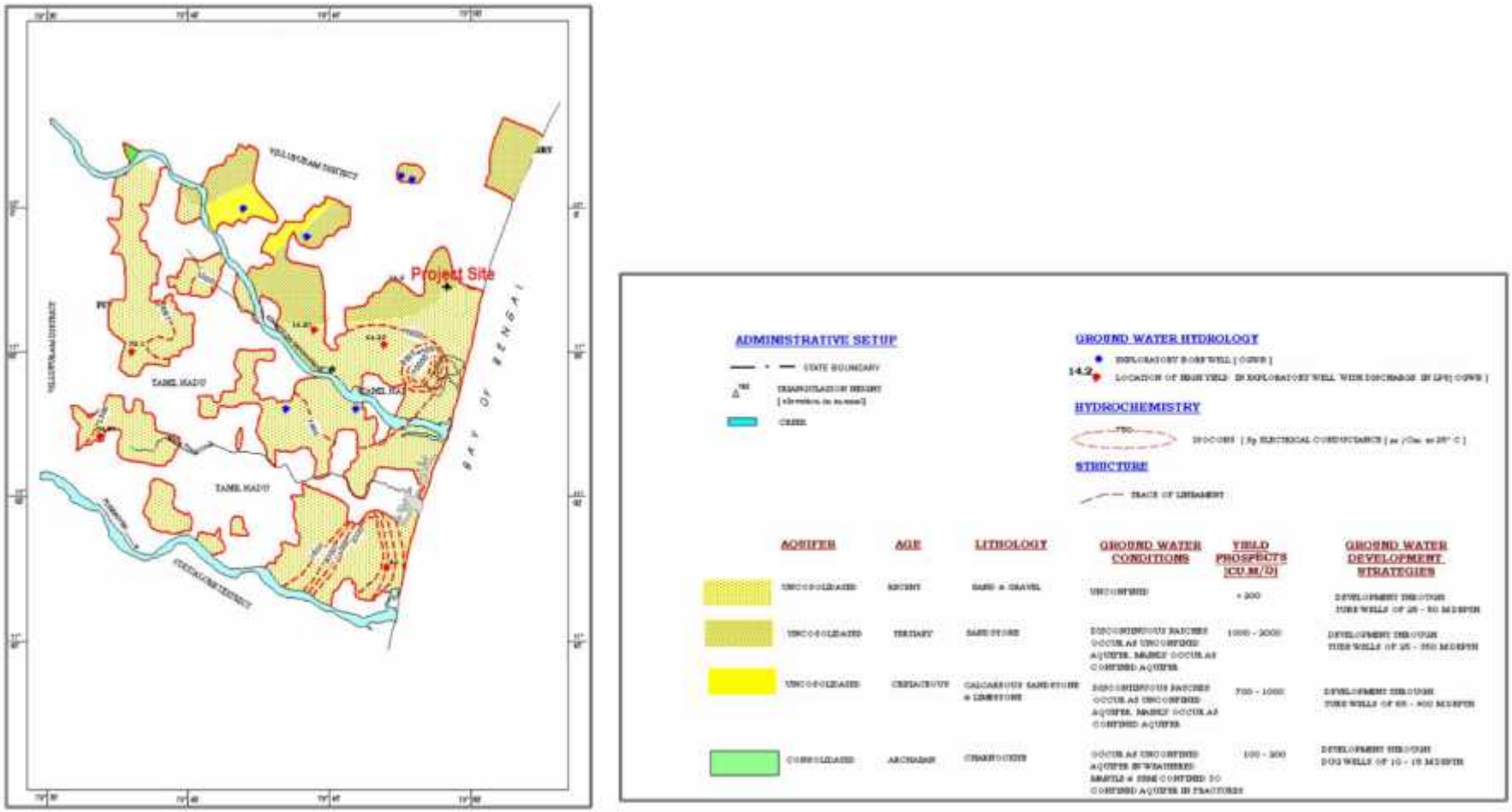


Figure 3-11 Geomorphology Map of Study area

3.5.7 Hydrogeology of PIA District

The porous sedimentary formations occur in almost the entire region and are represented by the semi-consolidated formations of Cretaceous and Tertiary and the unconsolidated Quaternary formations of recent age. Among the porous sedimentary aquifers, the Vanur-Ramanathapuram Sandstone (Cretaceous) and the Cuddalore sandstone (Tertiary) aquifers and the shallow alluvial (Quaternary) aquifers constitute the three major potential aquifer systems, in the region. Ground water occurs in these formations both under water table as well as under confined conditions and is being developed by means of dug wells, dug-cum borewells and tube wells.

Cuddalore sandstone, Kadapperikuppam formation and Manaveli formation are the three stratigraphic units of Tertiary aquifers. Out of the three, the Manaveli formation of Paleocene is mainly an aquitard and the localised granular zones donot provide any appreciable yield. Another unit of this group namely the Kadapperikuppam formation contains some productive aquifers. The thickness of this aquifer shows wide lateral and vertical variations. The Cuddalore sandstones of Mio-Pliocene age constitute the most potential aquifers. The Cuddalore sandstones comprising sandstones, sands and gravels occupy an extensive area. The thickness of these aquifers ranges between 20and 245 m. Ground water occurs in this aquifer mainly under confined conditions and is developed by means of tubewells ranging in depths between 27 and 366 m. The yields of the tube wells range between 200 and 3000 lpm for drawdowns varying from 5 to 10 m. The Kadapperikuppam aquifers are constituted by the fine grained sandstones and give moderate to good supplies of water as seen around Sedarapalli, Pillaiyarkuppam and further northeast. The thickness of aquifer ranges between 52 and 90 m south of Gingee river, whereas in the area north of Gingee river river, it is between 13 and 37 m. The piezometric head varied between 6.09 to 33.87 m bgl (June 2006) during premonsoon and 6.07 to 32.35 m bgl during post monsoon. Hydrogeology map of PIA district is given in **Figure 3-12.**



(Source: CGWB_Puducherry Region 2007)

Figure 3-12 Hydrogeology Map of PIA district

3.5.8 Drainage Pattern in PIA District

There are two major rivers draining this region 1) The Gingee river, which traverses the region diagonally from north-west to south-east and 2) the Ponnaiyar (Penniyar) river, which forms the southern border of the region. The river Gingee also known as the Varahanadi or Sankaraparani which has its source in the hills of Malayanur of Villupuram district, Tamil Nadu has a course of 34km in this region before it confluences with the Bay of Bengal. The river Ponnaiyar originates from the hills of Karnataka and enters the Puducherry region after flowing through the districts of Dharmapuri, Salem, Vellore and Cuddalore of Tamil Nadu. All the rivers are ephemeral in nature. About 140 small and two big tanks are in the region. These tanks are interlinked and act as water storage for agricultural purposes as well as to recharge the ground water. There are two Major water bodies within the study area. Kaliveli Lake which is 8.1 Km towards North and Bay of Bengal 1.72 Km in East direction from the project site. Other than these there are many minor water bodies within the study area**.** Drainage map of the study area is given in **Figure 3-13.**

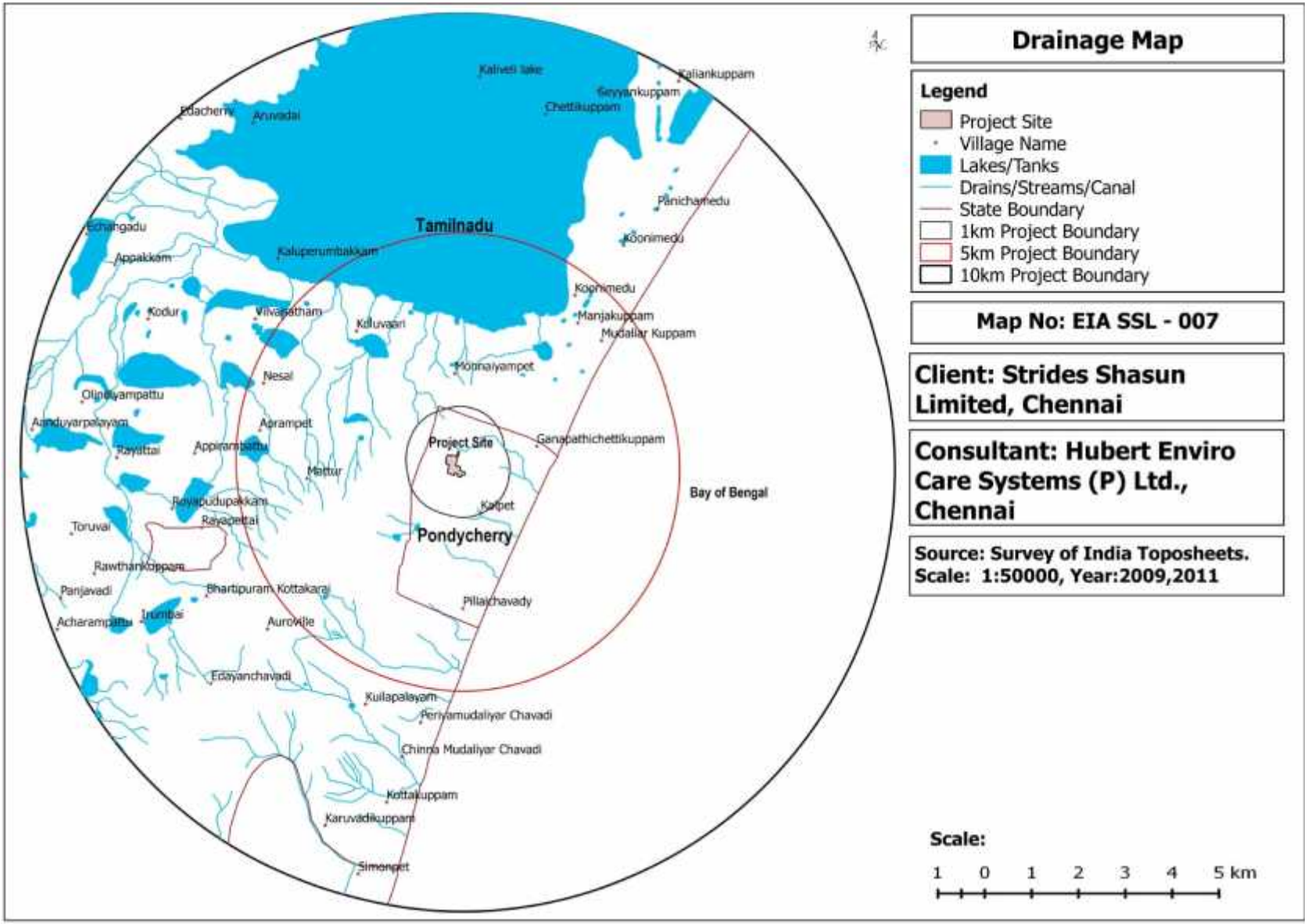


Figure 3-13 Drainage Map of the Study area

3.5.9 Soils in PIA District

Soils in the area have been classified into i) Red soil ii) Black soil iii) Alluvial soil iv) Colluvial soil. The major part is covered by Red soil of red sandy/clay loam type. Ferrugineous red soils are also seen at places. Black soils are deep to very deep and generally occur in the depressions adjacent to hilly areas, in the western part. Alluvial soils occur along the river courses and eastern part of the coastal areas. Sandy coastal alluviums (arenaceous soil) are seen all along the sea coast as a narrow belt. The study area covers recent alluvium soil. Soil Map of Tamil Nadu is given in **Figure 3-14.**

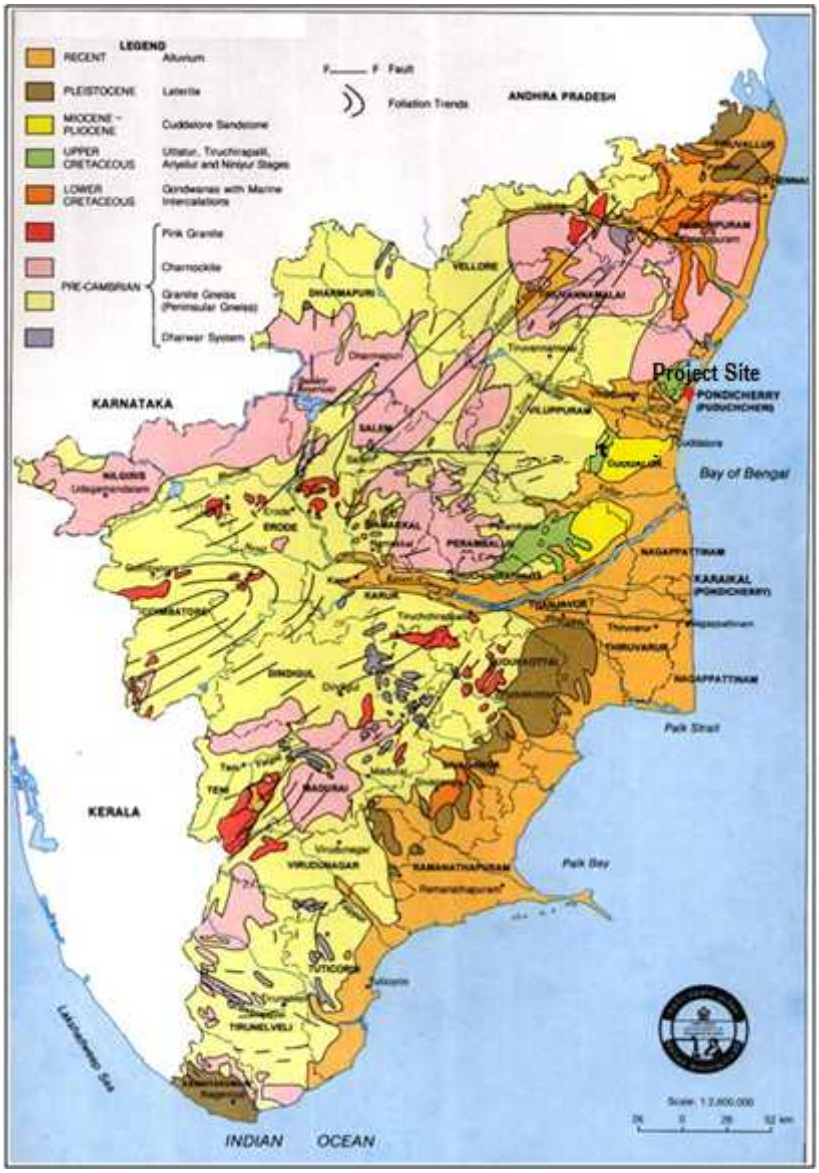
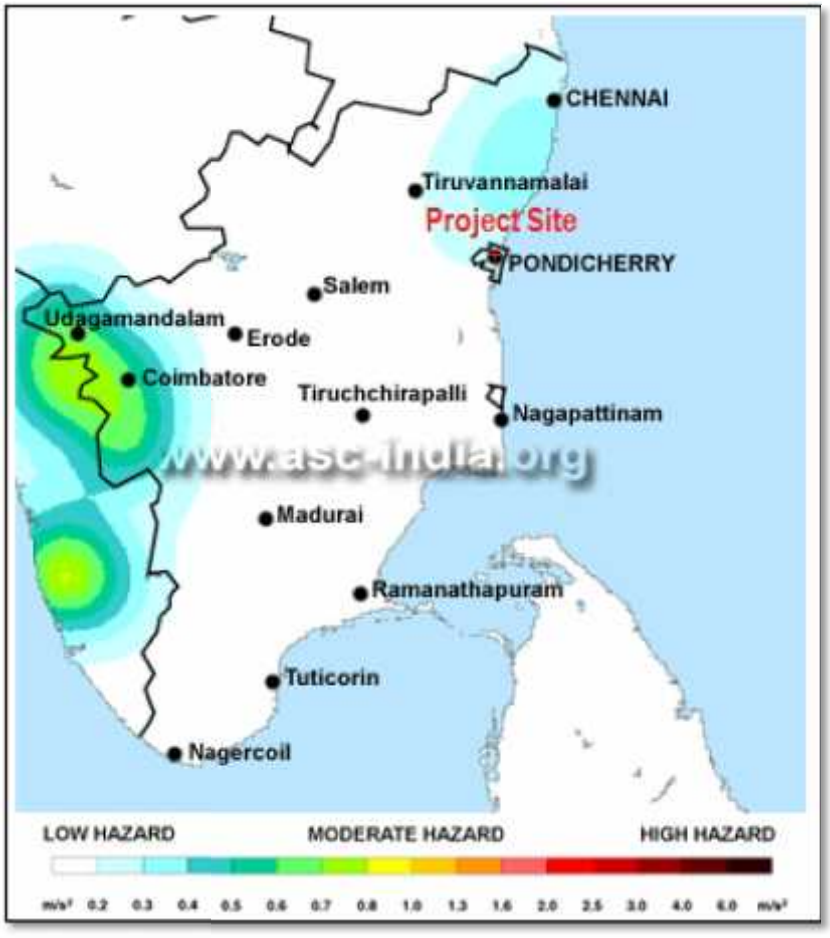


Figure 3-14 Soil Map of Tamil Nadu

3.5.10 Cyclones & Depressions, Winds and Coastal Erosion in PIA District

Puducherry, being a part of the Indian subcontinent, experiences tropical cyclones which originate from the depression generated in the Bay of Bengal during the northeast monsoon season (October to December). It experiences an average of 2 - 3 cyclones annually.

According to GSHAP (Global Seismic Hazard Map) data, Puducherry lies in a low hazard region. As per the 2002 Bureau of Indian Standards (BIS) map, Tamil Nadu & Puducherry fall in Zones II & III. Historically, parts of this region have experienced seismic activity in the M5.0 range. 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. Cyclone and wind Hazard Map of India is given in **Figure 3-15**.



(Source: GSHAP Hazard Map for Tamil Nadu & Puducherry).

Figure 3-15 Hazard Map for Tamil Nadu & Puducherry

3.5.11 Seismicity

As per the IS:1893 (Part-1) 2002 of Bureau of Indian Standards (BIS), the project location/study area falls in semi-arid region and the climate of the area is generally hot. The project location/study area falls in Zone II, which is categorised as a least active zone. The seismicity map of India is shown in **Figure 3-16.**

Figure 3-16 Seismicity Map of India

3.6 Air Environment

Baseline ambient air quality assessment gives the status in the vicinity of site and is an indispensable part of environmental impact assessment studies. Significant changes, in predominant winds and weather conditions are observed in winter, summer and post-monsoon seasons apart from the local topographic influences. The baseline status of air environment in the study area is assessed through a systematic air quality surveillance programme.

3.6.1 Meteorological Conditions

The regional air quality is influenced by the meteorology of that region. The principal weather parameters that influence the concentration of the air pollutants in the surroundings are wind speed, wind direction and temperature. The meteorological data is useful for proper interpretation of the baseline data. It is used as input for air quality dispersion models for predicting the post project environmental scenario i.e. ground level concentrations due to proposed utilities like boiler & DG sets, etc.

3.6.2 Meteorological Data Collection

Available secondary data pertaining to the meteorological parameters was obtained from the IMD Climatological tables. In addition, baseline meteorological data (primary data) was generated during the study period (July – September 2017). The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (BIS) i.e. IS:8829 and Indian Meteorological Department (IMD).

3.6.3 General Meteorological Scenario based on IMD Data

The nearest Indian Meteorological Department (IMD) station located to project site is Puducherry. The Climatological data for Puducherry (11° 55’ N and 79^{o} 50’ E), published by the IMD, based on daily observations at 08:30 and 17:30 hour IST for a 30 year period, is presented in the following sections on the meteorological conditions of the region. The monthly variations of the relevant meteorological parameters are reproduced in **Table 3-4.**

Table 3-4 Climatological Summary – Puducherry Region (1971-2000)

Month	Temp (oC)		Rainfall (mm)		Relative Humidity (%)		Station Level Pressure hPa		Mean Wind Speed (m/s)	Predominant Wind Directions (From)*	
	Daily Max.	Daily Min.	Total	No. of days	08:30	17:30	08:30	17:30		08:30	17:30
Jan	29.0	21.9	12.3	0.9	82	78	26.1	27.9	3.67	NW	NE
Feb	30.0	22.5	22.2	0.9	80	78	27.3	29.5	3.69	NW	NE
Mar	31.2	23.8	19.3	0.8	78	76	29.6	31.3	3.69	NW	SE
Apr	32.8	25.9	7.8	0.4	76	76	32.3	33.7	4.14	SE	SE
May	34.6	26.8	48.6	1.9	72	75	32.0	34.6	3.86	SW	SE
Jun	35.8	26.5	48.0	2.8	70	70	30.3	33.0	3.25	SW	SE
Jul	34.5	25.7	89.5	5.3	74	76	29.8	32.4	2.89	SW	SE
Aug	33.9	25.2	132.3	6.7	76	73	29.7	32.2	2.94	SW	SE
Sep	33.1	24.9	132.8	6.5	77	76	30.3	32.7	3.06	SW	SE
Oct	31.5	24.5	273.9	10.3	80	77	30.2	31.7	2.86	SW	SE
Nov	29.8	23.6	350.0	11.8	82	79	28.7	29.8	3.31	NW	NE
Dec	29.0	22.6	217.3	6.8	83	79	27.2	28.8	3.81	NW	NE
Max.	35.8	26.8	350	11.8	83	79	32.3	34.6	4.14	During Study Period Predominant Wind Directions - South West, South East	
Min.	29	21.9	7.8	0.4	70	70	26.1	27.9	2.86		
Avg/Total.	32.1	24.5	1354	55.5	77.5	76.1	29.5	31.5	3.43		

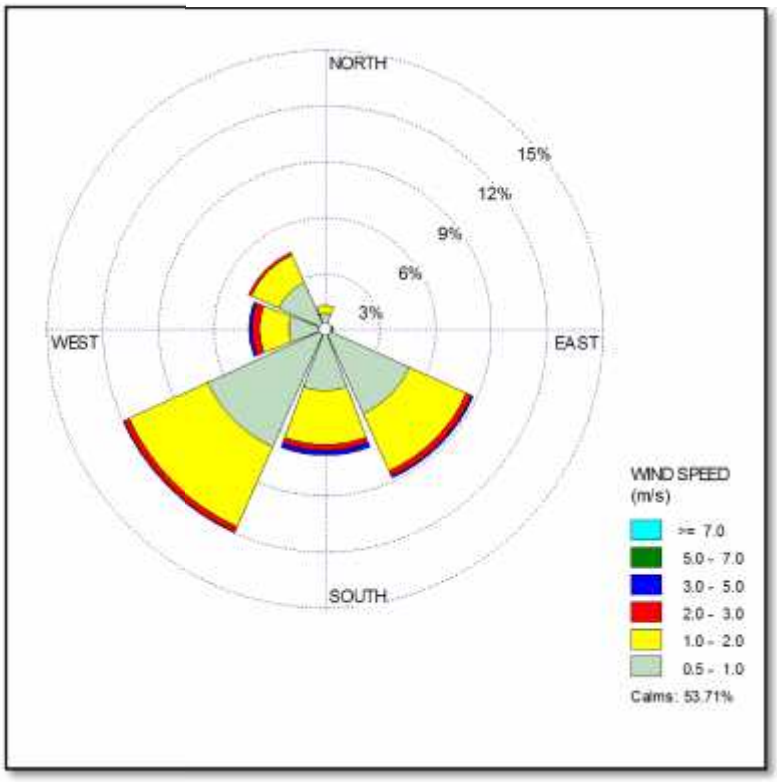
As per the above IMD Climatological, the observations drawn for the study period are the following.

- Daily maximum temperature during the study period is 34.5^{o}C and the daily minimum temperature is 24.9^{o}C were recorded in the months of July and September respectively.
- Maximum and minimum relative humidity of 77% and 73% were recorded in the months of September and August respectively.

- Maximum and minimum rainfall of 132.8 mm and 89.5 mm was recorded in the months of July and September respectively. Annual Total Rainfall is 1354 mm.
- Maximum and minimum Mean wind speed during the study period is 3.06 m/s and 2.89 m/s. was recorded in the months of September and July respectively. Predominant Wind during study period is from South West to North East.

3.6.4 Meteorological Scenario during Study Period

Meteorological scenario in and around the project site is an essential requirement during study period for proper interpretation of baseline air quality status. Meteorological data was collected during the study period; (July - September 2017).The wind rose of the study period is given in **Figure 3-17.**



(Source: www.wunderground.com)

Figure 3-17 Specific Wind rose for the Study Period (July - September 2017)

3.6.4.1 Meteorological data during Study Period

The meteorological data of study period was used for interpretation of baseline status and to simulate the meteorological conditions for prediction of impacts in modeling studies. Meteorology Data for the Study Period (July - September 2017) is given in **Table 3-5**.

Table 3-5 Meteorology Data for the Study Period (July - September 2017)

S. No	Parameter	Observation
1.	Temperature	Min Temperature : 23.5^{0}C Max Temperature : 35.8^{0}C Avg Temperature : 33.1^{0}C
2.	Relative Humidity Range	73%
3.	Average Wind Speed	2.9 m/s
4.	Predominant Wind Direction	SW, SE,S to NE, NW, N

3.6.4.2 Ambient Air Quality

The selection criteria for monitoring locations are based on the following:

- Topography/Terrain
- Meteorological conditions
- Residential and sensitive areas within the study area
- Representatives of regional background air quality/pollution levels and
- Representation of likely impacted areas

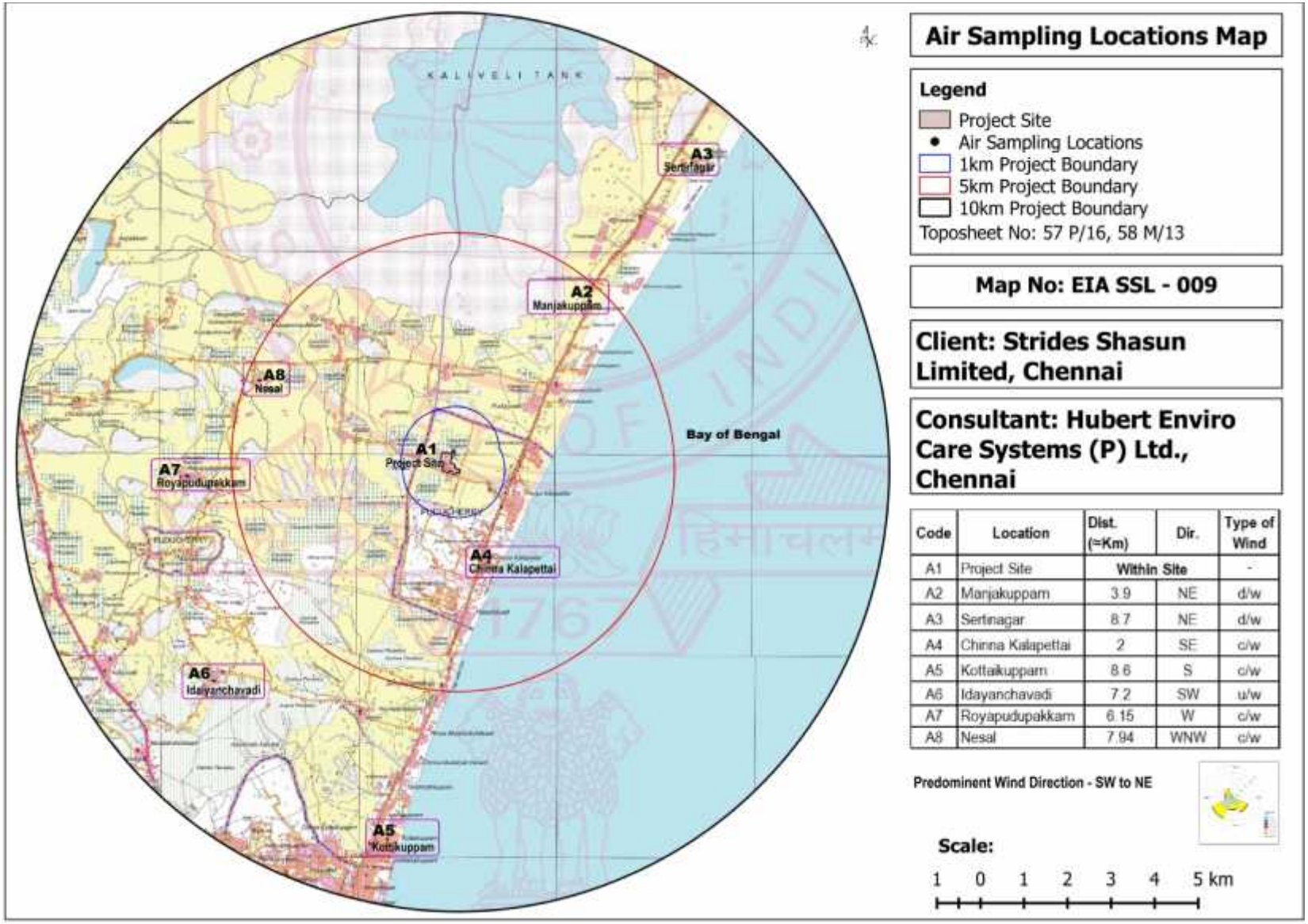
3.6.4.3 Ambient Air Quality Monitoring Stations

To evaluate the baseline air quality of the study area, eight (08) monitoring locations have been identified as per IMD Climatological data-Periyakalapet Region (1971-2000).The annual wind predominant is from South West to North East. Air Monitoring photographs are provided in **Figure 3-18.** Map showing the air monitoring locations are given in **Figure 3-19** and the details of the locations are given in **Table 3-6**.

Table 3-6 Details of Ambient Air Quality Monitoring Locations

Station Code	Location	Type of Wind	Geographical Coordinates	Distance (Km) from Project boundary	Azimuth Directions
A1	Project Site	-	12° 2'19.87"N 79°51'10.63"E	Within Site	
A2	Manjakuppam	d/w	12° 6'9.14"N 79°54'3.35"E	3.9	NE
A3	Sertinagar	d/w	12° 4'2.21"N 79°52'47.28"E	8.7	NE
A4	Chinna Kalapettai	c/w	12° 1'49.31"N 79°51'46.44"E	2.0	SE
A5	Kottaikuppam	c/w	11°57'55.50"N 79°50'23.44"E	8.6	S
A6	Idayanchavadi	u/w	11°57'50.90"N 79°46'32.54"E	7.2	SW
A7	Royapudupakkam	c/w	12° 1'52.17"N 79°47'35.02"E	6.15	W
A8	Nesal	c/w	12° 3'21.71"N 79°48'44.83"E	7.94	WNW

Figure 3-18 Air Monitoring Photographs



Code	Location	Dist. (≈Km)	Dir.	Type of Wind
A1	Project Site	Within Site		-
A2	Manjakuppam	3.9	NE	d/w
A3	Sertinagar	8.7	NE	d/w
A4	Chinna Kalapettai	2	SE	c/w
A5	Kottaikuppam	8.6	S	c/w
A6	Idayanchavadi	7.2	SW	u/w
A7	Royapudupakkam	6.15	W	c/w
A8	Nesal	7.94	WNW	c/w

Figure 3-19 Map showing the air monitoring locations

3.6.4.4 Ambient Air Quality Monitoring Techniques and Frequency

Ambient air quality was monitored twice in a week for One (01) season (shall cover 12 weeks), i.e. during study period (July - September). PM_{10}, $PM_{2.5}$, SO_2, NO_x, Pb, NH_3, C_6H_6, $C_{20}H_{12}$, As, Ni & VOC were monitored on 24 hourly basis and CO, O_3 & NH_3 were monitored on eight hourly basis. Sampling was carried out as per Central Pollution Control Board (CPCB) monitoring guidelines at each location. Analytical methods used for analysis of parameters are given in **Table 3-7**.

Table 3-7 Analytical Methods for Analysis of Ambient Air Quality Parameters

S. No	Parameters	Analytical method	NAAQ standards: 2009		Sampling Time
1	Sulphur Dioxide (SO_2), µg/m^3	IS:5182(Part-2):2001 (Reaff:2006)	50 (Annual)	80(24 Hours)	24 Hours
2	Nitrogen Dioxide (NO_2), µg/m^3	IS: 5182 (Part - 6): 2006	40 (Annual)	80 (24 Hours)	24 Hours
3	Particulate Matter ($PM_{2.5}$), µg/m^3	IS: 5182 (Part - 23): 2006	40 (Annual)	60 (24 hours)	24 Hours
4	Particulate Matter (PM_{10}), µg/m^3	IS:5182 (Part– 23): 2006	60 (Annual)	100 (24 hours)	24 Hours
5	CO mg/m^3	IS:5182(Part–10):1999 (Reaff:2006)	2 (8 hours)	4 (1hour)	8 Hours
6	Pb µg/m^3	IS:5182(Part–22):2004 (Reaff:2006)	0.5(Annual)	1(24 hours)	24 Hours
7	O3, µg/m^3	IS: 5182 (Part – 9): 1974	100(8hours)	180 (1hour)	8 Hours
8	NH3, µg/m^3	APHA(air) 2nd edition (Indophenol-blue method)	100(Annual)	400(24 hours)	8 Hours
9	Benzene, µg/m^3	IS:5182(Part–11):1999 (RA:2009)	5 (Annual)	5 (Annual)	24 Hours
10	Benzo (a) pyrene, ng/m^3	IS:5182(Part–12):2004(RA:2009)	1 (Annual)	1 (Annual)	24 Hours
11	Arsenic, ng/ m^3	APHA (air) 2nd edition	6 (Annual)	6 (Annual)	24 Hours
12.	Nickel, ng/ m^3	HECS/AIR/Ambient/SOP007	20 (Annual)	20 (Annual)	24 Hours
13.	Volatile Organic		-	-	-

	Compounds, µg/m^3	PID Method			
14.	Total Hydrocarbons, ppm	IS 5172 Part 17 GC Method	-	-	1 Hour

3.6.4.5 Results and Discussions

The variations of the pollutants PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, Pb, O_3, NH_3, C_6H_6, C_{20} H_{12}, As ,Ni, THC & VOC are compared with National Ambient Air Quality Standards (NAAQS), MoEF&CC Notification, November, 2009. Ambient Air Quality Monitoring Data (July - September, 2017) for the study area is given in **Table 3-8** and trends of measured ambient concentration in the study area are graphically represented in **Figure 3-20.**

Table 3-8 Summary of the average baseline concentrations of pollutants

Parameters	Conc.	NAAQ Standards	Locations							
			Project Site	Sertinagar	Manjakuppam	Chinna Kalapettai	Kottaikuppam	Idayanchavadi	Royapudupakkam	Nesal
			A1	A2	A3	A4	A5	A6	A7	A8
PM_{10} Conc. (µg/m³)	Min.	100 (24 Hours)	41.6	44.2	52.6	52.6	42.3	35.6	40.2	34.2
	Max.		62.5	71.2	78.6	72.1	69.8	69.9	65.3	62.3
	Avg.		51.3	59.4	59.6	60.8	58.2	52.6	51.4	48.5
	98th 'tile		61.6	70.3	74.6	71.0	69.8	67.554	64.472	61.15
$PM_{2.5}$ Conc. (µg/m³)	Min.	60 (24 Hours)	15.8	11.6	16.8	14.6	12.2	15.3	14.2	11.3
	Max.		34.6	35.4	34.2	36.4	27.6	27.1	28.1	24.6
	Avg.		21.8	21.6	23.8	25.0	22.8	21.1	22.6	18.1
	98th 'tile		34.1	34.5	33.9	35.1	27.4	26.4	27.5	24.1
SO_2 Conc. (µg/m³)	Min.	80 (24 Hours)	10.8	9.1	8.4	10.2	8.6	9.6	8.8	8.2
	Max.		16.3	21.3	19.2	19.2	15.6	19.3	15.3	14.2
	Avg.		13.8	13.1	11.3	12.6	11.8	12.1	11.1	10.8
	98th 'tile		16.3	20.1	18.0	16.9	15.6	17.6	14.8	14.2
NO_2 Conc.(µg/m³)	Min.	80 (24 Hours)	14.8	15.0	15.4	11.3	12.1	12.3	10.6	13.2
	Max.		29.6	30.4	23.6	28.7	30.2	28.3	32.6	26.3
	Avg.,		21.5	20.8	19.6	20.1	19.8	19.4	18.6	18.2
	98th 'tile		29.3	29.5	23.5	27.5	26.8	27.1	29.6	24.6
Pb (µg/m³)	Avg.	1 (24 hour)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)

CO (mg/m^3)	Avg.	4 (1hour)	0.82	0.91	0.7	0.74	0.56	0.65	0.06	0.01
O3 (µg/m^3)	Avg.	180 (1hour)	15.1	11.8	13.2	12.3	10.96	12.6	BDL (DL 10)	BDL (DL 10)
NH3 (µg/m^3)	Avg.	400 (24 hours)	5.47	BDL(DL 5)	BDL(DL 5)	BDL(DL 5)	BDL(DL 5)	BDL(DL 5)	BDL(DL 5)	BDL(DL 5)
Benzene (µg/m^3)	Avg.	5 (Annual)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)
Benzo (a) pyrene, (ng/m^3)	Avg.	1 (Annual)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)	BDL (1)
Arsenic (ng/ m^3)	Avg.	6 (Annual)	BDL (2)	BDL (2)	BDL (2)	BDL (2)	BDL (2)	BDL (2)	BDL (2)	BDL (2)
Nickel (ng/m^3)	Avg.	20 (Annual)	BDL (DL 10)	BDL (DL 10)	BDL (DL 10)	BDL (DL 10)	BDL (DL 10)	BDL (DL 10)	BDL (DL 10)	BDL (DL 10)
Volatile Organic Compounds(µg/m^3)	Avg.	-	78.6	13.8	14.2	13.65	11.1	12.1	BDL (DL 10)	BDL (DL 10)
Total Hydrocarbons(ppm)	Avg.	*	0.47	0.15	0.2	0.1	0.07	0.11	0.05	0.05

Note: BDL (Below detectable limit), DL (Detectable limit)

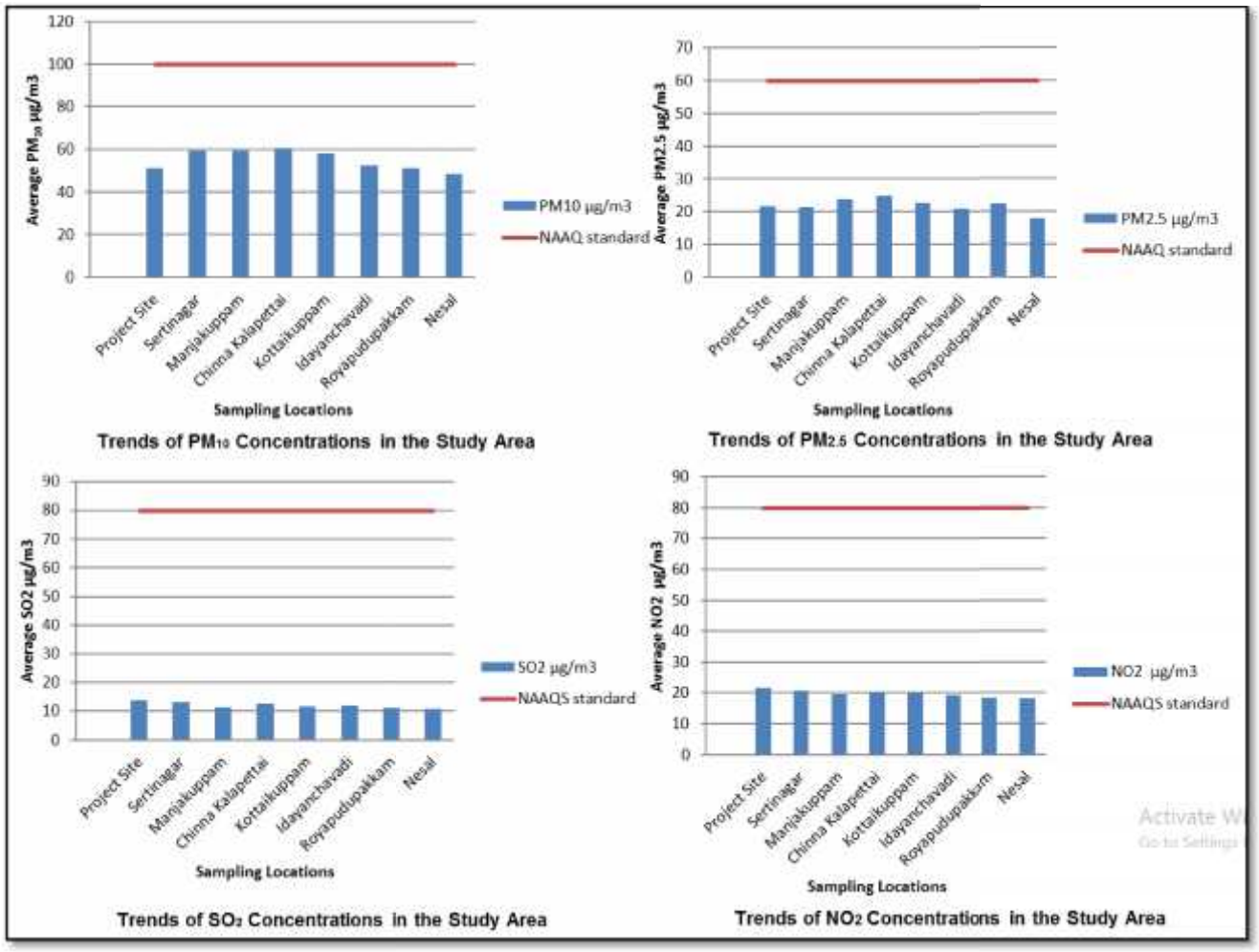


Figure 3-20 Trends of Measured Ambient Concentrations in the Study Area

3.6.4.6 Observations

Statistical analysis (minimum, maximum, arithmetic mean and 98-percentile values) of the ambient air quality in study area for the said period are given in **Table 3-8**. The results of such analysis are pictorially presented in **Figure 3-20.**

Particulate Matter (PM_{10})

Arithmetic Mean of the 24-hourly average values of PM_{10} varied station-wise between 48.5 µg/m^3 (at Nesal) and 60.8 µg/m3 (at Chinna Kalapettai) with overall mean of the 8 stations being 55.2 µg/m^3. The maximum 24-hourly average 98-percentile value of PM_{10} (max74.6 µg/m^3 was

found at Manjakuppam. All the locations were observed well within the limit of 100 μg/m^3, as stipulated in the National Ambient Air Quality Standards.

Particular Matter ($PM_{2.5}$)

Arithmetic Mean of the 24-hourly average values of $PM_{2.5}$ varied station-wise between 18.1 μg/m^3 (at Nesal) and 25.0 μg/m3 (at Chinna Kalapettai). The overall mean for the 8 stations was 22.1 μg/m^3. The 24-hourly average 98-percentile value of $PM_{2.5}$ (max 35.1 μg/m^3) was found at Chinna Kalapettai. All the locations were observed well within the of limit 60, μg/m^3, as stipulated in the National Ambient Air Quality Standards.

Sulphur Dioxide (SO_2)

Arithmetic Mean of the 24-hourly average values of SO_2 varied station-wise between 10.8 μg/m^3 (at Nesal) and 13.8 μg/m^3 (at Project Site). The overall mean for the 8 stations was 12.0 μg/m^3. The 24-hourly average 98-percentile values of SO_2 (max 20.1 μg/m^3 at Sertinagar) at all the locations were observed to be much within the of limit 80, μg/m^3, as stipulated in the National Ambient Air Quality Standards.

Nitrogen Dioxide (NO_2)

Arithmetic Mean of the 24-hourly average values of NO_2 varied station-wise between 18.2 μg/m^3 (at Nesal) and 21.5 μg/m^3 (at Project Site). The overall mean for the 8 stations was 19.7 μg/m^3. The 24-hourly average 98-percentile values of NO_2 (max 29.6 μg/m^3 was found at Royapudupakkam). All the locations were observed well within the of limit 80, μg/m^3, as stipulated in the National Ambient Air Quality Standards.

3.7 Noise Environment

The prevailing ambient noise level at a particular location is nothing but the resultant (total) of all kinds of noise sources existing at various distances around that location. The ambient noise level at a location varies continuously depending on the type of surrounding activities. Ambient noise levels have been established by monitoring noise levels at eight (08) locations in and around 10Km distance from project area during study periodusing precision noise level meter. The noise monitoring locations in the study area were selected after giving due consideration to the various land use categories. The land use categories include commercial, residential, rural and sensitive areas. Noise levels were recorded on an hourly basis for one complete day at

each location using pre- calibrated noise levels. Noise Monitoring photographs are provided in **Figure 3-21.** A map showing the noise monitoring locations is given in **Figure 3-22**.

3.7.1 Results and Discussions

Based on the recorded hourly noise levels at each monitoring location, the day equivalent (L_d) and night equivalent (L_n) were calculated;

- L_d: Average noise levels between 6:00 hours to 22.00 hours.
- L_n: Average noise levels between 22:00 hours to 6.00 hours.

The comparison of day equivalent noise levels (L_d) and night equivalent noise levels (L_n) with the respective CPCB stipulated noise standards for various land use categories are shown in the **Table 3-9**.

Figure 3-21 Noise Monitoring Photographs

Table 3-9 Day and Night Equivalent Noise Levels

S. No	Location	Location Code	Distance (km) from Project boundary	Azimuth Direction	Noise level in dB(A) Leq		CPCB Standard		Environmental Setting
					Day	Night	Lday (Ld)	LNight (Ln)	
1.	Project Site	N1	Within Site		60.8	55.2	65	55	Commercial(Inside Industry, but Plant not in Industrial Zone)
2.	Manjakuppam	N2	3.9	NE	52.1	44.3	55	45	Residential
3.	Sertinagar	N3	8.7	NE	60.2	50.8	55	45	Residential
4.	Chinna Kalapettai	N4	2.0	SE	59.4	50.1	65	55	Commercial
5.	Kottaikuppam	N5	8.6	S	58.3	45.3	55	45	Residential
6.	Idayanchavadi	N6	7.2	SW	51.1	47.5	55	45	Residential
7.	Royapudupakkam	N7	6.1	W	56.1	48.9	55	45	Residential
8.	Nesal	N8	7.9	WNW	55.5	47.2	55	45	Residential

3.7.2 Observations

- In the commercial sector, daytime Leq value were in the ranges of (59.4 – 60.8) dB(A), and the nighttime Leq values varied in the range of (50.1 – 55.2) dB(A).
- In the Residential sector, daytime Leq values were in the ranges of (51.1 – 60.2) dB(A), and the nighttime Leq values varied in the range of (44.3 – 50.8) dB(A). The highest value of 60.2 dB(A) was found at Manjakuppam during the daytime.

The field observations during the study period indicate that the ambient noise levels were slightly exceeded the prescribed standards by MoEF&CC.

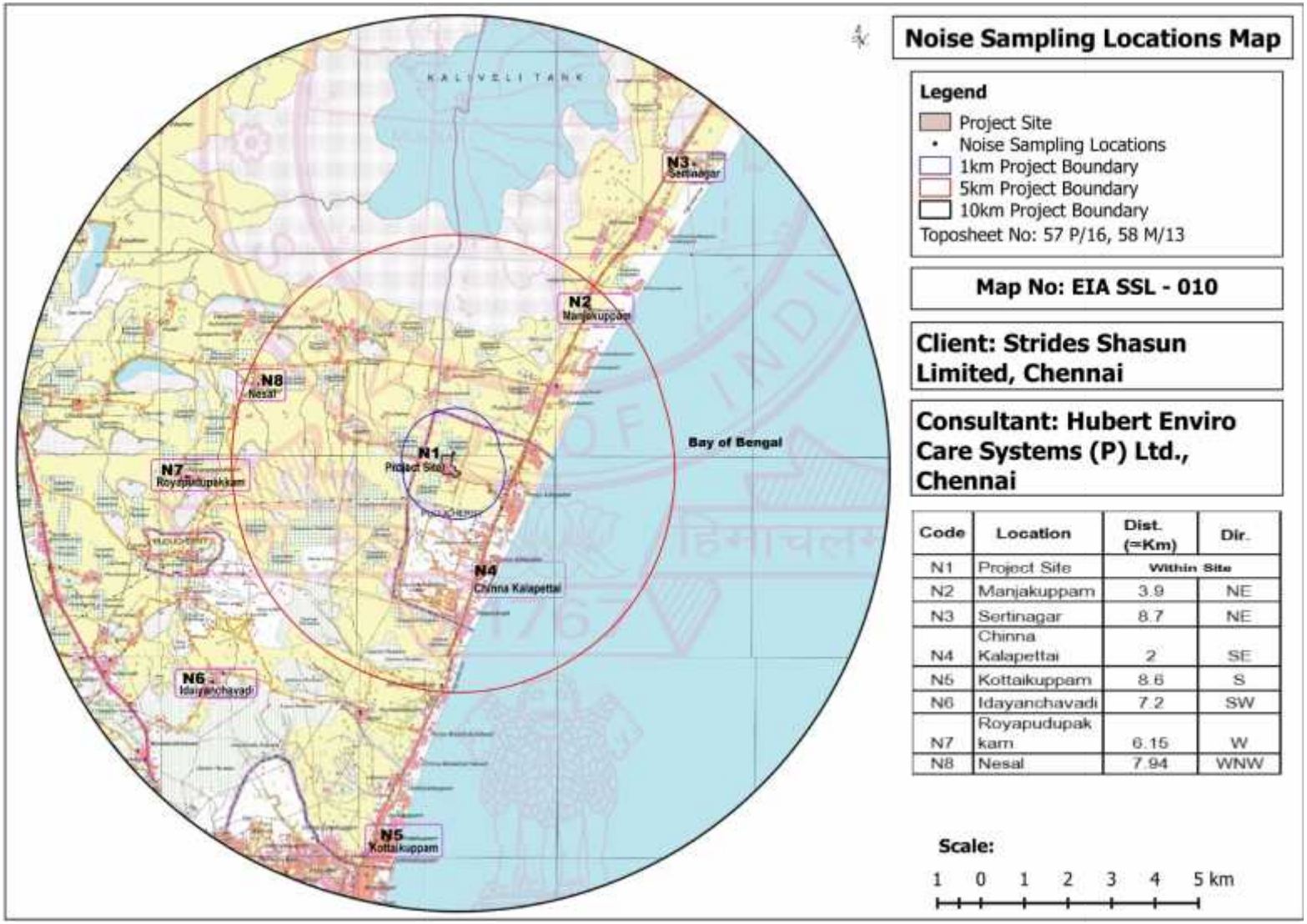


Figure 3-22 Map showing the Noise monitoring locations

3.8 Water Environment

3.8.1 Surface Water Resources

There are two principal basins in Puducherry: the Gingee River which cuts the territory diagonally and Pennaiyar forming a rim in south. Gingee runs North West to south east of Puducherry. There are quite a few lakes in Puducherry. The largest two of them are Bahour and Oussoudu mainly used for fishing purpose. They lie in Puducherry district. The main fishes found in these lakes are sardines, shark, ribbon fish and many more. Fishery earns good revenue for Puducherry all through the year but especially from the month of May to July.

There are two major water bodies within the study area: Kaliveli Lake which is 2.89 Km towards North and Bay of Bengal 1.82 Km in East direction from the project site. Other than these there are many minor water bodies within the study area.

3.8.1.1 Surface Water Quality Assessment

To establish the baseline status of water environment, the existing representative sampling locations for surface water within a radial distance of 10Km from project site have been selected as per CPCB guidelines of Water Quality Monitoring through an adequate survey of the project area. Test methods used for the analysis of water quality parameters is given in **Table 3-10**.

Table 3-10 Test methods used for the analysis of water quality parameters

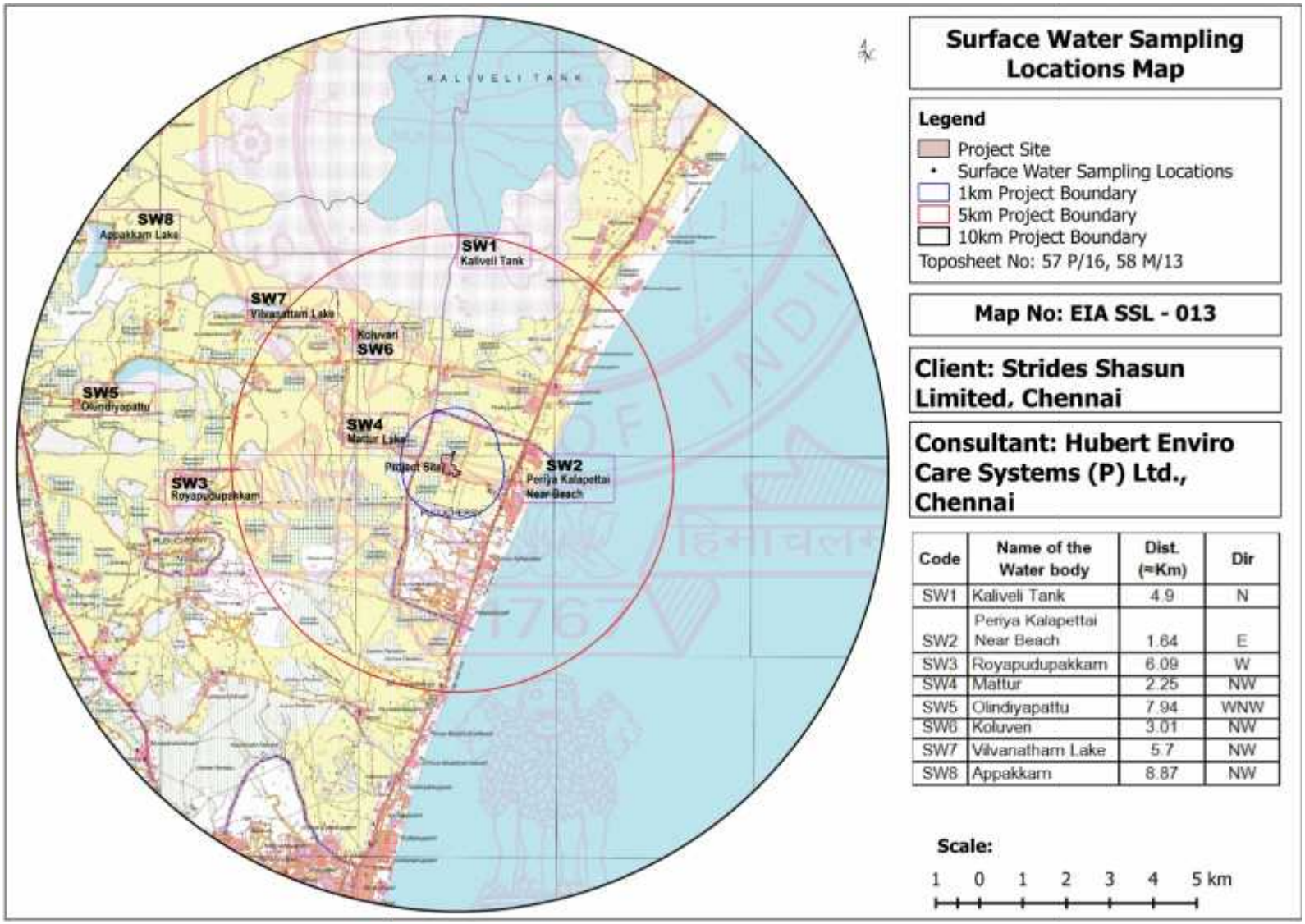
S. No	Parameter Measured	Test Method
1	pH (at 25°C)	IS:3025 (Part - 11): 1983 (Reaff: 2006)
2	Electrical Conductivity	IS:3025 (Part - 14): 1983 (Reaff: 2006)
3	Color	IS:3025 (Part- 4) 1983 (Reaff 2006)
4	Total Hardness as CaCO3	IS:3025 (Part - 21) 1983 (Reaff 2006)
5	Total Alkalinity as CaCO3	IS:3025,1 (Part - 23) 1986 (Reaff 2009)
6	Cadmium	IS:3025 (Part 41) 1991
7	Chloride as Cl	IS:3025 (Part - 32) 1988(Reaff 2009)
8	Total Dissolved Solids	IS:3025:1(Part - 16) 1984 (Reaff 2006)
9	Aluminium as Al	IS:3025 (Part - 55) 2003 (Reaff 2009)
10	Chromium as Cr	IS:3025 (Part - 52) 2003 (Reaff 2009)
11	Lead as Pb	IS:3025 (Part - 47) 1994 (Reaff 2009)
12	Zinc as Zn	IS:3025 (Part - 49) 1994 (Reaff 2009)
13	Sodium as Na	IS:3025,5(Part - 45) 1993 (Reaff 2006)
14	Temperature	IS:3025 (Part - 9) 1983 (Reaff 2006)
15	Chemical oxygen demand as O2	IS:3025 (Part-58)-2006
16	Dissolved Oxygen (mg/l)	IS:3025 (Part - 38)1989 (Reaff 2009)
17	Salinity	-
18	Copper as Cu	IS:3025 (Part - 42)1992 (Reaff: 2009)
19	BOD,5 days @200C as O2	5210B APHA22nd Edn 2012

The prevailing status of water quality at eight sampling locations each for ground water and surface water has been assessed during July - September 2017 are presented in **Table 3-11.** Surface water quality results are provided in **Table 3-12**. Surface water sampling photographs were provided in **Figure 3-23.** A map showing the surface water monitoring locations is given in **Figure 3-24**.

Table 3-11 Details of Surface water sampling locations

S. No	Name of the Water body	Type of water body	Distance from Project Boundary	Direction from project boundary
1	Kaliveli Lake	Lake	4.9	N
2	Periya Kalapettai Near Beach	Sea	1.64	E
3	Royapudupakkam	Lake	6.09	W
4	Mattur	Lake	2.25	NW
5	Olindiyapattu	Lake	7.94	WNW
6	Koluveri	Lake	3.01	NW
7	Vilvanatham Lake	Lake	5.70	NW
8	Appakkam	Pond	8.87	NW

Figure 3-23 Surface water Sampling Photographs



Code	Name of the Water body	Dist. (≈Km)	Dir
SW1	Kaliveli Tank	4.9	N
SW2	Periya Kalapettai Near Beach	1.64	E
SW3	Royapudupakkam	6.09	W
SW4	Mattur	2.25	NW
SW5	Olindiyapattu	7.94	WNW
SW6	Koluven	3.01	NW
SW7	Vilvanatham Lake	5.7	NW
SW8	Appakkam	8.87	NW

Figure 3-24 Map showing the surface water monitoring locations

Table 3-12 Surface water Monitoring Results

S.No	Parameters	Units	DW Standards (IS 10500:2012) Acceptable Limit	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8
1	Source	-	-	Lake	Sea	Lake	Lake	Lake	Lake	Lake	Pond
2	Colour	Hazen	5	12.8	4.7	7.8	5.8	15.7	11.8	7.8	8.4
3	pH at 25°C	-	6.5 to 8.5	7.35	7.53	7.48	8.01	7.14	7.78	7.59	7.51
4	Turbidity	NTU	1	14	12	4	2	34	27	16	14
6	Electrical Conductivity@25◦C	µmhos/cm	-	37302	52339	493	357	893	644	702	567
7	Total Suspended solids	mg/l	-	24	32	15	9	43	32	21	26
8	Salinity	-	-	24.9	35.7	0.136	0.107	0.285	0.206	0.219	0.211
9	Total Dissolved Solids	mg/l	500	23649	35329	338	238	611	426	477	388
10	Total Alkalinity as $CaCO_3$	mg/l	200	100	160	91	73	99	99	104	78
11	Total Hardness as $CaCO_3$	mg/l	200	8200	6519	180	70	317	159	208	153
12	Calcium as Ca	mg/l	75	561	540	47.5	21.4	52.3	54.8	65.4	46.6
13	Magnesium as Mg	mg/l	30	1652	1256	14.86	3.89	45.33	5.34	10.93	8.97
14	Sodium as Na	mg/l	-	6540	10560	34.9	22.8	96.3	63.8	69.2	65.9
15	Potassium as K	mg/l	-	652	310	16.5	9.67	13	12.7	8.54	12.6
16	Chloride as Cl	mg/l	250	13760	19750	58.766	42.552	141.042	97.492	104.728	100.306
17	Sulphate as SO_4	mg/l	200	100	2530	40	34	124	57	76	44
18	Carbonate	mg/l	-	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)

							(DL1)				
19	Bicarbonate	mg/l	-	254	195	110.565	89.586	120.686	120.204	126.441	94.689
20	Nitrate as NO_3	mg/l	45	0.213	0.138	1.072	0.987	2.931	0.765	1.083	0.720
23	Fluoride as F	mg/l	1	0.41	0.61	0.21	0.24	0.58	0.27	0.31	0.25
24	Sulphides	mg/l	0.05	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL (DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)
25	Oil & Grease	mg/l	-	BDL(DL4)	BDL(DL4)	BDL(DL4)	BDL (DL4)	BDL(DL4)	BDL(DL4)	BDL(DL4)	BDL(DL4)
26	Arsenic	mg/l	0.01	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)
27	Cyanide	mg/l	0.05	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)
28	Cadmium	mg/l	0.003	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)
29	Chromium	mg/l	0.05	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)
30	Iron	mg/l	0.3	0.57	1.71	0.48	0.63	0.33	1.21	0.56	0.61
31	Lead	mg/l	0.01	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)
32	Manganese	mg/l	0.1	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)
33	Mercury	mg/l	0.001	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)
34	Nickel	mg/l	0.02	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)

35	Selenium	mg/l	0.01	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)
36	Phosphate	mg/l	-	0.080	0.087	0.410	0.130	0.040	0.510	0.710	0.340
37	Zinc	mg/l	5	0.65	0.72	1.86	1.34	2.48	1.19	3.06	2.61
38	Dissolved Oxygen	mg/l	-	5.5	6.2	6.3	6.5	5.8	6.1	6.2	6.2
39	COD	mg/l	-	17	4.8	12	16.7	27	21	15	16
40	BOD, 3 Days @27°C	mg/l	-	8.6	2.3	4.6	5.6	12.7	7.4	7.8	6.4

3.8.1.2 Results and Discussions

A summary of analytical results are presented below:

SW8 sample collected were pond water sample were SW2 sample collected near Sea shore where as rest all samples were collected from nearby lakes. The analytical results were provided in **Table 3-12**.

pH values all samples were mostly in the neutral level (7.14 – 8.01) which were within the drinking water standard limit (6.5 - 8.5). Conductivity varied between (357 - 52339) micromhos/cm with TDS ranging between (238 - 35329) mg/l. Such high values of conductivity and TDS may be attributed to seawater tidal influence in Periya Kalapettai.
The dissolved oxygen levels were observed in all the samples levels varied from 5.5 – 6.5 mg/l which is above the required level of 4 mg/l for fish. Algae growth and natural regeneration/reoxygenation could be main reason of such levels of DO and pH. BOD varied between (2.3 – 12.7) mg/l. Nitrate nitrogen level ranged between (0.138 – 2.9) mg/l. Total Hardness values were observed in the range of (70 – 8200) mg/l, Chloride and Sulphate contents were (42.5 – 19750) mg/l and (34 – 2530) mg/l respectively. Levels of Calcium and Magnesium were (21.4 – 561) mg/l and (3.89 – 1652) mg/l respectively.
Fluoride content was observed (0.21 – 0.61) mg/l. Toxic constituents as cyanide were below the respective detection limits in all these samples. Among heavy metals and trace elements iron and zinc varied between (0.33 – 1.71) mg/l and (0.65 – 3.06) mg/l, others like boron, arsenic, mercury, lead, cadmium and chromium were below their respective detection limits.

3.8.2 Groundwater Resources

The estimation of groundwater resources for the region has shown that the Puducherry Region is over exploited. Tube wells are the only ground water abstraction structures used for both domestic and irrigation in the region. The yield of tube wells in shallow alluvial aquifers is of the order of 1 to 2 lakh litres/day. The extraction of groundwater by shallow tube wells in the Alluvium is of the order of 2.5 ha.m./year. The average command area for tube well is about 3 ha. The deep tube wells of 200 mm dia and 100 – 400 m depth in Tertiary and Cretaceous aquifers can yield as high as 1000 lpm discharge, which can be pumped with 10 to 15 HP submersible pumps. The average annual draft of deep tube wells varies from 70 – 200 m^3/hr. Assuming 200 days pumping in a year, with average daily pumping of 10 hours, the annual draft varies from 0.14 to 0.40 MCM (Million Cubic Meters).

The groundwater potential of the gross geographical area of the basin is estimated on pro-rata basis from the district-wise groundwater resources-2007 published by the Central Groundwater Board (CGWB) as given in **Table 3-13.**

Table 3-13 Groundwater Potential in Puducherry PIA District

Attribute	Potential /Quantity
Area of the district	293 Sq. Km
Annual Replenishable Groundwater Resources	85.54 MCM
Total Annual Groundwater Draft for all purposes	137.69 MCM
Allocation for domestic and industrial use for next 25 years	25.63MCM
Stage of Groundwater Development	179%

3.8.2.1 Groundwater Quality

Total ***eight (08)*** groundwater monitoring locations were identified for assessment in different villages around the project site based on the usage of sub surface water by the settlements/ villages in the study area. The groundwater results are compared with the desirable and permissible water quality standards as per IS: 10500 (2012) for drinking water. Groundwater monitoring locations in **Table 3-14** and results are given in **Table 3-15**. Groundwater sampling photographs provided in **Figure 3-25.** A map showing the groundwater monitoring locations is given in **Figure 3-26**.

Table 3-14 Details of Groundwater Quality Monitoring Locations

Station Code	Location	Distance (km) from Project boundary	Azimuth Directions
GW1	Project Site	Within Site	
GW2	Manjakuppam	3.9	NE
GW3	Sertinagar	8.7	NE
GW4	Chinna Kalapettai	2	SE
GW5	Kottaikuppam	8.6	S
GW6	Idayanchavadi	7.2	SW
GW7	Royapudupakkam	6.1	W
GW8	Nesal	7.9	WNW

Figure 3-25 Groundwater sampling photographs

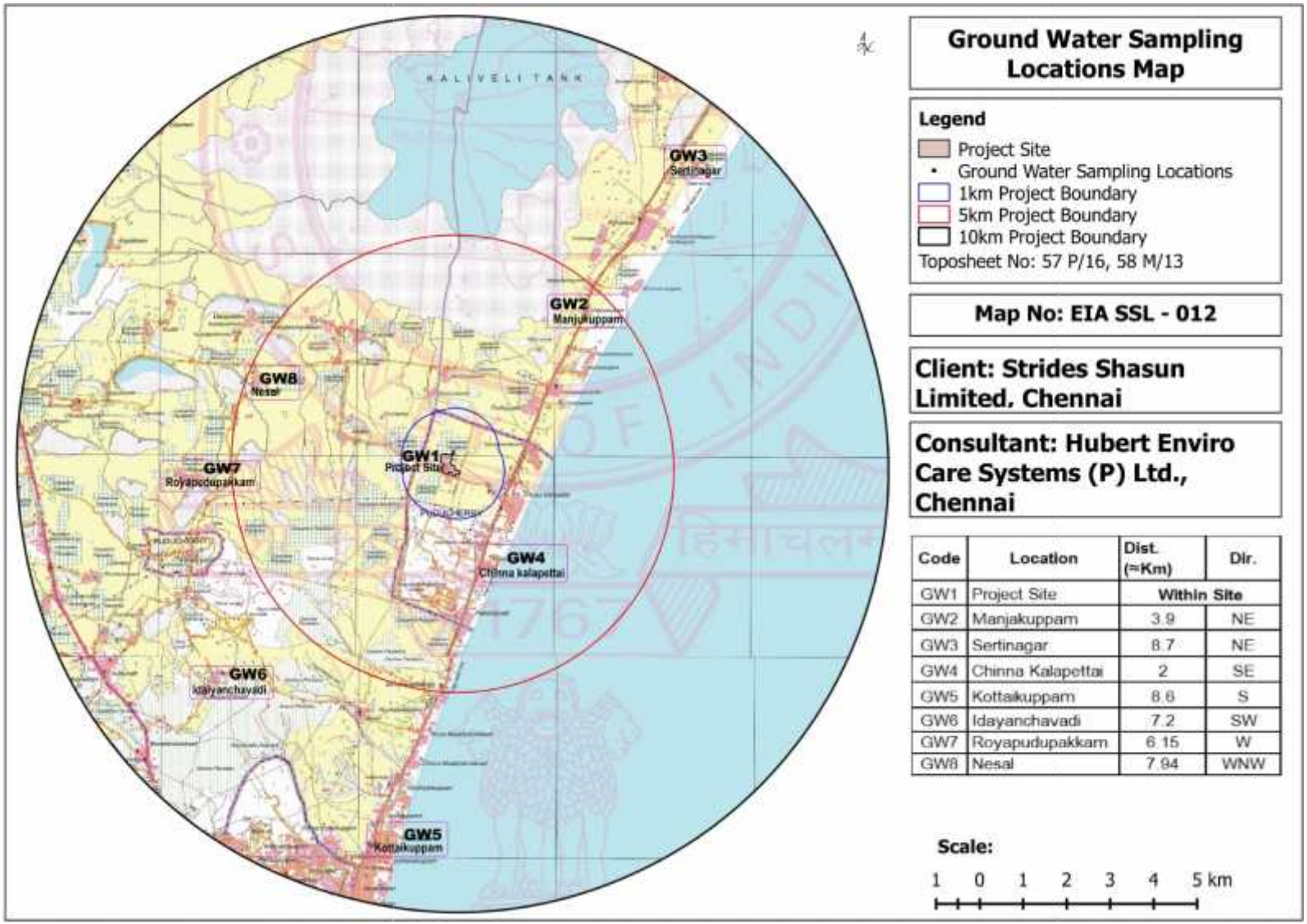


Figure 3-26 Map Showing Groundwater Locations

Table 3-15 Groundwater Monitoring Results

S.No	Parameters	UNIT	DW Standards (IS 10500:2012) Acceptable Limit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
1.	Source	-		Bore Well	Bore Well	Bore Well	Bore Well	Bore Well	Bore Well	Open Well	Open Well
2.	Colour	Hazen	5	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
3.	pH	-	6.5 to 8.5	7.65	7.4	7.38	6.98	7.26	7.74	7.64	6.98
4.	Turbidity	NTU	1	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)
5.	Total Suspended Soilds	mg/l	-	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)
6.	Electrical Conductivity 25◦C	µmhos/ cm	-	1092	1469	1755	773	1612	674	1690	973
7.	Total Dissolved Solids	mg/l	500	736	1022	1180	527	1077	442	1137	664
8.	Total Alkalinity as $CaCO_3$	mg/l	200	116	234	226	76	287	60	234	102
9.	Total Hardness as $CaCO_3$	mg/l	200	355	377	501	234	453	123	432	265
10.	Calcium as Ca	mg/l	75	72.7	78.6	110	54.4	87.6	32.6	100	66.7
11.	Magnesium as Mg	mg/l	30	42.1	44.0	55.0	23.8	56.8	10.1	44.0	23.8

12.	Sodium as Na	mg/l	-	127	160	193	93	145	83.2	172	118
13.	Potassium as K	mg/l	-	14	22	26	16	20	15.8	25	19
14.	Chlorides as Cl-	mg/l	250	187	234	289	148	225	136	275	176
15.	Sulphate (SO_4)	mg/l	200	92.7	127	148	61	118	58	157	88
16.	Carbonate	mg/l	-	BDL(DL 1)	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)	BDL(DL1)
17.	Bicarbonate	mg/l	-	142	285	276	93	350	74	285	124
18.	Nitrates(NO_3)	mg/l	45	4.21	4.87	5.02	2.04	4.54	3.57	4.87	2.04
19.	Fluoride as F-	mg/l	1	0.54	0.51	0.58	0.51	0.49	0.44	0.51	0.51
20.	Sulphides	mg/l	0.05	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)
21.	% Sodium	%	-	46.2	44.0	44.4	39.7	55.8	44.7	47.1	47.1
22.	SAR		-	3.6	3.8	2.7	3.0	3.3	3.6	3.2	3.2
23.	Arsenic	mg/l	0.01	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)
24.	Cyanide	mg/l	0.05	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)
25.	Cadmium	mg/l	0.003	BDL (DL0.01	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)

				)							
26.	Chromium	mg/l	0.05	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)
27.	Copper	mg/l	0.05	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)	BDL (DL0.01)
28.	Iron	mg/l	0.3	0.21	0.16	0.23	0.156	BDL(DL 0.02)	BDL(DL 0.02)	0.28	BDL(DL 0.02)
29.	Lead	mg/l	0.01	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)	BDL (DL0.1)
30.	Manganese	mg/l	0.1	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)
31.	Mercury	mg/l	0.001	BDL DL0.00 1)	BDL DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)	BDL (DL0.001)
32.	Nickel	mg/l	0.02	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)	BDL (DL0.05)
33.	Selenium	mg/l	0.01	BDL (DL0.00 5)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)	BDL (DL0.005)
34.	Zinc	mg/l	5	1.65	1.06	2.76	1.98	3.67	1.77	4.54	3.87
35.	Phosphate	mg/l	-	0.11	0.04	0.03	0.81	0.05	0.58	0.04	0.81
36.	Dissolved Oxygen	mg/l	-	NA	NA	NA	NA	NA	NA	NA	NA
37.	BOD 3days @27°C	mg/l	-	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)	BDL(DL 1)
38.	COD	mg/l	-	BDL(DL 4)	BDL(DL 4)	BDL(DL 4)	BDL(DL 4)	BDL(DL 4)	BDL(DL 4)	BDL(DL 4)	BDL(DL 4)

3.8.2.2 Results and Discussions

Analysis of groundwater monitoring for stations GW1, GW2, GW3, GW4, GW5, GW6, GW7 and GW8 are depicted in **Table 3-15.**

The samples collected from stations GW1, GW2, GW3, GW4, GW5 & GW6 were Borewell samples were as GW7 &GW8 are open well samples (water being drawn through hand pump/Taps). Since the groundwater is used without treatment by a large portion of population, the quality of ground water is of much concern. There has been little fluctuation in pH with overall range of 6.98–7.74, generally above the neutral and within the permissible limits of (6.5-8.5) stipulated in drinking water quality standards.

Conductivity varied between 674-1755 micromhos/cm. TDS ranged between 442-1180 mg/l. Total alkalinity varied between 60-287 mg/l, which is above the permissible limit of 200 mg/l for drinking water. Total Hardness values were observed to vary in the range of 123-501 mg/l. Chloride and Sulphate contents were 136-289 mg/l and 58-157 mg/l respectively. Levels of Calcium and Magnesium were 32.6-110 mg/l and 10.1-56.8 mg/l respectively.

Fluoride content was observed to vary in the range of 0.44-0.58 mg/l, and below the prescribed limit of 1 mg/l for drinking water. Among heavy metals and trace elements while iron was detected, others like boron, arsenic, mercury and lead were below their respective detection limits. Iron levels were below the respective detection limits.

3.9 Soil as a resource and its Quality

Alluvial soils occur along the river courses and eastern part of the coastal areas. Sandy coastal alluvium (arenaceous soil) are seen all along the sea coast as a narrow belt. The project site is slit loam

3.9.1 Soil quality

In order to assess the quality of soil at different locations in the study area, various land use categories were taken into account. Soil sampling was carried out at Eight (08) locations in the study area. Soil analysis was carried as per IS: 2720 methods. Soil quality monitoring locations & results are given in **Table 3-16 & Table 3-17.** Map showing the soil monitoring locations is given in **Figure 3-27.**

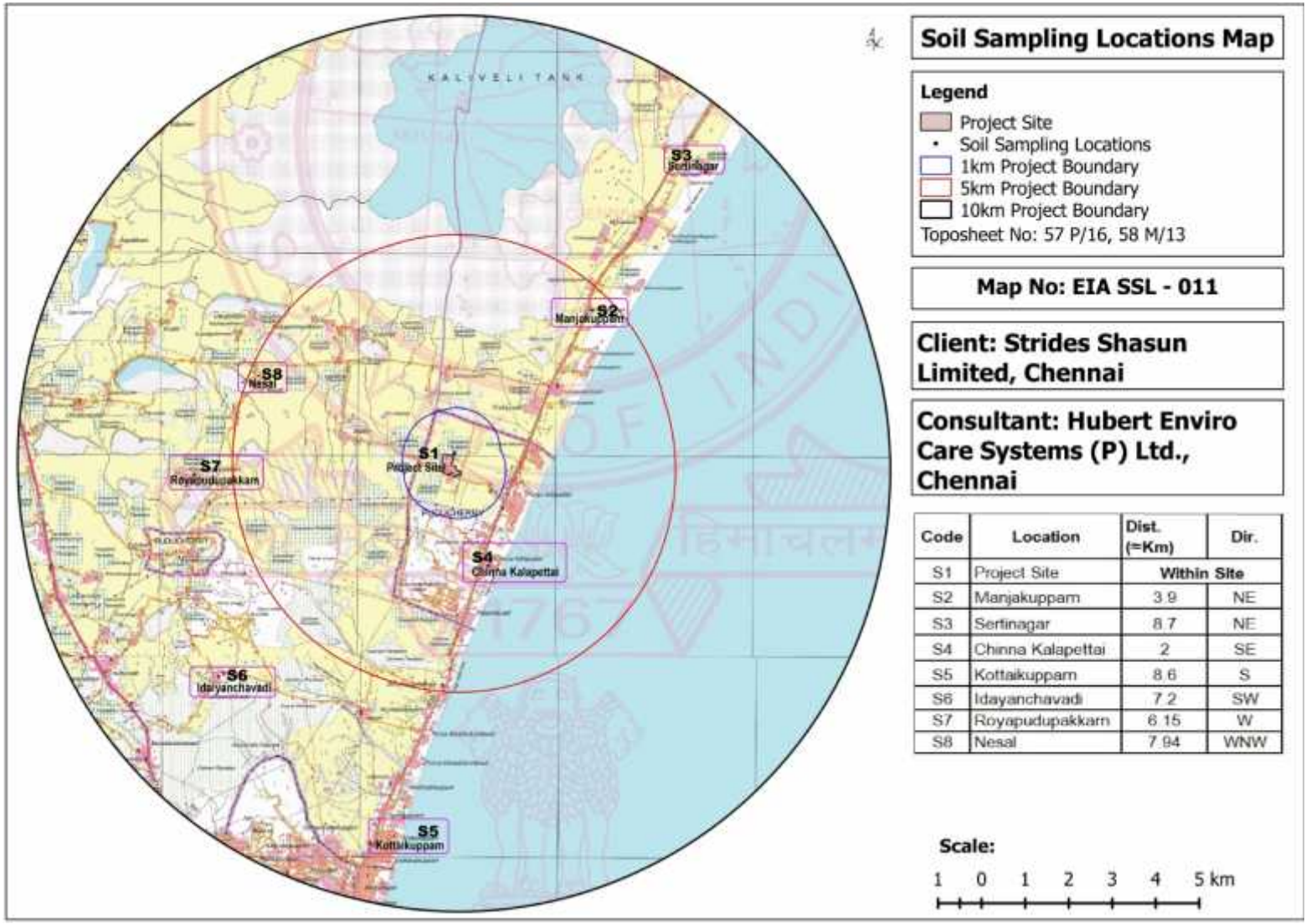


Figure 3-27 Map showing the soil monitoring locations

Table 3-16 Soil Quality Monitoring Locations

Location Code	Location	Distance (Km) w.r.t project site	Direction w.r.t. project site
S1	Project Site	Within Site	
S2	Manjakuppam	3.9	NE
S3	Sertinagar	8.7	NE
S4	Chinna Kalapettai	2	SE
S5	Kottaikuppam	8.6	S
S6	Idayanchavadi	7.2	SW
S7	Royapudupakkam	6.1	W
S8	Nesal	7.9	WNW

Table 3-17 Soil Quality Monitoring Results

S.No	Parameters	Units	S1 Project Site	S2 Sertinagar	S3 Manjakuppam	S4 Chinna Kalapettai	S5 Kottaikuppam	S6 Idayanchavadi	S7 Royapudupakkam	S8 Nesal
1	Colour	-	Reddish Brown	Brown	Reddish Brown	Brown	Brown	Brown	Brown	Reddish Brown
2	Texture	-	Slit Loam	Slit Loam	Slit Loam	Slit Loam	Slit Loam	Slit Loam	Slit Loam	Slit Loam
3	Sand	%	32	30	36	29	29	35	23	13
4	Silt	%	56	58	53	63	62	58	68	68
5	Clay	%	12	12	11	8	9	7	9	19
6	pH	-	7.87	7.02	7.7	6.9	8.15	7.3	7.2	7.65
7	Electrical Conductivity	µmhos/cm	714	126	101	110	245	141	121	160
9	Bulk Density	gm/cc	1.42	1.37	1.42	1.41	1.42	1.35	1.34	1.38
10	Cation Exchange Capacity	meq/100 gm	7.1	6.6	6.1	6.3	5.7	5.0	6.7	11.9
11	Moisture content	%	11.0	3.3	5.1	4.6	3.8	4.3	9.1	5.3
12	Water Holding Capacity	%	24.4	28.0	19.6	28.6	19.6	20.5	22.7	27.5
13	Organic Carbon	%	0.312	0.224	0.192	0.654	0.340	0.480	0.587	0.482
14	Organic matter	%	0.538	0.386	0.331	1.127	0.586	0.828	1.012	1.121
15	Nitrogen as N	kg/ha	91	74	67	188	99	119	154	123
16	Phosphorus	kg/ha	59	51	47	106	63	73	90	75
17	Potassium	kg/ha	79	65	60	154	85	100	128	104
18	Calcium	%	297	177	137	297	217	97	137	297
19	Magnesium	%	96	54	144	121	96	72	120	116
20	Boron	mg/kg	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)
21	Cadmium	mg/kg	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)

22	Chromium	mg/kg	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)
23	Copper	mg/kg	25.1	15.0	11.6	25.1	18.3	8.2	11.6	25.1
24	Iron	mg/kg	62.4	35.1	93.6	78.7	62.4	46.8	78.0	75.4
25	Manganese	mg/kg	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)	BDL(DL 0.1)
26	Zinc	mg/kg	10.8	14.85	13.5	22.05	15.3	15.3	8.1	12.15

3.9.2 Results and Discussions

The soil is mostly sand Loamy sandy in nature. The chemical characteristics of the soils in the study area are presented in **Table 3-17.** A number of parameters were determined which are indicative of chemical and fertility characteristics. Few soil samples were generally slightly acidic with pH range 6.9 -7.02 where as the other samples shows alkaline in nature with a range of (7.2-8.15). Electrical conductivity (EC) was found varying between 101-245 µmhos/cm. As the EC value is at lower level, the soil cations and anions are less which leads to deficiency of minerals to plants.

The quantity of nitrogen in surface soils generally ranges between (67-188) kg/ha Most of the nitrogen is available in form of nitrates, nitrites, NH4+ and organic nitrogen. The observed Phosphorous in the study area soils was found normal ranging between (47-106) kg/ha Cation Exchange Capacity (CEC) varied between (5.0-11.9) meq/100gm. Organic matter content of the soil samples was fairly in high range (0.386-1.127) % In general the nutrients and mineral levels were considerable less.

3.10 Biological Environment

A habitat or an area comprises of different kinds of plants and animals within its boundary. The distribution of flora and fauna in the given area represents the biological elements present in the study area, its value, description of community uniqueness, the dominant species, its response to impacts and mitigation measures to overcome any negative impacts. The detailed ecological assessment of the study area has been carried out.

There is no appreciable forest cover in the U.T. The only existing patch of forest in Puducherry is the vegetation available in Swadeshi Cotton Mills Campus, a sizable portion of which was cleared for the construction of District Court building.

Wildlife population in Puducherry comprises of small mammals, birds, reptiles and fishes. A large number of birds are sighted in the botanical garden which adds great educational and recreational value to Puducherry. The gate leading to the garden is reminiscent of French architecture and it stands out from its immediate surroundings because it is smack in the middle of the old Tamil town. The Botanical Gardens were laid out in 1826 in ornate French style, with pruned trees, beautiful flower beds and gravel lined paths and fountains. The French introduced many exotic plants from all over the world, many of which thrived. The sprawling 22 acres garden houses more than 1500 species of plants with placards indicating the species, common name and interesting information like the uses of the tree, amount of oxygen generated and its medicinal value; this could well qualify as one of the best botanical gardens in South India. A mix of endangered and exotic species of plants is spread out all over the place. There are 28 plots dividing the Botanical Garden and each has a separate theme.

Mangrove vegetation is seen to some extent in the estuaries and along the sides of Ariyankuppam river (in Puducherry region), Gouthami river near Guirempeta (in Yanam region). Some of the important mangrove species in Puducherry are *Rhizophora apiculata*, *Rhizophora mucronata*, *Avicennia marina*, *Bruguiera cylindrica*, *Bruguiera gymnorrhiza* (Rhizophoraceae), *Acanthus ebracteotus*, *Acanthus illicifolius* (Acanthaceae) etc shown in **Figure 3-28**. Two large water bodies namely, Ossudu and Bahour tanks. During the year 2008, Ousteri wetland, largest lake in Puducherry was declared as a bird sanctuary which is 13.7 Km South West direction from project boundary, home for hundreds of species of migratory birds such as are little Grebes, Great Cormorant, Pelican, Grey heron, Egrets, Indian Pond heron, white storks, painted storks, white spoonbills, Black headed Ibises, Tufted Ducks, common coots, Jacanas, Whiskered Terns etc., variety of fishes, mussels and crabs, and breeding sites of common coot in South India. Similarly, the backwaters of Karaikal which is 8.1 Km from project site in North direction has an importance of its own as

it is the largest wetland in India and also a semi-permanent water body. The banks of the lake have a large collection of flora and fauna that has great ecological significance. It is a main wintering ground for resident as well as the migratory birds. The main attraction of the lake is the migratory birds. The migratory birds that breed in the northern part of the Eurasia known as Palaearctic come here to spend their winters. This species of birds start arriving here in the month of July and August and start moving away in March and April each year. The wild animals recorded in the U.T. are Jackal, Black Napped Hare, Bonnet Macaque, Jungle Cat, Civet Cat, Mongoose, Monitor Lizard, Olive Ridley Turtle and Leather Backed Turtle. Among these, the Olive Ridley Turtle and Leather Backed Turtle have been declared as endangered.

Baseline Biological survey was carried out to assess the ecology of the study area. The floral diversity is grouped into trees, shrubs, climbers, herbs. Similarly the faunal diversity is grouped into mammals, birds, reptiles, amphibians Discussions were held with local people together related information on the richness of plant and animal resources, employment opportunities, facilities for education, health and socio economic condition.

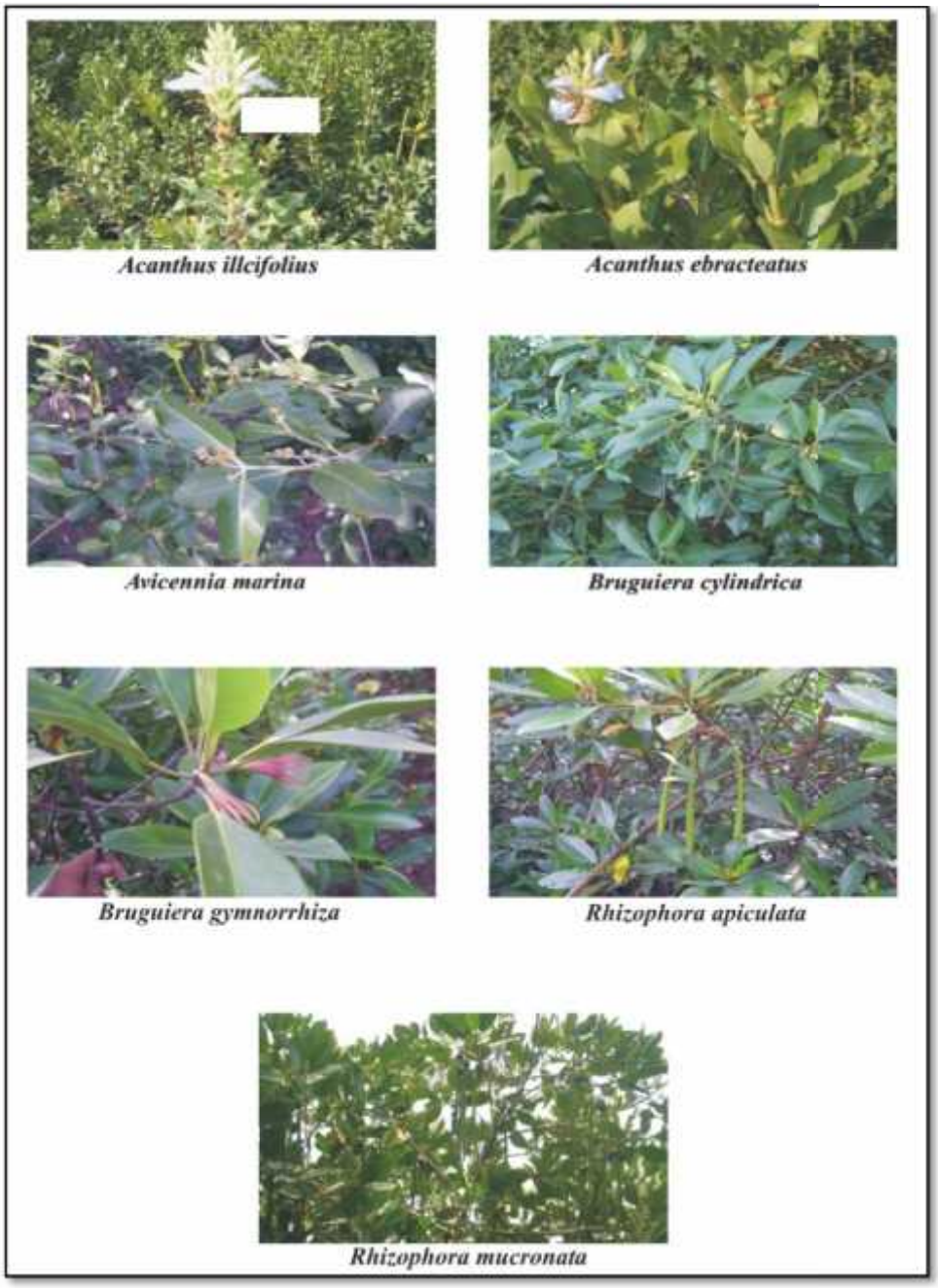


Figure 3-28 Important mangrove species in Puducherry

A biodiversity richness map within 10 km radius of the project area is included in **Figure 3-29.**

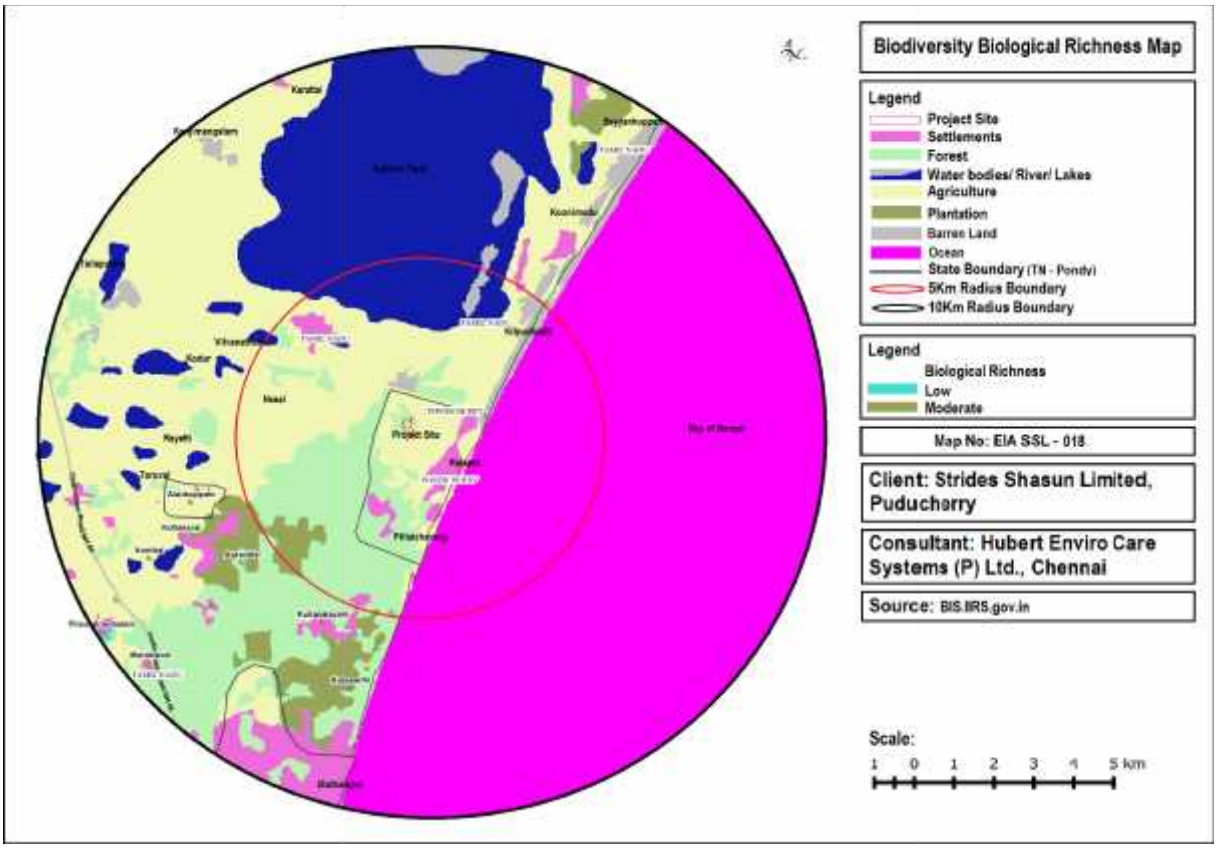


Figure 3-29 Biodiversity Richness Map

3.10.1 Flora

The Vegetation present within a defined area is termed as a plant community. This is determined by the nature of the dominant species it contains. By the term dominant species or dominance, it is understood that species of plants having same life and growth, forms predominating in an area. It was observed that the flora, which includes herbs, shrubs and trees, were sparsely distributed within study area. List of flora reported/observed in the study area is given in **Table 3-18**.

Table 3-18 List of Flora Reported/Observed in the Study Area

I.No	Botanical Name	Family Name	Local Name	IUCN Red List of Threatened Species
1	Acacia auriculiformis Benth.	Fabaceae	Pencil Maram	LC
2	Artocarpus heterophyllus Lam.	Moraceae	Palaa maram	NA
3	Azadirachta indica A.Juss.	Meliaceae	Vembu	NA
4	Bambusa bambos (L.) Voss	Poaceae	Moongil	NA
5	Bauhinia purpurea L.	Fabaceae	Mandharai	LC
6	Bauhinia variegata L.	Fabaceae	Semmandharai	LC
7	Borassus flabellifer L.	Arecaceae	Panai maram	NA
8	Callistemon citrinus (Curtis) Stapf	Myrtaceae	Bottle brush	NA
9	Caryota urens L.	Arecaceae	Kondal panai	LC
10	Ceiba pentandra (L.) Gaertn.	Malvaceae	Ilava maram	NA
11	Citrus aurantiifolia (Christm.) Swingle	Rutaceae	Elumitchai	NA
12	Cocos nucifera L.	Arecaceae	Madhana poomaram	NA
13	Cycas circinalis L.	Cycadaceae	Madhana poomaram	EN
14	Delonix regia (Hook.) Raf.	Fabaceae	Mayilkonnai	NA
15	Ficus benghalensis L.	Moraceae	Arasa maram	NA
16	Ficus benjamina L.	Moraceae	Benjamin tree	NA
17	Ficus religiosa L.	Moraceae	Arasa maram	NA
18	Grevillea robusta A. Cunn. ex R. Br.	Proteaceae	Silver oak	NA
19	Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	Odhiya maram	NA
20	Leucaena leucocephala (Lam.) de Wit	Fabaceae	Savundal	NA
21	Mangifera indica L.	Anacardiaceae	Maa maram	DD
22	Manilkara zapota (L.) P.Royen	Sapotaceae	Sappotta	NA
23	Melia azedarach L.	Meliaceae	Malai vembu	NA
24	Melia dubia Cav.	Meliaceae	Malai vembu	NA
25	Millettia pinnata (L.) Panigrahi	Fabaceae	Pungum	LC
26	Millingtonia hortensis L.f.	Bignoniaceae	Maramalli	NA
27	Mimusops elengi L.	Sapotaceae	Mahizha maram	NA
28	Morinda pubescens Sm.	Rubiaceae	Nuna	NA
29	Muntingia calabura L.	Malvaceae	Singapore cherry	NA
30	Peltophorum pterocarpum (DC.) K.Heyne	Fabaceae	Iyal vagai	NA
31	Phoenix sp.	Arecaceae	Phoenix maram	NA
32	Phoenix sylvestris (L.) Roxb.	Arecaceae	Pereatchai	NA
33	Pithecellobium dulce (Roxb.) Benth.	Fabaceae	Kodukka puli	NA
34	Plumeria alba L.	Appocynaceae	Malai arali	NA
35	Polyalthia longifolia (Sonn.) Thwaites	Annonaceae	Nettilingam	NA
36	Prosopis juliflora (Sw.) DC.	Fabaceae	Velikatthaan	NA
37	Psidium guajava L.	Myrtaceae	Koiyya	NA

38	Ptychosperma elegans Blume	Arecaceae	Solitaire palm	NA
39	Punica granatum L.	Lythraceae	Maadhulai	LC
40	Ravenala madagascariensis Sonn.	Strelitziaceae	Visiri vaazhai	NA
41	Roystonea regia (Kunth) O.F.Cook	Arecaceae	Bottle palm	NA
42	Samanea saman (Jacq.) Merr.	Fabaceae	Kondrai maram	NA
43	Saraca asoca (Roxb.) Wilde	Fabaceae	Ashoka maram	NA
44	Senna siamea (Lam.) H.S.Irwin & Barneby	Fabaceae	Siamese cassia	NA
45	Spathodea campanulata Beauv.	Bignoniaceae	Patadi	NA
46	Sterculia foetida L.	Malvaceae	Kuthirai pidukkan	NA
47	Swietenia macrophylla King	Meliaceae	Magogani	VU
48	Tabebuia rosea (Bertol.) Bertero ex A.DC.	Bignoniaceae	Trumpet flower tree	NA
49	Tamarindus indica L.	Fabaceae	Puliya maram	NA
50	Tectona grandis L.f.	Lamiaeae	Teakku	NA
51	Terminalia catappa L.	Fabaceae	Vadamaram	NA
52	Thespesia populnea (L.) Sol. ex Corrêa	Malvaceae	Poovarasu	NA

*LC- Least Concern, NT- Near Threatened, EN- Endangered, NA-Not yet assessed, DD -Data Deficient, VU-Vulnerable

3.10.2 Fauna

This area hosts common mongoose, field mouse, Bandicoot. List of fauna reported/observed within the study area is given in **Table 3-19.** There is no National park/Wildlife Sanctuary within10Km radius of the study area and also there is no reserve forest present within study area of 10Km radius.

Table 3-19 List of fauna reported/observed within the study area

Sl. No	Scientific Name	Family Name	Common Name/English Name	IUCN Red List of Threatened Species
Reptiles				
1.	Bungarus candidus	Elapidae	Krait	LC
2.	Najanaja	Elapidae	Cobra	NA
3.	Nerodia piscator	Colubridae	Freshwater snake	NA
4.	Ptyas mucosus	Colubridae	Rat snake	NA
5.	Vipera russeli	Viperidae	Viper	NA
Butterflies				
6.	Graphium agamemnos	Papilionidae	Tailedjay	NA
7.	Junonia almana	Nymphalidae	Peacock pansey	LC
8.	Junonia atlites	Nymphalidae	Grey pansey	NA
9.	Neptis hylas	Nymphalidae	Common sailor	NA
10.	Pachlioptahector	Papilionidae	Crimson rose	NA
11.	Papilodemoleus	Papilionidae	Lime butterfly	NA
12.	Papilopolymnstor	Papilionidae	Blue mormon	NA
13.	Parantica aglea	Nymphalidae	Glassy tiger	NA
Amphibians				
14.	Rana hexadactyla	Dicroglossidae	Frog	NA
15.	Rana tigrina	Dicroglossidae	Bullfrog	NA

Mammals				
16.	Bandicota indica	Muridae	Bandicoot	LC
17.	Bandicota bengalensis	Muridae	Bandicoot	LC
18.	Herpes tesedwardii	Herpestidae	Common mongoose	NA
19.	Rattus norvegicus	Muridae	Fieldmouse	LC
20.	Lepus nigricollis	Leporidae.	Hare	LC
21.	Canis auries	Canidae	Jackal	NA
22.	Funambulus spp.	Sciuridae	Squirrel	NA
23.	Funambulus palmarum	Sciuridae	Squirrel	LC
24.	Sussucrofa	Suidae	Wildpig	NA

*LC- Least Consern, NA-Not yet assessed

3.10.2.1 Birds

List of Birds reported/observed within the study area is provided in **Table 3-20** and List of Birds reported/observed in Kaliveli Lake is provided in **Table 3-21.**

Table 3-20 List of of Birds reported/observed within the study area

Sl. No	Scientific Name	Family Name	Common Name/English Name	IUCN Red List of Threatened Species Family
1.	Acridotherestristicus	Sturnidae	Common myna	LC
2.	Aegithinatiphia	Aegithinidae	Iora	LC
3.	Alcedoatthis	Alcedinidae	CommonKingfisher	LC
4.	Ardeolagrayii	Ardeidae	PondHeron	LC
5.	Artamusfuscus	Artamidae	AshySwallowShrike	LC
6.	BubulcusIbis	Ardeidae	CattleEgret	LC
7.	Caprimulgusasiaticus	Caprimulgidae	Night Jar	LC
8.	Centropussinensis	Cuculidae	CrowPheasant	LC
9.	Chalcophapsindica	Columbidae	EmeraldDove	LC
10.	Cinnyrisasiatica	Nectariniida	PurpleSunbird	LC
11.	Columbuslivibus	Columbidae	RockPigeon	LC
12.	Copsychussaularis	Turdidae	MagpieRobin	LC
13.	Coracias benghalensis	Coraciidae	IndianRoller	LC
14.	Corvus splendens	Corvidae	Housecrow	LC
15.	Corvus culminatus	Corvidae	Junglecrow	LC
16.	Cypsiurus balasiensis	Apodidae	Palmswift	LC
17.	Dicruruslongicaudatus	Dicruridae	GreyDrongo	LC
18.	Dicrurusmacrocerus	Dicruridae	BlackDrongo	LC
19.	Egrettagarzetta	Ardeidae	LittleEgret	LC
20.	Eudynamisscolopaceus	Cuculidae	Koel	LC
21.	Galeridamalabarica	Alaudidae	MalabarCrestedLark	LC
22.	Haliasturindus	Accipitridae	Brahmnykite	LC
23.	Hierococysvarius	Cuculidae	CommonHawkCuckoo	LC
24.	Lalagesykesi	Campephagidae	Blackheadedcocho	LC
25.	Lobpluviamalabaraica	Charadriidae	Yellowwattledlapwing	LC
26.	Lonchura	Estrildidae	Spottedmunia	LC
27.	Megalai mamerulinus	Cuculidae	IndianCuckoo	LC
28.	Merops orinetalis	Meropidae	CommonBeeEater	LC
29.	Microfus affinis	Apodidae	Houseswift	LC
30.	Milvus migrans	Accipitridae	Pariahkite	LC
31.	Milyus migrans	Accipitridae	CommonKite	LC
32.	Oriolus oriolus	Oriolidae	IndianOriole	LC
33.	Passerdomisticus	Passeridae	HouseSparrow	LC

34.	Ploceusphilippines	Ploceidae	Weaverbird	LC
35.	PsittaculaKrammeri	Psittaculidae	Roseringedparakeet	LC
36.	Pycnonotuscafer	Pycnonotidae	Redventedbulbul	LC
37.	Pycnonotus luteolus	Pycnonotidae	WhitebrowedBulbul	LC
38.	Quillscontronix	Phasianidae	Greyqauil	LC
39.	Saxicoloides fulicata	Turdidae	Indianrobin	LC
40.	Sterna albifrons	Laridae	IndianRiverTern	LC
41.	Tchitrea paradisi	Monarchidae.	ParadiseFlycatcher	LC
42.	Temenuchuspagodaru	Sturnidae	BrahmnyMyna	LC
43.	Tephrodornispondicerai	Tephrodornithidae	CommonWoodshrike	LC
44.	Turdoides striatus	Leiothrichidae	Whiteheadedbabler	LC
45.	Tylo alba	Tytonidae	BarnOwl	LC
46.	Vanellus indicus		RedwattledLapwing	LC

*LC- Least Concern

Table 3-21 List of of Birds reported/observed within Kaliveli Lake

Sl.No	Sciencific Name	Family	Common Name/English Name	IUCN Red List of Threatened Species
1.	Accipiter badius	Accipitridae	Shikra	LC
2.	Accipiter nisus	Accipitridae	Eurasian Sparrowhawk	LC
3.	Acridotheres tristis	Sturnidae	Common Myna	LC
4.	Acrocephalus agricola	Acrocephalidae	Paddyfield Warbler	LC
5.	Acrocephalus dumetorum	Acrocephalidae	Blyth's Reed Warbler	LC
6.	Acrocephalus stentoreus	Acrocephalidae	Clamorous Reed Warbler	LC
7.	Actitis hypoleucos	Scolopacidae	Common Sandpiper	LC
8.	Alauda gulgula	Alaudidae	Oriental Skylark	LC
9.	Alcedo atthis	Alcedinidae	Common Kingfisher	LC
10.	Amandava amandava	Estrildidae	Red Avadavat	LC
11.	Amaurornis phoenicurus	Rallidae	White-breasted Waterhen	LC
12.	Anas acuta	Anatidae	Northern Pintail	LC
13.	Anas poecilorhyncha	Anatidae	Indian Spot-billed Duck	LC
14.	Anastomus oscitans	Ciconiidae	Asian Openbill	LC
15.	Anhinga melanogaster	Anhingidae	Oriental Darter	NT
16.	Anthus campestris	Motacillidae	Tawny Pipit	LC
17.	Anthus godlewskii	Motacillidae	Blyth's Pipit	LC
18.	Anthus richardi	Motacillidae	Richard's Pipit	LC
19.	Anthus rufulus	Motacillidae	Paddyfield Pipit	LC
20.	Anthus trivialis	Motacillidae	Tree Pipit	LC
21.	Apus affinis	Apodidae	Little Swift	LC
22.	Ardea alba	Ardeidae	Great Egret	LC
23.	Ardea cinerea	Ardeidae	Gray Heron	LC
24.	Ardea intermedia	Ardeidae	Intermediate Egret	LC
25.	Ardea purpurea	Ardeidae	Purple Heron	LC

26.	Ardeola grayii	Ardeidae	Indian Pond-Heron	LC
27.	Artamus fuscus	Artamidae	Ashy Wood swallow	LC
28.	Athene brama	Strigidae	Spotted Owlet	LC
29.	Bubulcus ibis	Ardeidae	Cattle Egret	LC
30.	Burhinus indicus	Burhinidae	Indian Thick-knee	LC
31.	Calandrella dukhunensis	Alaudidae	Sykes's Short-toed Lark	LC
32.	Calidris minuta	Scolopacidae	Little Stint	LC
33.	Calidris pugnax	Scolopacidae	Ruff	LC
34.	Calidris subminuta	Scolopacidae	Long-toed Stint	LC
35.	Calidris temminckii	Scolopacidae	Temminck's Stint	LC
36.	Cecropis daurica	Hirundinidae	Red-rumped Swallow	LC
37.	Centropus sinensis	Cuculidae	Greater Coucal	LC
38.	Ceryle rudis	Alcedinidae	Pied Kingfisher	LC
39.	Charadrius alexandrinus	Charadriidae	Kentish Plover	LC
40.	Charadrius dubius	Charadriidae	Little Ringed Plover	LC
41.	Charadrius mongolus	Charadriidae	Lesser Sand-Plover	LC
42.	Chlidonias hybrida	Laridae	Whiskered Tern	LC
43.	Chlidonias leucopterus	Laridae	White-winged Tern	LC
44.	Chroicocephalus ridibundus	Laridae	Black-headed Gull	LC
45.	Ciconia ciconia	Ciconiidae	White Stork	LC
46.	Circus aeruginosus	Accipitridae	Eurasian Marsh-Harrier	LC
47.	Circus macrourus	Accipitridae	Pallid Harrier	NT
48.	Circus melanoleucos	Accipitridae	Pied Harrier	LC
49.	Circus pygargus	Accipitridae	Montagu's Harrier	LC
50.	Cisticola juncidis	Cisticolidae	Zitting Cisticola	LC
51.	Clanga clanga	Accipitridae	Greater Spotted Eagle	VU
52.	Columba livia	Columbidae	Rock Pigeon	LC
53.	Copsychus saularis	Muscicapidae	Oriental Magpie-Robin	LC
54.	Coracias benghalensis	Coraciidae	Indian Roller	LC
55.	Corvus macrorhynchos	Corvidae	Large-billed Crow	LC
56.	Corvus splendens	Corvidae	House Crow	LC
57.	Cypsiurus balasiensis	Apodidae	Asian Palm-Swift	LC
58.	Dendrocitta vagabunda	Corvidae	Rufous Treepie	LC
59.	Dicrurus macrocercus	Dicruridae	Black Drongo	LC
60.	Dinopium benghalense	Picidae	Black-rumped Flameback	LC
61.	Egretta garzetta	Ardeidae	Little Egret	LC
62.	Elanus caeruleus	Accipitridae	Black-shouldered Kite	LC
63.	Eremopterix griseus	Alaudidae	Ashy-crowned Sparrow-Lark	LC
64.	Eudynamys	Cuculidae	Asian Koel	LC

	scolopaceus			
65.	Euodice malabarica	Estrildidae	Indian Silverbill	LC
66.	Falco tinnunculus	Falconidae	Eurasian Kestrel	LC
67.	Francolinus pondicerianus	Phasianidae	Gray Francolin	LC
68.	Gallinago gallinago	Scolopacidae	Common Snipe	LC
69.	Gelochelidon nilotica	Laridae	Gull-billed Tern	LC
70.	Halcyon smyrnensis	Alcedinidae	White-throated Kingfisher	LC
71.	Haliastur indus	Accipitridae	Brahminy Kite	LC
72.	Hieraaetus pennatus	Accipitridae	Booted Eagle	LC
73.	Hierococcyx varius	Cuculidae	Common Hawk-Cuckoo	LC
74.	Himantopus himantopus	Recurvirostridae	Black-winged Stilt	LC
75.	Hirundo rustica	Hirundinidae	Barn Swallow	LC
76.	Hydrophasianus chirurgus	Jacanidae	Pheasant-tailed Jacana	LC
77.	Hydroprogne caspia	Laridae	Caspian Tern	LC
78.	Iduna caligata	Acrocephalidae	Booted Warbler	LC
79.	Ixobrychus sinensis	Ardeidae	Yellow Bittern	LC
80.	Jynx torquilla	Picidae	Eurasian Wryneck	LC
81.	Lalage melanoptera	Campephagidae	Black-headed Cuckooshrike	LC
82.	Lanius cristatus	Laniidae	Brown Shrike	LC
83.	Lanius schach	Laniidae	Long-tailed Shrike	LC
84.	Lanius vittatus	Laniidae	Bay-backed Shrike	LC
85.	Limosa limosa	Scolopacidae	Black-tailed Godwit	NT
86.	Lonchura malacca	Estrildidae	Tricolored Munia	LC
87.	Lonchura striata	Estrildidae	White-rumped Munia	LC
88.	Mareca penelope	Anatidae	Eurasian Wigeon	LC
89.	Merops orientalis	Meropidae	Green Bee-eater	LC
90.	Merops philippinus	Meropidae	Blue-tailed Bee-eater	LC
91.	Microcarbo niger	Phalacrocoracidae	Little Cormorant	LC
92.	Milvus migrans	Accipitridae	Black Kite	LC
93.	Mirafra affinis	Alaudidae	Jerdon's Bushlark	LC
94.	Mycteria leucocephala	Ciconiidae	Painted Stork	NT
95.	Numenius arquata	Scolopacidae	Eurasian Curlew	NT
96.	Nycticorax nycticorax	Ardeidae	Black-crowned Night-Heron	LC
97.	Oriolus kundoo	Oriolidae	Indian Golden Oriole	LC
98.	Orthotomus sutorius	Cisticolidae	Common Tailorbird	LC
99.	Pastor roseus	Sturnidae	Rosy Starling	LC
100.	Pelecanus philippensis	Pelecanidae	Spot-billed Pelican	NT
101.	Pernis ptilorhynchus	Accipitridae	Oriental Honey-buzzard	LC
102.	Phalacrocorax fuscicollis	Phalacrocoracidae	Indian Cormorant	LC
103.	Phoenicopterus roseus	Phoenicopteridae	Greater Flamingo	LC
104.	Phylloscopus	Phylloscopidae	Greenish Warbler	LC

	trochiloides			
105.	Platalea leucorodia	Threskiornithidae	Eurasian Spoonbill	LC
106.	Plegadis falcinellus	Threskiornithidae	Glossy Ibis	LC
107.	Pluvialis fulva	Charadriidae	Pacific Golden-Plover	LC
108.	Prinia inornata	Cisticolidae	Plain Prinia	LC
109.	Prinia socialis	Cisticolidae	Ashy Prinia	LC
110.	Psilopogon haemacephalus	Megalaimidae	Coppersmith Barbet	LC
111.	Psittacula krameri	Psittacidae	Rose-ringed Parakeet	LC
112.	Pycnonotus cafer	Pycnonotidae	Red-vented Bulbul	LC
113.	Pycnonotus luteolus	Pycnonotidae	White-browed Bulbul	LC
114.	Saxicola caprata	Muscicapidae	Pied Bushchat	LC
115.	Saxicola maurus	Anatidae	Siberian Stonechat	LC
116.	Spatula clypeata	Anatidae	Northern Shoveler	LC
117.	Spatula querquedula	Anatidae	Garganey	LC
118.	Sterna hirundo	Laridae	Common Tern	LC
119.	Streptopelia chinensis	Columbidae	Spotted Dove	-
120.	Streptopelia decaocto	Columbidae	Eurasian Collared-Dove	LC
121.	Streptopelia senegalensis	Columbidae	Laughing Dove	LC
122.	Sylvia althaea	Sylviidae	Hume's Whitethroat	LC
123.	Tachybaptus ruficollis	Podicipedidae	Little Grebe	LC
124.	Tephrodornis pondicerianus	Vangidae	Common Woodshrike	LC
125.	Terpsiphone paradisi	Monarchidae	Indian ParadiseFlycatcher	LC
126.	Threskiornis melanocephalus	Threskiornithidae	Black-headed Ibis	NT
127.	Tringa glareola	Scolopacidae	Wood Sandpiper	LC
128.	Tringa nebularia	Scolopacidae	Common Greenshank	LC
129.	Tringa ochropus	Scolopacidae	Green Sandpiper	LC
130.	Tringa stagnatilis	Scolopacidae	Marsh Sandpiper	LC
131.	Tringa totanus	Scolopacidae	Common Redshank	LC
132.	Turdoides affinis	Leiotrichidae	Yellow-billed Babbler	LC
133.	Upupa epops	Upupidae	Eurasian Hoopoe	LC
134.	Vanellus indicus	Charadriidae	Red-wattled Lapwing	LC

*LC- Least Concern, NT- Near Threatened, VU-Vulnerable, NA-Not yet assessed, DD -Data Deficient

3.10.2.2 Fishes

The fishes/ aquatic fauna of the study area are reported based on the field sampling and confirmed by the local people and secondary data provided by Thiruvallur district office is listed. The fishes like Chirocentrus dorab, Lesser Sardines, Anchoviella, Flying Fish, Sciaenids, Caranx, Mackerel, Seer, Crabs found in good numbers in the study area. The various species of fishes reported/observed within the study area are given in **Table 3-22**.

Table 3-22 List of various species of fishes reported/observed within the study area

Sl.No	Scientific Name	Family Name	Common Name	IUCN Red List of Threatened Species
1.	Acantopsis choirorhynchos	Cobitidae	Horseface loach	LC
2.	Alepes mate	Carangidae	Scad	LC
3.	Allothunnus fallai	Scombridae	Tuna	LC
4.	Alosa chrysochloris	Clupeidae	Blue Herring	LC
5.	Amblypharyngodon mola	Cyprinidae	Mola carplet	LC
6.	Anguilla bengalensis	Anguillidae	Indian longfin eel	NT
7.	Aristichthys nobilis .	Cyprinidae	Bighead carp	NA
8.	Barilius modestus	Cyprinidae	Indus baril	NA
9.	Bathypterois atricolor	Ipnopidae	Attenuated spider fish	LC
10.	Brama brama	Bramidae	Pomfrets	LC
11.	Bregmaceros mcclellandi	Bregmacerotidae.	Indian cod	NA
12.	Carangoides malabaricus	Carangidae	Malabar trevally	LC
13.	Carcharhinus hemiodon	Carcharhinidae	Puducherry shark	CR
14.	Carcharhinus sorrah	Carcharhinidae	Spottail shark	NT
15.	Centroberyx affinis	Berycidae	Golden Snapper	NA
16.	Channa micropeltes	Channidae	Giant snakehead	LC
17.	Channa striata	Channidae	Murrel	LC
18.	Chanos chanos	Chanidae	Milk fish	NA
19.	Chitala lopis	Notopteridae	Clown featherback	LC
20.	Congresox talabonoides	Muraenesocidae	Indian pike conger	NA
21.	Decapterus ruselli	Carangidae	Naked breast trevally	LC
22.	Dussumieria acuta	Dussumieriidae	Rainbow sardine	NA
23.	Elagatis bipinnulata	Carangidae	Rainbow runner	LC
24.	Exocoetus spp.	Syngnathidae	Flying fish	NA
25.	Harpodon nehereus	Synodontidae	Bombay duck	NA
26.	Hemiramphusarchipelagicus	Hemiramphidae	Jumping halfbeak	NA
27.	Hilsa llisha	Clupeidae	Hilsa	NA
28.	Lepidocephalichthys guntea	Cobitidae	Guntea loach	LC
29.	Lepturacanthus saval	Trichiuridae	Ribbon Fish	NA
30.	Leuciscus leuciscus	Cyprinidae	Croaker	LC
31.	Macrobrachium spp.	Palaemonidae	Giant freshwater Prawn	NA
32.	Megalaspis cordyla	Carangidae	Horse mackerel	LC
33.	Moringua javanica	Moringuidae	Java spaghetti eel	NA
34.	Mullus barbatus	Mullidae	Red Mullets	LC
35.	Opisthonema libertate	Clupeidae	Thread herring	LC
36.	Pampus argenteus	Stromateidae	Silver Pomfret	NA
37.	Pellona ditchela	Pristigasteridae	Indian pellona	LC
38.	Penaeus indicus	Penaeidae	White prawn	NA
39.	Penaeus monodon	Penaeidae	Tiger prawn	
40.	Pisodonophis boro	Ophichthidae	Rice-paddy eel	LC
41.	Platycephalus indicus	Platycephalidae	Bartail flathead	DD
42.	Priacanthus tayenus	Priacanthidae	Purple-Spotted Bigeye	LC
43.	Rastrelliger sp	Scombridae	Mackerels	NA
44.	Sardinella albella	Clupeidae	White sardine	LC
45.	Sardinella longiceps	Clupeidae	Oil Sardines	LC

46.	Sarotherodon mossambica	Cichlidae	Tilapia	NA
47.	Scoliodon laticaudus	Carcharhinidae	Spadenose shark	NT
48.	Scylla serrata	Portunidae	Green crab	NA
49.	Sphyraena barracuda	Sphyraenidae	GreatBarracuda	LC
50.	Stolephorus indicus	Engraulidae	Indian anchovy	NA
51.	Stromateus fiatola	Stromateidae	Blue butterfish	NA
52.	Synodus indicus	Synodontidae	Indian lizardfish	NA
53.	Trichiurus lepturus	Trichiuridae	Ribbon fish	LC
54.	Wallogo attu	Siluridae	Boal	NA
55.	Zenarchopterus striga	Zenarchopteridae	Hooghly halfbeak	NA

*LC- Least Concern, NT- Near Threatened, VU-Vulnerable

3.11 Socio-economic profile of the Project Influence Area

Puducherry is the largest district with a geographical area of 293 Sq.km in the Union Territory of Puducherry. It is bounded by Villupuram district on the North, Cuddalore district on the South, Villupuram and Cuddalore districts of Tamil Nadu on the West and Bay of Bengal on the East.

3.11.1 Social Economic Aspects

A socio-economic study was undertaken in assessing aspects which are dealing with social and cultural conditions, and economic status in the study area. The study provides information such as demographic structure, population dynamics, infrastructure resources, and the status of human health and economic attributes like employment, per-capita income, agriculture, trade, and industrial development in the study area. The study of these characteristic helps in identification, prediction and evaluation of impacts on socio-economic and parameters of human interest due to proposed project developments. The parameters are:

- Demographic structure
- Infrastructure Facility
- Economic Status
- Health status
- Cultural attributes
- Awareness and opinion of people about the project and Industries in the area.

Table 3-23 provides the certain important social indicators of Puducherry District.

Table 3-23 Puducherry District Social Indicators

S. No	Social Indicators	Value
1	Decadal variation	29.2
2	Urban population	69.2
3	Sex ratio	990
4	Sex ratio for 0-6 age group	967
5	Population density (per square Km)	3,232
6	Scheduled caste population	16%
7	Scheduled tribe population	Not notified
8	Literacy rate	85.4
9	Work Participation rate	36.6
10	Main Workers	90.7%
11	Marginal Workers	9.3%
12	Infant Mortality rate (the number of deaths of children less than one year of age per 1000 live births).	16
13	Institutional delivery	99.9%

(Source:Census 2011)

3.11.1.1 Occupation

The project area comes under the Puducherry district under Union Territory of Puducherry and Vanur & Tindivanam taluk of Vilupuram district of Tamil Nadu. Demography: The male population (49.50%) and female population (51.50%) are distributed evenly in the project area. The area consists of 12.83% of Scheduled Caste and 0.43% Scheduled tribe population. The average family size is 4.25. The demographic details within the study area are given in **Table 3-24.**

Table 3-24 Demographic details within the study area

Name	Household Total Population	Total Population	Male	Female	Child population	Scheduled Caste	Scheduled Tribe
5 Km							
Puduchery (part)	2952	12784	6304	6480	1356	722	0
Vanur							
Bommayapalayam	2083	8266	4095	4171	901	614	4
Koluveri	347	1475	756	719	144	1003	0
Mattur	378	1678	834	844	213	629	0
Nesal	354	1566	788	778	183	692	0
10 Km							
Puduchery (part)	19032	79605	39412	40193	8124	5641	0
Tindivanam taluk							
Anumandai	1547	6539	3249	3290	821	639	8
Chettikuppam	516	2065	1047	1018	204	359	53
Koonimedu	1726	7528	3545	3983	964	1283	0
Seyyankuppam	400	1700	890	810	209	151	155
Vanur taluk							
Appirambattu	291	1307	670	637	140	168	0
Aruvadai	136	567	284	283	55	0	0
Irumbai	1478	5830	2921	2909	683	1041	28
Kaluperumbakkam	509	2122	1062	1060	232	997	0
Kodur	411	1869	945	924	241	1377	51
Kottakuppam (TP)	7048	31726	15690	16036	3907	3888	106
Olundiyappattu	442	1831	884	947	209	598	167
Royapudupakkam	533	2565	1271	1294	270	1029	117

Tiruchitrambalam	1951	8031	3984	4047	956	1421	33
Toruvai	192	800	388	412	70	192	21
Vilvanatham	264	1085	554	531	152	785	51
Total	42590	180939	89573	91366	20034	23229	794

3.11.1.2 Employment and Livehood

Agriculture is the main occupation in Puducherry district, which provides livelihood for majority of the population. The main workers of the study area are 84.94% i.e. a person who has worked for major part of the reference period (i.e. six months or more during the last one year) in any economically productive activity is termed as 'Main worker'. Those who involved in the agriculture are 18.21% and other workers are 79.89%. Workers group distribution within the study area is given in **Table 3-25.**

Table 3-25 Workers group distribution within the study area

Villages	Total Workers	Main Workers	Marginal Workers	Agricultural workers				Main Workers		Marginal workers	
				Main Workers		Marginal workers					
				Cultivators	Agri. labors	Cultivators	Agri. labors	Household Ind	Other workers	Household Ind	Other workers
5 Km											
Puduchery (part)	4284	3859	425	156	513	16	109	43	3147	9	291
Vanur											
Bommayapalayam	3674	2647	1027	202	276	51	90	60	2109	31	855
Koluveri	733	607	126	21	375	8	62	6	205	3	53
Mattur	867	693	174	104	393	0	143	5	191	1	30
Nesal	767	135	632	25	12	12	566	5	93	10	44
10 Km											
Puduchery (part)	28741	26646	2095	263	328	46	202	462	25593	67	1780
Tindivanam taluk											
Anumandai	2767	1274	1493	215	220	69	1096	38	801	43	285
Chettikuppam	850	617	233	66	197	7	205	3	351	6	15
Koonimedu	2671	2046	625	193	307	40	311	52	1494	14	260
Seyyankuppam	729	649	80	203	256	10	61	19	171	1	8
Vanur taluk											
Appirambattu	691	424	267	46	33	39	32	6	339	4	192
Aruvadai	209	168	41	45	104	2	39	0	19	0	0
Irumbai	2669	2397	272	130	578	12	156	37	1652	9	95
Kaluperumbakkam	969	349	620	125	31	55	518	1	192	1	46
Kodur	884	558	326	23	362	5	110	1	172	0	211
Kottakuppam (TP)	11376	10051	1325	131	278	6	56	128	9514	43	1220
Olundiyappattu	1059	878	181	68	557	18	126	42	211	3	34
Royapudupakkam	976	948	28	183	364	0	5	11	390	1	22
Tiruchitrambalam	2956	2650	306	95	113	29	114	121	2321	19	144

Toruvai	415	339	76	79	18	0	0	0	242	0	76
Vilvanatham	552	537	15	50	375	0	0	0	112	0	15
Total	68839	58472	10367	2423	5690	425	4001	1040	49319	265	5676

Source: Stastical handbook 2014

3.11.1.3 Education Facilities

The area has good educational facilities like primary, secondary and higher educational infrastructure. The study area has good literacy rate of 82.47%. **Table 3-26** shows details of education infrastructure.

Table 3-26 Details of Education Infrastructure

Name	Literates	Percentage
5 Km		
Puduchery (part)	9891	86.55
Vanur		
Bommayapalayam	5661	76.86
Koluveri	924	69.42
Mattur	998	68.12
Nesal	1062	76.79
10 Km		
Puduchery (part)	61557	86.12
Tindivanam taluk		
Anumandai	4487	78.47
Chettikuppam	1485	79.80
Koonimedu	5179	78.90
Seyyankuppam	1045	70.09
Vanur taluk		
Appirambattu	848	72.66
Aruvadai	342	66.80
Irumbai	3771	73.27
Kaluperumbakkam	1386	73.33
Kodur	1041	63.94
Kottakuppam (TP)	22641	81.39
Olundiyappattu	1165	71.82
Royapudupakkam	1813	79.00
Tiruchitrambalam	6214	87.83
Toruvai	578	79.18
Vilvanatham	510	54.66

(Source: 2011 Census)

3.11.1.4 Health Facilities

In Puducherry district, there are 5 major hospitals which provide Allopathic medical care services. There are 2 Community Health Centres and 27 Primary Health Centres in the district to provide health care facilities to the rural population. Apart from details provided in **Table 3-27**

that there are 11 ESI hospitals in the district for the health care service for industrial workers in the district.

Table 3-27 Summary of socioeconomic indicators within the study area

S. No	Particulars	Study Area	Unit
1	Number of villages in the Study Area	21	Nos.
2	Total Households	42590	Nos.
3	Total Population	180939	Nos.
4	Children Population (<6 Years Old)	20034	Nos.
5	SC Population	23229	Nos.
6	ST Population	794	Nos.
7	Total Working Population	68839	Nos.
8	Main Workers	58472	Nos.
9	Marginal Workers	10367	Nos.
10	Agricultural Workers	12539	Nos.
11	Household Industries	1305	Nos.
12	Other Workers	54995	Nos.
13	Literates	132598	Nos.

CHAPTER – 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 General

Environmental Impact is any change in the environmental attributes, adverse or beneficial, caused or induced by the proposed action or set of actions. The predicted adverse impacts during each stage of project development are superimposed over the baseline status of the existing environmental quality to infer the scenario of environmental conditions in the post-project stage. The main purpose of identifying the impacts is that it helps in adopting appropriate mitigation measures for the adverse consequences if any.

It also addresses the prediction and evaluation of the various significant impacts that are likely to occur. The impacts on the environmental indices viz. air, water, soil, noise, biological and socioeconomic conditions are scrutinized methodically and assessed. The most likely impacts on the environment due to the proposed project need to be appraised during the operation phase. The particulars on impacts that could be triggered on the environmental attributes by the activities of the proposed project are discussed below.

4.2 Construction Phase

For the proposed expansion, new Production Blocks are to be constructed. The major activities considered in the construction phase are civil works, mechanical works, machinery works, transportation works and other related activities. Majority of impacts would be washed off as the project is situated in better geographical plain having capacity of natural mitigation of air pollutants due to efficient dispersion in natural condition. However, the following principal impacts to the environment are considered for further planning of mitigation measures:

- Release of construction materials and dust into the environment from the construction site/materials can spoil the surrounding air quality
- Improper disposal of construction wastes can damage air, water and land quality
- The use of automobiles and machinery during construction can deteriorate the air quality and generate temporary emission
- The use of automobiles and machinery generates Noise pollution from construction activities
- Effects may occur due to the accumulation of the contaminant in water resources &

soil due to uptake of construction material

- Short term heavy construction might cause increase in noise level
- Effects on work place condition & human health due to the accidents during the construction works.
- Effects on the socio-economic activity due to direct impacts or indirect impacts on socio-economic activities.

The above mentioned points express that the heavy construction can contaminate Air, Land, Water and Socioeconomic balance of surrounding region but they can substantially be minimised or reduced to significant extent by practising suitable and probable mitigation methods. Major focus shall be concentrated mainly on operational and maintenance activity of construction phase, deciding proper manner and route of working of the vehicles in order to avoid accidents and heavy traffic, providing suitable facilities and effective conditions to avoid occupational hazards and proper medical aid in case of occurrence of any accident so as to avoid any loss of life. Some of the major beneficial impacts to be focused are:-

- Employment opportunities: recruitment of local labourers
- Trading opportunities: procurement of construction materials locally
- Clean up operations, landscaping and plantations

Hence, the construction activities can have some moderate temporary and permanent impacts on site. The short-term impact will be mostly effective during construction phase. The construction phase activities could have some impacts on on-site noise and air quality, land use and ecology. It might also develop minor impacts on on-site soils, water quantity & quality. The other impacts of construction phase will be small in magnitude as well as temporary in nature and are expected to wear out gradually once the construction activity is completed. Further, the major and long term impacts can also be reduced and minimized by proper and substantial implementation of mitigation measures. In brief during the construction phase following mitigation measures shall be taken in consideration and implemented to prevent or minimize the respective impacts.

So there is no significant impact on Land, Air, Water, Noise, Soil & Ecology Environment during expansion with increase in production capacity.

4.3 Operation Phase

From an environmental perspective, this phase is of paramount significance due to its potential to invoke long-term impacts. The adverse effects that are likely to occur during this operational phase of the project are: Air Pollution (gaseous emissions), Effluent generation, noise generation, solid waste generation.

4.3.1 Air Environment

Base line data reveals that ambient air quality in the study area for the Parameters $PM_{2.5}$, PM_{10}, SO_2, NO_2, & VOC are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural& Other areas. The major air pollution sources from the industry are DG sets, boilers and reactors. Emission of PM, SO_2& NO_2 from stacks attached to Boiler, Acid Fume (HCL) emission & VOC from scrubber attached to Reactor are the only source of air pollution The DG set and boiler sources are provided with stacks of adequate height so as to disperse the emanating flue gases containing suspended particulate matters, oxides of sulphur and nitrogen without affecting the ground level concentrations. The process emissions generated from the reactors are scrubbed out by wet scrubbers.For the expansion following changes are proposed

- New Production block proposed
- New IBU recovery block proposed
- New Hydrogenator block proposed

4.3.1.1 Study Area

Strides Shasun Limited is a global pharmaceutical company whose goal is to ensure that no patient shall be denied access to high quality & affordable medicine and support. The current study area is ideally positioned at Periya Kalapet, Puducherry District, Puducherry UT as shown in **Figure 4-1**.

Figure 4-1Study area showing Strides Shasun boundary

4.3.1.2 Objective

The objective of this study is to evaluate the ambient air quality due to emission of gaseous pollutant from existing stacks for the study period (July to September 2017) by using numerical simulation methods. By using these methods we can determine the maximum ground level concentrations (GLC) for various air pollutants through air dispersion modeling technique. The maximum GLC's would then be utilized to assess the extent and magnitude of potential air quality and its impact resulting from the emissions from the stack of Strides Shasun. Base line data reveals that ambient air quality in the study area for the Parameters PM, SO_2& NO_2, are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural & Other areas.

The major air pollution sources from the industry are DG sets, boilers and reactors. The DG set and boiler sources are provided with stacks of adequate height so as to disperse the emanating flue gases containing suspended particulate matters, oxides of sulphur and nitrogen without affecting the ground level concentrations. The emissions generated from the reactors are scrubbed out by wet scrubber and Bag filter.

4.3.1.3 Meteorological Data

The site specific meteorological data for three months from July to September 2017 was obtained from secondary sources. Other data included for AERMET were daily wind speed, wind direction, temperature, relative humidity, air pressure, precipitation, and solar radiation recorded during the period. AERMET reformats meteorological data so that it can be used as input for AERMOD model.

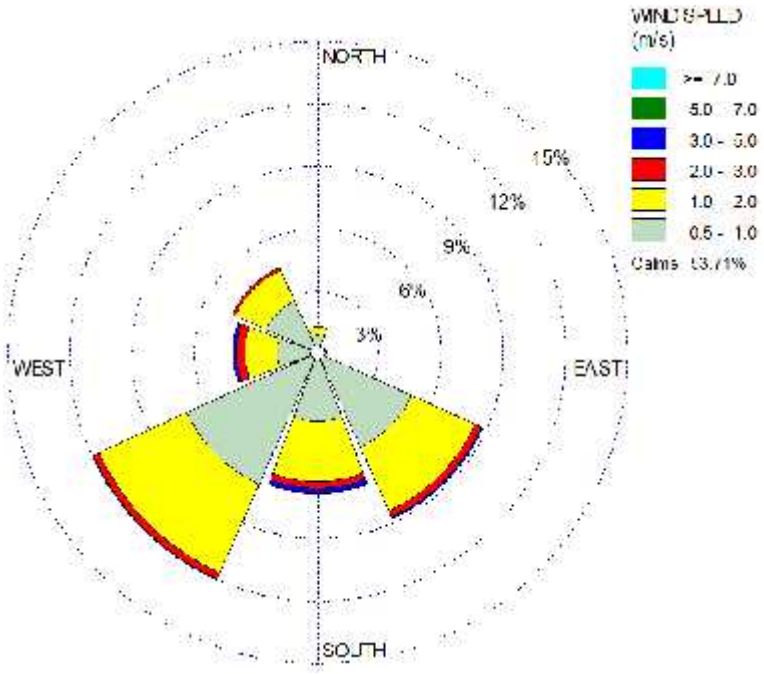


Figure 4-2 Meteorological data considered for modelling

4.3.1.4 AERMET Process

For the 3 phase AERMET processing of the meteorological data, specifications of the land use in the area are required to determine the terrain roughness for modelling. The land use was characterized for in and around the site. The surface characteristics for the site and

surroundings were selected and used to calculate the Albedo, Bowen ratio and surface roughness parameter.

The meteorological data were processed in the AERMET software to generate wind flow pattern & to generate surface meteorological data and profile meteorological data in a prescribed format that can be fed to AERMOD for modelling.

4.3.1.5 AERMOD Process

AERMOD Software Version 8.0.1 was used for air dispersion modelling and is applicable to a wide range of buoyant or neutrally buoyant emissions up to a range of 50 km. In addition to more straight forward cases, AERMOD is also suitable for complex terrain and urban dispersion scenarios.

AERMOD is a steady-state plume model. In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the Convective Boundary Layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function. This behaviour of the concentration distributions in the CBL was demonstrated by Willis and Deardorff (1981) and Briggs (1993). Additionally, in the CBL, AERMOD treats “plume lofting,” whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into the elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate. For sources in both the CBL and the SBL AERMOD treats the enhancement of lateral dispersion resulting from plume meander. The emissions from existing and proposed stacks are estimated and only proposed stack emissions are used for the air dispersion modelling as shown in **Table 4-1** and **Table 4-2.**

Table 4-2Locations of air polluting sources of existing and proposed expansion are shown in **Figure 4-3**. Maximum concentration value obtained for SO_2, NOx and PM using different scenarios is shown in **Figure 4-4**-**4.9** and Ground Level Concentration (GLC) for existing and proposed stacks is given in **Table 4-3 & 4.8** respectively.

Table 4-1 Existing Stack Emission details

Source	Fuel used	Stack Details					Vol. Flow Rate (Nm^3/Hr)	Emission per stack (g/s)				
		No of Stacks	Height (m)	Dia. (m)	Temp (°C)	Exit Velocity (m/s)		PM	SO_2	NOx	CO	HC
1500 KVA * 2 DG sets	Diesel	2	18	0.25	262	16.9	1659	0.0552	0.0295	1.0323	0.1216	BDL
1000 KVA * 2 DG set	Diesel	2	18	0.25	188	12.7	1447	0.0382	0.0257	0.2978	0.3378	BDL
1 No. Boiler 16 TPH	Bio-Briquettes	1	40	0.5	118	10.1	5426	0.0909	0.0651	0.1417	0.7325	--
1 No. Boiler 3.5 TPH (Stand By)	Bio-Briquettes	1	30	0.5	--	--	--	0.004	0.0195	0.042	0.219	--
2 No. Boiler 4.5 TPH (Stand By)	Bio-Briquettes	1	30	0.5	--	--	--	0.004	0.0195	0.042	0.219	--
Total Emission (g/s)								0.1843	0.1203	1.4717	1.1919	BDL

Table 4-2 Additional/ Proposed Stack Emission Details

Source	Fuel used	Stack Details					Emission per stack (g/s)			
		No of Stacks	Height (m)	Dia. (m)	Temp (°C)	Exit Velocity (m/s)	PM	SO_2	NOx	CO
1000 KVA DG set	Diesel	2	20	0.35	180	12	0.028	0.015	0.516	0.061
1500 KVA 1 DG sets	Diesel	2	20	0.35	180	14	0.019	0.013	0.149	0.169
Boiler 16 TPH (Standby & existing boiler with common stack)	Bio-Briquettes	1	30	0.56	130	8	0.091	0.065	0.142	0.732
1 No. Boiler 3.5 TPH	Bio-Briquettes	1	30	0.5	150	10.1	0.004	0.0195	0.042	0.219
1x 15 lacs Kcal/hr Thermic Fluid Heater	Bio-Briquettes						0.002	0.014	0.55	0.127
Total Emission (g/s)							0.144	0.1265	1.399	1.308

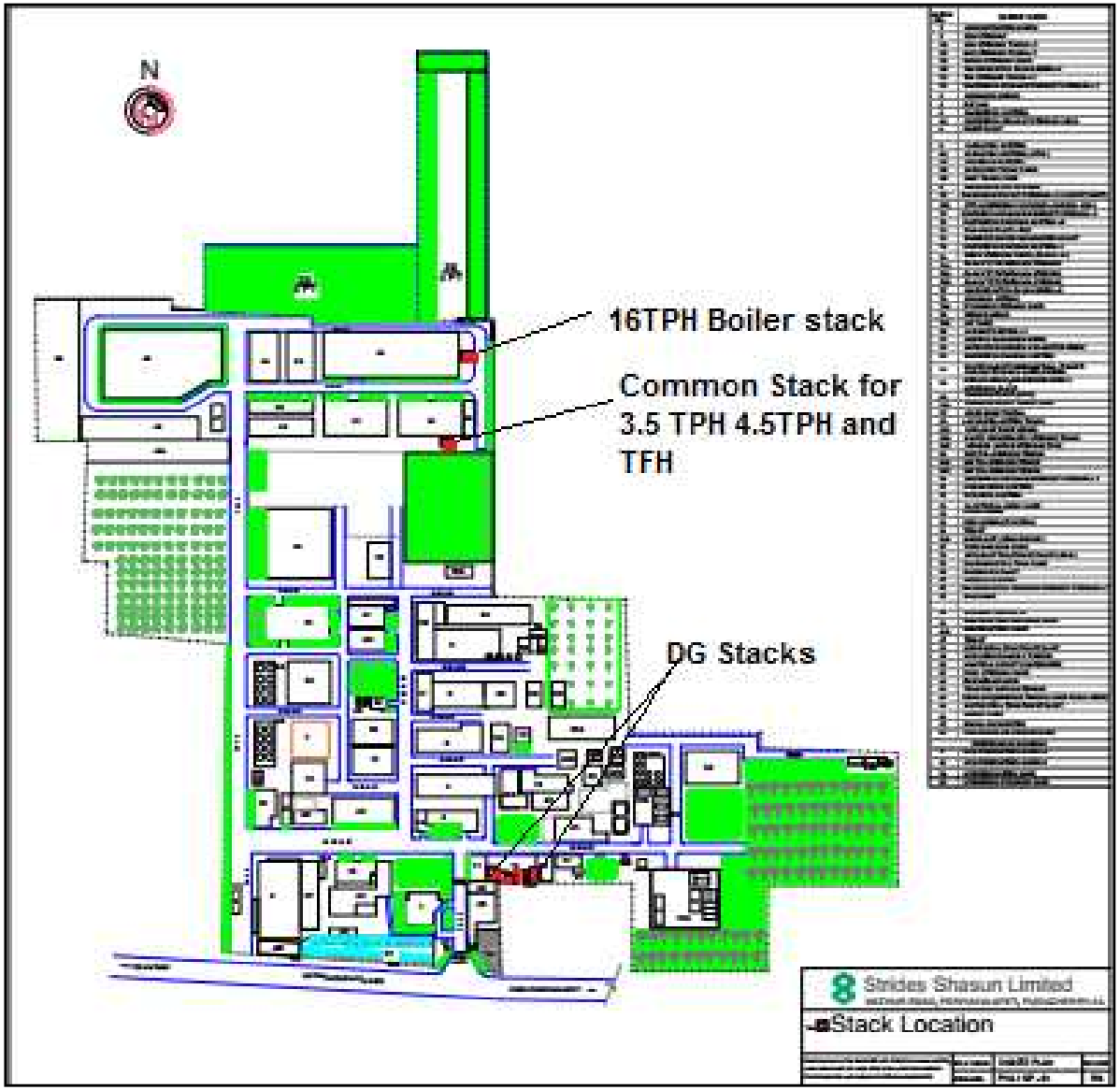


Figure 4-3 Locations of existing and proposed stacks demarcated on Layout map

Scenario 1: If all the proposed DG and boilers are under operation

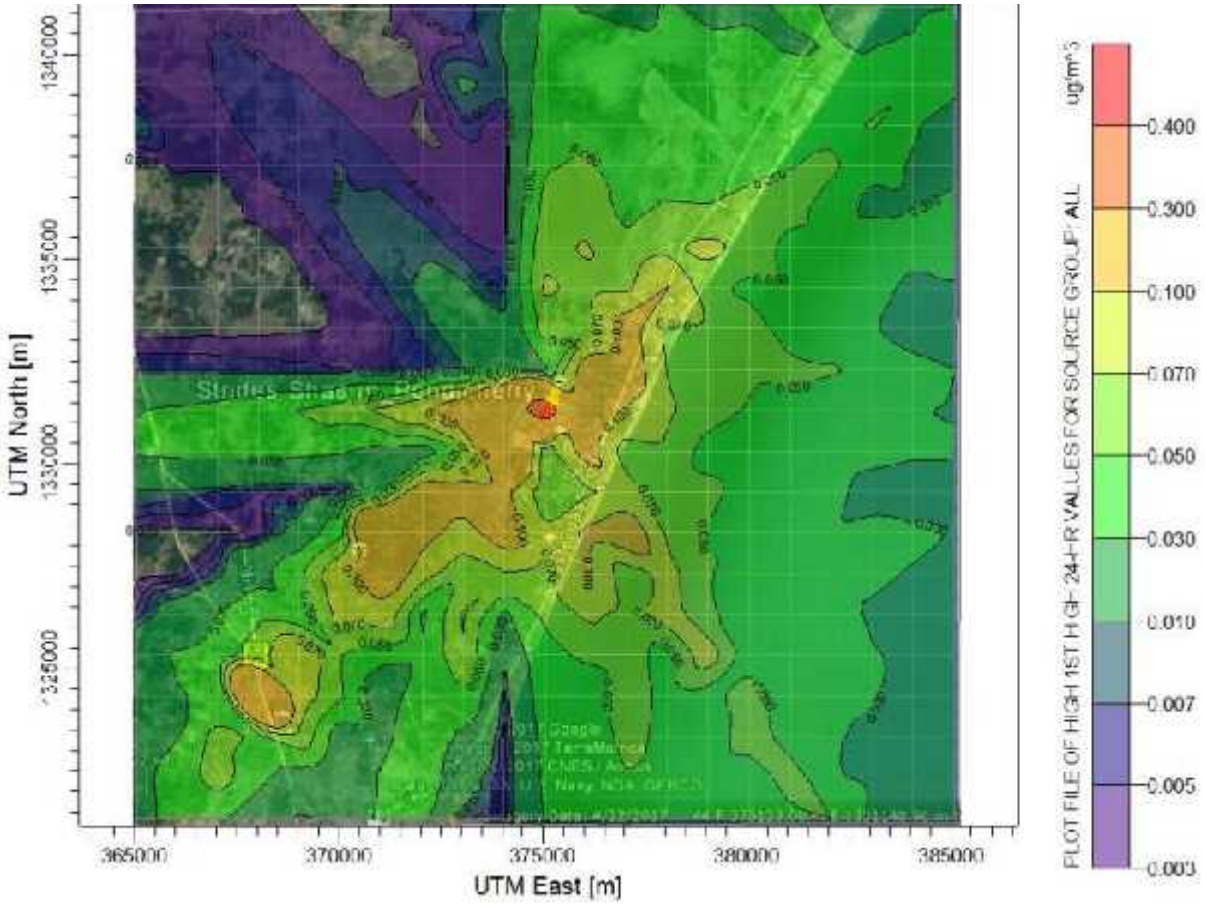


Figure 4-4 Predicted 24 hrs GLC's of PM within 10 km radius of the Study area

Table 4-3 Predicted Top 10 Highest Concentration of Particulate Matter

S.NO	UTM coordinates (m)		Conc. (µg/m³)	Distance from Centre of Sources (Km)	Direction from Source Centre
	E	N			
1	375052.5	1331304	0.39141	0	0
2	368040	1324338	0.25121	9.8	SW
3	371045.3	1328318	0.23294	5	SSW
4	374050.7	1331304	0.20789	1	W
5	374050.7	1330309	0.19928	1.5	SW
6	371045.3	1327323	0.14824	5.6	SW
7	372047.1	1329313	0.13718	3.5	WSW
8	377056	1328318	0.13644	3.6	SSE
9	376054.2	1331304	0.13413	1	E
10	373048.9	1331304	0.13388	2	W

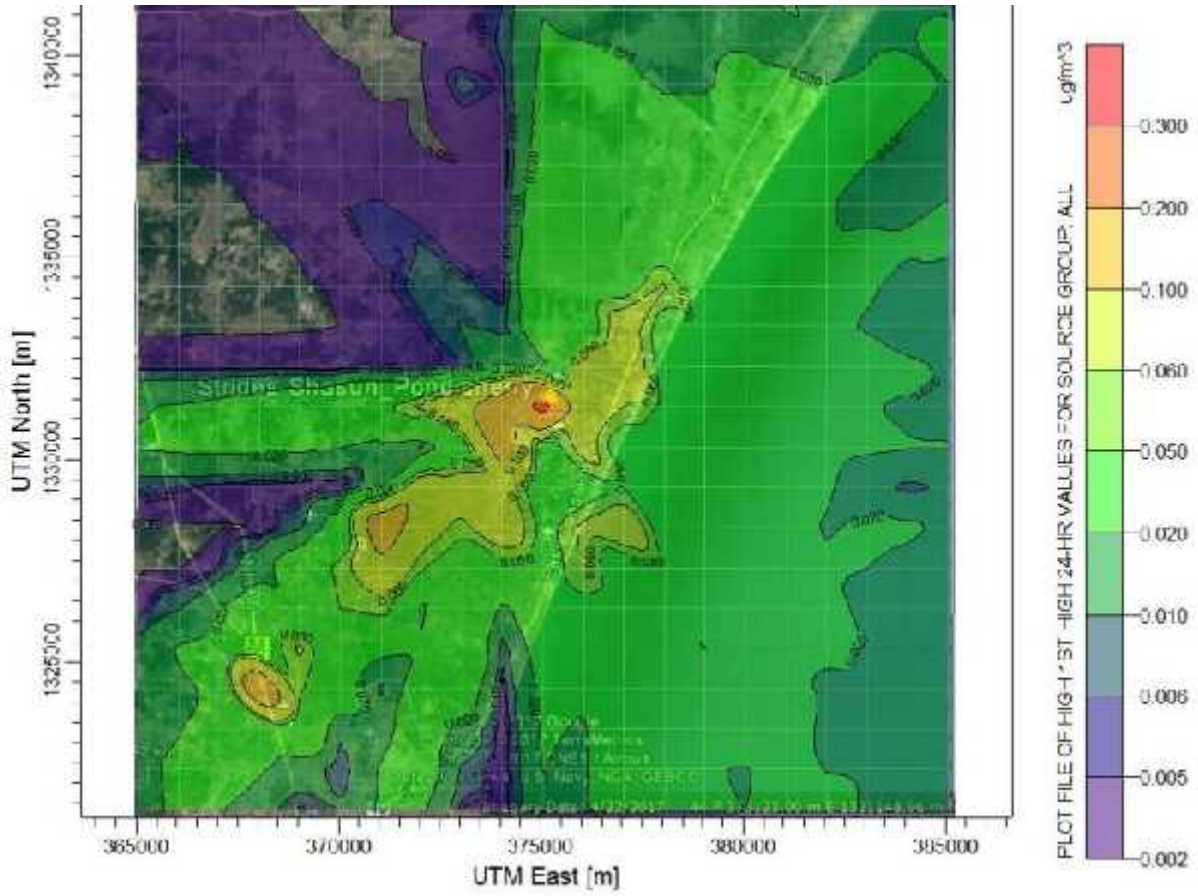


Figure 4-5 Predicted 24 hrs GLC's of SO_2 within 10 km radius of the Study area

Table 4-4 Predicted Top 10 Highest Concentration of Sulphur Dioxide

S.NO	UTM coordinates (m)		Conc. (µg/m³)	Distance from Centre of Sources (Km)	Direction from Source Centre
	E	N			
1	375052.5	1331304	0.2284	0	0
2	368040	1324338	0.15231	9.8	SW
3	371045.3	1328318	0.14112	5	SSW
4	374050.7	1331304	0.13411	1	W
5	374050.7	1330309	0.1287	1.5	SW
6	371045.3	1327323	0.09362	5.6	SW
7	373048.9	1331304	0.08682	2	W
8	372047.1	1329313	0.08442	3.5	WSW
9	377056	1328318	0.08263	3.6	SSE
10	376054.2	1331304	0.08049	1	E

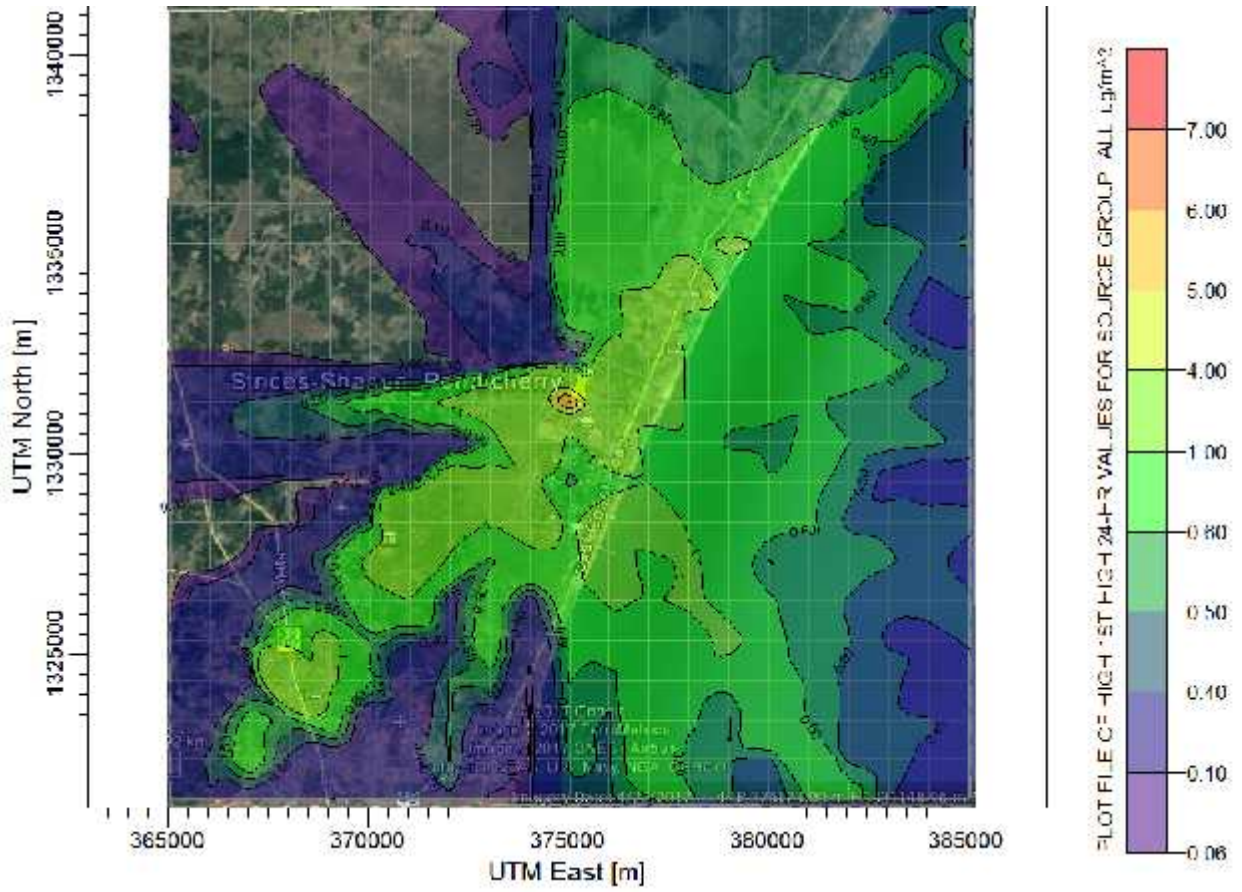


Figure 4-6 Predicted 24-Hrs' GLC's of NOx within 10 km Radius of the Study Area

Table 4-5 Predicted Top 10 Highest Concentration of Nitrogen Oxide

S.NO	UTM coordinates (m)		Conc. (µg/m^3)	Distance from Centre of Sources (Km)	Direction from Source Centre
	E	N			
1	375052.5	1331304	6.13467	0	0
2	368040	1324338	3.42915	9.8	SW
3	371045.3	1328318	3.08869	5	SSW
4	374050.7	1331304	2.45965	1	W
5	374050.7	1330309	2.24404	1.45	SW
6	376054.2	1331304	1.87357	1	E
7	377056	1328318	1.83854	3.5	SSE
8	371045.3	1327323	1.7293	5.7	SW
9	376054.2	1330309	1.71617	1.45	SE
10	372047.1	1329313	1.6908	3.5	SSW

Scenario 2: If only proposed DG sets are working

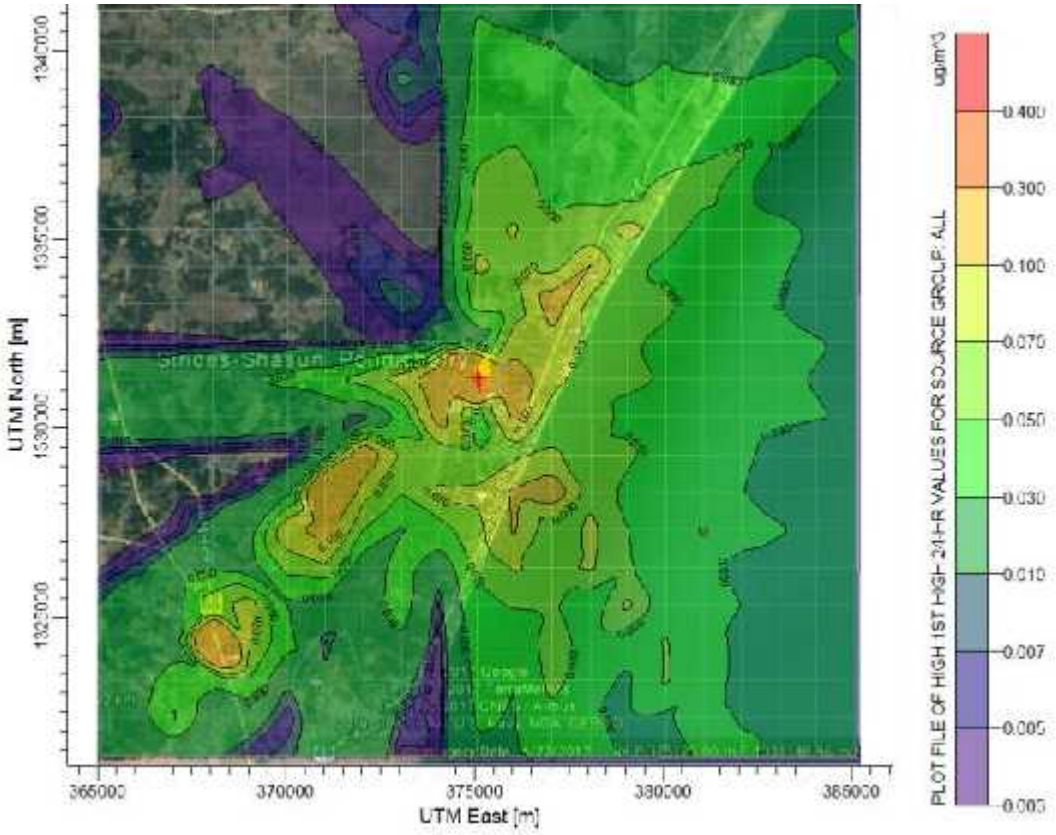


Figure 4-7 Predicted 24 hrs GLC's of PM within 10 km radius of the Study area

Table 4-6 Predicted Top 10 Highest Concentration of Particulate Matter

S.NO	UTM coordinates (m)		Conc. (µg/m³)	Distance from Centre of Sources (Km)	Direction from Source Centre
	E	N			
1	375052.5	1331304	0.30356	0	0
2	368040	1324338	0.2346	9.8	SW
3	371045.3	1328318	0.22307	5	SSW
4	374050.7	1331304	0.1372	1	W
5	372047.1	1329313	0.13718	3.5	WSW
6	376054.2	1331304	0.1325	1	E
7	377056	1328318	0.12909	3.6	SSE
8	371045.3	1327323	0.12029	5.6	SW
9	377056	1333294	0.11892	2.8	SW
10	374050.7	1330309	0.11642	1.5	SW

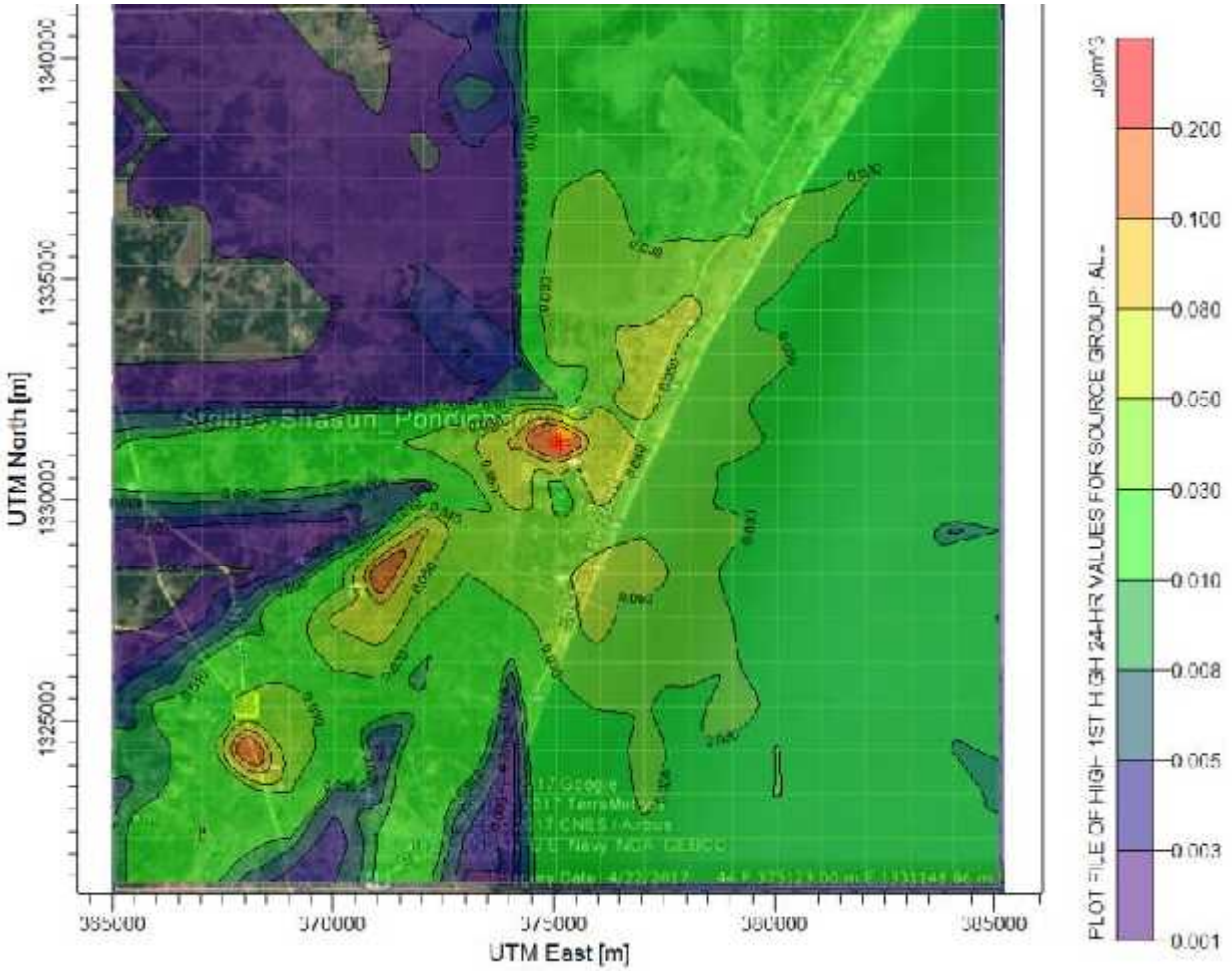


Figure 4-8Predicted 24 hrs GLC's of SO_2 within 10 km radius of the Study area

Table 4-7 Predicted Top 10 Highest Concentration of Sulfur Dioxide

S.NO	UTM coordinates (m)		Conc. (µg/m³)	Distance from Centre of Sources (Km)	Direction from Source Centre
	E	N			
1	375052.5	1331304	0.16555	0	0
2	368040	1324338	0.14043	9.8	SW
3	371045.3	1328318	0.13406	5	SSW
4	372047.1	1329313	0.08442	1	W
5	374050.7	1331304	0.08355	3.5	WSW
6	376054.2	1331304	0.07933	1	E
7	377056	1328318	0.07737	3.6	SSE
8	371045.3	1327323	0.07362	5.6	SW
9	377056	1333294	0.07341	2.8	SW
10	374050.7	1330309	0.06942	1.5	SW

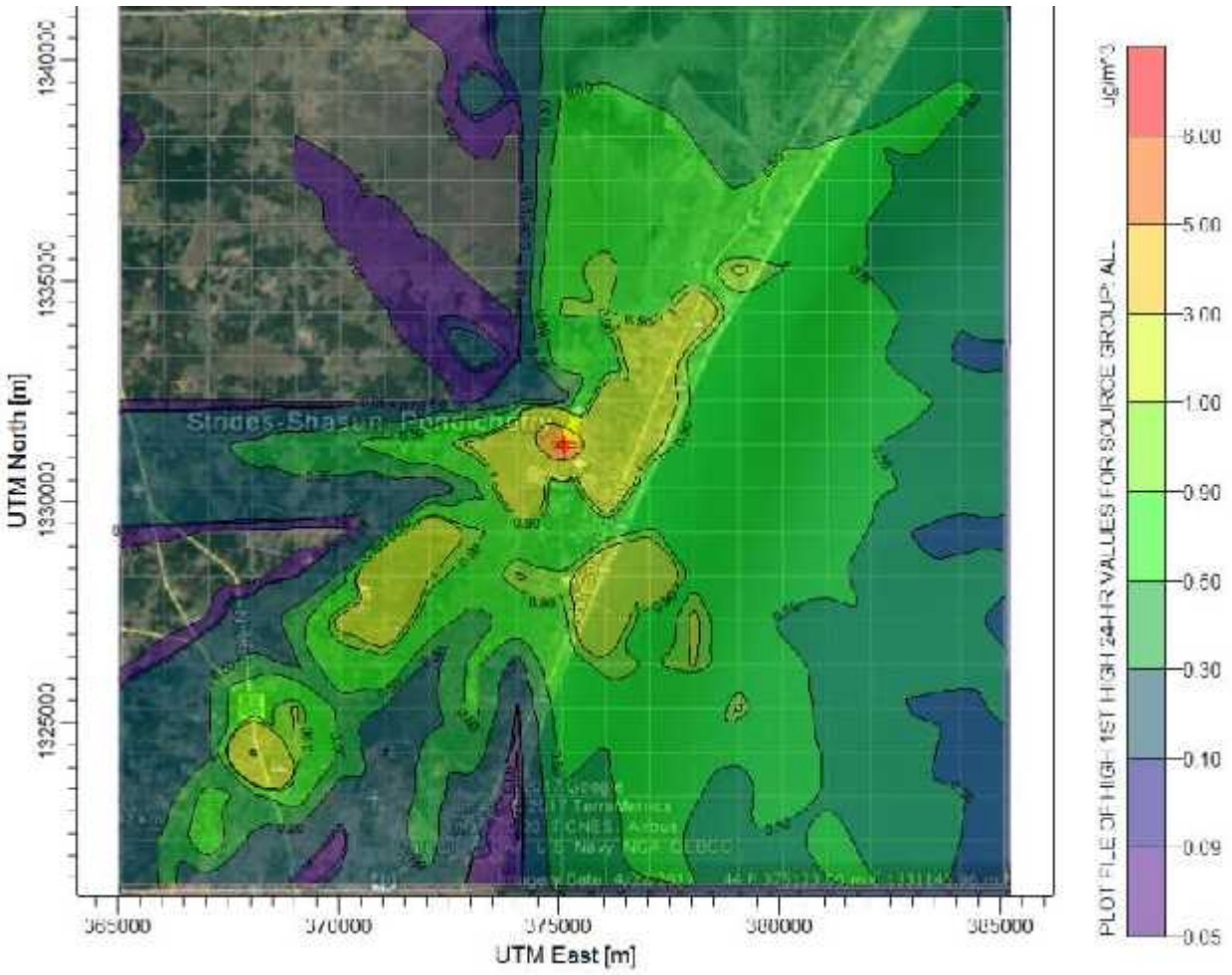


Figure 4-9Predicted 24-Hrs' GLC's of NOx within 10 km Radius of the Study Area

Table 4-8Predicted Top 10 Highest Concentration of Nitrogen Oxide

S.NO	UTM coordinates (m)		Conc. (µg/m³)	Distance from Centre of Sources (Km)	Direction from Source Centre
	E	N			
1	375052.5	1331304	5.41492	0	0
2	368040	1324338	3.20087	9.8	SW
3	371045.3	1328318	3.00142	5	SSW
4	376054.2	1331304	1.80654	1	E
5	374050.7	1331304	1.76022	3.5	WSW
6	377056	1328318	1.75314	3.6	SSE
7	372047.1	1329313	1.68992	1	W
8	374050.7	1330309	1.60945	1.5	SW
9	371045.3	1327323	1.51385	5.6	SW
10	376054.2	1330309	1.51099	1.5	SE

4.3.1.6 Conclusion:

Scenario 1

It was observed that the maximum concentration observed due to proposed expansion for PM, SO_2 and NOx are 0.39µg/m^3, 0.22 µg/m^3 and 6.13 µg/m^3. So it can be concluded that even after the expansion of the plant the impact envisaged is minimum and concentrations are within the NAAQ standards. The total increase in concentrations above baseline status is estimated and the percentage increase is summarised in **Table 4-9**

Table 4-9 Total Maximum GLCs from the proposed Stack Emissions

Pollutant	Average Base line Conc. (µg/m^3)	Estimated Incremental Conc. at source (µg/m^3)	Total Conc. (µg/m^3)	NAAQ standard	Distance from Source	Direction	% increase
PM	62.5	0.39	62.89	100	0	0	0.62
SO_2	16.3	0.22	16.55	80	0	0	1.35
NOx	29.6	6.13	35.73	80	20.7	NOx	29.6

Scenario 2

It was observed that the maximum concentration observed due to proposed expansion for PM, SO_2 and NOx are 3.35µg/m^3, 1.01µg/m^3 and 18.29µg/m^3. So it can be concluded that even after the expansion of the plant the impact envisaged is minimum and concentrations are within the NAAQ standards. The total increase in concentrations above baseline status is estimated and the percentage increase is summarised in **Table 4-10.**

Table 4-10 Total Maximum GLCs from the proposed Stack Emissions

Pollutant	Average Base line Conc. (µg/m^3)	Estimated Incremental Conc. at source (µg/m^3)	Total Conc. (µg/m^3)	NAAQ standard	Distance from Source	Direction	% increase
PM	62.5	0.303	62.8	100	0	0	0.48
SO_2	16.3	0.165	16.46	80	0	0	1.01
NOx	29.6	5.415	35.01	80	0	0	18.29

4.3.1.7 Pollution Control Measures

Air Pollution & Fugitive Emission Control

The major air pollution sources from the industry are DG sets, boilers and scrubbers. The DG set and boiler sources are provided with stacks of adequate height so as to disperse the emanating flue gases containing suspended particulate matter, oxides of sulfur and nitrogen without affecting the ground level concentrations. The emissions generated from the reactors are scrubbed out by wet scrubbers. The source of emission, capacity and the various Air Pollution Control (APC) measures taken are listed in the **Table 4-11**.

Base line data reveals that ambient air quality in the study area for the Parameters $PM_{2.5}$, PM_{10}, SO_2, NO_2, & VOC are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural & Other areas. Emission of PM, SO_2& NO_2 from stacks attached to Boiler, Acid Fume (HCl) emission & VOC from scrubber attached to Reactor are the only source of air pollution.

For the expansion following changes are proposed

- New Production Block
- New IBU Recovery Block
- New hydrogenator Block

In order to assess the air quality impact of the proposed expansion air quality modelling was done using AERMOD software. In the existing Production DGs of capacity 1500KVA (2 nos.) & 1000 KVA (2 nos.) were available. After the proposed expansion, 1 no. of 1500 KVA DG and 1 no. of 1000 KVA DG will be added. The existing and proposed emission details and control measures are shown in **Table 4-11.**

Table 4-11Air Pollution Control Measures Proposed for Expansion

Details	Air pollution source			No of stacks			APC Measures
	Existing	Proposed	After expansion	Existing	Proposed	Total	
Stack Process	IBU	-	IBU	1	1	2	Existing Wet Scrubber/Proposed Bag filter
	S-IBU	-	S-IBU	0	1	1	Bag Filter

	IBU Lysine	-	IBU Lysine	0	1	1	Bag Filter
	-	IBU Sodium	IBU Sodium	0	1	1	Bag Filter
	-	DC-90	DC-90	0	1	1	Bag Filter
	-	Pilot Plant	Pilot Plant	0	1	1	Bag Filter
	-	Pregabalin	Pregabalin	0	1	1	Bag Filter
	-	Sapropetrin	Sapropetrin	0	1	1	Bag Filter
Stack – Non Process (DG)	2 x 1500 KVA 2 x 1000 KVA	1 x 1500 KVA 1 x 1000 KVA	3 x 1500 KVA 3 x 1000 KVA	4	2	6	Chimney 18 m height, AGL
Boiler – Bio Mass Briquette	1 x 16TPH 1 x 3.5 & 2 x 4.5 TPH (standby boiler)	1 x 16TPH (Standby) 1x 15 Lac K Cal /hr Thermic Fluid Heater	2 x 16TPH (1 in Standby) 1x 15 Lac K Cal /hr Thermic Fluid Heater 1 x 3.5 TPH 2 x 4.5 TPH (standby boiler)	2	0	2	Multi cyclone dust collector going in for bag filter and then to stack, 30 m AGL
Total No of Stacks				7	10	17	

4.3.2 Water Requirement

The total water requirement after proposed expansion will be 2315 KLD. The fresh water consumption will be 498 KLD sourced from in house borewells. 1817 KLD recycled water will be consumed of which 746 KLD treated sewage will be sourced from Public Works Department (PWD), Mahatma Gandhi Medical College (MGMC), Puducherry Institute of Medical Sciences (PIMS) etc and process effluent of 43 KLD. For greenbelt, floor washing, boilers and cooling towers and water to Strides Shasun Formulation Unit treated water will be used.

4.3.2.1 Impact due to Waste Water Generation

The proposed expansion facility will generate 45 KLD sewage from domestic activities and 550KLD effluents from industrial operations/processes. Apart from the effluents and sewage of

the API unit, the Combined effluent plant also treats 43 KLD of process effluent and156 KLD of sewage from the Strides Shasun Formulation Unit lying towards northeast and adjacent to the API unit. The Combined wastewater Treatment Plant in the existing facility will be modified to handle the increased quantity of effluents after expansion. The existing ZLD system was commissioned in September 2017. ZLD adequacy report is attached as **Annexure 10** and wastewater treatment system specifications as **Annexure 11.** High pollutant stream is treated in Stripper and MEE. The condensate is sent to Biological treatment followed by RO plant for usage in Process/Non process area.

Less pollutant stream along with externally procured treated sewage is sent to Biological treatment followed by RO for using in Process/Non process area. Marine outfall has been discontinued in October 2017.

Concentrate from Multiple Effect Evaporator (MEE) is treated in Agitated Thin Film Drier (ATFD) and the sludge generated from biological treatment system and ATFD salts are currently stored inhouse and options to dispose to nearby TSDF sites/co processor (Refer PPCC NOC and Agreement with TSDF as **Annexure 23**). Hence no significant impact is envisaged due to expansion.

4.3.2.2 Mitigation Measures

Various mitigation measures including ZLD system is proposed to minimise the impact if any on the water environment due to the wastewater/runoff generation during the operation phase of the project. The following are the key mitigation efforts:

- Institutional arrangement for monitoring of water by pollution
- Preventive measures as well as after, measures in case any contamination
- Monitoring should ensure early determination of any threats to water resources in terms of contamination
- If contaminated proper expertise need to be brought in to schematise the various recharge mechanism to reduce or nullify the impact effects.

4.3.2.3 Wastewater Quality and Quantity

The existing facility will generate 5 KLD of sewage from domestic activities and 55 KLD of process effluents from industrial processes. Process effluent generated from the proposed expansion along with the wastewater (43 KLD process effluent and 156 KLD sewage water) from Strides Shasun formulation unit will be treated in combined effluent treatment plant. The

effluents generated from manufacturing process (550 KLD) will be sent to the MEE. The condensate from MEE (750 KLD) will be sent for Biological Treatment to ETP (Biological Treatment Plant 1) followed by RO I. The wastewater from Strides Shasun formulation unit will be sent to Biological Treatment Plant 2 followed by RO III. The reject from RO I (113 KLD) and RO II (208 KLD) will be sent to RO III and permeate recycled. The Reject from RO III (80 KLD) will be sent to MEE.Condensate from Multiple Effect Evaporator (MEE) will be treated in Agitated Thin Film Drier (ATFD) and the sludge generated from biological treatment system and ATFD salt will be stored inhouse with options to dispose to nearby TSDF sites/Co processor. The domestic sewage (45 KLD) and treated sewage procured (746 KLD) from PIMS, MGMC, PWD etc. will be treated in BTP 2 followed by RO II. Permeate from RO II (1180 KLD) will be recycled along with Permeate from RO I (638 KLD) making up a total of 1817 KLD of recycled water. Reject from RO II (208 KLD) along with reject from RO I (113 KLD) is sent to RO III and permeate from RO III (241 KLD) will be recirculated into RO II for treatment.

The Combined wastewater Treatment Plant in the existing facility will be modified to handle the increased quantity of effluents after expansion, hence no significant impact is envisaged after expansion.

Adequacy report of ZLD system is attached as **Annexure 10** and STP process flow diagrams along with their specifications are attached as **Annexure 11.**

4.3.3 Noise Environment

The impacts of the proposed modification of project mix on the noise levels of the surrounding areas were assessed. All equipments in the plant is designed/operated to have a noise level not exceeding 85 to 90 dBA as per the requirement of Occupational Health and Safety Administration Standard (OHSAS). In addition, since most of the noise generating equipment would be in closed structures, the noise transmitted outside would be still lower.

4.3.3.1 Impacts

Major sources of noise generation in Strides Shasun unit, noise generation sources during operational phase are classified into two categories:

- Stationary sources due to operation of heavy duty machinery at the project site like Boilers, Compressors, DG sets, Pumps etc.
- Mobile sources corresponding to mainly vehicular traffic for staff mobilization, materials, material transportation, liquid fuel transportation to project site, etc.

The impact of vibrations beyond the site would be negligible during normal operation phase. However, the impacts on workers engaged in the plant area would be considerable due to occupational exposure. The fixed major equipment/units such as boiler house, compressors, pumps, DG sets etc., also generate vibrations during operational phase and may cause exposures to the workers/operators engaged at these units.

4.3.3.2 Mitigation Measures

- The major noise generating equipment like Compressors, DG sets, TFH, Boiler Feed water pumps etc. is enclosed in an acoustic enclosure designed for an insertion loss of 25 dB (A) and silencers to other equipment etc.

- Major noise generating equipment is designed with 85 dB (A) ensuring cumulative noise at 1.0 m remains at 85 dB (A).
- The occupational noise exposure to the workers in the form of eight hourly time weighted average is maintained well within the prescribed Occupational Safety and Health Administration (OSHA) standard limits.
- Adequate PPE are provided to the staff exposing to noise risks.
- Acoustic silencers are provided in equipment wherever necessary.
- Acoustic design with sound proof glass panelling is provided for critical operator cabins / control rooms of individual modules as well as central control facilities.
- Use of personal protective equipments/devices such as ear-muffs, ear plugs etc. is strictly enforced for the workers engaged in high noise areas.
- Existing premises will attenuate and mitigate noise levels, 33% greenbelt developed along the periphery and at various locations within the industry.
- Ambient noise levels are monitored at regular intervals during operational phase of the project. Work place monitoring is also carried out at regular intervals to ensure that noise levels are well within the standards prescribed by the Factories Act.
- Various standards pertaining to vibrations are formulated by statutory bodies like Bureau of Indian Standards (BIS) and Director General of Mines Safety (DGMS), which is being practiced would be continued to mitigate the workers' health effects due to vibrations.

4.3.4 Solid waste management

4.3.4.1 Impacts

During operation phase is likely to generate various types of solid waste which can be broadly categorized as Hazardous Waste and Non-hazardous Waste. Further, the generated solid waste generation may include Biodegradable, Recyclable and Inert compounds. If the solid waste generated is not properly managed and disposed in unauthorised manner, it will impact on soil quality, groundwater and air quality. Municipal solid waste during construction phase will be limited to about 30Kg/day for about 6 months of construction period. Solid waste generated from operation phase of existing plant is 35 TPA which will increase to 60 TPA after proposed expansion.

4.3.4.2 Mitigation Measures

The Source of municipal waste in the industry will be from the domestic use and strict guidelines put in place in order to manage the solid waste generation during the construction phase will be disposed off to organic waste convertor along with the existing quantity generated by operation. After expansion also the same will be practiced and the recovered manure from convertor will be used for greenbelt of the facility.

The various hazardous waste generated from the process is stored in a separate hazardous waste storage area and properly disposed as per the Hazardous and Other Wastes (Management and Trans boundary Movement) Amendment Rules, 2016.

- Used Oil - Collected in Leak proof containers and disposed only to PPCC registered authorized reprocessors provided the oil meets the standards as per schedule-5 part-A of the rules.
- Spent solvent -Stored in a secured manner and hand over to PPCC authorized recycler.
- Sludge from ETP & MEE– ATFD salts are currently stored inhouse with options to dispose to nearby TSDF sites/Co processor.
- Chemical sludge from wastewater treatment – Disposed to Secured landfill
- Process waste/Distillation residue/Spent lubricating oil/Spent catalyst/Spent carbon/Filter medium/Residue containing oil/off specification products/Spent organic solvent/Slugde from wastewater treatment arising out of cleaning/disposal of barrels/ containers – Disposed through PPCC authorized vendors.

- Discarded barrels/containers/liners contaminated with hazardous chemicals – Disposed through authorized recyclers
- Date expired/discarded off specification drugs/ medicines – Disposed off through PPCC authorized Biomedical Treatment facility

Thus, it can be concluded that there will be no impact on the surrounding environment due to generation and disposal of solid waste during operation phase of the project.

4.3.5 Land Environment

Land is in possession of M/s. Strides Shasun Limited. The present land is being used industrially since 1986. The Plant facilities are spread over 1,05,115.54 sq.m, (25.99 Acres).The Proposed activity does not change the land use classification of the site.

The Air and Emissions source from DG, Boilers and Process with APC measures, adequate stacks heights and vents attached to scrubber will be within the norms. Moreover, vents of proper height have been provided for quick dispersion and dilution of pollutants into the air. Thus, there will be no additional effect on the surrounding soil due to gaseous emission from the project.

There will be no major effect of wastewater on soil as there is ZLD plant to treat the effluent. The domestic wastewater will be treated through Biological treatment plant an. Thus, there will be practically very insignificant impact on land due to disposal of wastewater.

All necessary control steps for each type of Solid Wastes generated will be taken, and hence there will be no impact on solid wastes generation on surrounding soil environment.

4.3.6 Ecology

Air emissions, liquid effluent disposal and solid waste generation are likely to have some impact on terrestrial ecosystem. However, there will be no net increase in air pollution. Plant is already maintaining ZLD system and the solid wastes will be collected and disposed off properly. Hence, negligible impact on ecology is expected.

Existing plot has a greenbelt of 7.39 Acres (28.45 %) of the 25.99 Acres total land area. Green belt after expansion will be 9.19 Acres (35.37 %) of 25.99 Acres. Greenbelt will be developed along the periphery and at various locations within the industry thereby negating impacts of noise and gaseous emissions. Greenbelt Layout is attached as **Annexure 6.**

4.3.7 Socio-Economic Environment

The project to manufacture bulk-drugs is likely to have certain positive impacts on socio economic environment.

Company has carried out various activities in nearby villages as part of their CSR like organizing medical camp, green belt development, water supply programmes etc. The company intends to spend around 17.5 Crore rupees on CSR activities over the next 5 years with focus on Education, Healthcare, Skill development for employment among rural youth and Development of social infrastructure. Tentatively planned CSR activity for the next Five years is as given in below **Table 4-12**.

Table 4-12 Estimated fund allocation for CSR Activities from 2017 – 2022

S. No	Activities	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-2022
1	Education	4.02	25.95	50.00	55.00	60.05	66.55	73.20	80.52
2	Health Care	23.49	40.30	50.00	60.00	72.00	86.40	103.68	124.41
3	Skill Development for Employment Social Infrastructure	38.02	108.53	100.00	175.00	200.00	200.00	200.00	200.00
Total		65.53	174.78	200.00	290.00	332.05	352.95	376.88	404.93
Grand Total		440.31			1,756.81				

Various modes of indirect employment i.e. transportation, increased business opportunities to shopkeepers etc will reflect in the improved quality of life of the people in the study area.

Thus, it can be said that the proposed project will have significant beneficial impact on the socio economic scenario in the study area.

CHAPTER – 5

ANALYSIS OF ALTERNATIVES

5 ANALYSIS OF ALTERNATIVES

5.1 History and Background of the Site

Strides Shasun Limited is an integrated, leading global supplier of development and manufacturing services for Bulk drugs, intermediates, API (Active Pharmaceutical Ingredients) and Formulations to the Pharmaceutical Industry. Strides Shasun Limited (Formerly known as Shasun Pharmaceuticals Ltd) was incorporated in 1986 headquartered at Chennai, India. On 19th November 2015, pursuant to the strategic decision to combine the two companies, Shasun Pharmaceuticals Limited was amalgamated and merged with Strides Arcolab Limited. Consequently, the name of the new combined business is in the name of Strides Shasun Limited.

The State of the art Multi Product Manufacturing facility of Strides Shasun Limited is located at Plot no. R.S No. 30/4 PT, 32/1A, 32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Periakalapet, Mathur Road, Puducherry. Strides Shasun Limited Puducherry proposes expansion of Bulk Drugs manufacturing Facility from existing capacity of 4800 TPA with 5 products to 9156TPA with 8 products. The facility is proposed within a total of 25.99 Acres.

5.2 Current Proposal

Since this expansion project is only a minor one to augment the production process of new and existing pharmaceutical products the area earmarked for future development inside the already existing site will best fit in terms of ease in operation and to address environmental issues, health and safety issues. This expansion project is located within the existing facility of Strides Shasun Ltd, Puducherry. The process equipment, supporting infrastructure and pollution control equipment will be installed inside the existing premises. As the proposed project is expansion with increase in production capacity within the premises of the existing unit in Periyakalapet, Puducherry there are no alternative sites analysed.

However based on the current set up the following are the advantages of the site:

- The proposed project site is suitable from operation point of view since it is situated just next to the already existing manufacturing unit.
- The project site shall not require displacement of habitation. As it is located inside the premises of the existing facility, there is no habitation present inside the project area.
- The plot allotted for the expansion is flat and stable to increase its resistance against any natural disturbances like earthquake.

- The project site is free from any environmental restrictions like forest, natural parks; wild life sanctuaries.
- The project does not involve any displacement of local residents as it is located inside the existing premises.

5.3 Results of the Analysis

The process used for production is made by M/s. Strides Shasun Limited. And in house there would not be any changes in the process. The process made by M/s. Strides Shasun Limited is cost effective with high quality in output.

No alternative site has been considered due to the benefits of the above site. With its innovative technology the project is expected to meet the market demands of the pharmaceutical products that will aid in addressing the issues in healthcare as well as lead to economic prosperity.

The current site is under possession of M/s. Strides Shasun Ltd. Therefore no further site analysis has been carried out under this EIA.

CHAPTER – 6

ENVIRONMENTAL MONITORING PROGRAM

6 ENVIRONMENTAL MONITORING PROGRAM

6.1 Introduction

The primary aim of environmental monitoring program is to formulate a systematic, site-specific plan for monitoring the environmental parameters within the impact area, during and after commissioning of the project, which would aid in assessing the effectiveness of mitigation and environmental protection measures implemented for the proposed project based on the existing environmental scenario and the probable environmental impacts appraisal.

The plan framed for the intended facility will describe:

- The details of the proposed mitigation measures taken for safeguarding the environment at the project site as well as in the vicinity of the industrial site
- Details of management plans (Greenbelt development plan, Solid waste management plan etc)
- Post project environmental monitoring programme to be undertaken after commissioning of the project.
- The associated cost components of the pollution control systems installed at the site.

For each of the environmental attributes, the monitoring plan specifies the parameters to be monitored, location of monitoring sites, frequency and duration of monitoring and it also denotes the applicable standards, implementation and supervising responsibilities.

Environmental monitoring programme for the proposed project is formulated. Environmental Monitoring Programme is an important component during environmental management of the project. The institutional mechanism planned and implemented to mitigation and monitoring measures during all stages of the project is discussed in **Chapter 9.** The project management especially the Environmental Management Cell (EMC) should always go for a rational approach with regards to environmental monitoring. This includes judicious decision making in consultation with institutional stakeholders (e.g. Puducherry Pollution Control Board (PPCC) or reputed environmental consultants for appropriate changes in the monitoring strategy, i.e., changes in the sampling frequency, sampling location, monitoring parameters and any new/additional requirements.

The following are the main objectives of the environmental monitoring program:

- Provide ETP for the protection of water resources

- Provide information for documentation of monitoring of mitigation measures and impacts
- Tool for the statutory authority of unanticipated adverse impacts or sudden changes in the environmental condition due to the proposed project
- Provides information that could be used for evaluating the effectiveness of implemented mitigation measures
- Provides information that could be used to verify predicted impacts and thus validate impact prediction techniques
- The efficacy of the mitigation measures being followed during operational phases can be assessed and the measures can be revised, made more stringent and reinforced based on the monitoring results
- Environmental Monitoring can also serve a basic component of a periodic environmental regulatory auditing program for the proposed project
- Coordination with local bodies with regards to solid waste management

The following programme as detailed in the environmental monitoring programme for operation phases implemented by Strides Shasun Limited. Besides the monitoring, the compliances to all environmental clearance conditions and regular permits from PPCC /MoEF&CC shall be monitored and reported periodically. The likely significant impacts and mitigation measures will also be monitored.

The environmental attributes to be monitored during operational phases of the project, specific description along with technical details of environmental monitoring including the monitoring parameters, methodology, sampling locations and frequency of monitoring are presented in Section below.

6.2 Objectives

- Ensure day to day operational activities are conducted in a manner in compliance with the applicable regulatory approvals including legislation and industry standards
- Evaluate the adequacy of mitigation and pollution control measures implemented for reducing the adverse impacts caused during the construction and operation stage and suggest additional mitigation measures, if appropriate, in the light of the results
- Define a detailed framework to monitor and document for achieving full compliance with statutory requirements
- Encourage good environmental management practices through planning, commitment and continuous improvement

- Develop clearly defined environmental monitoring program designed to assess the nature and extent of environmental impacts of the proposed operations and progressively refine such programs against the targets
- Define roles and responsibilities of site personnel and ensure that all people onsite are fully informed of their responsibilities and accountabilities with regard to the environment
- To comply with all regulations stipulated by the Central Pollution Control Board (CPCB)/ State Pollution Control Board (SPCB) related to air emission and liquid effluent discharge as per air and water pollution control act/ laws
- To handle hazardous wastes as per the Hazardous Waste (Management & Handling) Rules 1989and Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and subsequent amendments.
- Review, improve and update environmental management procedures and standards
- Establish response procedures for actual/potential environmental impacts including community complaints and ensure corrective action is taken
- Perspective budgeting and allocation of funds for environmental management expenditure, Continuous development and search for innovative technologies for a cleaner and better environment.

6.3 Project Environmental Monitoring

Environmental Monitoring details are as given in **Table 6-1**.

Table 6-1Environmental Monitoring details

S. No	Area of Monitoring	Frequency of Sampling	Parameters to be Analyzed
1	Ambient Air Quality	Monthly monitoring for 12 parameters	All 12 Parameters based on NAAQ standards as on 16 November,2009
		Continuous monitoring and real time data transfer to online monitoring system of PPCC and CPCB.	PM_{10},$PM_{2.5}$,SO_2,NOx and Ozone
2.	Noise	Every six months by inhouse staff and yearly by external agencies	Ambient Equivalent continuous Sound Pressure Levels (Leq) near compressors, motors, reactors, DG sets at day and night-time.
3.	Stack Emission	Monthly	PM, SO_2 and NO_x
		Quarterly	VOC emissions
4	Fugitive emissions	Once in six months (near Production block and RM storage)	VOC emissions
5.	Liquid Effluents	Monthly	pH, Temp, Conductivity, TSS, TDS, BOD,COD
		Quarterly by PPCC	pH, Temp, Conductivity, TSS, TDS, BOD, COD
6.	Ground Water	Once in six months	pH, Temp, Conductivity, TSS, TDS, BOD, O&G Heavy metals, COD
7.	Soil	Once in six months(near Hazardous waste storage area, at site)	Physicochemical properties, Nutrients, Heavy metals
8.	Workplace	Once in six months	Noise, VOC & Lux Level

6.4 Monitoring by Strides Shasun

The environmental monitoring shall be carried out by Strides Shasun within their industry premises. Monitoring guidelines should clearly indicate the conditions of discharge and the consequences with regards to the penal action and the impact to ground water resources of the region. Groundwater is the sole water source for millions of people in the adjoining areas. Strides Shasun Ltd. should not only limit the environmental monitoring as stated above, environmental monitoring programme in terms of parameters, location and frequency shall be formulated as per the stipulations laid by PPCC/CPCB/MoEF&CC/SEIAA in their respective Environmental Clearance/Consent To Establish (CTE)/Consent To Operate (CTO).

6.5 Compliance Reports

As a part of environmental monitoring programme, following compliance reports shall be submitted to PPCC and Regional Office of MoEF&CC.

- Half yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions on June 01 and December 01 of every calendar year
- Environmental statement (Form-V) for the financial year ending March 31 to PPCC on or before September 30 every year
- Format for maintaining records of hazardous waste if any in Form-3 as per Hazardous and other Wastes (Management and Handling and Transboundary movement) Rules, 2008
- Format for maintaining hazardous waste imported and exported in Form-10 as per Hazardous Waste (Management and Transboundary movement) Rules, 2016
- Safety data sheet for hazardous chemicals shall be maintained as per schedule-9 of MSIHC rules, 1989 (amended 2000),
- Format for maintaining notification of major accident in schedule-6 as per MISHC rules, 1989 (amended 2000)
- Water Cess returns in Form-1 as per Rule 4 (1) of Water (Prevention & Control of Pollution) Cess Rules 1978 on or before the 5th of every calendar month.

PPCC Monitoring Compliance Report is included in **Annexure 28.**

6.6 Greenbelt Management

Strides Shasun is committed to maintaining greenbelt to mitigate any emissions resulting from its activities and hence enhance air quality around the premises. An area of 9.19 Acres (37193

Sq.m) will be earmarked for greenbelt development after the proposed expansion. Local species which can withstand dust emission, has good spread of foliage for effective noise mitigation and consumes less water for growth. Environmental Management Cell/team will monitor the following activities of greenbelt and landscape development:

- Development of nursery (if possible)
- Treatment and sowing of seeds
- Watering
- Transport of seedlings
- Planting of seedlings
- Fencing of plantation area
- Weeding and soil working
- Pruning (trimming of plant)
- Replacement/Inter planting
- Watch and ward of plantation

During operation phase periodic monitoring of plantation growth, manuring, watering, pruning, and replacement will be performed in order to properly maintain vegetation, greenbelt, landscape and green cover. Edible species in the existing greenbelt shall be replaced with non edible species in a phase by phase replacement program within March 2018.The list of species in the existing and proposed greenbelt is given as **Table 6-2**.

Table 6-2 List of Existing and Proposed trees in Greenbelt

S.No	Name of the Plant	Scientific Name	Existing	Proposed	Total
1	Silver wattle	Acacia dealbata	20	0	20
2	Sarakonnai	Cassia Fistula	10	5	15
3	Yellow Konnai	Cassia siamea	18	4	22
4	Gulmohar	Delonix regia	20	10	30
5	Neem Tree	Azadirachta indica	65	20	85
6	Coconut Tree	Cocos nucifera	110	0	110
7	Mango Tree	Mangifera indica	15	0	15
8	Cashew Tree	Anacardium occidentale	100	0	100
9	Bamboo Tree	Bambusa vulgaris	1500	600	2100
10	Jack tree	Artocarpus heterophyllus	11	0	11
11	Guava Tree	Psidium guajava	10	0	10
12	Sapota	Manilkara zapota	12	0	12
13	Teak	Tectona grandis	100	30	130
14	Eucalyptus	Eucalyptus globus	12	0	12
15	Palm Tree	Syagrus romanzoffiana	9	0	9
16	Drumstick	Moringa oleifera	15	0	15
17	Tamarind	Tamarindus indica	5	0	5
18	Citrus	Citrus limon	25	0	25
19	Christmas	Araucaria columnaris	15	0	15

20	Pomegranate	Punica granatum	12	0	12
Total			2084	669	2753

6.7 On-site Mock Drills Requirements

On-site mock drills are very important as it helps employees to be aware of the safety procedures and how to react during the time of crisis. Conducting mock drills at regular intervals enhances preparedness and checks the viability of environmental/disaster management plan. Mock drills are essential for the following reasons:

- Helps in revising/improving the environmental/disaster management plan.
- Helps to evaluate whether the responsible officials are trained efficiently for the unforeseen event.
- Helps in evaluating whether the emergency equipment are being maintained at Strides Shasun premises.

To ensure efficient environmental/disaster management, Strides Shasun authority/EHS department/EMP cell shall conduct periodic on-site mock drills in case of occurrence of the following activities:

- Fire, Natural calamities (cyclones, floods, earthquakes).
- Power break down.
- Oil spill.
- Bomb threats; War alerts/terrorist attacks.

Mock drills should also involve fire department, police, municipal authorities, hospitals and other department/agencies that are mandated to provide emergency support. Documenting the outcome of mock drills is an important aspect as this helps in revising the existing plan more efficiently. In all safety programmes the right personnel need to be employed and this is of utmost importance.

CHAPTER – 7

ADDITIONAL STUDIES

7 ADDITIONAL STUDIES

7.1 Public Hearing

The Proposed Project is termed under Schedule 5 (f), Category A, Bulk Drugs and Intermediates as per the EIA Notification 2006.The proposed project is located at Periyakalapet, Puducherry. As per MoEF & CC Office Memorandum, dated 3rd June 2009; EIA Notification, 2006 in para 7 (i), sub section III it attracts public hearing for expansion or modernization or change of product mix in existing projects as it is not located inside industrial estate. As the project is located within 5 Km of Tamilnadu Puducherry interstate boundary, it attracts general condition as per EIA notification 2006 and hence to be appraised by EAC, MoEF & CC under Category A, 5(f).

7.2 Disaster Management Plan

An onsite emergency plan is attributed to the response plan that contains and minimizes the effects due to emergencies within the installations which have a potential to cause damage to people and facilities within the installation premises.In the On-Site and Off-Site emergency action plan, an effort is made to cover aspects like risk and environmental impact assessment, emergency organization, communication system, action on site in case of an emergency, off-site emergency plan, training, rehearsal, record etc., in detail.

The on-site emergency plan is attached as **Annexure 14**.

7.3 Rehabilitation and resettlement (R &R)

Rehabilitation and resettlement (R&R) is not applicable since the project is coming up within already existing premises of Strides Shasun Limited at Periyakalapet, Puducherry.

7.4 Risk Assessment

The detailed risk assessment report for the proposed project is enclosed as **Annexure 15.**

7.5 Toxicity Studies

As directed in the ToR obtained by Strides Shasun from MoEF dated 16th August 2017, Toxicity studies were carried out for all the chemicals used in the production process to study their impact in the local environment. The methodology and results of the same is enclosed as **Annexure 17.**

7.6 CRZ demarcation studies

CRZ demarcation studies have been recommended in the additional ToR issued by MoEF&CC. The facility is located about 1.72 Km towards east of Bay of Bengal and hence is falling outside the purview of the CRZ Notification, 2011. Also, the marine disposal pipeline in the existing facility has already been discontinued with effect from October 2017. Hence CRZ demarcation has not been carried out for the proposed expansion.

CHAPTER – 8

PROJECT BENEFITS

8 PROJECT BENEFITS

The main objective of the proposed project is to meet the current market demand as newer diseases and changes in lifestyle increased the demand for new drugs in the current global scenario.

The benefit of the proposed expansion of Strides Shasun Limited includes:

- Effective Drugs to treat life threatening disease, which will save millions of lives
- The project site shall require no displacement of habitation and away from the habitation area, as it is located within already existing premises of Strides Shasun Limited at Periyakalapet, Puducherry.
- Socio-economic benefit to the locals as it would provide employment for operation of the plant both direct employment and indirect employment (Contract works).
- Various Skill Development, Education, Healthcare Programmes & Infrastructure developments are proposed through the CSR programmes by which many villages around the facility will be benefitted.
- Water will be recycled and reused in this project thereby reducing the stress on the resource
- There will be better revenue generation for the govt by means of Taxes and duties.
- As Strides Shasun proposes these products for export purpose, there will be better foreign exchange benefiting the Govt.
- The image of our country will be better positioned as we enter into partnership to deliver products which are being developed by major Pharma companies. Strides Shasun will be one among few companies in the world to produce such complex molecules.
- Also by this project the socio economic development of the local region will be getting a boost by means of job opportunities for transport, supplementary supplies, employees of Strides Shasun living around the facility which will create overall social development.
- The proposed products will be produced in a better and more efficient manner with necessary mitigation measures in place to lower any impacts on the surrounding environment.
- The proposed project which has zero liquid discharge system, which does not discharge any effluent to ground or surroundings,
- The proposal will bring trade and export opportunities to the country.

- It will also provide employment opportunities to a larger population.
- The corporate social responsibilities that will be taken up by the proposed project will improve the well-being of the society and the corporate responsibilities towards the protection of the environment will help in conserving the ecosystem.

CHAPTER – 9

ENVIRONMENTAL MANAGEMENT PLAN

9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 Introduction

This Environmental Management Plan (EMP) for the M/s. Strides Shasun Ltd identifies the principles, procedures and methods that will be used to control and minimize the environmental impacts of the proposed minor construction and operational activities associated with the expansion project development. It is intended to ensure that commitments are made by Strides Shasun to minimize project related environmental and social impacts.

As part of the ongoing commitment of Strides Shasun Ltd to excel in environmental and social performance the proponent shall ensure the following:

i. Fulfill all environmental conditions associated with project approvals.
ii. Develop, promote and foster a shared sense of responsibility for environmental and performance of the project.
iii. Promote environmental awareness and understanding among employees and contractors through training, identification of roles and responsibilities towards environmental management.
iv. Linking project performance to overall environmental performance.
v. To monitor the environmental performance throughout the project and implement an adaptive management approach for continuous improvement and to meet the regulations.

9.2 Objectives of EMP

- To suggest the formation of a core group (Environment Management Cell) responsible for implementation of environmental control & protective measures as well as monitoring of such implementation.
- To ensure project components are compliant with all laws and approval conditions.
- Continue baseline monitoring
- Facilitate a continual review of post construction and operation activities.
- To suggest preventive and mitigation measures to minimize adverse impact and to maximize beneficial impacts like.
- Preparation of afforestation or Greenbelt Development scheme.
- Preparation of rain water harvesting scheme and energy conservation actions

- To prepare a capital cost estimate and annual recurring cost for Environmental Management Plan.
- To prepare a detailed action plan for implementation of mitigation measures.
- Measure the effectiveness and success of proposed mitigation measures

9.3 EMP Roles and Responsibilities

9.3.1 Environmental Management Cell

The effective implementation of the mitigation measures and consistent functioning of the proposed project, an Environmental Management System (EMS) has been proposed. The EMS includes the following:

- Environmental Management Cell
- Environmental Monitoring Program
- Personnel Training
- Regular Environmental Audits and Corrective Action Plan
- Documentation-Standard Operating procedures of Environmental Management

- All the activities will be monitored to ensure the appropriate implementation of all environmental mitigation activities and to identify areas where environmental management plan compliance is not satisfied.
- For effective implementation of the system, it is also necessary to have a permanent organizational set-up. Company has set-up permanent Environmental Management Cell (EMC) for the effective implementation and monitoring of environmental management system.
- The company has assigned responsibility to the concerned personnel for implementation of environmental control measures.
- The Environmental Management Cell (EMC) set-up by the company is given as below in **Figure 9-1**.

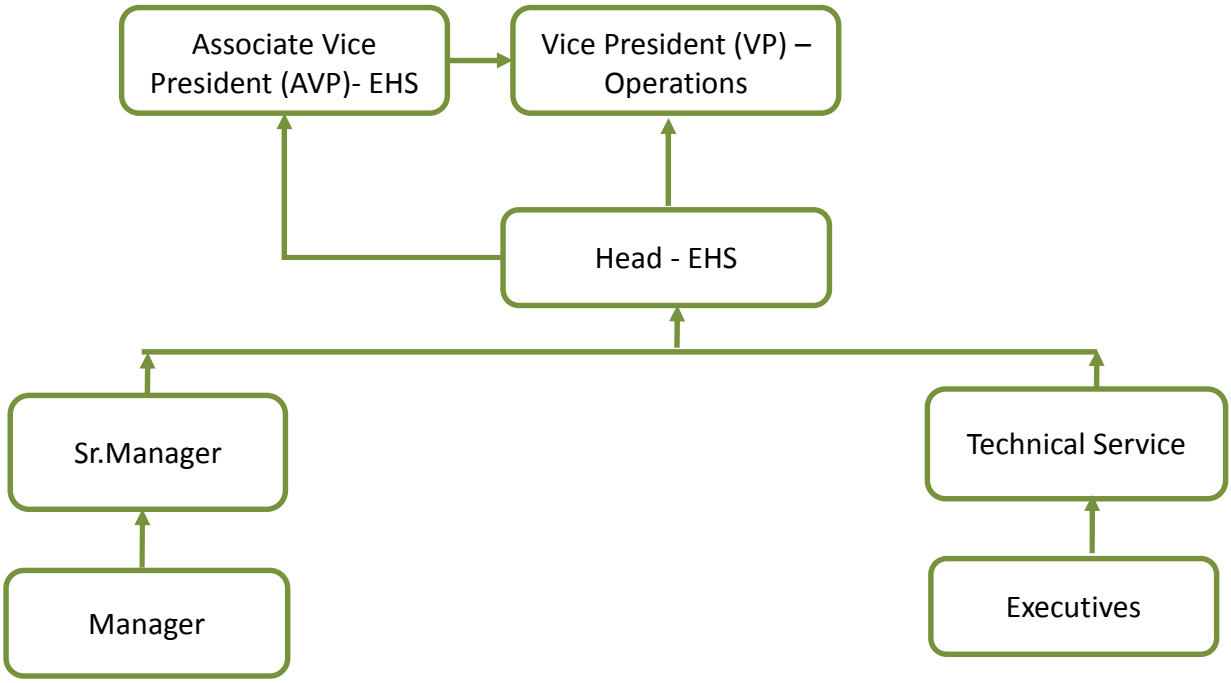


Figure 9-1 Environment Management Cell Organogram

This section describes the organizational structure and responsibilities for implementation of the EMP as shown below in **Table 9-1.**

Table 9-1 EMPResponsibility

S.No	Organization	Responsibility
1.	M/s. Strides Shasun Limited	Overall responsibility for environmental performance of Strides Shasun Ltd • Decision-maker on applicable policies to the Strides Shasun Ltd. • Overall supervisory role during the construction phase • Overall responsibility for EMP implementation during the operating phase • Review reports of the Environmental Monitoring Consultant (EMC) • Responsible for changes to the EMP as part of an adaptive approach to environmental and social management of the company

2.	M/s Strides Shasun-Limited	• Develop an environmental Cell, headed by the VP – Operations with a team having EHS Professionals to implement EMP responsibilities. • Oversight, implementation, monitoring and compliance of the EMP and any approval conditions, including construction supervision and performance of all Shasun staff, contractors and all subcontractors • Review of EMP performance and implementation of correction action, or stop work procedures, in the event of breaches of EMP conditions, that may lead to serious impacts on local communities, or affect the reputation of the project • Ensuring effective communication and dissemination of the content and requirements of the EMP to contractors and subcontractors • Report on environmental performance also to other government regulators as required. • Assisting the contractor with implementation of EMP sub-plans • Ensuring compliance to all project social commitments, including implementation of corporate social responsibility. • Report environmental performance of the project directly to MoEF & CC/PPCC
3.	Supervising Engineer	• Implementation of the Environmental Monitoring Plan during construction and operation. • Supervision of contractor performance of implementation of the Construction. • Reporting any incidents or non-compliance with the EMP to the PPCC. • Ensuring adequate training and education of all staff involved in environmental supervision. • Reporting to MoEF&CC/PPCC regarding EMP performance as part of an overall commitment to continuous improvement.
4.	Construction Contractor	• Preparation and implementation of the Construction Management Plan • Prepare and maintain records and all required reporting data as stipulated by the EMP, for submission to the Supervising Engineer. • Ensure that all construction personnel and subcontractors are informed of the intent of the EMP and are made aware of the required measures for environmental and social compliance and performance • During construction, maintain traffic safety along access roads, with special emphasis on high traffic areas
5.	Independent Environmental Monitoring Consultant (IEMC)	• Report to MOEF & CC/SEIAA on project compliance with environmental and social commitments in the EMP, EIA and other applicable standards.

In addition to the above, company has EHS policy as given in **Figure 9-2** to adhere with standard operating process in order to comply with the statues and bring into focus any infringement of any norms and directives with regards to the Health, Safety and Environment and to take further corrective actions. Organization of EHS is given in **Figure 9-3**.

Strides Shasun

ENVIRONMENT, HEALTH & SAFETY POLICY

Strides Shasun Limited accepts Environment, Occupational Health & Safety as its business and ethical responsibility and is committed to provide a healthy, safe and environment friendly workplace in its business of manufacture and supply of Pharmaceuticals Formulations, Active Pharmaceuticals Ingredients and their intermediates including all products manufactured.
To achieve this, the company will, in particular,

- Comply with all applicable laws, regulations and standards related to Environment, Occupational Health & Safety.
- Provide required resources for implementation and monitoring of this policy.
- Make environmental, health, safety considerations a priority in the planning for new projects, products, and processes, and upgrading of existing products and processes.
- Strive for continual improvement in the performance of its Occupational, Health, Safety & Environment standards, taking into account, employees' involvement, community expectations, management practices, scientific knowledge and technology.
- Integrate the environment, health & safety practices and performance as an essential factor in the employee Performance Evaluation.
- Prevent the employee injuries by managing the risk through implementing a system of periodical risk assessment, safety audit etc., to identify and control hazards related to fire, chemical, mechanical and environment
- Encourage and promote waste minimisation, energy efficiency and resource conservation, for supporting sustainable development
- Encourage employees' compliance to the EHS policy by promoting this as an inherent part of their work culture and providing support through training, workshops and other motivational activities etc.
- Educate all employees, contractors, sub-contractors, transporters, visitors and other interested parties about the EHS policy & emergency procedures so that they abide by the rules, regulations, instructions and systems in respect of EHS policy & emergency procedures.
- Promote the policy through prominent displays to bring it to attention of all.
- Report the EHS performance in the annual report.
- Review this policy periodically and revise appropriately.

S. Abhaya Kumar
Executive Director

Date: - 28.03.2016

Figure 9-2EHS Policy of Strides Shasun

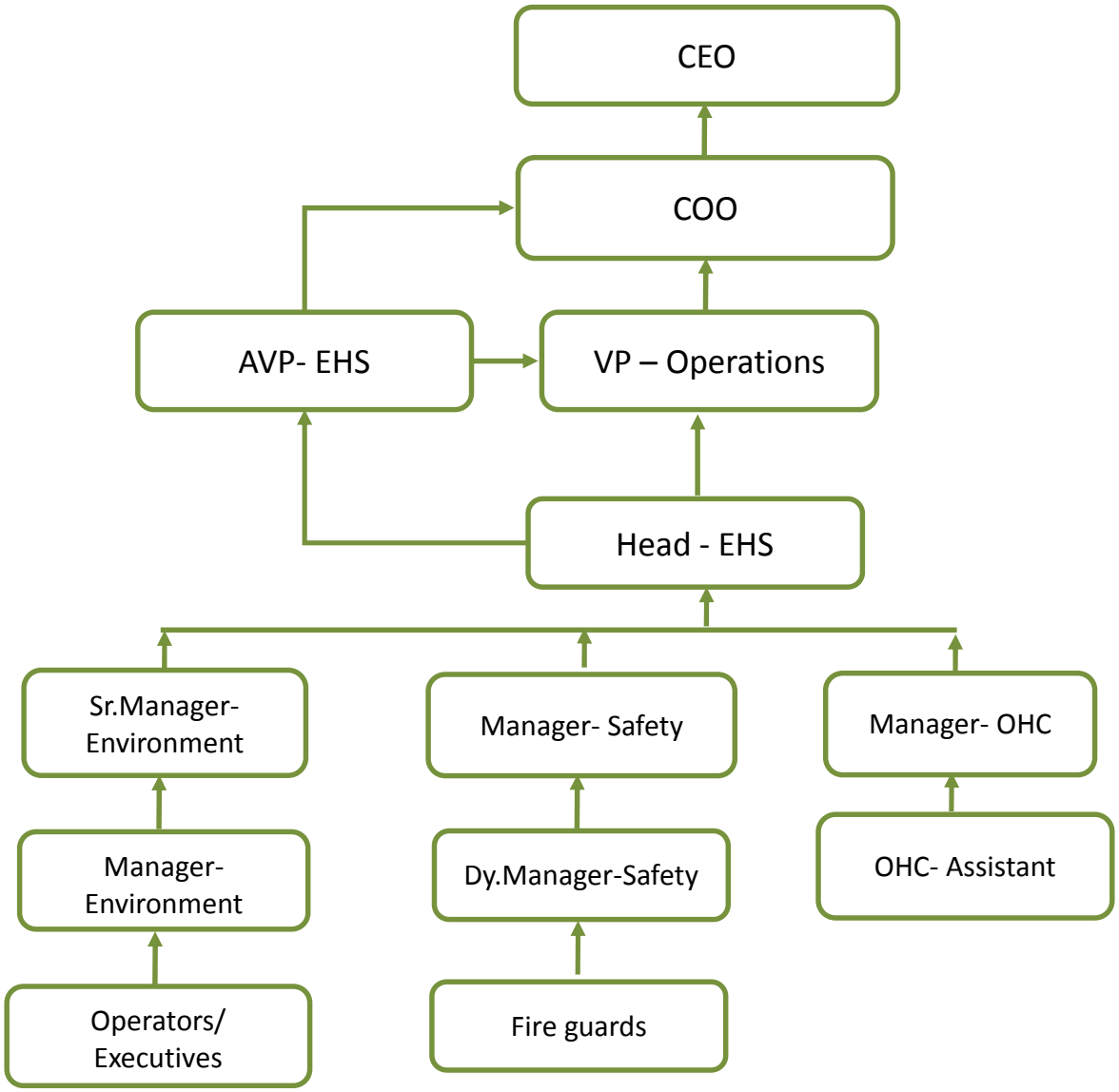


Figure 9-3 EHS Organogram of Strides Shasun

9.3.2 Compliance against the Consent Condition

Compliance against the consented conditions shall be observed with respect to the following Acts

- Water (Prevention & Control of Pollution) Act, 1974
- Air (Prevention & Control of Pollution) Act 1981
- Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules 2016.

Table9-2Compliance against the Consent Condition

S. No.	Description	Frequency	Remark
1.	Renewal of Consent	Once in a year	Application for renewal shall be done 60 days before the expiry date.
2.	Environmental Statement	Once in a year	Would be submitted for every financial year before 30th September of next year.
3.	Hazardous Waste Returns	Once in a year	Would be submitted for every financial year before 30th June of next year.
4.	Cess Returns	Monthly	Twelve Returns would be submitted every year.

9.3.3 Roles and Responsibilities for Environmental Management

The roles and responsibilities of Industry are brought out in **Table9-3.** These roles and responsibilities can be shared by developer as a part of agreement with Strides Shasun Limited and shall have clear terms on environmental management responsibilities.

Table9-3 Roles and Responsibilities of Industry

S. No.	Component	Responsibility of Industry
1	General agreement	Strictly adhere to the plot allotment guidelines and agreement. No pollutant shall be released to Natural water systems that affect the common people of the region.
2	Water supply	Water requirement shall be met from existing Inhouse Borewell Groundwater shall not be contaminated by discharge of pollutants into streams, ponds and other surface water bodies.
3	Water recycle/reuse	Industries adopted recycle/reuse methodologies to the maximum extent possible. (Zero Liquid discharge facility and Rain water Harvesting)
4	Wastewater collection/ conveyance	The wastewater conveyance (pipeline) within industry provided
5	Treated wastewater monitoring protocol	Monitoring of wastewater on a regular basis by Strides Shasun Ltd. carried out as per SOPS and regulatory standards at their respective holding for pH, TDS, TSS, BOD &COD etc.
6	Rainwater harvesting	Rainwater harvesting in industry premises adopted.

S. No.	Component	Responsibility of Industry
7	Waste management	Industry has independent Hazardous/Non-hazardous waste collection and segregation system and has a temporary storage facility for 90 days detention which is designed as per the requirement. Wastes are periodically disposed to PPCC authorized vendors as per the Authorisation for Handling of Hazardous Waste issued by PPCC. Industry shall follow "The Hazardous Wastes (Management, Handling and Transboundary Movement) Third Amendment Rules, 2016".
8	Post project environmental monitoring	Industry specific critical pollutants shall be monitored at industry level. Specific requirement of monitoring and carried out as a part of compliance to CTE/CTO.
9	Stack monitoring	Stack monitoring carried out by MoEF approved laboratory
10	Greenbelt development	Greenbelt and green areas developed in the industry level as per MoEF & CC norms.
11	Storm water management	Stormwater collection provided within the industry and discharge facility into the common municipal storm water drains provided outside the premises.

9.4 EMP for Construction Phase

Environmental monitoring will be done during construction and operation. Details of the proposed environmental monitoring program are presented in Chapter 6 of the report. The focus of monitoring during the construction phase will be to implement systematic observations to periodically measure the success of proposed mitigation measures and continue baseline data collection. The majority of construction monitoring shall be done visually and verified by the Construction Supervisor. An Independent Environmental Monitoring Consultant (IEMC) will be responsible for carrying out environmental sampling and monitoring on all environmentally related issues regarding the Construction Contractor's activities. Specific aspects to be addressed during construction phase include:

1. Air quality
2. Noise
3. Water quality and water resources
4. Solid waste

5. Land environment
6. Ecology
7. Socio Economic

9.4.1 Air Quality

During construction activities, dust re-suspension and emissions from the movement of vehicles and construction activity is expected. However, the following measures will be taken to reduce / contain such emissions.

- The entire construction area will be barricaded to isolate from other plant area.
- Water will be sprinkled on inner roads to prevent re-suspension of dust into ambient air due to movement of heavy vehicles etc.
- Roads shall be kept free from mud, debris and other obstacles.
- Separate construction material storage yard will be created within the site and it will be enclosed.
- Cement bags will be separately stored under cover in bales. Sand will be stacked under tarpaulin cover.
- Transport vehicles and construction equipments/machineries will be properly maintained to reduce air emissions.
- Idle running of vehicles will be minimized during material loading/unloading operations.

9.4.2 Noise Environment

- Following measures are proposed during construction period to mitigate adverse impacts of noise
- Construction activities will be confined to daylight hours.
- All machineries to be used for construction purpose will be of highest standard of reputed make and compliance of noise pollution control norms by these equipments will be emphasized by SPL.
- All construction workers working in high noise areas will be provided appropriate PPEs like ear muffs and made to wear them during working hours.
- Signage boards will be kept to reduce noise levels within site.

9.4.3 Water Quality and Water Resources

- Maximum water requirement for construction purpose including domestic water requirement of construction workers is estimated to be approximately 12 KLD.
- Water requirement will be met from supply by private tankers.
- Since the construction workers are hired from nearby villages there will be no housing facility at the site for construction workers.
- Proper and sufficient sanitary facility already exists at the site in the form of toilets & STP.

9.4.4 Solid Waste

- Main solid waste generation during construction phase will be construction debris like rubble, brickbats, debris, steel scrap, wooden scrap, sand, gravel etc. However, these materials are inert in nature and will not result into leaching of any substance or its constituent.
- These materials will be carefully sorted and will be used within premises for filling of low lying areas.
- Wooden scrap, steel scrap, plastic will be given to authorized scrap dealers.
- On completion of civil work, all debris etc. will be completely removed from site to avoid any incompatibility with future use.
- All the wastes will be stored at a designated site within the premises to prevent scattered discharge on land.

9.4.5 Land Environment

Following steps are proposed to mitigate impact of construction activity on the project land area

- Top soil layers shall be stored and will be used for green belt development.
- Proper drainage will be maintained as is it an existing site.
- Re-vegetate, wherever feasible to contain Runoff.
- Solid waste will be properly disposed off with authorized vendors to avoid impacts on land. No open burning/disposal of waste will be allowed.

9.4.6 Ecology

Project site is an existing unit and there is no cutting of trees for the expansion project and no

major impact on ecology is anticipated. Since the site is located within existing premises of Strides Shasun Ltd, there will be no major impact on ecology.

9.4.7 Socio Economic

As there will be no temporary housing colony for construction workers, no socio economic impact due to the same is envisaged. Overall socio-economic effect of construction phase will be positive due to direct and indirect employment opportunity for the local population.

9.5 EMP for Operational Phase

Monitoring during the operation phase shall reflect those environmental and socio-economic issues that may persist upon completion of construction activities. Monitoring shall focus on evaluating the effectiveness of project mitigation measures and continue baseline monitoring and sampling. The mitigation measures to prevent adverse impact during the operation phase of the project shall focus on the following:

1. Air quality
2. Noise environment
3. Water quality and water resources
4. Solid and hazardous waste
5. Land environment
6. Ecology
7. Socio Economic

9.5.1 Air Quality

The major source of emission is from Vent condensers, Boiler & DG stack. The details of proposed source of air pollution & corresponding Air Pollution control equipment are already given in Chapter 4 Environmental Impacts and mitigation measures.

APC measures are adequate stack height to disperse the pollutants. Adequate green belt has been developed to mitigate the pollution arising due to movement of vehicles. Some of the existing air pollution control measures are shown in **Figure 9-4.** Regular monitoring of DG-Stack and Ambient air quality will be carried out. Except DG stacks all the other stacks are connected to online monitoring system. Sensors are shown in **Figure 9**:**5.** List of Sensors connected to online monitoring system are given in **Table 9-4**.

Table 9-4 List of Sensors connected to Online Monitoring System

S.No.	CEMS details	Source: stack / ambient	Name of the Stack attached to / Location	Commissioned Year
1	VOC Monitor 1	Ambient	IBU Derivative plant	2015
2	VOC Monitor 2	Ambient	Above the Ibuprofen Finished Product Storage room-3	2015
3	HCl Sensor	Ambient	IPCA section	2015
4	VOC Monitor 3	Ambient	ETP Block	2015
5	SPM, SOx, NOx, Cox -1	Stack	Old boiler house chimney	2015
6	SPM, SOx, NOx, COx -2	Stack	New boiler house chimney	2017

Wet Scrubber

Bag Filter

Figure 9-4 Existing air pollution control measures

The following additional measures are proposed to mitigate negative impact during the operation phase on the surrounding air environment.

- VFD installed in the boiler ID to control the excess air.
- Cyclone separator & Bag filter is installed in boiler belt conveyor & crusher to collect the briquette dust.
- Wet ash from boiler combustion zone (moving grate) will be collected in wet ash conveyor (conveyor dipped in water) and same will be transferred to the weather proof storage yard.
- Dry Ash from boiler economizer- bag filter will be conveyed through belt conveyor and it will be fed to the closed ash bunker. From the Bunker it will be transferred to the Tractor through screw conveyor, which is distributed for the local agricultural purpose.
- Height of scrubber vent is as per statutory requirement.
- Adequate spares of critical components of scrubber system are kept to ensure trouble – free operations and continuous compliance to emission norms.

Boiler Stack Monitor

VOC Monitor (IBU Derivative block)

Figure 9:5 Sensors Connected to Online monitoring system

Fugitive emission control

- Fugitive emission at various locations of the work zone environment is monitored on regular basis. Moreover following measures have been taken to minimize the fugitive emissions
- The identified reactors are connected either with acid scrubber (Caustic Solution as the scrubbing media) or with filter (to scrub the VOC emissions).
- All process operations are done in a closed system.
- For identified reactors reflux condensers are provided to eliminate the emissions.
- Acids are pumped from storage tank to reactors by pipe line in a closed system
- For corrosion protection, tanks are painted with anticorrosive paints and RCC dykes provided.

Solvent Handling System

The following actions are taken for the management of solvent handling in the various process operations.

- The identified reactors are connected to chilled brine condenser system having adequate heat transfer area and residence time.
- The reactors& pumps are provided with mechanical seals to avoid any leakages.
- Solvents are stored in separate location specified with all safety measure like solvent storage tank.
- Double earthing provided in all the electrical equipment wherever solvent handling is done.

  Entire plant area is declared flame proof. Solvent storage tanks are underground to avoid vapour loss. Solvents having boiling point <45°C are connected with vent condenser with chilled brine circulation.

Some of the measures are shown in **Figure 9-6.**

Storage tanks with dykes

Safety Valves

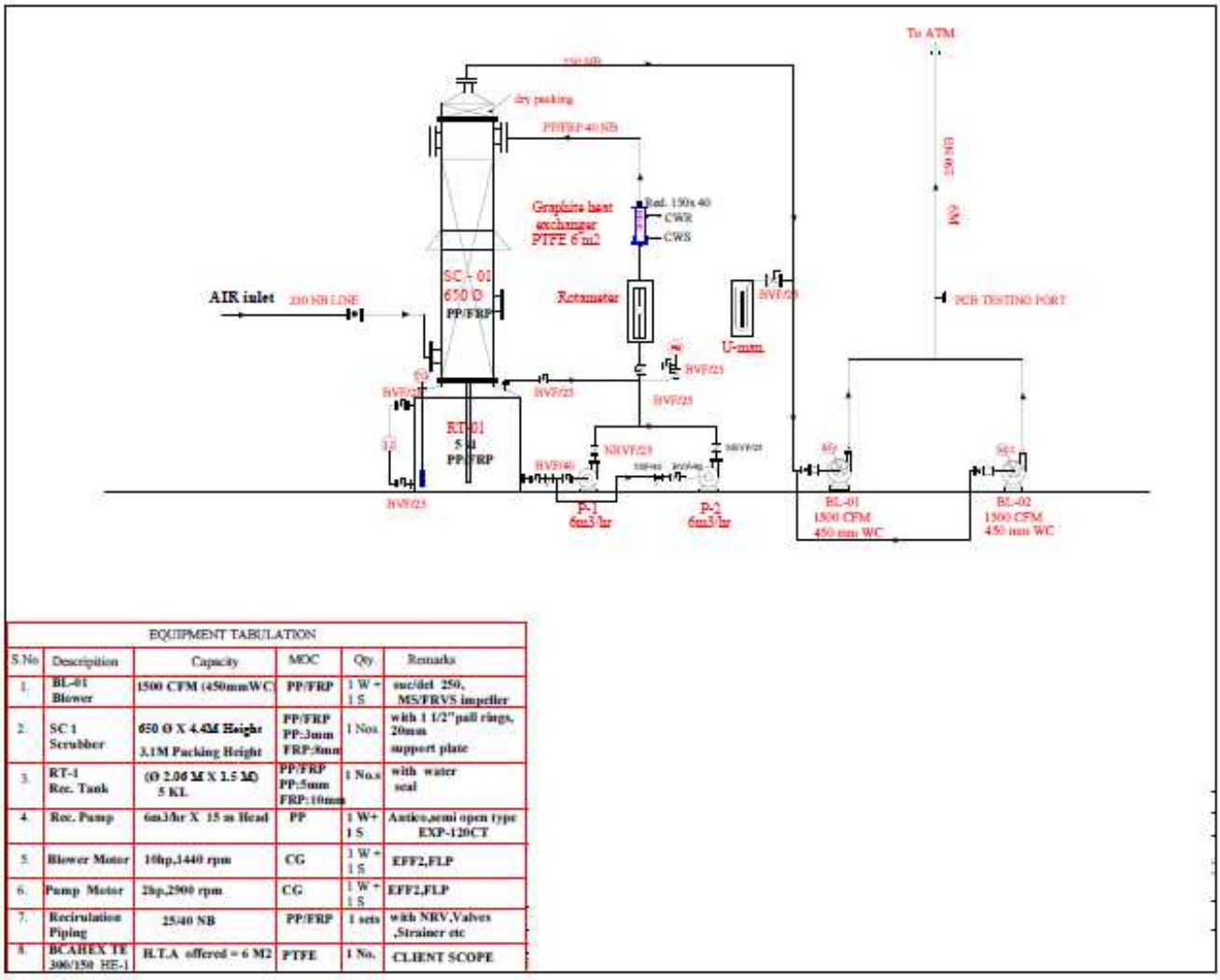
Underground Solvent Storage tank

Figure 9-6Solvent Handling System

Acid Scrubber

The acid scrubbing system basically comprises of packed scrubbing column with caustic solution as scrubbing media. Gas streams emanating from the process are fed into a Packed Tower bottom, to contact with scrubbing liquid circulated through the packed tower spray nozzles at the top. The toxic or corrosive compounds are absorbed by the scrubbing

liquid and uncontaminated vapour is vent out. The scrubber prevents the escaping of toxic or corrosive contaminants from the process vapour. The clean gas exits through the top of the scrubbing unit. On pH variation, the scrubbing liquid will be sent to ETP for treatment to take fresh caustic lye. After scrubbing with alkyl medium, clean air is exhausted to the atmosphere. P& I diagram of Acid Scrubbing system is given in **Figure 9-7.** Acid scrubber in existing facility is shown in **Figure 9-8**.



EQUIPMENT TABULATION

S.No	Description	Capacity	MOC	Qty	Remarks
1.	BL-01 Blower	1500 CFM (450mmWC)	PP/FRP	1 W + 1 S	suc/del 250, MS/FRVS impeller
2.	SC 1 Scrubber	650 Ø X 4.4M Height 3.1M Packing Height	PP/FRP PP:3mm FRP:8mm	1 Nos.	with 1 1/2" pall rings, 20mm support plate
3.	RT-1 Rec. Tank	(Ø 2.06 M X 1.5 M) 5 KL	PP/FRP PP:5mm FRP:10mm	1 No.s	with water seal
4.	Rec. Pump	6m3/hr X 15 m Head	PP	1 W+ 1 S	Aatico,semi open type EXP-120CT
5.	Blower Motor	10hp,1440 rpm	CG	1 W + 1 S	EFF2,FLP
6.	Pump Motor	2hp,2900 rpm	CG	1 W + 1 S	EFF2,FLP
7.	Recirulation Piping	25/40 NB	PP/FRP	1 sets	with NRV,Valves ,Strainer etc
8.	BCAHEX TE 306/150 HE-1	H.T.A offered = 6 M2	PTFE	1 No.	CLIENT SCOPE

Figure 9-7 P&I of Acid Scrubbing System

Figure 9-8 Acid Scrubber

Solvent Recovery

Solvents used in the process are recovered within the process and reused.

9.5.2 Noise Environment

The major source of noise pollution in the industry is DG sets, boilers, reactors, Air compressors, Boiler feed water pumps. DG sets are provided with integral acoustic enclosures. Also the ambient noise levels will be ensured within the ambient standards by inbuilt design of mechanical equipment and buildings apart from vegetation along the periphery and at various locations within the industry premises. The plant will be specifically designed with due consideration on minimizing noise pollution. Higher noise levels may be felt only near the active working areas and therefore the workers are provided with personal protective equipment as a safety measure.

Following measures are proposed to mitigate negative impact of operation phase of the project on the surrounding noise environment.

- All the noise generating equipments will be designed / operated to ensure that noise level does not exceed 75-70 dB (A) at plant boundary as per the requirement of Central / State Pollution Control Board.
- Noise generating sources will be maintained properly to minimize noise generated by them.
- Wherever feasible, acoustic enclosures will be provided for compressors, DG sets.
- Compliance with noise control norms will be given due importance at the time of purchase of various equipments and it will be mentioned while placing the purchase orders and guarantee for noise standards will be sought from suppliers.
- Moreover, all the personnel working in other high noise generating areas too will be provided with sufficient ear protecting devices.
- Green belt will act as a noise barrier.
- Training will be imparted to personnel to generate awareness about effects of noise and importance of using PPEs.

9.5.3 Water and Wastewater Management

9.5.3.1 Wastewater Treatment System

The effluents and domestic sewage generated during operation will be treated in Combined Effluent Treatment Plant (ZLD system).The existing ZLD system was commissioned in September 2017.TheCombined wastewater Treatment Plant in the existing facility will be handling the increased quantity of effluents after expansion as it is found adequate.ZLD adequacy report is attached as **Annexure 10** and wastewater treatment system specifications as **Annexure 11.** Marine disposal in the existing has been discontinued with effect from October 2017.

The following measures are proposed to mitigate negative impact of operation phase of the project on the water quality and water resources.

The total water requirement after proposed expansion is 2315 KLD. Freshwater consumption is 498 KLD sourced from inhouse borewells. 1817 KLD recycled water will be consumed of which 198 KLD will be sent back to the Strides Shasun Formulation unit. 590 KLD treated sewage is sourced from PWD, MGMC, PIMS etc and 156 KLD of treated sewage water and 43 KLD of process effluent will be sourced from Strides Shasun Formulation Division.

The proposed expansion facility will generate 45 KLD sewage from domestic activities and 550 KLD effluents from industrial operations/processes. Process effluent generated from the proposed expansion along with the wastewater (43 KLD process effluent and 156 KLD sewage) from Strides Shasun formulation unit would be treated in combined effluent treatment plant. The effluents generated from manufacturing process (550 KLD) will be sent to the MEE. The condensate from MEE (750 KLD) will be sent for Biological Treatment to ETP (Biological Treatment Plant 1) followed by RO I. The wastewater from Strides Shasun formulation unit will be sent to Biological Treatment Plant 2 followed by RO II I. The reject from RO I (113 KLD) and RO II (208 KLD) will be sent to RO III and permeate recycled. The Reject from RO III (80 KLD) will be sent to MEE.Concentrate from Multiple Effect Evaporator (MEE) will be treated in Agitated Thin Film Drier (ATFD) and the sludge generated from biological treatment system and ATFD salt will be stored inhouse with options to dispose to nearby TSDF sites/Co processor. The domestic sewage (45 KLD) and treated sewage procured (746 KLD) from PIMS, MGMC, PWD etc will be treated in BTP 2 followed by RO II. Permeate from RO II (1180 KLD) will be recycled along with Permeate from RO I (638 KLD) making up a total of 1817 KLD of recycled water. Reject from RO II (208 KLD) along with reject from RO I (113 KLD) is sent to RO III and permeate from RO III (241 KLD) will be recirculated into RO II for treatment.

The detailed process flow diagram of ZLD is shown in the subsequent **Figure 9-9**. The Combined wastewater Treatment Plant in the existing facility will be modified to handle the increased quantity of effluents after expansion; hence no significant impact is envisaged after expansion. Adequacy of existing ZLD is enclosed in **Annexure-10.** The detail of existing wastewater treatment is enclosed in **Annexure -11.**

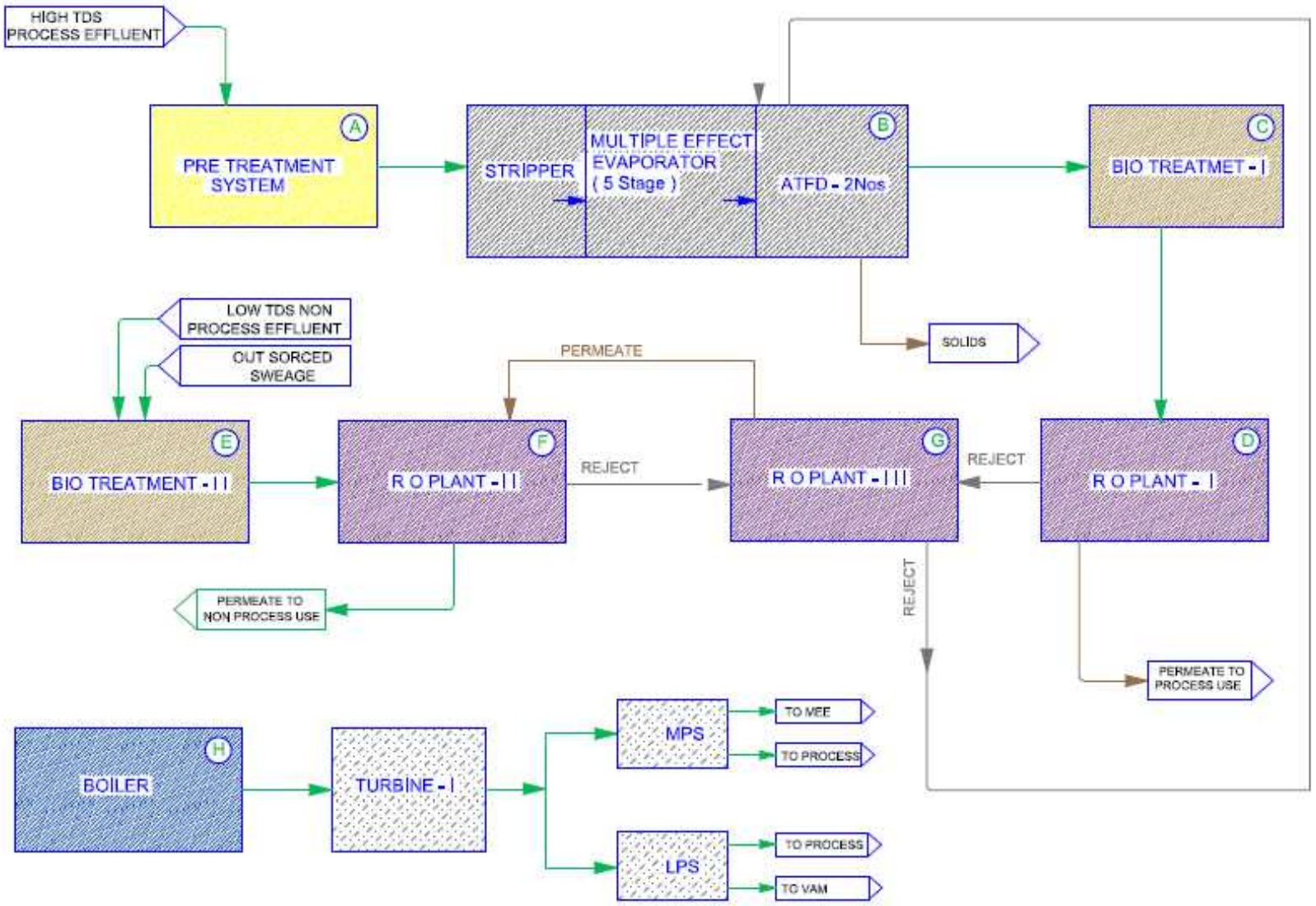


Figure 9-9 Process flow diagram of ZLD treatment system

9.5.3.2 Rainwater Harvesting

Rain water harvesting is the technique through which rain water is captured from the roof catchments with closed pipe system (without mixing surface water to avoid the spillage contamination) into the recharge pits & excess water is stored in the Rain water Storage Tank/sumps. Strides Shasun has developed rain water harvesting structures to harvest the runoff water from the rooftops and storm water drainage system for recharge of ground water.

Rooftop harvesting is practiced for Non process areas (Admin Building and canteen) from where the water collected is used for groundwater recharge through 3 recharge pits of 3m length and 1200 mm diameter. The water from process area rooftops is diverted through pipelines for rainwater collection and sourced to Cooling towers from 200 KL storage sump.

Ground coverage of (Admin and canteen building) = 814.98 Sq.m

Collection efficiencies of 80% = 652 Sq.m

Runoff of coefficients for Roofs Conventional = 0.70 to 0.80

Runoff of coefficients taken as = 0.75

Annual average rainfall for Puducherry = 1354 mm

(*Source: IMD, Puducherry (1971 –1998))*

Volume of water received (m^3) = Area of catchment in m^2 x Runoff coefficient x Annual of rainfall (mm)

Volume of water received (m^3) = 652 Sq.m x 0.75 x 1.354m

= 662.10 KL/year

Considering annual average 55 rainy days,

Volume of water received = 12 KLD

No. of recharge pits provided = 3 nos each of 1.2m dia and 3m length, i.e~ 3.4 m^3capacity each

Ground coverage of (Proposed process building) = 1861.27 Sq.m

Collection efficiencies of 80%	=	1489 Sq.m
Runoff of coefficients for Roofs Conventional		= 0.70 to 0.80
Runoff of coefficients taken as		= 0.75
Annual average rainfall for Puducherry		= 1354 mm

(*Source: IMD, Puducherry (1971 –1998))*

Volume of water received (m^3) = Area of catchment in m^2 x Runoff coefficient x Annual of rainfall (mm)

Volume of water received (m^3) = 1489 Sq.m x 0.75 x 1.354m

= 1512 KL/year

Considering annual average 55 rainy days,

Volume of water received = 27.5 KLD

No. of recharge pits to be provided = 9 nos each of 1.2m dia and 3m length, i.e~ 3.4 m^3capacity each

Ground coverage of (Existing Process area)	=	1635.80 Sq.m
Collection efficiencies of 80%	=	1308.64 Sq.m
Runoff of coefficients for Roofs Conventional	=	0.70 to 0.80
Runoff of coefficients taken as	=	0.75
Annual average rainfall for Puducherry	=	1354 mm

(*Source: IMD, Puducherry (1971 –1998))*

Volume of water received (m^3) = Area of catchment in m^2 x Runoff coefficient x Annual of rainfall (mm)

Volume of water received (m^3) = 1308.64 Sq.m x 0.75 x 1.354m

= 1329 KL/year

Considering annual average 55 rainy days,

Volume of water received = 24.16 KLD

Volume of Rain water storage tank to cooling tower = L x B x H

=5m x 2 m x 3 m

= 30 KL

9.5.3.3 Stormwater Management

Stormwater will be diverted through stormwater drains provided throughout the Strides Shasun premises to the common municipal collection drain outside the existing facility. Stormwater management layout is attached as **Annexure 13.**

9.5.4 Solid and Hazardous waste Management

9.5.4.1 Solid waste management

The solid waste generation can be broadly categorized into Non- Hazardous & Hazardous. The details of waste generation before & after expansion are listed below Non Hazardous wastes like Packing material will be disposed through authorized vendors , Food waste from canteen will be composted and used as manure for the green belt, Boiler Ash is being distributed to the local villagers for agricultural purposes. The quantity of non hazardous waste expected to be generated in the proposed facility is given in **Table 9-5**.

Table 9-5 Non Hazardous waste to be generated

S. No.	Description	Quantity (T/year)		Method of Collection	Method of Disposal
		Existing	After Modification		
1	Food waste from canteen	35	60	Manual	Composted in Organic waste convertor and used as manure
2	Boiler ash	690	1240	Manual	Distributed to the local villagers for agricultural purposes

Note: As per CPCB guidelines: MSW per capita/day =0.45kg

9.5.4.2 Hazardous waste Management

The solid waste generated in process and Combined ETP is sent to PPCC authorized vendors. Chemical containing residue from decontamination and disposal will be treated in ETP. Spent organic solvent, discarded containers/ barrels/ liners used for hazardous waste and spent carbon are disposed through PPCC authorized vendors. Hazardous wastes i.e. used/spent oil and residue, Waste/residue containing oil will be stored in 200 litre MS/HDPE barrels while ETP sludge and spent Carbon etc. will be stored in polythene bags and will be disposed through PPCC authorized vendor. Date Expired / Discarded off specification drugs / Medicines will be disposed through authorized Bio Medical waste Treatment Facility. The quantity of hazardous waste expected to be generated in the proposed facility is given in **Table9-6**.

Solid wastes are stored separately in the “Solid Waste Storage Area” within the factory premises. It has non – percolating R.C.C. floor & covered roof. The storage area has proper illumination and ventilation and equipped with fire extinguisher device. Board displaying the quantity of hazardous waste stored is displayed outside the storage block.

Table9-6 Hazardous waste and Management

Sl.No	Schedule No	Name of the Hazardous Waste	Existing Quantity KLA/TPA	Additional Quantity KLA/TPA	Total Quantity KLA/TPA	Method of Stage / Disposal
1	Class A of Schedule II	Waste Sodium Dichromate Solution	22000	13000	35000	Selling to Authorized Vendor
2	34.3 Schedule I	ETP Sludge	3	5	8	Sent to Coprocessing in Cement Industries/ GEPIL
3	5.1 Schedule I	Spent Lubricating Oil	4	6	10	Dispose to Authorized Vendor
4	5.2 Schedule I	Waste / Residue containing Oil	150	150	300	Dispose to Authorized Vendor
5	20.2 Schedule I	Spent Solvent	900	680	1580	Dispose to Authorized Vendor
6	20.3 Schedule I	Distillation Residue	48	48	96	Dispose to Authorized Vendor
7	28.1 Schedule I	Process Residue / Waste	720	620	1340	Dispose to Authorized Vendor
8	28.2 Schedule II	Spent Catalyst / Spent Carbon	54	20	74	Dispose to Authorized Vendor
9	28.3 Schedule II	Off Specification Product	1	4	5	Dispose to Authorized Vendor
10	28.4 Schedule II	Date Expired / Discarded Off Specification drugs / Medicines	1	2	3	Bio Medical waste Treatment Facility
11	28.5 Schedule II	Spent Organic Solvent	36	50	86	Dispose to Authorized Vendor
12	33.2 Schedule I	Sludge from Treatment of Waste water arising out of cleaning / disposal of Barrels / containers	20	10	30	Dispose to Authorized Vendor

Sl.No	Schedule No	Name of the Hazardous Waste	Existing Quantity KLA/TPA	Additional Quantity KLA/TPA	Total Quantity KLA/TPA	Method of Stage / Disposal
13	33.3 Schedule I	Discarded Containers / Barrels / Liners , Contaminated with Hazardous waste Chemicals	250	180	430	Dispose to Authorized Vendor
14	35.1 Schedule I	Chemical Sludge from Wastewater treatment	4800	6180	10980	ATFD salts are currently stored inhouse and options to dispose to nearby TSDF sites/Co processor.
15	34.4 Schedule I	Oil and Grease Skimming Residues	1	1	2	Dispose to Authorized Vendor
16	35.2 Schedule I	Spent Catalyst	1	1	2	Dispose to Authorized Vendor
17	35.3 Schedule I	Spent Carbon	90	50	140	Dispose to Authorized Vendor

Hazardous Waste Authorization is enclosed in **Annexure 12.**

9.5.5 Land Environment

Following measures are proposed to mitigate negative impact during operational phase of the project on the land environment.

- Air emissions are effectively controlled by use of scrubbers/bag filters and therefore deposition of air pollutants in and around the premises and surrounding area is not envisaged.
- Disposal of solid waste is carried out through authorized vendor. No disposal/burning of solid waste will be permitted within the premises.
- Treated stream from combined ETP is used for greenbelt only after appropriate treatment. No effluent is discharged directly on land without treatment; hence impact on the land environment is not envisaged.

- Hazardous materials are prohibited to be drained or dumped in the premises. Accidental spills shall be cleaned, reported and monitored.
- Thus, no impact on land is envisaged due to discharge of gaseous emission, solid waste or liquid effluent from the proposed expansion with increase in production capacity.

9.5.6 Ecology

Since the proposed project is equipped with wastewater treatment system, and the treated effluent will be sent to RO and recycled to process boiler feed, chiller and green belt. Solid wastes generated during the operation phase are disposed off through authorized vendor and hence no impact is anticipated due to solid waste in and around the site. The air pollution control devices are already in place in the facility will control release of air pollutants to a greater extent, however a two tiered thick green belt consisting of shrubs and trees around the periphery of the site has been planned to intercept and arrest air pollutants released at various heights and to attenuate the increased quantity of air pollutants released into the environment. It is expected that the ecology of the region is preserved by these mitigation measures.

9.5.7 Green Belt Development Plan

Strides Shasun Ltd has already developed a greenbelt of 28.45 % of the plot area spread over 7.39 acres in consultation with horticulture experts as per MoEF &CC / CPCB guidelines. After the proposed expansion, 9.19 acres will be the green belt area. Additional area of 1.80 acres is proposed for green belt development, making up a total of 35.37% of the total plot area. As the proposed expansion will be coming up within the premises of the existing facility, the proponent is having difficulty in the development of 10m wide greenbelt around the periphery of the plant. Hence in the proposed greenbelt development, the proponent shall cover 2.48 acres which constitutes 26.98 % of the greenbelt at 10m width from the periphery of the facility as recommended vide ToR issued by MoEF&CC (attached as **Annexure 1**). Moreover, the proponent shall develop an overall area of 35.37% of its total land area. To compensate where the 10m width is not achievable; the species used for proposed greenbelt shall be of dense and thick spreading foliage). Greenbelt layout is attached as **Annexure 6**.

As directed by MoEF&CC, adequate numbers of saplings are planted all along the periphery of the plant, roadways and available open spaces. The major aim of greenbelt development plan is to attenuate air pollutants released into the environment but it can also help in overall

improvement in the environmental conditions of the project site. The plan will address the following issues such as attenuation of air pollution, noise reduction, improving the biodiversity of the region, adding aesthetics and combating soil erosion and prevention of land degradation. A well designed green-belt helps in intercepting particulate matter and gaseouspollutants and helps in purifying the air. Trees acts as effective barrier and absorber of noise. The green belt around an industry acts as a buffer in the event of emission control equipment failure and acts as an indicator in the event of toxic release by visible morphological changes in the leaves, stem etc. To obtain the benefits of greenbelt and to maximize its potential in environmental management around an industry, choice of the green belt tree and shrub species plays a vital role.

As part of the initiative to improve the green cover near the roadways of the site Trees and shrubs will be planted along the roadsides. Since automobiles are the source of pollution of gaseous and particulate pollutants the choice of plants for road side includes shrubs of height 1 to 1.5 meter, medium sized trees of 3-5 meter height and tall trees of 10-20 m height. Medium sized trees, alternating with shrubs are ideal for sorption of particulates and gases.

Selection of Trees

Adequate numbers of saplings are planted all along the periphery of the plant and available open spaces. The major aim of greenbelt development plan is to attenuate air pollutants released into the environment but it can also help in overall improvement in the environmental conditions of the project site. The plan will address the following issues such as attenuation of air pollution, noise reduction, improving the biodiversity of the region, adding aesthetics and combating soil erosion and prevention of land degradation.

A well designed green-belt helps in intercepting particulate matter and gaseous pollutants and helps in purifying the air. Trees acts as effective barrier and absorber of noise. The green belt around an industry acts as a buffer in the event of emission control equipment failure and acts as an indicator in the event of toxic release by visible morphological changes in the leaves, stem etc. To accrue the benefits of greenbelt and to maximize its potential in environmental management around an industry, choice of the green belt tree and shrub species plays a vital role.

For development of greenbelt in outside of private property it is advisable to select tree species high are tolerant to air pollutants, since certain species of trees has the ability to uptake large quantities of SO_2 than other species and grow at a faster rate by utilizing the available nutrients

in the soil etc. Some of the recommended species for greenbelt development are given in **Table 9-7**

In general, following factors have to be considered for the selection of tree species.

- Native tree species should be preferred over non-native trees.
- The trees must be tolerant to all the pollutants present in the area.
- The trees which are evergreen and forms large round canopy with broad leaves.
- The morphological feature of leaves like rough surfaced and large number of stomatal apertures.
- The trees should be able to grow faster and should help in stabilization of the soil.
- The tree should consume only less ground water and tree which sucks more water will not select for plantation.
- The trees should maintain ecological, land and hydrological balance of the region

Table 9-7Recommended plant species for green belt development

S. No	Scientific name	Type of plant	Tolerance limit To Dust	Canopy shape	Stomatal index
1.	Annona squamosa	Tree	Yes	Vase like	26.19
2.	Azadirachta indica	Tree	Yes	Vase like	29.2
3.	Bauhinia purpurea	Tree	Yes	Spreading	23.58
4.	Bauhinia racemosa	Tree	Yes	Spreading	25.68
5.	Bougainvillea spectabilis	Shrub	Yes	Weeping	32.53
6.	Caesalpinia pulcherrima	Shrub	Yes	Spreading	29.09
7.	Cassia fistula	Tree	Yes	Spreading	20.4
8.	Hibiscus rosa-sinensis	Shrub	Yes	Spreading	23.32
9.	Ixora rosea	Shrub	Yes	Spreading	20.30
10.	Polylathia longifolia	Tree	Yes	Columnar	22.27
11.	Tectona grandis	Tree	Yes	Columnar	23.48

9.5.8 Socio – Economic Environment

Strides Shasun Limited is committed to the socio – economic upliftment of the people in region and has actively involved in formulating and implementing proactive measures as part of the corporate social responsibility. Moreover, various modes of indirect employment i.e., transportation, increased business opportunities to shopkeepers, small scale business entrepreneurs etc. will lead to development of the area.

9.6 Hazard Identification and Safety System

Strides Shasun Limited is committed to protecting the safety, health and well- being of its employees, the community in which we operate and the wider environment. They review and improve our processes, services and products to reduce industrial risk and impacts. They educate, train and motivate employees to conduct their activities in a safe, healthy and environmentally responsible manner.

Strides Shasun Limited, Periyakalapet site is certified for the Integrated Management system (IMS) which includes ISO: 14001:2004 and BS OHSAS 18001:2007. The health and Safety management system provides the framework towards organized efforts and procedures for identifying workplace hazards and reducing exposure to harmful situations and substances and thereby reducing accidents. It also includes training of personnel in accident prevention, accident response, emergency preparedness and use of protective clothing and equipment.

Systems are put in place to ensure the safe handling, movement, storage, recycling, reuse, or management of waste, air emissions and wastewater discharges. The organization implements a series of checks and balances in administrative procedures and authorizations such that all process safety related matters receive proper review and approval prior to initiating changes or modifications. On-site emergency plan is chalked out to mitigate any emergency arising out of potential risks posed by the activities/operations carried out within the plant.

9.6.1 Hazard Identified In the Factory

1. Fire and explosion hazard due to various chemical reactions/ operations
2. Fire hazard due to use/handling/storage of flammable chemicals
3. Electric Shock
4. Health hazard due to exposure to chemicals and spillage of corrosive chemicals
5. Natural calamities like Tsunami, Cyclone, Earthquake, Floods, etc., and other external threats can trigger any of the above emergencies.

9.6.2 Actions initiated in various Emergency scenarios

In case of fire:

1. If it is possible try to approach and stop the leak of material or close the main valve.
2. Transfer of material to be done depending upon the circumstances.
3. Try to approach with caution and use fire extinguisher or water or foam arrangements based on the nature of fire.

4. If the chances of escalation exist and to save the surroundings steps have to be taken to cool the surroundings and storages.
5. If it is possible the source of ignition can be removed.
6. Isolate any power sources nearby.
7. Try to contain the leak and avoid spreading.
8. Always use the appropriate personal protective equipments.

In case of toxic release

1. Approach from upwind direction continuously.
2. Wear all PPE'S including Respiratory Protection.
3. If possible try to arrest the leak using proper gadgets.
4. Take steps to transfer the contents to another storage tank.
5. If the spill is small use absorbing materials to absorb the spill.

In case of toxic release

1. Cut off stream.
2. Spray cold water on the mass
3. Evacuate the people nearby.

In case of Electric Fire or Shock

1. Isolate the power supply to the affected area immediately before approaching the site.
2. Do not use water for extinguishing the fire. Use CO_2 type or DCP type or dry sand to extinguishing the fire.
3. Remove any flammable or combustible material from the vicinity of the incident.
4. Remove the affected person to an open area and check his breathing.
5. If he is unconscious and not breathing initiate artificial resuscitation procedure.
6. Do first aid for any burn injury.
7. Physically isolate the burnt electrical components. Do not energize till the entire circuitry is checked with megger or other devices with safety mechanisms.

9.6.2.1 Available Safety Systems

First Aid:

All the injured will be brought to the OHC where the Doctor/Para medical staff will render necessary first aid and refer the cases to hospital for further medical attention depending

upon the severity. Necessary transport will be made available for transporting the patients to nearby hospital (PIMS/Be Well Hospital).

Emergency Equipments and PPEs

Each Emergency Cupboard consist the following items

1. Self Contained Breathing Apparatus (SCBA)
2. Air suits / Air Line Respirators
3. Respirator / Full Face Mask (Air purifying)
4. PVC / Acid Suit
5. Helmet
6. Ear Muff
7. Safety Glass & Face Shield
8. Gum boot
9. Safety Belt
10. Manila Rope / Life Safety Rope
11. Fire Axe
12. Fire Proximity Suit
13. Fire Gel Blankets / Water Gel Blanket
14. Spill Kit
15. Safety Ladder
16. Emergency Flameproof Torches

9.6.3 Process Safety

Process safety is treated as a priority and Process safety reviews are conducted on a periodic basis and findings addressed prior to the start-up of new or modified processes. Process Hazard Analysis (PHA) necessitates the site for identifying, evaluating, controlling, and documenting hazards at various times and stages in the life cycle of a processes and operations.

PHA is conducted for the following:

- New processes, products, materials and facilities prior to start up
- Cyclic/Periodic PHAs of existing facilities
- Dismantling of a process facility
- Management of change (e.g. process design basis, hazards of materials, equipment design basis, personnel, etc)

PHAs include the activities of identification of significant hazards, consequence analysis, human factors evaluation and facility siting evaluation, inherently safer process evaluation, risk analysis, and development of recommendations.

9.6.4 Occupational Health and Safety Program

Industrial Hygiene is one of the fast emerging fields and is a critical requirement for the well being of employees, for which Strides Shasun has developed a comprehensive Occupational health program.

The occupational Health Management system / the industrial hygiene and medical system protects and enhances health, productivity, and wellness by anticipating, recognizing, evaluating, controlling, and managing workplace health hazards (e.g., chemical, physical, biological, ergonomic, psychological, etc). These systems also mitigate illnesses and injuries by promptly recognizing, treating, investigating, and taking corrective actions.

Strides Shasun Occupational Health & Wellness Program covers the policies, work practices and procedures to provide a safe and healthy environment and protect the shop floor employees, laboratory employees and researchers from health hazards associated with the use of hazardous chemicals.

Strides Shasun's Occupational Health & Wellness Program covers the policies, work practices and procedures to provide a safe and healthy environment and protect the shop floor employees, laboratory employees and researchers from health hazards associated with the use of hazardous chemicals.

1. OH Hazard Communication program
2. Trainings at Managers level and below Managers level
3. IH and Chemical hazards review for all raw materials
4. Specialist walk through survey / IH Field observations conducted
6. Qualitative Chemical Exposure Risk Assessments (ChERA)
7. Quantitative Exposure monitoring conducted
8. Personal and Area Sampling
9. Noise, Illumination and VOC monitoring
10. Ventilation study for fume hoods and dispensing booths.
11. IH / Health surveillance for employees in hazardous operations
12. IH inputs from Medical Doctor

9.6.5 Occupational Health Monitoring

9.6.5.1 Medical Surveillance Program

Medical surveillance program is essential to assess and monitor employees' health and fitness both prior to employment and during the course of work; to determine fitness for duty and to provide emergency and other treatment as needed. Effectiveness of a medical program depends on active involvement of employees.

Dedicated OHC with 24 hour nurse and Doctor in general shift is made available for the employees. Strides Shasun also has tie up with Community based dispensary and holds 3 month medical camp every year for the benefit of local people. Strides Shasun medical surveillance program include following major elements:

1. Developing a OH-IH Medical Surveillance Program
2. Pre-Employment Examination and Periodic Medical Examinations
3. Determination of Fitness for Duty
4. Communications
5. Emergency Medical Treatment
6. Medical Records

9.6.5.2 Pre-Employment Screening / Examinations

All employees shall be subject to pre-placement medical examinations to determine their fitness for the nature of jobs on site. Potential exposures to the work environment shall be considered before placing an employee on the job.

9.6.5.3 Periodic Medical Examinations

Periodic medical examination is the same as the pre-employment screening and may be modified according to current conditions, such as changes in the employee's symptoms, site hazards, or exposures.

Comparison of sequential medical reports with baseline data is essential to determine biologic trends that may mark early signs of adverse health effects, and thereby facilitate appropriate protective measures. Annual medical checkups are provided for employees. Medical report of employees is attached as **Annexure 16**. Dedicated OHC with a doctor in general shift and 24 hour nurse is available in OHC with ambulance.

9.6.6 Operational Control Measures

9.6.6.1 Vapor / Fumes Control

- The process involves solvent usage operation equipment i.e. reactors & centrifuge vents are connected to the filter scrubber.
- The process involved corrosive chemicals operation equipment i.e. reactors & centrifuge vents are connected to wet scrubber with suitable scrubbing media.
- Solvent distillation reactors vapor column connected with primary condenser and the distillate liquid passed through sub cooler and collected to receiver.
- Low boiling solvents receivers are provided with insulation and circulated with chilled water.
- Solvent storage tank are inerted with nitrogen atmosphere.
- Reaction vessel vacuum is being followed to break with nitrogen on avoiding vapor exposure.

9.6.6.2 Fire & Explosion Controls

Elevated Fire hydrant water sump capacity is 358 m^3 and 280 nos. of Fire extinguishers and 40 nos. of single point fire hydrant &4 nos. of 360ºfire hydrant,4 nos. of Foam water monitors and Sprinkler systems are provided in various locations of the plant and well experienced Fire fighting team of 7 members. 60% of staff is trained for firefighting. The fire NOC is enclosed in **Annexure - 17**

Following arrangements were made for protection against fire hazards:

- Storage tanks vents connected to breather valve with inbuilt flame arrester.
- Operational equipments i.e. Reactors, centrifuges, RCVD etc. are inerted with nitrogen atmosphere.
- Pressure, critical reaction, dust explosion& heating operation involved equipment are provided with safety relief system [SRV with rupture disk].
- High temperature alarm, utility alarm, temperature indicator and controls, level transmitter, pressure gauge and compound gauge is provided in all reaction equipment.
- Process equipments are protected with static controls by double earthing and bonding.
- Smoke & Heat detectors are provided in administration block, laboratory, offices etc.

- Fixed fire protection system – Fire hydrants, Fire suppression system, sprinkler systems, fire alarms, fire blanketing system, foam monitor, water monitor systems and foam cans available in the facility.
- Portable fire protection system – Fire extinguisher i.e. CO_2, Mechanical foam, DCP, S-DCP, ABC DCP Automodular & clean agents with different capacity provided in all process and service locations.

9.6.6.3 Exposure Controls

- Air handling system (AHU) is provided in all centrifuges with supply and exhausts system and also with local exhausts ventilation.
- Clean room operations areas are provided with AHU supply and exhaust system.
- Corrosive chemical involving process equipment is equipped with wet scrubbers and exhaust system.
- Raw material dispensing booth is facilitated in warehouse for dispensing chemicals.
- Solvents being transferred through centrifugal pump and high boiling liquids transferred through residual vacuum.

9.6.6.4 On Line Leak Detections

- Portable LEL Detectors used for continuous monitoring.

9.7 Chemical Management System

Strides Shasun's policy of protecting employee health and safety and the environment requires safe management of chemicals throughout the life cycle. Since the nature of Stride Shasun's activities are such that highly hazardous chemicals are employed and the inventories of chemicals are large, a well conceived system of chemicals management is put in place to enable the facility to conform to the EHS policy as well as meet the requirements of the regulations applicable to the operations.

The Chemicals Management system provides with a framework for managing the various aspects associated with handling chemicals in a safe and environmentally sound manner with the below salient features.

1. MSDS/Chemical Hazard Review
2. Hazardous chemical classification based on HMIS
3. Hazards identification and their mitigation
4. Bulk Chemical storage safety inspections

5. Chemical transport safety checklists

9.8 Emergency Management

Strides Shasun is committed to constructively report and investigate all EHS incidents (e.g. near misses, illnesses, injuries, process safety, environmental, fire, distribution accidents, etc) to establish the facts and hence take prompt steps to prevent a recurrence.

A detailed Incident Investigation and Reporting (IIR) guideline is in place to assure an effective and efficient incident reporting and investigation process, and implementing appropriate corrective or preventive measures to prevent recurrence of such incidents. The essential aspects of Emergency Management system is given below:

1. Identification of potential emergency scenarios and schedule for Local wet drills
2. Revision of Emergency response plan based on Consequence Analysis
3. Emergency Response Team Training
4. Periodic evacuation mock drills and observations of gaps - Table top exercises
5. Onsite Emergency Preparedness and Response Plan (Attached as **Annexure 14**)
6. Business continuity Plan

The organization of Emergency response team is given below in **Figure 9-10**.

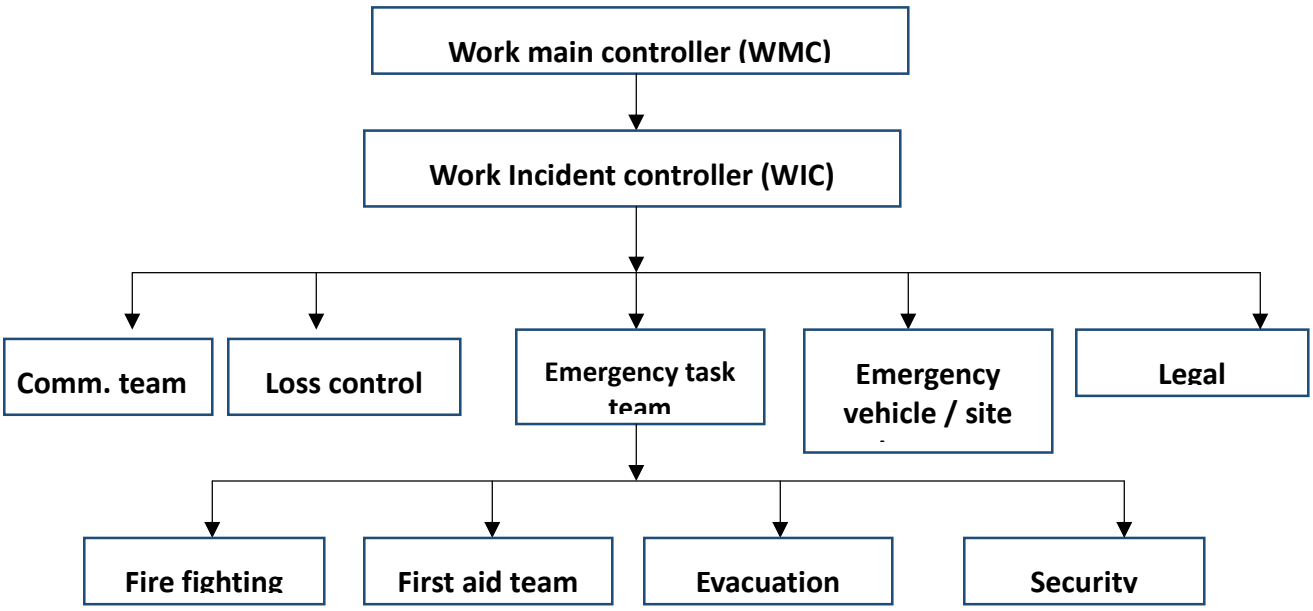


Figure 9-10 Organization of Emergency Response Team

9.8.1 Materials Handling Storage and Transportation

- Considered the properties of the materials involved in order to establish efficient material handling procedure.

- Operators are physically qualified and trained in the operation of the equipment and the safe practice followed.
- General consideration concerning the storage of the materials is piled, cradled, cross tied, packed and blocked so that they will not fall or slide.
- Safe rules for the manual handling of the materials and operation of the vehicles is practiced.

9.8.2 H&S Audits & Inspections Program

Strides Shasun has established and implemented a comprehensive Audit and Inspection program to be carried out and managed by competent resources.

- Special Fire safety audits /Fire Risk Assessments
- Self and Inter/ Cross unit audits
- Critical equipment safety inspection
- Emergency and life saving equipment inspection
- IMS internal and external audits
- Daily Safety Inspection
- Monthly Environmental inspection
- Daily Workplace exposure monitoring using VOC meters - PID
- Customer EHS audits - By MNC Pharma Majors

9.8.3 Monitoring and Verifications

- Vessels and storages are tested for their integrity at regular frequency.
- Preventive / opportunity maintenance carried out.
- Condition monitoring techniques are followed.
- Sensors and alarms are provided to alert on fugitive emissions.
- Area monitoring by personal sampler is carried out.
- Measurement of noise level, organic vapour and illumination is carried out at various production blocks, pilot plants and packing units.

9.8.4 Personal Protection Equipment and Measures

- **Chemical Handling Area:** Non-respiratory protection such as Helmet, Safety goggles, Nitrile/Neoprene/PVC gloves, Safety shoes and respiratory protection such as Full/half face respirator with organic/inorganic cartridge. For Ammonia application, Ammonia

cartridge and for powder/dust application rating with P-10 and P-100 particulate dust mask to be used.

- **Material loading/unloading operation (for RCVD / FBD / Centrifuge):** Supplied Air Breathing Apparatus (SABA) to be used.
- **Welding operation:** Welders should use welding face shield, leather apron, leather gloves and safety shoes. Helper should use UV resistant goggles, leather apron leather gloves and safety shoes.
- **Gas Cutting operation:** Both cutter and helper should use IR resistant goggles, leather gloves and safety shoes.
- **Boiler operation:** Cotton type retardant suit, IR resistant goggles, helmet, safety shoes and cotton gloves.
- **Concentrated Acid and Base handling (i.e. Sulphuric acid/HCL/Caustic Lye):** Full body PVC suit, Gum boot and PVC gloves.
- **Electrical Work Area (MCC and PCC):**433 V to 22 kVA electrical resistance gloves, Electrical safety shoes (without metal toe guard) and helmet and electrical gloves. Tested date and due dates should be marked legibly.
- **Working at Height:** Personal fall protection (i.e. Full body harness), helmet and Safety shoes. Breathing air stations are provided throughout the plant area with full face mask and air is supplied from a dedicated compressor and the air is fed to the system after purification

9.8.5 Industrial Hygiene Monitoring

Strides Shasun has carried out Health hazards monitoring for the existing plant through the following activities and the same will be implemented for the proposed expansion facility.

Exposure to airborne chemical substances in the workplace were monitored by through area and personal monitoring depending of the nature of the processes, sources of chemical exposure and toxicity of the chemicals by the following sampling methods:

- Area Monitoring – sampling pumps or passive monitoring badges are placed at static/fixed locations to collect airborne chemicals in the areas. Time weighted average (TWA) concentration of the chemicals present in the air is calculated.
- Personal Monitoring - this is a method using personal passive monitoring badges or sampling pumps attached to the individuals, subject to chemical exposure. TWA then computed from the analytical results and determined the exposure level to the individuals.

- Noise Monitoring - Measurement of individual noise sources (e.g. compressors, motors, reactors, DG etc.) were monitored by in- house program in every six month on periodical basis in addition to the yearly monitoring by external agencies.
- Local Exhaust Ventilation (LEV) Tests- Identify physical agents such as heat and cold stress and repetitive motion task.

9.8.6 Health and Safety Measures

The following measures are in place in the existing facility and will be also adopted as part of health and safety programme after the expansion:

- Regular inspection and maintenance of pollution control systems.
- All measures related to safety such as safety appliances, training, safety awards, posters, slogans are undertaken.
- The workers exposed to noise sources are provided with ear muffs/plugs.
- Adequate facilities for drinking water and toilets are provided to the employees.
- The fire and safety equipments are properly utilized and maintained regularly.
- The health of the workers is regularly checked by a well qualified doctor and proper records kept for each worker.
- Isolated storage for all hazardous chemicals with adequate safety measures, signboard outside storage etc.
- Fire – proof electric fittings are used.
- Workers are provided training to deal with emergency situation, to operate fire extinguishers, to provide first – aid to affected persons by arranging safety work-shop once in six months.
- Showers and hand – wash are provided in vicinity of work area with ample quantity of water available.
- Fire and Smoke detectors are installed at suitable places in the premises to get alert warning and avoid major accident.
- Automatic water sprinklers are installed at ideal locations to retard spread of fire.
- On site emergency plan has been prepared and implemented to safe guard human life and property.
- Moreover, based on past occupational health record of its existing unit, Strides Shasun has already put in place adequate safety measures and does not anticipate any adverse effect on health of workers.

9.9 Environmental Management Cell

In addition to preparing an EMP, it is also necessary to have a permanent organizational set up for the effective implementation of environmental management plan. Since Environmental Management Cell already exists at Strides Shasun Ltd., increasing the strength of the environmental management team would help to deal with EMP effectively and efficiently. Hence it will be ensured that the team consists of officers from various departments to co-ordinate the activities concerned with management and implementation of the environmental control measures. This team will undertake the activity of monitoring the stack emissions, ambient air quality, noise level, water quality etc., either departmentally or by appointing external agencies wherever necessary. Regular monitoring of environmental parameters will be carried - out to find out any deterioration in environmental quality and also to take corrective steps, if required, through respective internal departments. The Environmental Management Cell will also collect data about health of workers, green belt development etc.

9.9.1 Responsibilities of Environment Management Cell

The cell will be responsible for monitoring of the plant safety and safety related systems which include:

- Checking of safety related operating conditions.
- Visual inspection of safety equipments.
- Preparation of a maintenance plan and documentation of maintenance work specifying different maintenance intervals and the type of work to be performed.
- Timely renewal of Consolidated Consents & Authorization (CC & A) will also be taken care of.
- Submitting environmental monitoring report to PPCC. Data monitored by the cell will be submitted to the Board regularly and as per the requirement of PPCC. The cell will also take mitigative or corrective measures as required or suggested by the Committee.
- Keeping the management updated on regular basis about the conclusions / results of monitoring activities and proposes measures to improve environment preservation and protection.
- Conducting regular safety drills and training programs to educate employees on safety

practices.

- A qualified and experienced safety officer will be responsible for the identification of the hazardous conditions and unsafe acts of workers and advise on corrective actions, organise training programs and provide professional expert advice on various issues related to occupational safety and health.
- Conducting audits to ensure that recommended safety and health measures are followed.

9.9.2 Monitoring of Environment

A regular monitoring of environmental parameters like air, water, industrial effluent, noise and soil as well as performance of pollution control facilities and safety measures in the plant are important for proper environmental management of any project. Therefore, the Environment Health and Safety department will handle monitoring of air and water pollutants as well as the solid wastes generation as per the requirements of PPCC and CPCB. Monitoring of various parameters will be carried out online regularly to assess the pollution level inside the plant and in nearby area which will be useful to compile pollution related data for remedial measures and find out efficiency level of pollution control measures adopted. Apart from these, services of a PPCC registered and NABL accredited laboratory will be taken for this purpose. Details of Environmental Monitoring Plan have already been mentioned in Chapter 6.

9.10 Corporate Social Responsibility

Strides Shasun Limited realises the role to be played by an MNC in contributing for social welfare and have hence dedicated14 % of the project cost for CSR activities, to the tune of17.5 crore Rupees over the next five years. The CSR budget of the company over the past 2 years and next 5 years is outlined in **Table9-8**. CSR Policy of the company is attached as **Annexure 19**. The following activities were taken up as a part of CSR during the last financial year

A. Education & Skill Development

1. Implementing the school counselling project at the local Girls schools and Boys schools
2. Examination skill/life skill/ public exam coaching at local schools
3. Building Smart classrooms for Digitalisation of education in local schools
4. Renovation of the school building
5. Awareness programs to focus on the importance on the parental education/ Environmental Conservation

B. Health

1. Medical camps and awareness camps for the communities in the diverse fields
2. Maintenance of Community Dispensary
3. Mobile medical units

C. Skill Development for employment & Social infrastructure

1. Provide sponsorship for the Swami Vivekanda rural community college students with assured employments
2. Training centre or a resource centre for the unemployed youths of the community
3. RO plant installations/ Building public infrastructure like community halls

The activities listed above are not limited to and Company will plan and perform other activities according to the need of local community in future.

Cultural events organized at Govt. Higher Secondary School

Blood Bank equipment Donated to Indira Gandhi Medical and Reserch Centre

Eye check up camp at Kalapet Girls Higher Secondary school

Life skill programme to empower trainers to REACH schools in Puducherry

ROPlant for fisherman area

Kalapet Kuppam Temple donations

Figure 9-11 CSR Activities carried out

Table9-8 CSR Budget

S. No	Activities	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-2022
1	Education	4.02	25.95	50.00	55.00	60.05	66.55	73.20	80.52
2	Health Care	23.49	40.30	50.00	60.00	72.00	86.40	103.68	124.41
3	Skill Development for Employment Social Infrastructure	38.02	108.53	100.00	175.00	200.00	200.00	200.00	200.00
Total		65.53	174.78	200.00	290.00	332.05	352.95	376.88	404.93
Grand Total		440.31			1,756.81				

9.11 Budgetory Provisions for EMP

Adequate budgetary provisions have been made by Strides Shasun Ltd for execution of environmental management plan. The details of capital and recurring (per annum) budget earmarked for pollution control, operation and maintenance of pollution control facilities, for greenbelt development and maintenance will be as given in**Table 9-9**

Table 9-9Cost of Environmental Protection Measures

Particulars	Investment in Crores		
	Existing	Proposed	After change in product mix
EMP			
MEE	10.00	2.00	12.00
ETP	15.00	2.00	17.00
RO Plant	4.00	-	4.00
Green Belt Area	1.00	0.50	1.50
DG with Acoustic	2.00	1.20	3.20

Online Monitoring system	1.00	0.50	1.50
Air Pollution Equipments			
Boiler & Chimney	4.50	4.00	8.50
DG Chimney	0.50	0.20	0.70
Scrubber	0.25	0.75	1.00
EHS			
Safety Equipments	1.00	1.00	2.00
OHC	0.50	0.05	0.55
Annual Medical Check up	0.25	0.05	0.30
Total	40.00	12.25	52.25
Recurring Cost/month	0.50	1.40	1.90

CHAPTER – 10

SUMMARY & CONCLUSION

10 SUMMARY & CONCLUSION

10.1 Summary

Strides Shasun Ltd. Puducherry proposes an expansion in the production capacity at its existing facility in Periyakalapet, Puducherry. The proposal includes change in product mix with increase in capacity from the existing capacity of 4800 TPA (5 Products) to 9156 TPA (8 products).An Environmental Impact Assessment study has been carried out and assessment made for the proposed project based on the TOR and baseline quality data collected for the study area. Identification and anticipation of the potential environmental impacts due to the proposed project with a delineation of appropriate impact mitigation measures in an Environmental Management plan during both construction and operation phases is provided in the EIA report prepared.

The proposed project will ensure that the industrial activities relevant to the project are environmentally sound with no adverse impacts posed on the natural environment in the surrounding area.

The marginal impacts that might be caused by the proposed activity will be mitigated by the pollution control and environmental management measures.

In a true and a larger sense, in view of the considerable benefits from the project with no major impacts, the proposed project is said to be more beneficial to the nation.

The EMP that will be implemented for the construction and operation stages of the project will include:

- Air Pollution control and management
- Noise Control and Management
- Hazardous and Solid waste Management
- Sewage treatment and Management
- Effluent treatment and Management
- Hazardous and solid waste management
- DMP (Risk Assessment, Onsite and Offsite emergency Plan)

In order to effectively implement the EMP planned, an environmental management system will be formulated.

10.2 Conclusion

The baseline study carried out for the study area indicates that all the physical, chemical and biological characteristics of the environmental attributes in the surrounding area are well within the permissible limits.

Based on this environmental assessment, the possible impacts during both pre-project and post-project phase are anticipated and the necessary adequate control measures are formulated to meet the statutory compliances.

With very minute negative impacts, the project positively leads to commercial business opportunities, employment opportunities, increased revenue and infrastructural development.

Hence this project may kindly be granted Environmental Clearance.

CHAPTER – 11

DISCLOSURE OF CONSULTANT

11 DISCLOSURE OF CONSULTANT

In order to assess the potential environmental impacts due to the proposed Expansion of Bulk Drugs Manufacturing Facility from 4800 TPA (5 Products) to 9156 TPA (8 Products) by M/s. Strides Shasun Limited, at R.S No30/4 PT, 32/1A,32/2, 32/3, 33/1, 33/10, 33/11, 33/13, 33/2, 33/3, 33/2, 33/3, 33/4, 33/5, 33/6, 33/9, 34/1, 34/2, 34/3, 34/4, 34/5, 34/6, 34/7, 34/8, 35/4, 35/5, 35/6, 35/7, 36/5, Periyakalapet, Puducherry UT. Strides Shasun Ltd. has engaged Hubert Enviro Care Systems (P) Limited, Chennai to undertake EIA study. The nature of consultancy service rendered covers terrestrial environmental assessment.

11.1 Brief Profile of Hubert Enviro Care Systems (P) Limited (HECS)

Enviro Care Systems was started in the year of 1997 by Dr. J.R. Moses with the vision to serve the world in all environmental related problems by completing the latest technological advancements available.

In the year 2004, Enviro Care Systems became Hubert Enviro Care Systems (P) Ltd after having collaboration with Hubert Stavoren B.V. for higher Technology.

The company provides total pollution control solutions to several industries like Thermal Power Plant, Pharma, R&D Facilities, Electroplating and Manufacturing, IT Parks, Residential Complexes, Dairies, Food Processing, Textile mills, Breweries, etc.

The company is specialized in executing projects right from concept development, supply, erection, commissioning and operation on turnkey basis. HECS has successfully executed more than 200 environmental engineering projects for various industrial sectors both in India and overseas.

HECS has state-of-art facilities to provide quality environmental consultancy and engineering solutions.

Strength of HECS

Number of Employees

Total no of Employees	: 674
No of Employees engaged in EIA	: 105
Consultancy	: 25
Laboratory	: 80
Projects	: 13
Operation & Maintenance	: 556

Quality Policy of HECS

Hubert Enviro Care Systems (P) Ltd

HECS

IMS POLICY

We are committed to achieve customer satisfaction in our activities of provision of environmental services such as Project Engineering/ Consultancy / EIA services/ Laboratory and site monitoring / testing services / operations and maintenance of Pollution control systems with best quality, on time service and value for their money by

- *Meeting the ever-changing Customer requirements and their latent expectation so as to focus on customer delight through proactive measures using latest technology and team work.*
- *Conserving resources, reducing waste generation and prevention of pollution through respecting nature*
- *Minimizing the Occupational health and safety hazards and prevention of injury and ill health at work place.*
- *Complying with all applicable legal & other requirements.*
- *Enhancing total quality in all aspects of management, environmental & safety responsiveness and Mind set among the work force.*
- *Continually improving the overall organizational performance by adopting the integrated Management system through appropriate planning, implementing and reviewing the objectives and targets and there by achieve, sustain and improve over all organizational development.*

Date: 01-02-2013
Place: Chennai

J R Moses
C E O

QCI-NABET - EIA Accreditation

Consultancy	Hubert Enviro Care Systems Pvt. Ltd., Chennai
NABET Certificate No	NABET/ EIA/ 1618/SA 0015
MoEF Reg. Lab	F.No. Q-15018/29/2007-CPW

National Accreditation Board for Education & Training (NABET) is a constituent board of the Quality Council of India (QCI). QCI, NABET has accredited HECS for carrying out Category 'A & Category B' EIA studies in the following sectors:

1. Mining of minerals including Open cast only (**Sector # 1 as per NABET scheme**)
2. *Offshore and onshore oil and gas exploration development & production (**Sector # 2 as per NABET scheme**)
3. Thermal Power Plants (**Sector # 4 as per NABET scheme**)
4. Metallurgical Industries (Ferrous and Non Ferrous)(**Sector # 8 as per NABET scheme**)
5. Cement Plants (**Sector # 9 as per NABET scheme**)
6. Petroleum refining industry (**Sector # 10 as per NABET scheme**)
7. Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics) (**Sector # 18 as per NABET scheme**)
8. Petrochemical Based Processing (**Sector # 20 as per NABET scheme**)
9. 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) (**Sector # 21 as per NABET scheme**)
10. Isolated storage and handling of Hazardous Chemicals ((**Sector # 28 as per NABET scheme**)
11. *Industrial Estates/Parks/Complexes/Areas, Export Processing Zone (EPZs), Special Economic Zones (SEZs), Biotech Parks and Leather Complexes (**Sector # 31 as per NABET scheme**)
12. Building and large construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions (**Sector # 38 as per NABET scheme**)
13. Townships and Area development projects (**Sector # 39 as per NABET scheme**)

Note:-List 'A' – Accredited EIA Consultant Organizations Complying with Version 3 of the Scheme – as on 5th September, 2017 (#) Further details may be seen on the following URL:www.hecs.in