ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF CITY GAS DISTRIBUTION IN TIRUPPUR, TAMIL NADU

Client:
Adani Gas Limited

ET-005667

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CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Adani Gas Ltd. (hereinafter referred to as "AGL) is developing and operating City Gas Distribution (CGD) networks to supply Piped Natural Gas (PNG) to industrial, commercial and domestic (residential) customers and Compressed Natural Gas (CNG) to the transport sector in Tiruppur district in the state of Tamil Nadu in India.

AGL, is a Gujarat based and Bombay Stock Exchange listed company of Adani Group, an Indian multinational conglomerate headquartered in the Ahmedabad city of Gujarat. With a global footprint in developing and operating mines, the Group has diversified interests in natural resources, logistics, and energy and infrastructure businesses. The Group manages its major businesses through its three listed entities viz., Adani Enterprises Limited (AEL), Adani Power Limited (APL) and Adani Port and Special Economic Zones Limited (APSEZ).

Adani Group is one of the largest developers of ports, power plants, and infrastructure buildings in India. With the installed capacity of 10440 MW of thermal power plants and around 5000 km of overhead transmission line, Adani group is the leading independent private power producer in India. Fortune, India's largest edible oil brand is owned by the group. The company has combined market capitalisation in excess of US $ 20 billion, a sales turnover of US $ 9.4 billion. Headquartered in Ahmedabad, India, the company has already set up city gas distribution networks in Ahmedabad and Vadodara in Gujarat, Faridabad in Haryana and Khurja in Uttar Pradesh.

With the Government of India planning to offer additional geographical areas for gas distribution in the Xth round involving 50 (Gas Agencies) GAs comprising of 123 districts coupled with rapid urbanization, AGL is on track to become one of the largest private sector CGD companies of the world. AGL is committed to achieve approximately 23 lakh domestic piped natural gas connections and install approximately 500 CNG stations in these 13 new GAs.
List of 13 GAs (state-wise) for which Adani Gas Limited has been granted authorization to lay city gas infrastructure and supply natural gas in the IXth round of CGD bidding is as under:

1. Surendranagar District (Except areas already authorized) -Gujarat
2. Kheda (except areas already authorized), Morbi (Except areas already authorized) & Mahisagar Districts- Gujarat
3. Porbandar District-Gujarat

4. Barwala & Ranpur Talukas-Gujarat
5. Navsari (Except areas already authorized), Surat (Except areas already authorized), Tapi (Except areas already authorized) & The Dangs Districts-Gujarat
6. Nuh & Palwal Districts (Project Area) - Haryana
7. Bhiwani, Charkhi Dadri & Mahendragarh Districts- Haryana
8. Udupi District- Karnataka
9. Cuddalore, Nagapattinam & Tiruvarur Districts- Tamil Nadu
10. **Tiruppur District- Tamil Nadu**
11. Bhilwara & Bundi Districts- Rajasthan
12. Chittorgarh (Other than Rawatbhata Taluka) & Udaipur Districts- Rajasthan
13. Balasore, Bhadrak & Mayurbhanj Districts- Odisha

AGL group has been granted authorization for laying, building, operating or expanding the CGD Network in Tiruppur district in the state of Tamil Nadu. The grant has been authorized subject to the petroleum and natural gas regulatory board (authorizing entities to lay, build, operate or expand city or local natural gas distribution networks) regulations, 2008. Under this, the CGD network will be covering 5,187 square kilometers of area. 75 CNG Stations, 3,75,005 PNG Connections and 829 Steel Pipe (Inch-km). The activities of laying, building and operating or expansion of the CGD network had to commence immediately after signing and issuance of authority dated, 13th September 2018. Also, the activities must be completed as per the mentioned schedule in tenure of 8 contract years.

TUV SUD South Asia Pvt. Ltd. (TUV SUD) has been assigned by Adani Gas Limited for undertaking Environmental Impact Assessment (EIA) of its proposed City Gas Distribution (CGD) project at Tiruppur districts in the state of Tamil Nadu in India.

1.2 PROJECT BRIEF

Adani Gas Limited has been granted authorization for laying, building, operating or expanding the CGD Network in Tiruppur district in the state of Tamil Nadu. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 5,187 square kilometers.

Adani Gas Limited is responsible for designing and installation of optimal size of the infrastructure in terms of pipeline of various types including steel belting of the authorized area, online compressors of adequate capacity for compressing of natural gas into CNG, allied equipment and facilities in the CGD network depending upon the potential demand for natural

gas. The infrastructure in the CGD network will be adequate to maintain uninterrupted flow of natural gas in the pipelines and will also be able to maintain supplies at adequate pressure to online CNG stations.

Adani has planned to lay 8" & 4" diameter steel pipeline, approx. 220 kms for the gas distribution throughout Tiruppur district. The pipeline runs from proposed gas station at Perumanallur to various locations in Tiruppur.

The proposed project will provide 75 LCNG stations throughout the district. There are total 9 charge areas for the entire project. 2.8 acre of un-irrigated farmland for one LNG station has been identified on National Highway (NH 544) and will be acquired on willing buyer-willing seller mode. Since there is no GAIL tap off in the city for the gas as on date, it is proposed that the LNG will be brought in liquid form and stored at the gas station and will be transmitted to the consumers.

1.3 NEED & SCOPE OF EIA

The purpose of this EIA is to assess the potential environmental impacts due to the proposed project in a study area of 10 km radius around and 500 m on both sides of the pipeline. The assessment covers both construction and operation phases of the project. The EIA forecasts changes (positive and negative) that may occur as a result of key project activities to the baseline environmental conditions in the study area. Early identification of impacts and their mitigation reduces the risk of long-term adverse environmental effects.

Scope of EIA:

- Assessment of the present status of environmental components such as air, water, noise, soil, topography and drainage, traffic and socio- economic conditions based on field data/ secondary data.
- Identification of the potential impacts of various activities proposed to be undertaken during construction and operation phases of the project.
- Prediction and evaluation of the impact of activities.
- Identifying the mitigation measures, management plan and monitoring schedule, if any

1.4 TUV SUDS APPROACH & BRIEF METHODOLOGY FOR THE STUDY

The broad approach and methodology adopted for the project is described below:

a) Identified and reviewed applicable local, state, national and international environmental and social regulatory and institutional frameworks;

b) Established environmental baseline conditions of the site and surrounding area through the following:
- Detailed surveys to observe environmental and social characteristics of the project area in all three districts;
- Discussions with the local community, project affected people, panchayats and identification key issues during planning, construction and operation phase of the project;
- Primary baseline data collection of the site and study area with respect to water and soil quality, ambient air and noise quality and ecology mainly terrestrial flora & fauna and Avifauna in particular;

c) Assessed the socio-economic environment through collation of secondary information of the site, supplemented by personal and group consultations with the local communities to understand community perception with regard to the project and its activities. The approach included:
- Stakeholder identification;
- Focussed group consultations with landowners, general community, SC community and other impacted groups;
- Field surveys and data compilation;
- Group/Community Consultations: Group meetings and consultations with local and community representatives; and

d) Reviewed the current HR, Social, Environmental, Occupational Health and Safety Management System of AGL.

e) Preparation of the EIA report.

The present Report has been prepared based upon the reconnaissance survey by TUV SUD team for preliminary assessment of the site. This survey included verification of location and site condition viz terrain & topography, soil & geology, vegetation cover in the project area and investigation into environmental monitoring records of Ambient Air Quality, Noise levels, Surface water and groundwater, soil in study area of 10 km radius.

1.4.1 AGENCIES CONTACTED

The following stakeholders were contacted during the ESIA study:
- Project Proponents:
  - Representatives from AGL - onsite
- Local Community:
  - Residents – Tiruppur district villages
  - PAP- Tiruppur district village

1.5 LIMITATIONS OF THE STUDY

The EIA report has been prepared based on the professional judgement to certain facts with resultant subjective interpretations. Professional judgments expressed herein are based on the facts which were available within the limits of the scope of work, information provided by the client or its representative, prevailing secondary data, budget and schedule.

The consultation undertaken during the site visit was based on the present understanding of the project and the project footprint. This assessment may slightly change in case of a change in the plant location as finalized at the time of study. The documents like land records, and management system were limited for review at the time of visit.

Also, the consultations undertaken as part of the impact assessment were restricted to the stakeholders who were available during the site visit. Also, due to the large number of the villages within the study area and the limited time in which the assessment had to be completed, the EIA team undertook consultation in a sample of the villages with a focus for coverage of maximum number of stakeholder groups.

1.6 REGULATORY FRAMEWORK

The Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified the Environmental Impact Assessment (EIA) Notification, 2006 under the provisions of the Environment (Protection) Act, 1986, which regulates development and their expansion/modernization of 39 sectors/activities listed in the Schedule to the EIA Notification, 2006. There are two Categories of the projects in the notification namely Category ‘A’ and Category ‘B' projects. Category ‘A’ projects are appraised at the level of MoEF&CC and Category 'B' projects are appraised by the respective State Environment Impact Assessment Authority (SEIAA) following the procedure prescribed under the EIA Notification, 2006.

As per project/ Activity 6 (a) of Schedule of EIA Notification 2006, oil and gas transportation pipelines which pass through national parks, sanctuaries, coral reefs or ecologically sensitive areas sites require Environmental Clearance (EC).

A recent notification by dated 7th November 2014 by MoEF&CC (Annexure-1) accorded general approval under the Forest (Conservation) Act, 1980 (FC Act) for underground laying of optical

fibre cables, telephone lines, drinking water supply pipeline and CNG/ PNG pipelines along the petroleum pipelines within existing right of way not falling in National Parks and Wildlife Sanctuaries, without felling of trees, where the maximum size of the trench is not more than 2.00 meter depth and 1.00 meter width.

The present project does not fall under any notified area in the state of Tamil Nadu hence no clearance is required. The client needs to intimate the project detail to the respective State Environment Impact Assessment Authority (SEIAA) following the procedure prescribed under the EIA Notification, 2006.

Also if the pipeline is passing through the land under the control of PWD (Building and roads) as on either side of the flowing water course of all canals, branches, distributaries, major-minor channels etc., under the control of irrigation department, the land along the railway track and station yards under the control of Indian railways, and land under the control of national or state highway – the client is advised to take permission from the concerned authority.

The project also require permission from Irrrigation Department associated with Bhawanisagar dam who are the controlling authority for all the rivers passing through the Tiruppur city that falls in the pipeline route

Table 1-1: Applicability of all Act, Laws & Rules to the project

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
1.	Environmental (Protection) Act & Rules, 1986	To protect and improve overall environment	As all environmental notifications, rules and schedules are issued under this act	MoEF&CC GoI, Forest, Ecology & Environment Department, CPCB, TNPCB	No
2.	The Irrigation Laws (Amendment) Act, 1964	To maintain the uninterrupted flow of natural water ways and canals	For using land under the Right of Way basis for laying the CNG PNG pipeline across a either side of the flowing water course of all canals, branches, distributaries, major-minor channels etc.	Water Resources Department, Govt. of Tamil Nadu (PWD)	Yes Application will be made to the Bhawanisagar Dam authorities who control the rivers and riverine in Tirupur
3.	The Railways Act, 1989	To manage safety of railways	For using land under the Right of Way basis for laying the CNG PNG pipeline	Indian Railways (IR)	Yes, Application for NOC is made
4.	National Highway Authority of India (NHAI)	To manage safety National Highway, State Highway	For using land along the highway on right of way basis for laying the CNG PNG pipeline	National Highway Authority of India (NHAI)	Yes, Application for NOC is made

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
5.	Environmental Impact Assessment (EIA) Notification, 2006	To provide environmental clearance to new development activities following environmental impact assessment	As per project/ activity 6 (a) of Schedule of EIA Notification 2006, oil and gas transportation pipelines which pass through national parks, sanctuaries, coral reefs or ecologically sensitive areas sites require Environmental Clearance (EC). The project lies in Category A of the notification.	MoEFCC	No
6.	Forest (Conservation) Act, 1980	To check deforestation by restricting conversion of forested areas into non-forested areas	The project does not lie along and in the protected forest area.	Forest Department, MoEFCC	No
7.	National Forest Policy (Revised), 1988	To maintain ecological stability through preservation and restoration of biological diversity	No eco sensitive zone exists along the project corridor, from which the pipeline passes through	Forest Department	No
8.	Wildlife Protection Act, 1972	To Protect wildlife sanctuaries and National Park	No wildlife sanctuary falls within 10 km of the project road.	NBWL, SBWL & Chief Wildlife Warden, MoEFCC	No
9.	Water (Prevention and Control of Pollution) Act, 1974	To control water pollution by controlling emission & Water pollutants as per the prescribed standards	This act will be applicable during construction, for establishments of hot mix plant, construction camp, workers' camp, etc	TNPCB	Yes

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
10.	Air (Prevention and Control of Pollution) Act as amended in 1987	To control air pollution by controlling emission and air pollutants according to prescribed standards	This act will be applicable during construction; for obtaining NOC for establishment of hot mix plant, workers' camp, stone crusher, construction camp, & other heavy machinery.	TNPCB	Yes
11.	Noise Pollution (Regulation and Control) rules, 2000	Noise pollution regulation and controls	This act will be applicable as vehicular noise on project routes required to assess for future years and necessary protection measure need to be considered in design.	TNPCB	Yes
12.	The Explosives Act (& Rules), 1884	An Act to regulate the manufacture, possession, use, sale, transport, import and export of Explosives	For transporting and storing diesel, bitumen etc.	TNPCB	Yes
13.	Public Liability Insurance Act, 1991	Insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto	Contractor need to stock hazardous material like diesel, Bitumen, Emulsions etc. safely in designated locations within the construction camp	TNPCB	Yes
14.	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	Storage, handling, transportation and disposal of hazardous waste	Storage and handling of hazardous waste during construction	TNPCB	Yes

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
15.	Solid Waste Management Rules, 2016	Management and handling of solid waste	For disposal of solid waste generated during construction	TNPCB	Yes
16.	Construction and Demolition Waste Management Rules	Management of construction and demolition waste	For disposal of solid waste generated due to construction and demolition	TNPCB	Yes
17.	Batteries (Management & Handling) Amendment Rules, 2016	Management and handling of used lead acid batteries	Safe disposal of used lead batteries through authorized e waste recyclers	TNPCB	Yes
19.	E-Waste (Management) Rules, 2016	Effective mechanism to regulate generation, collection, storage, transport, import, export, recycling, treatment and disposal of e-wastes	Handling of e-waste	TNPCB	Yes
20.	Central Motor Vehicles Act , 1988	To control vehicular air and noise pollution	This rule will be applicable to road users and construction machinery	Motor Vehicle Department	Yes
21.	The Petroleum Act 1934, as amended in August 1976 The Petroleum Rules 1976, as amended in March 2002.	Operation, Storage and transportation of Petroleum products	The rule is applicable for as the transportation and distribution of compressed natural gas will take place	Ministry of Petroleum & Natural Gas	Yes

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
22.	Petroleum and Natural Gas Rules, 1959, amended 2009	As states own the blocks found within their territory and are therefore, responsible for awarding the licenses for onshore blocks,	The rule is applicable for as the transportation and distribution of compressed natural gas will take place through the state of Tamil Nadu	Ministry of Petroleum & Natural Gas & Tamil Nadu State Govt	Yes
23.	The Petroleum and minerals pipeline (acquisition of right of user in land) act, 1962	Acquisition of right of user in land [for laying pipelines for the transport of petroleum and minerals] and Provision of compensation in case of any damage, loss or injury is sustained by any person interested in the land under which the pipeline is proposed to be, or is being, or has been laid	The pipeline passes through residential and commercial areas, it may even passes from or near to private property.	Ministry of Petroleum & Natural Gas	Yes
24.	NOC from Gram Panchayat	As per Tamil Nadu state Government Policy, NOC is required from the Gram Panchayat.	Tamil Nadu Panchayats Act, 1958, Amended in 1994	Village Sirpanch	Application to village Panchayat falling in the stretch is to be made

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
	Petroleum and Natural Gas Regulatory Board Act, 2006	Regulation of refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas excluding production of crude oil and natural gas so as to protect the interests of consumers and entities engaged in specified activities	The project is proposed under this act and is bid out by PNGRB for uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country	PNGRB	Yes

Environmental issues during pipeline laying & construction stage generally involve equity, safety and public health issues. The construction agencies require complying with laws mentioned below as well:

- **Workmen's Compensation Act 1923** (the Act provides for compensation in case of injury by accident arising out of and during the course of employment);
- **Payment of Gratuity Act, 1972** (gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years);
- **Employees PF and Miscellaneous Provision Act 1952** (the Act provides for monthly contributions by the employer plus workers);
- **Maternity Benefit Act, 1951** (the Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.);
- **Contact Labor (Regulation and Abolition) Act, 1970** (the Act provides for certain welfare measures to be provided by the contractor to contract labour);
- **Minimum Wages Act, 1948** (the employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions);
- **Payment of Wages Act, 1936** (it lays down as to by what date the wages are to be paid, when it will' be paid and what deductions can be made from the wages of the workers);
- **Equal Remuneration Act, 1979** (the Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees);
- **Payment of Bonus Act, 1965** (the Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages);
- **Industrial Disputes Act, 1947** (the Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment);
- **Industrial Employment (Standing Orders) Act; 1946** (the Act provides for laying down rules governing the conditions of employment);
- **Trade Unions Act, 1926** (the Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities);
- **The Child Labour (Prohibition and Regulation) Amendment Act, 2016** An Act further to amend the Child Labour (Prohibition and Regulation) Act, 1986. (the Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry);

- **Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979** (the inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home to the establishment and back, etc.);
- **The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996** and the Cess Act of 1996 (all the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act; the employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for Workers near the workplace, etc.);
- **The Factories Act, 1948** (the Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours and rendering information-regarding accidents or dangerous occurrences to designated authorities).

1.7 STRUCTURE OF THE REPORT / CHAPTERISATION

The EIA Report will be chapterised under following heads:

Chapter 1: Introduction

This chapter provides background information of the existing pipeline, brief description and objectives of the project, scope of the study.

Chapter-2: Project Description

This chapter presents the details of the proposed project with description of the resources required and emissions, waste and wastewater anticipated to be generated.

Chapter-3: Description of Environment

This chapter describes the existing baseline status of environment components collected in a pre-defined study area based on primary and secondary data collection.

Chapter 4: Anticipated environment impacts and mitigation measures

This chapter describes the potential impacts of the proposed project and evaluates their significance based on parameters such as Intensity, Spatial extension, Temporal duration and Environmental Vulnerability. Impact avoidance and mitigation measures are delineated.

Chapter 5: Additional Studies

This chapter assesses the potential risks involved in the construction and operation of proposed facilities and presents a Disaster Management Plan (DMP).

Chapter 6: Analysis of Alternatives

The chapter entails the alternative options for the project.

Chapter 7: Project Benefits

This chapter presents the details of direct and indirect benefits due to proposed project.

Chapter 8: Environment Monitoring & Management Plan

This chapter describes the details of the monitoring schedule to be implemented for checking the effectiveness of mitigation measures. It covers the parameters, frequency and location of monitoring. If existing monitoring schedule is enough to cover the proposed development, the same has been clearly mentioned.

2 PROJECT DESCRIPTION

2.1 DESCRIPTION OF THE CITY GAS DISTRIBUTION PIPELINE

Adani Gas Limited has been granted authorization for laying, building, operating or expanding the CGD Network in Tiruppur district in the state of Tamil Nadu. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 5,187 square kilometers.

Table 2-1: Description of Work

Sr. No	Description of Work	Numbers
1	Number of CNG stations (Online and daughter booster stations) to be installed within 8 contract years from the date of authorization	75
2	Number of domestic piped natural gas connections to be achieved within 8 years from 28th September, 2018	375005
3	Inch-km of steel pipeline to be laid within 8 years from 28th September, 2018	829
4	Total Population	24,79,052
5	Total Geographical Area (Sq Km)	5,187
6	Total Household	7,12,210
7	No. of Charge Area	9

Source: PNGRB issued Grant of Authorization for Tirrupur CGD of AGL

Adani Gas Limited is responsible for designing and installation of optimal size of the infrastructure in terms of pipeline of various types including steel belting of the authorized area, online compressors of adequate capacity for compressing of natural gas into CNG, allied equipment and facilities in the CGD network depending upon the potential demand for natural gas. The infrastructure in the CGD network will be adequate to maintain uninterrupted flow of natural gas in the pipelines and will also be able to maintain supplies at adequate pressure to online CNG stations.

Adani has planned to lay 8” & 4” diameter steel pipeline, approx. 220 kms for the gas distribution throughout Tiruppur district. The pipeline runs from proposed LCNG station at Perumanallur to various locations in Tiruppur.

The proposed project will provide 75 CNG stations throughout the project. There are total 9 charge areas for the entire project. 2.8 acre of un-irrigated farmland for one LNG station has been identified on National Highway (NH 544) and will be acquired on willing buyer-willing seller mode. Since there is no GAIL tap off in the city for the gas, it is proposed that the LNG will be brought in liquid form and stored at the gas station and will be transmitted to the consumers.

Since the project does not lie in any notified protected forest no NOC and clearance are required to be obtained from Tamil Nadu forest department and MoEFCC, however intimation is to be sent to them detailing the project intent.

Pipeline passes along main district roads, state and national highway hence it is required to obtain clearance from the National Highway Authority of India (NHAI). It also crosses railway lines hence will be requiring clearance from Indian Railways.

The project also require permission from irrigation department associated with Bhawanisagar dam who are the controlling authority for all the rivers passing through the Tiruppur city that falls in the pipeline route.

2.2 PROJECT IMPLEMENTATION SCHEDULE

A grant of authorization was signed on 13th September 2018 by Petroleum and Natural Gas Regulatory Board (PNGRB) vide a letter of authorization to AGL group, which was accepted by them on 28th September 2018. The letter schedule D of the letter stated the year wise work program within the 8-contract year period. The details on which are given in table below:

Table 2-2: Project Implementation Schedule

Implementation Schedule					
Approximate PNG Connections (Cumulative)		**Approximate CNG Stations (Cumulative)**		**Approximate Inch-km of steel pipeline (Cumulative)**	
By the end of contract year	% of work program	By the end of contract year	% of work program	By the end of contract year	% of work program
1st	NIL	1st	NIL	1st	5
2nd	10	2nd	15	2nd	20
3rd	20	3rd	30	3rd	40
4th	30	4th	45	4th	60
5th	40	5th	60	5th	70
6th	60	6th	75	6th	80
7th	80	7th	90	7th	90
8th	100	8th	100	8th	100

Source: Adani Gas Limited

Adani Gas Limited has been granted authorization for laying, building, operating or expanding the CGD Network in Tiruppur district in the state of Tamil Nadu. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 5,187 square kilometers.

The project is still in conceptual stage and required regulatory permits are being obtained. No work has started yet on the any stage of the project.

Tiruppur district Stretch runs within the city on its arterial ring road. The details of pipeline loop and charge head is given in following table:

Table 2-3: Details with Charge Area of the pipeline project

Charge Area ID	Name
CA 01	Avinashi
CA 02	Dharapuram
CA 03	Kagayam
CA 04	Madathkulam
CA 05	Palladam
CA 06	Tiruppur
CA 07	Tiruppur North
CA 08	Tiruppur South
CA 09	Udumalaipettai

A Map of Geographical Area Tiruppur District approved by PNGRB shows the following loops of the proposed pipeline routes as given below in **Table 2-4**.

Table 2-4: Details of the loops and their length of the pipeline project

Loop Name	Road	Approximate Distance	Approximate Indication in Map
Permanallur – Tiruppur	SH -381/NH-19	10.7 km	Dark Red Line
Tiruppur – Samalapuram	SH- 169	19.9 km	Pink Line
Tiruppur – Palladam	Sh-19	25.7 km	Cyan Line
Chengapalli – Kangayam	NH- 81	28.5 km	Orange Line
Kagayam – Dharapuram	NH-83A	39.4 km	Green Line
Dharapuram – Udumalaipettai	NH - 97	39.6 km	Violet Line
Karathaluvu – Madathkulam	DR -149	8.5 km	Parrot Line
Kangayam – Palladam	SH -81	31.9 km	Pink Line
Chengapalli - Avinashi	SH - 544	19.2	Blue Line

Source: Primary Survey, TUV SUD

The proposed project was started in June-July 2019 and is expected to be completed in approximately 36 months from the date of approval environmental & other statutory clearances.

2.3 PIPELINE ROUTE & ACCESSIBILITY

Pipeline runs parallel along the man roads hence accessibility is not an issue. Project pipeline runs along major national and state highway connecting Tiruppur district. The route covers 33 villages in 7 talukas and 1 district.

Table 2-5: List of villages, cities, talukas and districts of Tiruppur falling in the project area

S. No	City/ Village		Taluka	District	State
1	1. Baikimpady 2. Kulai 3. Mittothu Colony 4. Mukka 5. Pav 6. Thenka 7. Yermal Thenka 8. Kaup 9. Kopalangadi 10. Kamala Mathu 11. Uliar Goli 12. Kote 13. Mudabettu 14. Katapady 15. Kinnymulki	16. Korangrapady 17. Kodankoor 18. Kota 19. Tekkatte 20. Kanukure 21. Koteshwar 22. CPC Layout 23. Adi Tiruppur 24. Tonse East 25. Tenka Bettu 26. Brahmavar 27. Kumargod 28. Sulkuduru 29. Kotathattu 30. Manoor 31. Kumbashi 32. Gopadi 33. Beejadi Kodladi	Tiruppur	Tiruppur	Tamil Nadu

Source: Primary Survey, TUV SUD

Figure 2-1: Location Map of Project Site

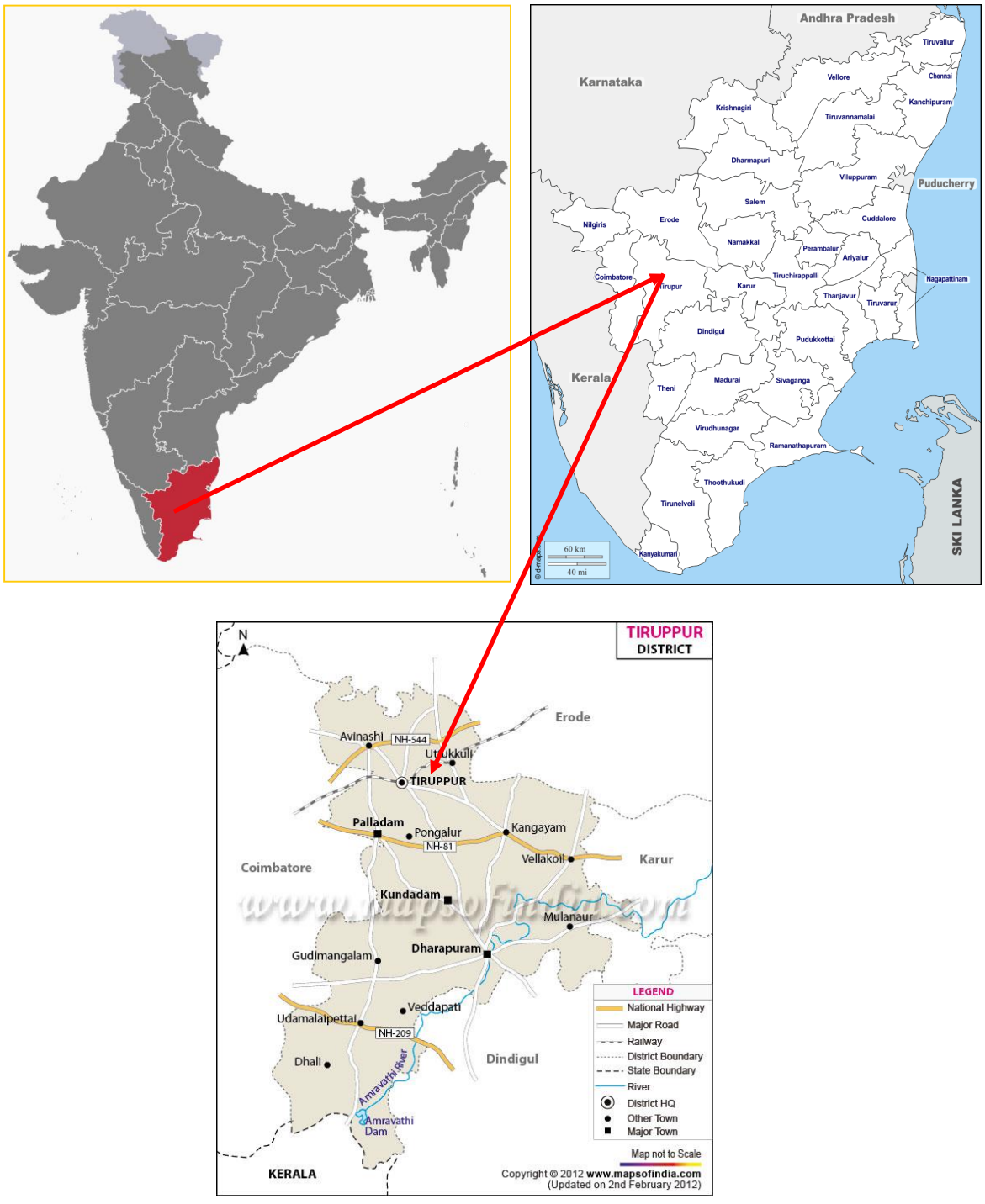
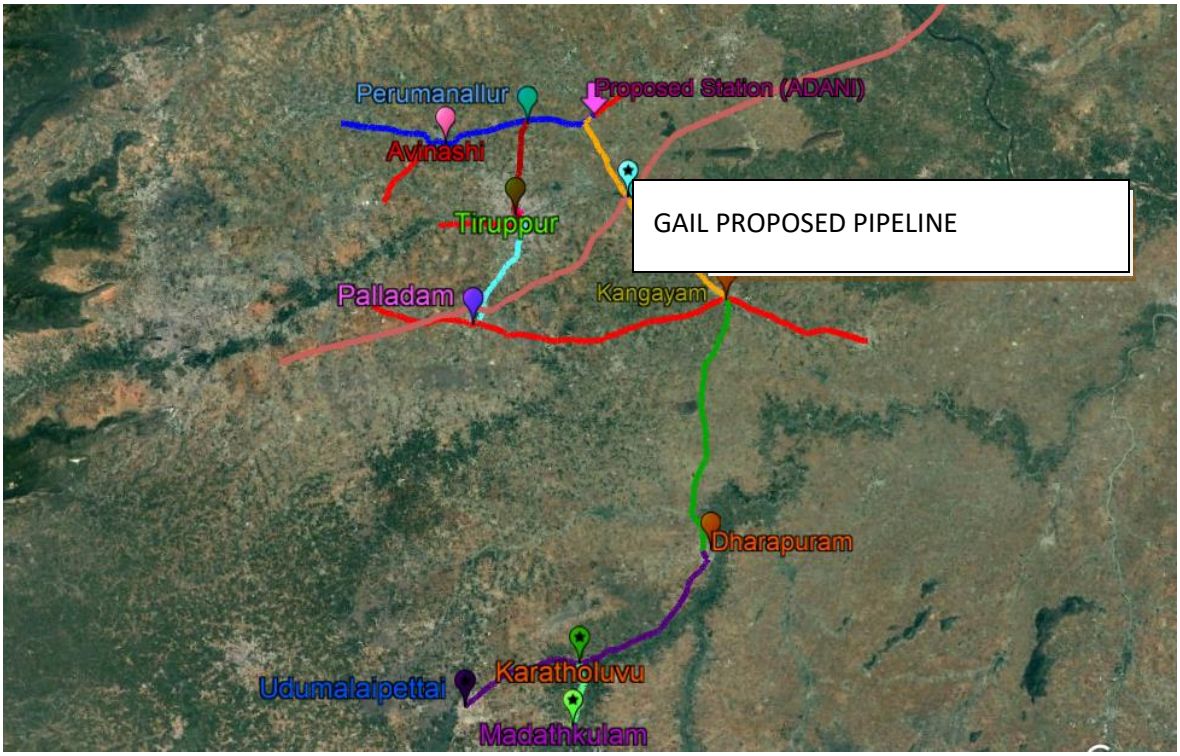


Figure 2-2: Route Map for the pipeline in Tiruppur



Source: Adani Gas Limited

Noyyal River Crossing

Table 2-6: List of Rivers, Canal, & Ponds falling in the pipeline route in the districts of Tiruppur

Sr. No	River/Canal/Rivulet	Project Phase
Tiruppur		
1	Noyyal River	Orange Line, Dark Red Line

Source: Primary Survey, TUV SUD

Table 2-7: List of Railway crossing falling in the pipeline route in the districts of Tiruppur

Sr. No	Railway Crossings	Project Phase
Tiruppur		
1	Railway crossing in Tirrupur	Pink Line

Source: Primary Survey, TUV SUD

2.4 PIPELINE DESIGN & CODE

As stated in PNGRB Notification 2008, the design, materials and equipment, welding, fabrication, installation, testing, operation and maintenance and corrosion control of CGD network shall be in accordance with requirements of ASME B31.8 except insofar as such requirements are specifically cancelled, replaced or modified by the requirements specified in these regulations.

The CNG Station, CNG Mother Station, CNG On-Line Station and CNG Daughter Station shall be designed, operated and maintained in line with the requirements of the Chief Controller of Explosives as detailed in the Gas Cylinder Rules, 2004 as modified or amended from time to time. This includes compression, handling and transportation activities of compressed natural gas.

It is intended to apply these regulations to all new and such aspects of already existing networks as design, fabrication, installation, testing at the time of construction and commissioning. However, if an Adani has laid, built, constructed or expanded the CGD infrastructure based on some other standard or is not meeting the standards specified in these regulations, then it needs to carry out a detailed technical audit of its infrastructure through a Board authorized or approved third party agency by the Board. Adani thereafter shall submit the recommendations made by the third party along-with its time-based mitigation plan and implementation schedule to the Board for authorization within six months from the date of notification of these regulations. Technical standards and specifications mentioned in PNGRB notification, 2008 including safety standards (hereinafter referred to as standards) for city or local natural gas distribution networks

are as specified in Schedule–I which cover material and equipment (Schedule–1A), welding (Schedule–1B), piping system components and fabrication (Schedule– 1C), design, installation and testing (Schedule–1D), operating and maintenance procedures (Schedule–1E), corrosion control (Schedule–1F) and miscellaneous (Schedule–1G).

Table 2-8: Applicable Standards & Codes

S. No	Standards & Schedule	Applicability
1	ASME B 16.25	Butt welding Ends
2	ASME B 31.8	Gas Transmission and Distribution Piping Systems
3	ASME B 16.11	Forged Fittings, Socket Welding and Threaded
4	ASME B 31.3	Process Piping
5	ASME B 31.4	Pipeline Transportation System for Liquid Hydrocarbons and Others
6	ASME B 16.5	Pipe line flanges and flanged fittings
7	ASME B 16.9	Factory made- Wrought Steel Butt welding Fittings
8	ASME PTC 10	Performance Test Code on Compressors and Exhausters
9	PNGRB T4S	Pipeline Design & Material Selection
	OISD-STD-226 Part II	Corrosion monitoring facilities (corrosion coupons and ER probes), electrochemical noise technique (ECN probes) or Linear polarization technique (LPR probes), UT sensor etc., shall be installed in pipelines
10	PNGRB Regulation, 2008- Schedule–I A	material and equipment
11	PNGRB Regulation, 2008- Schedule–1B	welding
12	PNGRB Regulation, 2008- Schedule–I C	piping system components and fabrication
13	PNGRB Regulation, 2008- Schedule–I D	design, installation and testing
14	PNGRB Regulation, 2008- Schedule–I E	operating and maintenance procedures
15	PNGRB Regulation, 2008- Schedule–I F	corrosion control
16	PNGRB Regulation, 2008- Schedule–I E	miscellaneous

Source: Secondary Data Survey, TUV SUD

Table 2-9: Technical details for the proposed pipeline

S.No	Description	Piping Details
1	Pipeline internal Diameter (Inches)	8” & 4”
2	Pipeline wall thickness (mm)	6.4
3	Piping material specification	API 5L X42

4	Normal operating pressure	19-40 kg/cm^2
5	Maximum allowable operating pressure	40 kg/cm^2
6	External Coating type & specification	3LPE
7	Design Throughput (MMSCMD)	0.3 MMSCMD
8	Pipeline Design Life	25 years
11	Design Temperature (C)	0-60 degree centigrate
12	Rating of Piping Components	Schedule 40 (API 5L *42)
13	Mainline Valve Stations	Will be installed at every 3 kms for the complete length of the pipeline

Source: Adani Gas Limited

2.5 ASSOCIATED FACILITIES

2.5.1 SCADA, TELECOMMUNICATION & LEAK DETECTION

The Master Control Station shall be equipped with Supervisory Control and Data Acquisition (SCADA) software running under multi-programming, multitasking real time operating system environment. The SCADA software shall incorporate control & monitoring of all locations including Block valves. Leak Detection system shall be provided, and the Leak Detection Software shall run in a separate machine at Master Control Station. This package will enable the operator to take optimal control actions and thus ensure the safety and security of the pipeline network.

The CGD system should have leak detection system in position and should be operative. For pipeline network it shall be odorisation based and for enclosures such as CGS, above ground DPRS, it shall be gas leak detection based. Gas detectors shall be installed at strategic locations covering to detect any gas leakage.

2.5.2 FIRE ALARM & FIRE FIGHTING SYSTEMS

As per the Petroleum and natural gas regulatory board notification 2008, Schedule 1 D, after construction activities relevant warning signs shall be displayed in the area. A proper Emergency Response Plan shall be in place and emergency contact numbers of relevant agencies should be visible. Firefighting equipment's should be available during commissioning.
As per the PNGRB notification, 2008 AGL operating CGD Networks shall provide for an Emergency Control Room, manned round the clock and equipped with effective communication system and emergency vehicles fitted with communication facilities, first aid equipment, fire extinguishers, gas detectors, repair kits and tools, maps, plans, material safety data sheets etc. at its disposal. The CGD entity shall put in place an Emergency Response Plan, a Disaster Management Plan and a Pandemic Plan. While preparing these plans the entity shall take into

confidence the various local authorities (i.e. The Fire authorities, Police authorities, Health authorities, local administration, Disaster Management authorities, Mutual aid, Factory inspectorate etc) and clearly elaborate on their role in case of an incident.

2.5.3 CORROSION PROTECTION

Underground carbon steel section beyond transition fitting is below ground, it shall be protected against corrosion by minimum 400 micron thick 2 pack high build epoxy coating. Above ground service piping shall be Galvanized Iron or copper or carbon steel protected by anti-corrosive coating.

2.6 LAYING OF PIPELINE

The pipeline construction is proposed to be carried out through deployment of 4 to 5 spreads. The sequence and methodology of construction of new pipeline is given below:

- Clearing and grading - A 30 m wide Right of Use (RoU) area will be cleared off vegetation and other obstacles such as boulders. Tree felling will not take place.
- Stringing–Pipes are transported to the site on trucks will be offloaded using side booms. Pipes are then strung adjacent to the trench. Trailers and cranes will be used for maneuvering of pipes. This activity may be done before or after trenching.
- Trenching - Trenchers and backhoe type excavators will be used to dig the trench for laying the pipeline. The topsoil in agricultural areas will be removed and stockpiled for restoration. The excavated sub-soil will be stockpiled separately for backfill.
- Bending – Pipes will be bent using a bending machine to the appropriate angle to match the vertical and horizontal alignment of the trench.
- Welding - Welding will be done using conventional manual/ semi-automatic welding involving a crew of welders and fitters. Once the pipe is strung a line-up crew will position the pipe using side booms in preparation for welding. Pipe strings to be welded will be effectively earthed. During welding, at least one end of the pipe string will be closed to prevent a forced draught effect.
- Non-Destructive Inspection - Mechanized Ultrasonic Testing (MUT) is the specified method to be applied for the execution of NDT. Each field weld will be 100% radiographed to test for soundness of the weld in compliance with specifications. NDT and its evaluation shall be performed in accordance with API Standard 1104.
- Coating: After welding at each weld joint, coating of field joints of bare pipes and the repair of coating shall be done by.

- Burial - General burial depth of the pipeline along the route will be with a minimum 1.0 m cover. Burial cover will be compacted to avoid future erosion by all weathers.
- Backfilling - The excavated sub-soil will be returned to the trench. The topsoil, which has been preserved on the side of the ROU, will be spread over the filledup trench. A crown of soil will be kept on top of the trenched portion to allow for future settlement. Backfilling will be managed so that damage from sizable rocks is not used or any other materials that may damage the pipeline.
- Crossings - The method used for the crossing of waterways and other infrastructure facilities will vary from place to place depending on the environmental setting and the geo-technical features of the area. The detail method of various types of crossings is specified below.

Table 2-10: Type of crossings required for various type of infrastructure

S.No	Type of Crossing	Method of Crossing
1	National Highway	Conventional Trenching/ Horizontal Directional Drilling (HDD)
2	State Highway	Conventional Trenching/ HDD
3	Other Roads	Conventional Trenching/ HDD
4	Railway Crossing	HDD
5	Major Lined Canal	HDD
6	Unlined Canal	HDD

Source: PNRGB Notification, 2008

- Restoration - Restoration of the ROU will be conducted progressively following the completion of construction work. This will involve removal of foreign materials such as construction debris and wastes. The ROU will be returned to its original condition by spreading the topsoil over the areas from where it was stripped, so that agricultural activities will be restored. Special focus will be given to restoration of side slopes and beds of natural water body crossings.
- Pipeline warning markers–In the final stages of construction, warning marker posts will be erected indicating the location of the pipeline and the crossing of other pipelines, cables and features. A marker tape will be placed in the trench 500 mm above the pipeline to indicate to future excavators that a pipeline is below and that they are nearing

The major construction activity involved during laying of pipeline are as follows:

- Transport of pipes from the place of availability to stock/lining yard.
- Transporting of pipes from the stock / lining yard to suitable places along the route of the pipeline.
- Application of lining and coating.
- Fabrication of fittings and special lining and coating of the same.

- Excavation and preparation of trenches for the pipes. Topsoil to be kept separately.
- Lowering the pipes into the trench.
- Jointing of pipes inside the trench.
- Welding of pipes.
- Rectification of defects and re-testing
- Finishing the coating and lining at weld joints.
- Back-filling of the trench with topsoil layer.
- Construction of valve chambers and erection of valve.
- Construction of necessary pipe supports, anchor blocks.
- Providing line markers

2.6.1 SITE PREPARATION & LAYING METHODOLOGY

The project is for laying of a Gas pipeline with open trenching. However, for the Portion passing through, train tracks, Canals, ponds bridges will be done by Horizontal Directional Drilling Method (HDD) to reduce the environmental impacts to minimum.

The usual approach to pipeline installation is to dig an open trench, place the pipeline and then bury it. Proposed pipeline is passing through commercial, industrial residential, agricultural areas, water bodies, public spaces etc. shall be laid by:

1. Horizontal Directional Drilling (HDD) method for pipeline.
2. Open cut method for remaining portion of pipeline.

Horizontal Directional Drilling (HDD) is a Trench-less methodology that provides an installation alternative that can offer a number of benefits over traditional open-cut method.

• In a sensitive wetland environment such as a river/creek crossing, wildlife habitats would be destroyed, and extensive mitigation efforts would be required while pipe laying by open cut method. As a result, trenchless or "no-dig" technology has been used extensively worldwide.

• HDD can be implemented with very little disruption to surface activities, requires less working space, and may be performed more quickly than open-cut methods.

• 8” Nominal bore, & 4” Nominal bore pipelines Steel Pipelines laid together by HDD methodology and remaining length of CRZ portion by Open Cut Method.

Open Cut Method is a usual approach to pipeline installation is to dig an open trench, place the pipeline and then bury it.

• pressure shall be between 16-40 Bar, 3 layers of PE coated steel pipes for the transportation of gas to its delivery centers.

2.6.2 PIPELINE BURIAL

As per the Petroleum and natural gas regulatory board notification 2008, all types of pipes (plastic and steel) and fittings shall be laid underground and shall not be exposed. The buried service lines are provided with a minimum cover of 1.0- 1.5 m. Where it is impractical to provide 1.0 m cover due to physical constraints, additional protective measures such as concrete slabs or high impact resistance plastic sheets shall be installed at least 300 mm above the service line. In no case the depth of cover shall be less than 600mm. For transition from plastic pipe to GI pipe, transition fittings shall be used. Plastic part of transition fitting protruding above ground shall be protected by encasing it with concrete guard.
In case carbon steel section beyond transition fitting is below ground, it shall be protected against corrosion by minimum 400 micron thick 2 pack high build epoxy coating. Above ground service piping shall be Galvanized Iron or copper or carbon steel protected by anti-corrosive coating.

In cases where HDD is used for pipeline burial, plastic or carbon steel, adequate depth of 2-2.5m shall be maintained under if the pipeline is going below from any of the listed features, i.e river/ canal beds, highways, roads, houses and industries.

Table 2-11: Minimum depth of cover for buried steel pipeline

S.No	Location	Minimum Cover (m)
1	Normal/ Rocky Terrain	1.0
2	Minor River/ unlined canal/ nala crossing/ tidal areas/ other water courses	1.5
3	Major River Crossings	2.5
4	Rivers with rocky bed	1.5
5	Lined canals/ drains/ nalahs	1.5
6	Drainage ditches at roadways and railways	1.0
7	Rocky Areas	1.0
8	Cased/ uncased road crossing	1.2
9	Cased railroad crossing	1.7

Source: PNGRB Notification, 2008

2.7 PROJECT REQUIREMENT

2.7.1 LAND

The land required for the project is only for CNG Stations and Tap off points. 60 CNG stations have to be setup for this project and one tap off point. The land for the Tap off point has been bought near to the GAIL Tap off point, as the LPG/CNG will be bought from Gail and converted

to CNG and transported further. Vacant land has already been bought with an area of 1.5 Acres. Rest all the required land will be bought in the near future.

2.7.2 MANPOWER RESOURCES

During the construction phase, local skilled and unskilled labour will get temporary employment based on required skill sets. However, as the development will be phase wise, the total number of locals employed at any one time may not be more than 500- 600. Adani has contracted out the construction work and management of labour to shanti contractors, local skilled and unskilled workers and service providers are preferred in order to boost local employment generation. As far as operation phase is considered, guards will be employed to patrol the pipeline areas, which will be around 20-30 people for this stretch. Skilled workers will be employed for the operation and maintenance. All these will also be contracted out to the subcontractors.

2.7.3 POWER REQUIREMENT

The power requirement will be bet from DG Sets during construction phase of the project.

2.7.4 WATER REQUIREMENT

Water requirement will be minimal for the project associated only with domestic use by the workers during construction and office staff during constructions and operations period at the distribution centers. Further, one-time water shall be required for Hydro testing of pipeline. The water shall be sourced from tankers. The water requirement for construction phase will be contracted out to private tankers. During the operation phase, water requirement will only be at the CNG stations.

2.7.5 EMISSION AND DISCHARGES

Fugitive dust shall be the main air pollutant, from the small diesel engines used for the construction works & movement of vehicles for which dust suppression system will be used as relevant points. No effluent will be generated during operation of the proposed project.

3 ENVIRONMENTAL DESCRIPTION

3.1 STUDY AREA

This chapter summarises the available baseline data on physical and biological resources within the principal area of interest i.e. the project area that would comprise of project components and associated facilities. Key existing sources of information used for this section comprises of government departments, analysis of available research papers and secondary data review from established sources such as Indian Meteorological Department, etc. Reconnaissance visits and physical, social and biological field surveys were carried to supplement the existing baseline data.

The scope of environmental assessment, existing features of the project and proposed improvement, methodology and regulations applicable to environmental assessment is highlighted in the previous sections. In this chapter, an attempt has been made to prepare a baseline environmental setting to meet out the applicability of Government of India (GoI) regulatory requirements. Considering the existing environmental scenario, potential impacts of road improvement will be identified and accordingly management plan will be proposed in forthcoming sections. The baseline environmental conditions will help in comparing and to monitor the predicted negative and positive impacts resulting from the project during construction and operation phases.

The area falling within 10 km radius from the project boundary has been considered as “Study Area” for the purpose of conducting EIA Study. The baseline data generation includes site visits, ecological surveys, social surveys and interviews, and secondary data review from established sources such as Indian Meteorological Department, Census of India.

The details pertaining to both the project taluka and district, from authentic government sources, have been presented where project area / project site specific information was not available in public domain.

3.2 TOPOGRAPHY

The Tiruppur District lies on the western part of Tamil Nadu bordering the Western Ghats and is surrounded by Coimbatore District in the West, Erode District to the North and northeast and Karur District in the East and Dindigul District in the South East. To the south, a minimum part of the district is bordered with Idukki District of Kerala state.

The Tiruppur District has gentle undulating topography with low to moderate slope mostly towards east. The area is characterised by dissected low hills and mounds. Central and Eastern parts are of pedeplain with gentle slope. The southern and south eastern parts of the district are represented by structural hills of Western Ghat Range.

DIVISION	TALUKS	FIRKA'S	VILLAGES
Tiruppur	Tiruppur North	2	7
	Tiruppur South	3	16
	Avinashi	4	41
	Uthukuli	2	49
Dharapuram	Dharapuram	7	29
	Kangayam	4	71
Udumalpet	Udumalpet	5	75
	Madathukulam	2	18

Firka: Patwar circles are the local revenue sub-divisions of the various districts of the states of India. These blocks should not be confused with the similar Panchayath union blocks (Blocks) and taluks.

3.3 GEOMORPHOLOGY

Tiruppur District is underlain by crystalline metamorphic complex in the western parts of district and sedimentary tract in eastern side. An area of 4551 Sq.km is covered by crystalline rocks (63%)and 2671 Sq.km is covered by sediments (37%). The general geological sequence of formation is given below:

Quaternary - Laterites, Sands and Clays
Tertiary - Sandstone, Gravels and Clays
Cretaceous - Limestone, Calcareous Sandstone and Clay unconformity.
Archaean - Charnockites, Gneisses, Granites, Dolerites and Pegmatite

- The major part of the area is covered by metamorphic crystalline rocks of charnockite, granitic gneiss of Archaean age intruded by dolerite dykes and pegmatite veins. These rocks are highly metamorphosed and have been subjected to very severe folding, crushing and faulting.
- Ground Water occurs under the phreatic condition and wherever there are deep seated fractures, it occurs under semi-confined to confined conditions.

- Occurrence of Ground Water in hard rock depends upon the intensity and depth of weathering, fractures and fissures present in the rocks.
- Granites and gneisses yield moderately compared to the yield in Charnockites.
- Depth of well in hard rock generally ranges between 8 and 15m below ground level.
- Generally yield in open wells ranges from 30 to 250m3/day and in bore well between 260 and 430 m3/day.The weathered thickness varies from 2.5 m to 42m in general there are 3 to 5 fracture zones within 100 m and 1 to 4 fracture zones between 100 and 200 m.

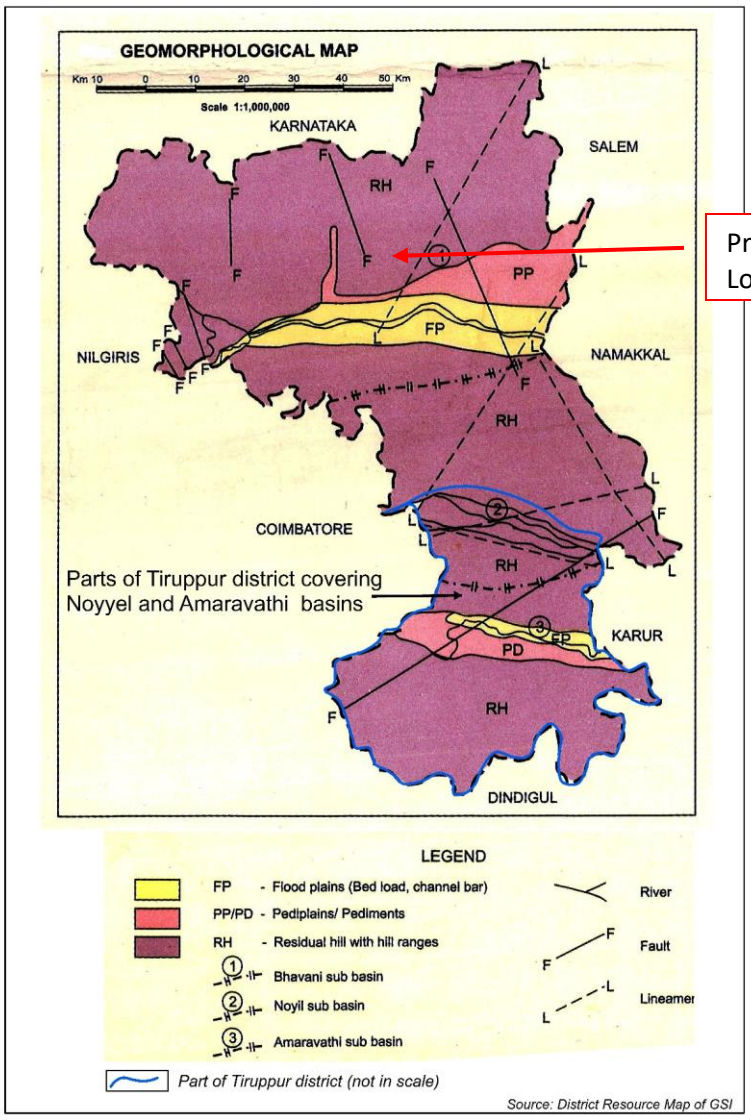


Figure 3-1 : Geomorphological Map of Tiruppur District

3.4 HYDROGEOLOGY

Groundwater occurs in all the crystalline formations of oldest Achaeans and Recent Alluvium. The occurrence and behaviour of groundwater are controlled by rainfall, topography, geomorphology, geology, structures etc.

Ground water is occurring in pheratic conditions in weathered and fractured gneiss rock formation. The weathering is controlled by the intensity of weathering and fracturing. Dug wells as wells as bore wells are more common ground water abstraction structures in the area. The diameter of the dug well is in the range of 7 to 10 m and depth of dug wells range from 15 to 18 m bgl. The dug wells yield up to 1 lps in summer months and few wells remains dry. The yield is adequate for irrigation for one or two crops in monsoon period.

3.5 DEPTH TO WATER LEVELS

The depth of wells varies from 6.64 to 17 m bgl. The present water levels in the firka is in the range of 1.964 to 21.628 mbgl during pre- monsoon (May 2015) and from 1.769 to 22.763 mbgl during post monsoon (January 2016).

The Quaternary deposits represented by the river deposits of Ponnaiyar and Varahanadhi spread over as patches in Tiruppur District. The alluvium consists of unconsolidated sands, gravelly sands, clays and clayey sands. The thickness of the sands ranges between 15 and 25 m in the alluvial formation which also form potential aquifers. In some areas, sand stone of tertiary formation are the potential groundwater reservoirs.

(ii) Aquifer Systems:
Occurrence and storage of groundwater depend upon three factors viz., Geology, Topography and rainfall in the form of precipitation. Apart from Geology, wide variation in topographic profile and intensity of rainfall constitutes the prime factors of groundwater recharge. Aquifers are part of the more complex hydro geological system and the behaviour of the entire system cannot be interpreted easily. In hard rock terrain the occurrence of Ground Water is limited to top weathered, fissured and fractured zone which extends to maximum 30 m on an average it is about 10-15 m in Tiruppur District.

In Sedimentary formations, the presence of primary inter granular porosity enhances the transmitting capacity of groundwater where the yield will be appreciable. The sedimentary area which occupies the eastern part of the District along the coastal tract is more favourable for

groundwater recharge. Ground Water occurs both in semi confined and confined conditions. A brief description of occurrence of groundwater in each formation is furnished below.

3.6 GEOLOGY

Tiruppur district of Tamil Nadu forms a part of southern Granulitic terrain and is predominantly occupied by crystalline rocks of Archaean to late Proterozoic age. Regionally, the rocks can be grouped under five categories namely i) Charnockite Group represented by Charnockite, Pyroxene Granulite and Magnetite Quartzite, ii) Peninsular Gneissic Complex (II) comprising hornblende-biotite gneiss, iii) Basic intrusive include Pyroxinite/Dunite iv) Younger intrusive comprising, Nepheline-Syenite, Pink Granite, Pegmatite and Quartz veins and v) Quaternary sediments of Kankar and soil.

3.6.1 SURFACE WATER

The area is drained by Bhavani, Noyyil, Amaravthi and Ponnani rivers. The major drainage patterns observed is i) Radial, ii) Parallel and iii) Dendritic to sub -dendritic.Only seasonal floods inundate lower parts of the basins. Basin sub soil water is used to irrigate the lands. Tanks and surface water bodies are spread over the entire firka. The drainage pattern is the dendritic and sub- dendritic.

3.6.2 GROUND WATER

The ground water resources have been computed jointly by Central Ground Water Board and State Ground Water Resources Data Centre (PWD, WRO, Govt. of Tamil Nadu) as on 31st March 2011. The computation has been done using GEC1997 methodology. The salient features of the computations are furnished in table.

Summarized block wise estimate of dynamic groundwater resources is given in Table 3-1.

Table 3-1: Ground Water Potential of the Districts

GW WORTHY AREA	REPLENISH ABLE GROUND WATER RESOURCES	NET GROUND WATER AVAILABLE	GROUND WATER DRAFT FOR IRRIGATION	GROUNDWAT ER DRAFT FOR DOMESTIC & INDUSTRIAL WATER SUPPLY	TOTAL GROUND WATER DRAFT	STAGE OF GROUND WATER DEVELOP MENT (%)	CATEGORY
(Sq.Km)	(In MCM)					%	
13.2678	13.2678	11.941	25.349	0.5516	25.9006	216.904	OVER EXPLOITED

Source: Groundwater Information Booklet, Tiruppur District, Tamil Nadu, December 2008

3.7 CLIMATE

The average temperature varies from 26 to 40° C. The area has a hot tropical climate. Highest temperatures were recorded during the months of April and May with temperatures reaching 40°C. The weather in the plains during the summer i.e., from April to June is generally dry and hot. Mornings in general are more humid than the afternoons, with the humidity exceeding 78% on an average. In the period between June to November the afternoon humidity exceeds 66% on an average. In the rest of the year the afternoons are drier, the summer afternoons being the driest.

Table 3-2: Temperature details of IMD Tiruppur (1981 - 2010)

Months	Min. Temp.(^{0}C)	Max. Temp. (^{0}C)	Months	Min. Temp.(^{0}C)	Max. Temp. (^{0}C)
January	19.7	30.6	**July**	23.0	30.9
February	20.6	33.1	**August**	22.9	31.4
March	22.6	35.6	**September**	22.8	31.9
April	24.3	35.8	**October**	22.6	31.1
May	24.6	35.0	**November**	21.5	30.0
June	23.6	32.4	**December**	20.0	29.7

Source: Climatological Normals (1981-2010)

3.7.1 RAINFALL

The southern and south western parts of the district enjoy maximum rainfall, due to the surrounding of Western Ghats. The rest of the district lies in the rain shadow region of the Western Ghats and experiences salubrious climate most periods of the year, except the extreme east part of the district. The mean maximum and minimum temperatures for Tiruppur city during summer and winter vary between 35 °C to 18 °C. The average annual rainfall in the plains is around 700 mm with the North East and the South West monsoons contributing to 47% and 28% respectively to the total rainfall. Month wise rainfall data of the district is given below in **Table 3-3**.

Table 3-3: Rainfall details of Tiruppur District (5 years)

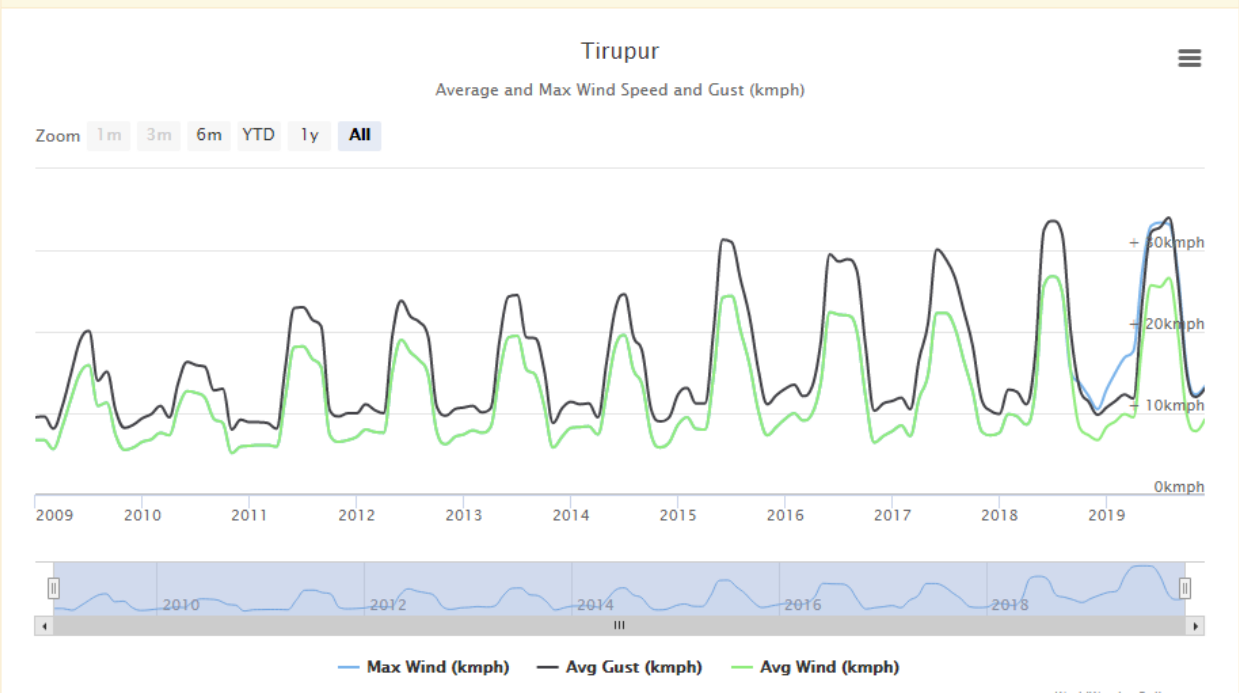
YEAR	JAN		FEB		MAR		APR		MAY		JUN	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2012	1.7	-76	0.0	-100	0.0	-100	65.3	36	21.6	-71	0.0	-100
2013	0.0	-100	38.2	454	0.5	-96	10.5	-78	24.8	-66	0.0	-100
2014	0.0	-100	0.0	-100	0.0	-100	0.0	-100	140.4	91	4.5	-80
2016	0.0	-100	0.0	-100	0.0	-100	12.5	-74	112.5	53	26.8	22

YEAR	JUL		AUG		SEPT		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2012	17.2	-37	43.1	36	15.8	-79	155.1	5	40.5	-66	0.0	-100
2013	0.7	-97	10.8	-66	25.6	-65	101.9	-31	28.1	-77	36.6	-21
2014	2.5	-91	112.9	256	122.3	65	284.4	93	26.9	-78	32.3	-31
2016	20.0	-26	15.6	-51	18.7	-75	142.8	-3	33.2	-72	29.2	-37

Source: IMD.

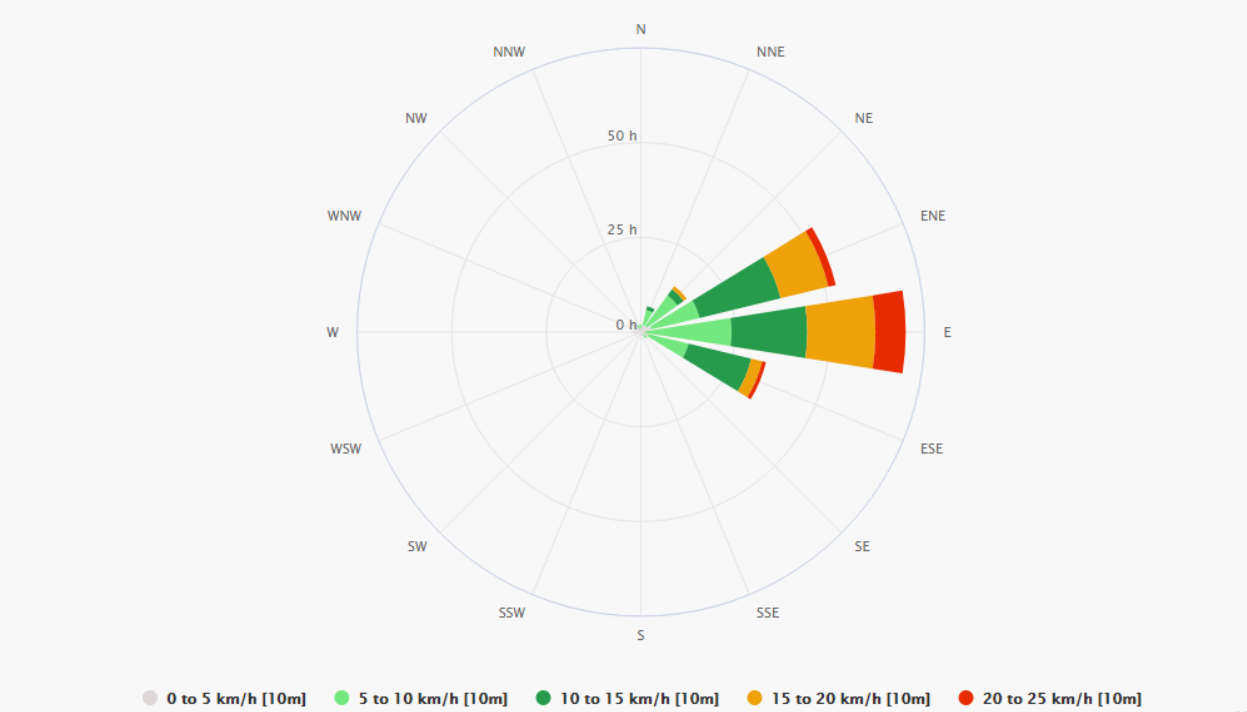
3.7.2 WIND

Table 3-4: Wind Speed (IMD Tiruppur)



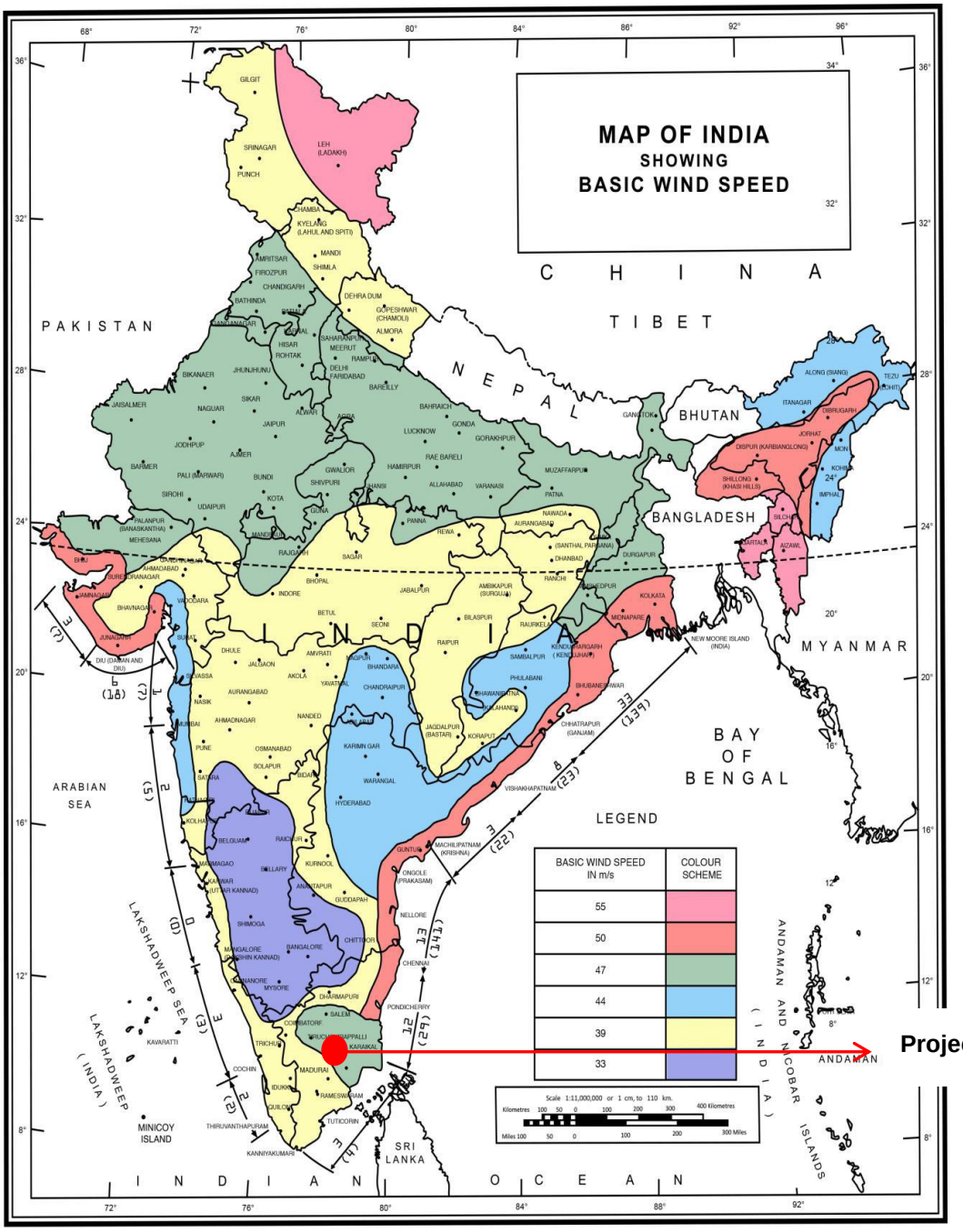
Source: Climatological Normals (1981-2010)

Wind Rose Diagram of Tiruppur



Source: Climatological Normals (1981-2010

Figure 3-2: Wind Hazard Map showing Project Site



Source: Climatological Normals (1981-2010)

3.7.3 NATURAL HAZARDS

Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (floods), climatological (droughts, etc.), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues). Natural hazards can have impacts on the developments; hence assessment of the natural hazards in the area is important for any development.

Seismicity

As per the seismic zoning map of India (given in the earthquake resistant design code of India [IS:1893, Part 1, 2002], the project site area falls in seismic Zone II, i.e the least active seismic zone. The IS code assigns zone factor of 0.16 for Zone II. The project under the Tiruppur Districts of Tamil Nadu hence lies in seismic zone II (Least Damage Risk Zone (MSK VI) as shown in Figure 3-3 below.

Figure 3-3: Geological Map of India with Seismic Zonation showing Project Site

Source: Map of India, Secondary Research, TUV SUD

3.8 AMBIENT AIR QUALITY

Ambient Air Quality Monitoring (AAQM) was carried out at a frequency of once a week at 2 locations by a NABL and MoEF&CC accredited laboratory. The air samples were analysed as per standard method specified by Central Pollution Control Board (CPCB), IS: 5184, and American Public Health Association. The monitored parameters, sampling frequency, code of practice and methods of measurement are given in **Table 3-5** below.

Table 3-5: Monitored Parameter, Sampling Frequency, Code of Practice and Method of Measurement

Sr. No.	Parameter	Sampling Frequency	Code of Practice	Method of Measurement
1.	Particulate Matter (PM10)	24 hours once a week	IS-5182 (PART-23):2006 & CPCB Guidelines	Gravimetric
2.	Particulate Matter (PM2.5)			
3.	Sulphur Dioxide (SO_2)	24 hours once a week	IS-5182 (Part-II):2001 & CPCB Guidelines	Improved West and Geake
4.	Oxides of Nitrogen (NOx)	24 hours once a week	IS-5182 (Part-VI): 2006 & CPCB Guidelines	Modified Jacob & Hochheiser (Na-Arsenite)
5.	Carbon Monoxide (CO)	8 hourly for 24 hours once a week	IS: 5182 (Part-X) & CPCB Guidelines	Non Dispersive Infra-Red (NDIR) spectroscopy

Table 3-6: Details of Ambient Air Quality Stations

Sr. No.	Monitoring Location	Geographical Coordinates	Location
1	AAQ1	11°12'05.7"N 77°20'23.8"E	Perumanalllur
2	AAQ2	11°06'09.4"N 77°20'29.4"E	Tiruppur Central

Table 3-7: Ambient Air Quality Monitoring Results

Parameter	Unit		AAQ1	AAQ2
PM_{10}	µg/m^3	NAAQS (24 hrs)	100	100
		Maximum	42.2	42.7
		Minimum	36.9	37.4
		Average	39.7	40.3

		98 Percentile	42.0	42.5
$PM_{2.5}$	µg/m^3	NAAQS (24 hrs)	60	60
		Minimum	12.2	12.3
		Maximum	13.9	14.1
		Average	13.1	13.3
		98 Percentile	13.9	14.0
SO_2	µg/m^3	NAAQS (24 hrs)	80	80
		Maximum	10.4	9.5
		Minimum	7.6	7.4
		Average	8.8	8.5
		98 Percentile	10.4	9.5
NOx	µg/m^3	NAAQS (24 hrs)	80	80
		Maximum	13.9	14.0
		Minimum	10.1	11.1
		Average	12.5	12.7
		98 Percentile	13.9	14.0
CO	mg/m^3	NAAQS (8 hrs)	2	2
		Minimum	<1.5	<1.5
		Maximum	<1.5	<1.5
		Average	<1.5	<1.5
		98 Percentile	<1.5	<1.5

NAAQS: Revised National Ambient Air Quality Standards dated 18th November 2009
ND: Not Detectable

Particulate Matter (PM_{10})

The Particulate Matter (**PM_{10}**) concentrations varied from 36.9 µg/m3 to 42.7 µg/m3 in two monitoring locations. The highest concentration of 42.7 µg/m^3 was observed at Tiruppur Central location and the lowest concentration of 36.9 µg/m3 was observed at Perumanallur. However, the **PM_{10}** concentrations at all the monitoring locations were found to be below permissible limits of CPCB.

Particulate Matter ($PM_{2.5}$)

The Particulate Matter ($PM_{2.5}$) concentrations varied from 21 µg/m^3 to 32 µg/m^3 in two monitoring locations. The highest concentration of 14.1 µg/m^3 was observed at Tiruppur Central location and the lowest concentration of 45 µg/m3 was observed at Perumanallur. However, the **$PM_{2.5}$**

concentrations at all the monitoring locations were found to be below permissible limits of CPCB.

Sulphur Dioxide (SO_2)

The Sulphur Dioxide (SO_2) concentrations varied from 7.4 µg/m^3 to 10.4 µg/m^3 in two monitoring locations. The highest concentration of 10.4 µg/m^3 was observed at Perumnanallur location and the lowest concentration of 7.4 µg/m3 was observed at Tiruppur Central. However, the SO_2 concentrations at all the monitoring locations were found to be below permissible limits of CPCB.

Oxides of Nitrogen (NOx)

The concentrations of oxides of Nitrogen (NOx) concentrations varied from 14 µg/m^3 to 10.1 \µg/m^3 in two monitoring locations. The highest concentration of 14 µg/m^3 was observed at Tiruppur Central location and the lowest concentration of 10.1 µg/m3 was observed at Perumnanallur. The local Traffic and Vehicle Movement one of the main sources to produce the Nox compounds. However, the NOx concentrations at all the monitoring locations were found to be below permissible limits of CPCB.

Carbon Monoxide (CO)

The Carbon monoxide (CO) concentrations at all locations were found to be below 1.5 mg/m^3 at all locations.

Inferences:

The ambient air quality observed in the area is good as all the parameters observed are considerably below National Ambient Air Quality Standards (NAAQS). The site and surrounding is predominantly rural with no identified major sources of pollution in the area. The movement of traffic was also observed to be limited in the area.

3.9 WATER QUALITY

In general, the quality of ground water at certain depths in the sandy aquifer are found good and potable and in the adjoining areas covered by lateritic/weathered gneissic rocks, it is sweet to alkaline. The dug wells in the alluvial area generally yield saline water during summer months and get fresh water during monsoon periods. The water samples collected from the dug wells /shallower zones during May-06 indicate the EC value as 500 to 10430µ/cm at 25°C in the higher order and 200 to 500µ/cm in the lower order. The EC in some of the deeper bore well

located at places recorded as high as 18830µ/cm at 25°c are saline. Some parts of Tiruppur have chloride concentration up to 4000 mg/l. Ground water quality of Tiruppur.

Some groundwater in the area is contaminated from the salinity of tidal recharge. This contamination is more pronounced in wells along the stream courses up to the distance where tidal effect extends. Further, Ground water in proximity to stream course is contaminated with seepage of domestic waste.
As a general rule, pumpage must be distributed in time and space and there should not be any concentration of wells to avoid saline water ingress.

3.9.1 GROUND WATER QUALITY MONITORING &ANALYSIS

Two groundwater sample and two surface water sample were collected to evaluate the water quality in the study area. Details of the sampling locations are given in the Table 3-9 and 3-10 below.

Table 3-8: Ground Water Quality Sampling Locations

S.No.	Monitoring Location	Geographical Coordinates	Distance and Direction
1	GW1	11°12'05.7"N 77°20'23.8"E	Perumanalllur
2	GW2	11°06'09.4"N 77°20'29.4"E	Tiruppur Central

The ground water sample was analyzed for parameters as mentioned in IS: 10500:2012 standards and the analysis was undertaken as per IS 10500 and relevant American Public Health Association (APHA) standard methods. The results of the analysis are presented in **Table 3-9** below.

Table 3-9: Results of Ground Water Quality Analysis

Sr. No.	Parameter	IS: 10500 (Drinking Water Standards), 2012*	Unit	Ground Water	
				GW-1	**GW-2**
1	Color	--	Hazen	1	1
2	Electrical Conductivity	--	uS /cm	506	514
3	Turbidity	1 (5)	NTU	3	5
4	pH	6.5-8.5	-	7.6	7.8
5	TDS	500 (2000)	mg/l	657	761

6	Total hardness	200 (600)	mg/l	423	411
7	Alkalinity	200 (600)	mg/l	233.3	255
18	Chlorides	200 (600)	mg/l	42.1	34.2
9	Sulphate	200 (400)	mg/l	4.1	2.3
10	Fluoride	1 (1.5)	mg/l	0.1	0.5
11	Boron	0.5 (1)	mg/l	0.5	0.1
12	Manganese	0.01 (0.03)	mg/l	BDL (<1)	BDL (<1)
13	Residual Chlorine	0.2 (1)	mg/l	BDL (<1)	BDL (<1)
14	Calcium	75 (200)	mg/l	45	66
15	Magnesium	30 (100)	mg/l	BDL (<1)	BDL (<1)
16	Iron	0.3	mg/l	0.04	0.05
17	Cadmium	0.003	mg/l	BDL (<1)	BDL (<1)
18	Arsenic	0.001 (0.05)	mg/l	BDL (<1)	BDL (<1)
19	Lead	0.01	mg/l	BDL (<1)	BDL (<1)
20	Zinc	5 (15)	mg/l	0.1	0.2
21	Chromium Hexavalent	--	mg/l	BDL (<1)	BDL (<1)
22	Copper	0.05 (1.5)	mg/l	BDL (<1)	BDL (<1)
23	Selenium	0.01	mg/l	BDL (<1)	BDL (<1)
24	Total Coliform	Shall not be detectable in any 100 ml sample	MPN	0	0

** Values in () indicate permissible limits*
ND: Not Detected
BDL: Below Detectable Limit

Inferences:

- The pH of groundwater samples is alkaline and ranges from 7.6-7.8.
- The total Coliform content in GW-1 was not detected. The insufficient depth of protective soil layers above the groundwater table, showed the vulnerability of the quality of groundwater used for drinking purposes. The ground water sample from open bore well water stored on tank was observed to be full of Sediment, Clay and microbial contamination.

3.9.2 SURFACE WATER QUALITY ANALYSIS

The surface water sample was analyzed for parameters as mentioned in IS: 2296-1982 standards and the analysis was undertaken as per IS 12296 and relevant American Public Health Association (APHA) standard methods. The results of Surface Water Quality analysis are given below in Table 3-10.

Table 3-10: Surface Water Quality Sampling Locations

S. No.	Monitoring Location	Geographical Coordinates	Distance and Direction
1	SW1	11°06'11.0"N 77°20'29.6"E	Noyyal Riiver, Tiruppur
2	SW2	11°04'37.5"N 77°12'15.9"E	Samalapuram Lake, Tiruppur

Table 3-11: Results of Water Quality Analysis

Sr. No.	Parameter	IS: 2296 (Class C)	Unit	Surface Water	
				SW1	SW2
1	Color	300	Hazen	2	2
2	Electrical Conductivity	--	uS/cm	124	111
3	pH	6.5-8.5	-	7.8	7.2
4	DO	4	mg/l	7.0	7.1
5	BOD (27^0C for 3 days)	3.0	mg/l	3	BDL (<2)
6	Total Dissolved Solids		mg/l	1155	371
7	Total hardness	200 (600)	mg/l	724	134
8	Alkalinity	200 (600)	mg/l	422	121
9	Chlorides	600	mg/l	73.1	12.9
10	Sulphate	200 (400)	mg/l	3	4.8
11	Fluoride	1.5	mg/l	0.6	0.3
12	Nitrate (as NO_3^-)	50	mg/l	42.5	9.3
13	Potassium (as K)		mg/l	126.1	12.3
14	Sodium (as Na)		mg/l	918	62.5
16	Calcium	75 (200)	mg/l	325	56
17	Magnesium	30 (100)	mg/l	62	10.5
18	Cadmium	0.01	mg/l	BDL (<1)	BDL (<1)

19	Cyanides	0.05	mg/l	BDL (<1)	BDL (<1)
20	Arsenic	0.001 (0.05)	mg/l	BDL (<1)	BDL (<1)
21	Chromium (as Cr)		mg/l	BDL (<1)	BDL (<1)
22	Copper	0.05 (1.5)	mg/l	BDL (<1)	BDL (<1)
23	Selenium	0.01	mg/l	BDL (<1)	BDL (<1)
24	Mercury		mg/l	BDL (<1)	BDL (<1)
25	Lead		mg/l	BDL (<1)	BDL (<1)
26	Aluminium (as Al)			BDL (<1)	BDL (<1)
27	Total Coliform	5000	MPN/1000 ml	45	NIL
28	Phenolic Compounds (as C_6H_5OH)	0.005	mg/l	BDL (<1)	BDL (<1)
29	Anionic detergents (as MBAS)	1.0	mg/l	BDL (<1)	BDL (<1)
30	Oils and grease		mg/l	BDL (<1)	BDL (<1)
31	Aluminium (as Al)		mg/l	BDL (<1)	BDL (<1)
32	Zinc (as Zn)		mg/l	BDL (<1)	BDL (<1)

** Values in () indicate permissible limits*
ND: Not Detected
BDL: Below Detectable Limit

Inferences:

The summary of the analysis of water samples results is as follows:

- pH of SW-1 and SW-2 was observed to be ranging from 7.2-7.8
- The coliform count in SW-1 and SW-2 was observed as around 45 as the surface water sample collection was carried out from flowing river which may contained some fecal waste due to open defecation and animal waste. Further, runoff from surface soil area during rainy season might have attributed to fecal contamination of the waterbodies.

3.10 SOIL QUALITY

The district is covered with three types of soils i) sandy soil covering the beaches and the adjoining stretches ii) yellow loamy soil and iii) red lateritic soil. The sandy soils are confined to a narrow strip of the coast having width ranging from less than 100 m to as much as a kilometer. These fine to medium texture sands are characterized by their extremely high rate of infiltration and act as a good recharge media for ground water. Yellow loamy soils are transported from origin and are found mostly along riverbanks and lower reaches of valleys. They are mostly

used for tile industries. This soil type is very well suited for irrigation and shows good response to irrigation practices. Red lateritic soil is the most dominant soil type in the area. The texture of these soils varies from fine to coarse. The soil in the valleys and immediate slopes are rich in loam whereas in upper slopes and pediplanes are much coarser in nature. The degree of leaching undergone by this soil type is also variable.

Table 3-12: Details of the Soil sampling locations

S.No.	Monitoring Location	Geographical Coordinates	Distance and Direction
1	S1	11°12'05.7"N 77°20'23.8"E	Perumanalllur
2	S2	11°06'09.4"N 77°20'29.4"E	Tiruppur Central

The soil samples were analyzed for various physical and chemical parameters of soil and the results of the soil quality analysis are given in Table 3-13 below:

Table 3-13: Results of Soil Quality Analysis

S. No.	Parameter	Unit	S1	S2
1	Soil Type		Sandy Loam	Sandy Loam
2	pH	---	7.3	7.6
3	Electrical Conductivity	µS/cm	356	166
4	Potassium (as K)	mg/kg	305	246
5	Sodium (as Na)	mg/kg	58.1	56.7
6	Organic Matter	%	1.57	1.7
7	Sodium Absorption Ratio	meq/kg	1.9	1. 8
8	Carbonate (as CO_3)	mg/kg	<20.0	<20.0
9	Chloride (as Cl-)	mg/kg	156	122
10	Phosphorus (as P)	mg/kg	9.6	12.2
11	Sulphate	mg/kg	23.3	44.3
12	Bulk Density	gm/cc	1.1	1.3
13	Moisture	%	0.67	0.55
14	Total N	mg/kg	34.1	65.3
15	Iron (as Fe)	mg/kg	5345	6734
16	Boron [as B]	mg/kg	5.4	<5.0
17	Copper (as Cu)	mg/kg	12.0	14.2
18	Zinc (as Zn)	mg/kg	6.5	13.2

The results of the soil quality analysis were compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) and as given in Table 3-14 below.

Table 3-14: Standard Soil Classification

Soil Parameters	Classification	
pH	Normal to saline	6.0 to 8.5
	Tending to become alkaline	8.5-9.0
	Alkaline	Above 9.0
Electrical conductivity (mmhos/cm)	Up to 1.00 – Normal	
	1.01- 2.00 - Critical to germination	
	2.01-4.00 - Critical for growth of the sensitive crops	
	Above 4.00 – Injurious to most crops	

Source: Indian Council of Agricultural Research, New Delhi

Inference

- pH of the soil samples ranged from 7.6 -7.3, showing normal to saline in nature;
- Electrical conductivity of SW-1 was observed in the level of 100-300 mmhos/cm which indicates low EC values may be good to crops

3.11 NOISE ENVIRONMENT

Primary noise monitoring was carried out for continuous 24 hours at the four (04) identified receptor locations to evaluate the baseline noise levels at the project site. The ambient noise monitoring has been undertaken, taking into consideration factors like wind induced noise and human activities such as movement of vehicles. The baseline ambient noise levels represent the background noise levels that would be present in the absence of the proposed Wind power plant.

Ambient noise level was monitored continuously for 24 hours using Sound Level Meter. Sound pressure levels were recorded at every 10 minutes to calculate the Leq (hourly) values. The relevant statistic measured was the LA90 (10min) (The A-weighted sound pressure level exceeded for 90 % of the 10minute interval). The noise levels obtained were analyzed to arrive at the equivalent continuous noise level (Leq) for day and nighttime. The day and nighttime hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively. The noise monitoring locations are given below in Table 3-17.

For noise levels measured over a given period of time it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceeds the time interval. The notation for the statistical quantities of noise levels is described below:

- Hourly Leq values have been computed by integrating sound level meter.
- Lday: As per the CPCB guidelines the daytime limit is between 06:00 hours to 22.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.
- Lnight: As per the CPCB guidelines the nighttime limit is between 22:00 hours to 06.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.

Table 3-15: Details of Noise Level Monitoring Locations

S.No.	Monitoring Location	Geographical Coordinates	Distance and Direction
1	N1	11°12'05.7"N 77°20'23.8"E	Perumanalllur
2	N2	11°06'09.4"N 77°20'29.4"E	Tiruppur Central

It was observed that the baseline noise levels ranged from 50.9-58 dB (A) during daytime and 61.7 to 62.5 dB (A) during nighttime. The noise monitoring analysis results are given in Table 3-17.

Table 3-16: Results of Noise Level Monitoring- Residential Areas

S.No.	Parameters	Unit	N1	N2
1	L10	dB(A)	42.3	41.6
2	L50	dB(A)	38.7	37.1
3	L90	dB(A)	34.9	33.7
4	LEQ	dB(A)	39.6	38.1
5	Ambient Noise Level- Leq day	dB(A)	40.5	40.1
6	Ambient Noise Level- Leq Night	dB(A)	36.7	35.2
7	Day-Night Sound Level (Ldn)	dB(A)	43.9	42.7

3.12 BIOLOGICAL ENVIRONMENT

3.12.1 FOREST AREA/ RESERVED FOREST/ NATIONAL PARKS & SANCTAURIES

Forest Cover of the State is 805 sq.km which is 15.52% of the State's geographical area. In terms of forest canopy density classes, the State has 50 sq.km (0.09 % of GA) very dense forest, 246 sq.km (4.75% of GA) moderately dense forest and open forest and 509 sq.km (9.8 % of GA) respectively. **Figure 3-4** presents the Forest Cover Map of Tamil Nadu state.

Comparative details between the Project Districts & State forest Cover have been presented in below

Table 3-17: Forest Cover in Project District and State

District / State	Area in Km²					% of Geographical Area
	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	
Tiruppur	5187	50	246	509	805	15.52

Source: India State of Forest Report, 2017

Figure 3-4: Forest Cover Map of Tiruppur State showing project location

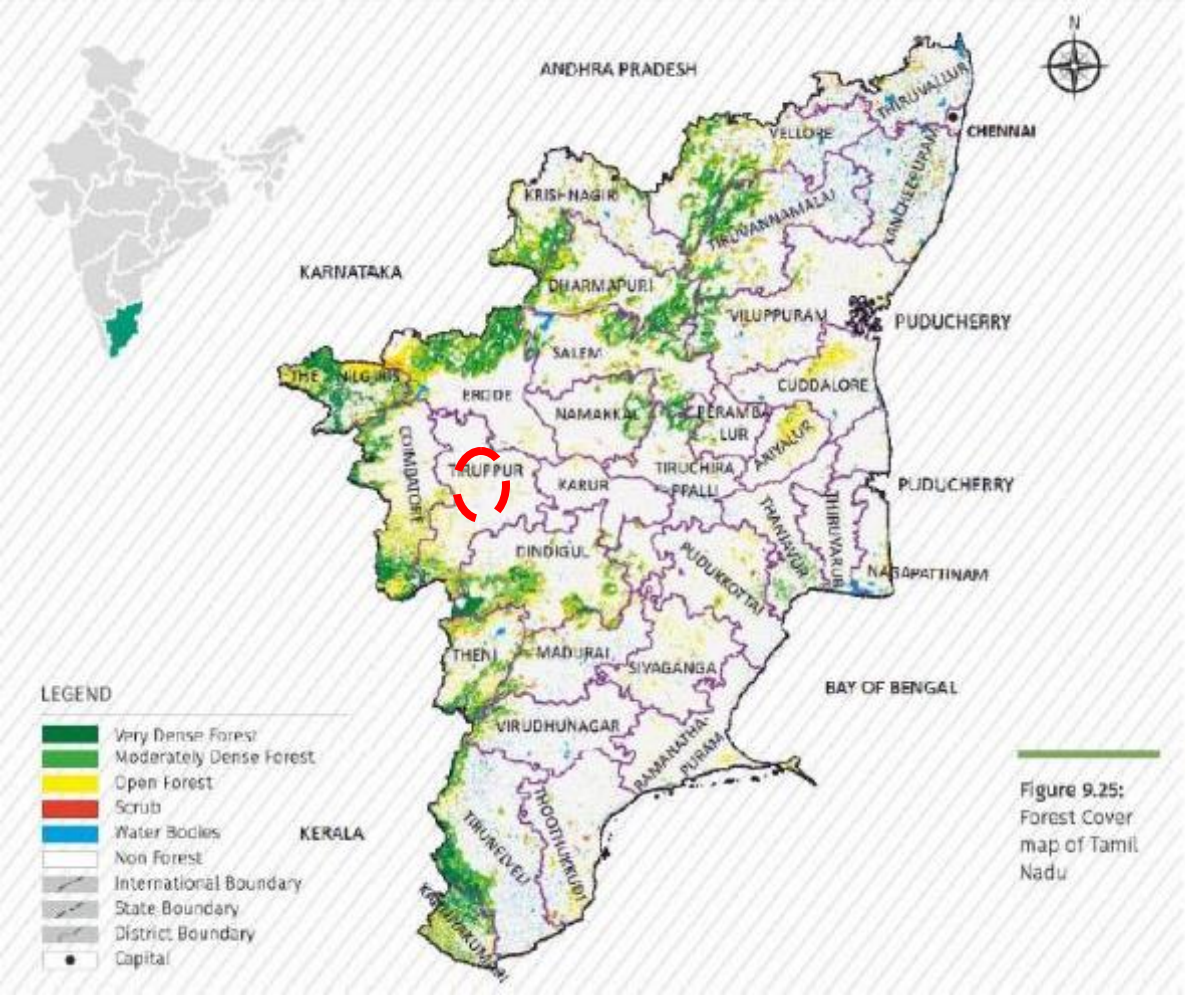


Figure 9.25: Forest Cover map of Tamil Nadu

Source: *The Tamil Nadu Forest Department*

Ecological studies are one of the important aspects of Environmental and Social Impact Assessment (ESIA) with a view to conserve biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the biotic components viz. physical and chemical components of the environment. Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important for safety of flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

This section of report describes, the methodology adopted for secondary data collection, diversity of higher flora and fauna recorded through primary field studies and the secondary data sourced from published scientific literature, habitat profile and ecosystem services profile and nearest designated areas of the project site.

Review of Secondary Data

The great plant wealth and diversity of Tamil Nadu is due to immense variety of climate, altitude and edaphic factors. Vegetation of the state can be broadly divided into four categories.

- Coastal vegetation
- Island vegetation
- Vegetation of the interior plains
- Vegetation of the hills and mountains

Littoral Vegetation

The soil is sea sand often blown and accumulating in low dunes with adequate time, but poor in nitrogen and mineral nutrient. Most of these have been converted into Casuarina plantation. The forest type occurs in reserve forest of Pichavaram, the littoral forests consists of plant species *Borasus flabellifer,Anacardium occidentale, Lannia coromandalica, Pandanus tectorius, Opuntia dillenii, Cassia auriculata, Sesuvium portulacastrum, Cyperus arenarius*.

Plantation

The division contains plantations of *Eucalyptus sp, Casuarina, Bambusa arundanacea, Prosopis juliflora* and other miscellaneous species.

Vegetation of the Interior plains

The vegetation of the plains at the foot or on the undulating slopes of hills and hillocks in the rocky area bordering the coastal plain comes under Southern tropical thorn forests of Champion and Seth (1968). These are often called as Scrub jungles. They are found in Chengalpattu, North and South Arcot, Pudukottai, Tiruchirapalli, Tirunelveli and less so in Salem, Periyar and Coimbatore districts. In these scattered forests, trees hardly reach 10 m in height and area often armed with spines and prickles. Most of the plants manifest several xeromorphic features. The common trees are *Acacia chundra, A. horrida, A leucophloe, A nilotica ssp. Indica, Albzia amara, Azadirachta indica, Chloroxylon sweitenia, Dalbergia spinosa, Dichrostachys cineraria, Limonia acidissima, Plecospermum spinarum, Strychnos nux-vomica, Strychnos potatorum, Wrightia tinctoria and Zizyphus spp. The shrubs commonly met with are Cadaba fruticosa, Capparis zeylanica, Carissa congesta, Cassia auriculata, Flacourtia indica, Maytenus emerginata, Pisonia aculeate, Scutia myrtina, Securegenia leucopyrus and Toddalia asiatica. The common climbers are cardiospermum canescens, C.halacacabum, Ceropegia candelabrum, C. juncea, Cissus quadrangularis, C. rependa, Cissampelos pareira var hirsute, Diosoria sp, Leptadenia reticulate, Pergularia daemia and Ventilago madraspatna*. During rainy season, a variety of herbaceous plants like *Achyranthes aspera, Allamania nodiflora, Apluda mutica, Aristida setacea, Blumea mollis, Cleome angustifolia and species of Cymbopogon, Glinus, Indigofera, Leucas, Mollugo* and *Oldenlandia* are seen.

Tropical thorn forest of Tamilnadu are differentiated into southern thorn forest, Carnatic umbrella thorn forest, Southern Euphorbia scrubs and southern thorn scrubs (Champion and Seth 1968). In southern thorn forest, species of Acacia, Mimosa and Zizyphus are predominantly met with. In Carnatic umbrella thorn forest Acacia planifrons is common. These forests are found in Kanyakumari, Madurai, Ramanathapuram and Tirunelveli.

Southern Euphorbia scrub is full of fleshy euphorbias. Barleria buxifolia, Calotropis gigantea, Euphorbia antiquorum, E.tricalli and Opuntia dillenii are common. Southern thorn scrubs are found in the plains like Chennai and its environs. Sandal bearing scrubs are met within Sirur reserve of Niligiris.

Vegetation of Hills and Mountains

Dry Deciduous forest

These forests are found at about 400 m and above. The canopy is closed. Most of the species are deciduous. The undergrowth is usually dense. The common trees are *Albizia amara, A.odorattissima, Anogeissus latifolia, Butea monosperma, Chloroxylon sweitenia, Dalbergia sp, Pterocarpus marsupium, Shorea roxburghii, Strychnos nuxvomica, Terminalia so. The bamoboo, Dendrocalamus stictus* is often found. *Dodonea viscose, Securinega virosa, Strobilanthes sp* are some of the shrubs found in these forests. The common climbers are *Combretum madraspatana, Cycas circinalis* is occasional. Species of *Abutilon, Achyranthes,*

Aristida, Bulbostylis, Cleome, Cymbopogon, Cyperus Digitaria, Heracleum, Hetropogon, Themeda, Tribulus etc form the ground layer.

South Indian Moist Deciduous forest

This type is below the zone of semi-evergreen forest. The trees reach a height 30-36 m and are deciduous. Bamboos are common. Epiphytes are rare. *Bombax ceiba, Dillenia pentagyna, Mitragyna parviflora, Tectona grandis, Terminalia sp, Vitex sp, and Zizyphus xylophorus are the common trees. Cycas circinalis is occasional. Helictris isora, Lantana camara and Zizyphus oenoplia* are common shrubs. Common climber is *Ipomea sp*. Common grass is *Imperata sp*

Semi-evergreen forest

This type occurs on slopes of hills and mountains usually upto 1000m. Canopy is of 2 or 3 storeys. Epiphytis orchids are present. Climbers and canes are common. Top canopy consists of Artocarpus sp, Dalbergia latifolia, Hopea sp. The second storey consists of species of Actinodaphne, Aglaia, Bischofia, Drypetes and Symplocos. Species of Glycosmis, Ixora, Lasianthus, Leea, Memecylon, Pavetta etc. form the shrubby vegetation. The common climbers are Butea parviflora, Cynanchum tunicatum, Entada pursaetha and species of Calycopteris, Dioscoria, Strychnos etc. Bambusa arundanacea and Ochlandra travencorica are also common.

Primary and Secondary Survey

The primary surveys were undertaken to identify the ecological features of the area with particular reference to identify and quantify any sensitive ecological communities in the study area within 10 km radius of the proposed project. Secondary surveys Literature surveys were conducted to identify Rare, Endangered, Endemic and Threatened species (REET) and/or habitats within the study area. The reference has been taken from The Wildlife (Protection) Act, 1972 and Red Data Book.

The field study was undertaken and the relevant, observations noted in that assessment have been included in the current assessment and referenced accordingly.

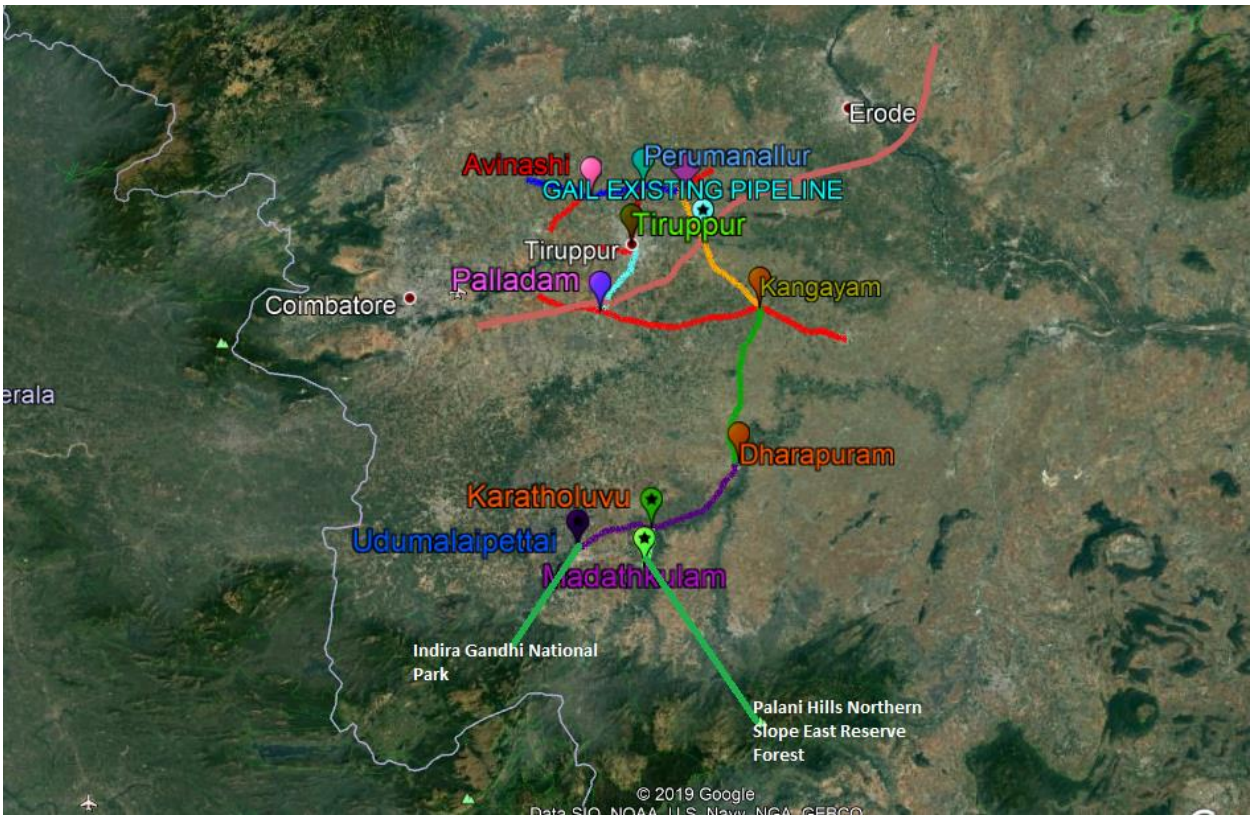
National Park/Sanctuary

As per literature survey in Coimbatore University, various departments of Forest reveal that there are no Wild life sanctuaries or National Parks or Biosphere or Hotspots in 10 km and 25 km radius from the proposed project site.

Table 3-18: GPS coordinates of the critical habitats around the project site

GPS point	Latitude	Longitude	Remarks	Distance
F1	10° 25.450'N	77° 10.285'E	Indira Gandhi National Park	29 Km from Madathkulam Loop
F3	10° 17.638'N	77° 33.919'E	Palani Hills Northern Slope East Reserve Forest	38 Km from Madathkulam loop

Figure 3-5: Map showing the eco-sensitive habitats identified in the proposed project area



Ecological sensitive habitat	Direction and Distance from the project site.
National Parks/ Wildlife Sanctuary/ Biosphere reserves/ Elephant Reserve/ Any Other Reserve	Indira Gandhi National Park, 29 Km from Madathkulam Loop Palani Hills Northern Slope East Reserve Forest, 38 Km from Madathkulam loop
Reserved Forests	Nil
Wildlife Corridors & Routes	No notified wildlife corridors are present in 10 km

	vicinity.
Wetlands / Water bodies	Noyyal River and few natural nalas
Ramsar Site	NIL
Important Bird Habitats	Nil
Breeding/nesting areas of endangered species	Not present
Mangroves	None

3.12.2 FLORA

The dry tropical vegetation is observed within the study area. The experimental finding of the pre monsoon season shows the dominance of grasse like Cyanodondactylon followed by Parthenium hysterophorus, Croton sparsiflorus and trees like Acacia nilotica, Azadirachta indica, Annona squamosa, Delonix regia, Ficus benghalensis within the study area. List of flora reported/observed in the study area is given in Table 3-19

Table 3-19: List of Flora within the project Area

S.No.	*Botanical Name*	Family	Habit	Status	Core	Buffer
1	*Acacia auriculiformis Benth.*	Leguminosae	Tree	Common	A	P
2	*Acacia leucophloea (Roxb.)*	Leguminosae	Tree	Dominant	P	P
3	*Acacia nilotica (L.) Delile*	Leguminosae	Tree	Dominant	P	P
4	*Aegle marmelos (L.) Corrêa*	Rutaceae	Tree	Rare	A	P
5	*Ailanthus excelsa Roxb*	Simaroubaceae	Tree	Dominant	A	P
6	*Alangium salviifolium (L.f.) Wangerin*	Cornaceae	Tree	Sparse	A	P
7	*Albizia amara (Roxb.) B.Boivin*	Leguminosae	Tree	Sparse	A	P
8	*Albizia lebbeck (L.) Benth.*	Leguminosae	Tree	Dominant	P	P
9	*Alstonia scholaris R.BR*	Apocynaceae	Tree	Dominant	A	P
10	*Annona squamosa L.*	Annonaceae	Tree	Common	P	P
11	*Anthocephalus cadamba (Roxb.) Miq.*	Rubiaceae	Tree	Rare	A	P
12	*Azadirachta indica A.Juss.*	Meliaceae	Tree	Dominant	P	P
13	*Balanitesa egyptiaca (L.) Delile*	Zygophyllaceae	Tree	Common	P	P
14	*Bauhinia purpurea L.*	Leguminosae	Tree	Dominant	P	P
15	*Bauhinia racemosa*	Caesalpiniaceae	Tree	Sparse	P	P
16	*Borassus flabellifer L.*	Arecaceae	Tree	Dominant	P	P
17	*Butea monosperma (Lam.) Taub.*	Leguminosae	Tree	Sparse	P	P
18	*Carica papaya L.*	Caricaceae	Tree	Common	A	P
19	*Cassia fistula L.*	Leguminosae	Tree	Sparse	P	P
20	*Cassia siamea Lam.*	Leguminosae	Tree	Common	A	P

21	*Ceiba pentandra (L.) Gaertn*	Malvaceae	Tree	Sparse	P	P
22	*Chukrasia tabularis*	Meliaceae	Tree	Common	A	P
23	*Citrus limon (L.) Burm. f.*	Rutaceae	Tree	Sparse	A	P
24	*Cocos nucifera L.*	Arecaceae	Tree	Dominant	A	P
25	*Dalbergia latifolia Roxb*	Leguminosae	Tree	Sparse	A	P
26	*Dalbergia sissoo DC.*	Leguminosae	Tree	Dominant	P	P
27	*Delonix regia (Hook.) Raf.*	Leguminosae	Tree	Dominant	A	P
28	*Dendrocalamus strictus*	Graminae	Tree	Dominant	P	P
29	*Diospyros melanoxylon Roxb.*	Ebenaceae	Tree	Sparse	A	P
30	*Dolichandron eatrovirens (Roth) K.Schum.*	Bignoniaceae	Tree	Sparse	A	P
31	*Eucalyptus globulus Labill.*	Myrtaceae	Tree	Common	P	P
32	*Euphorbia tirucalli L.*	Euphorbiaceae	Tree	Dominant	P	P
33	*Ficus benghalensis L.*	Moraceae	Tree	Common	A	P
34	*Ficus hispida L.f.*	Moraceae	Tree	Dominant	P	P
35	*Ficus microcape*	Moraceae	Tree	Sparse	A	P
36	*Ficus racemosa*	Moraceae	Tree	Common	P	P
37	*Ficus religiosa L.*	Moraceae	Tree	Sparse	P	P
38	*Gmelina asiatica L.*	Lamiaceae	Tree	Rare	A	P
39	*Holoptelea integrifolia Planch.*	Ulmaceae	Tree	Rare	A	P
40	*Lannea coromandelica (Houtt.) Merr.*	Anacardiaceae	Tree	Rare	A	P
41	*Leucaena leucocephala (Lam.) de Wit*	Leguminosae	Tree	Dominant	P	P
42	*Limonia acidissima L.*	Rutaceae	Tree	Common	A	P
43	*Madhuca indica Gmel.*	Sapotaceae	Tree	Common	A	P
44	*Mangifera indica L.*	Anacardiaceae	Tree	Common	A	P
45	*Morinda tinctoria Roxb.*	Rubiaceae	Tree	Sparse	A	P
46	*Murraya paniculata (L.) Jack*	Rutaceae	Tree	Common	A	P
47	*Musa paradisiaca L.*	Musaceae	Tree	Common	A	P
48	*Nerium odoratum Lam.*	Apocynaceae	Tree	Dominant	A	P
49	*Parkinsonia aculeata L.*	Leguminosae	Tree	Dominant	P	P
50	*Pavetta indica L.*	Rubiaceae	Tree	Dominant	A	P
51	*Peltophorum pterocarpum (DC.) K.Heyne*	Leguminosae	Tree	Dominant	P	P
52	*Phoenix sylvestris (L.) Roxb.*	Arecaceae	Tree	Dominant	P	P
53	*Phyllanthus emblica L.*	Phyllanthaceae	Tree	Dominant	P	P
54	*Pithecellobium dulce (Roxb.) Benth.*	Leguminosae	Tree	Dominant	P	P
55	*Plumeria alba L.*	Apocynaceae	Tree	Dominant	A	P
56	*Plumeria rubra L.*	Apocynaceae	Tree	Rare	A	P
57	*Polyalthia longifolia (Sonn.) Thwaites*	Annonaceae	Tree	Dominant	A	P

58	*Pongamia pinnata (L.) Pierre*	Leguminosae	Tree	Dominant	P	P
59	*Prosopis chilensis (Molina) Stuntz*	Leguminosae	Tree	Rare	A	P
60	*Prosopis juliflora*	Mimosaceae	Tree	Dominant	P	P
61	*Psidium guajava L.*	Myrtaceae	Tree	Common	A	P
62	*Pterospermum heyneanum G.Don*	Malvaceae	Tree	Sparse	A	P
63	*Randia uliginosa*	Rubiaceae	Tree	Sparse	A	P
64	*Samanea saman (Jacq.) Merr.*	Sapindaceae	Tree	Common	A	P
65	*Sapindus emarginatus Vahl*	Sapindaceae	Tree	Common	A	P
66	*Saraca asoca (Roxb.) Willd*	Leguminosae	Tree	Sparse	P	P
67	*Soymida febrifuga (Roxb.) A. Juss.*	Meliaceae	Tree	Rare	A	P
68	*Syzygium cumini (L.) Skeels*	Myrtaceae	Tree	Common	P	P
69	*Tamarindus indica L.*	Leguminosae	Tree	Dominant	P	P
70	*Tecoma stans (L.) Juss. ex Kunth*	Bignoniaceae	Tree	Dominant	A	P
71	*Tectona grandis L.f.*	Lamiaceae	Tree	Dominant	P	P
72	*Terminalia catappa L.*	Combretaceae	Tree	Dominant	P	P
73	*Thespecia populnea*	Malvaceae	Tree	Dominant	A	P
74	*Thevetia neriifolia*	Apocynaceae	Tree	Dominant	P	P
75	*Trema orientalis*	Ulmaceae	Tree	Dominant	A	P
76	*Vitex negundo L.*	Verbenaceae	Tree	Dominant	P	P
77	*Ziziphus mauritiana Lam.*	Rhamnaceae	Tree	Sparse	P	P
78	*Abutilon indicum (L.) Sweet*	Malvaceae	Shrub	Dominant	P	P
79	*Agave americana L.*	Asparagaceae	Shrub	Sparse	P	P
80	*Balanites roxburghii Planch.*	Zygophyllaceae	Shrub	Sparse	P	P
81	*Caesalpinia bonduc (L.) Roxb.*	Leguminosae	Shrub	Sparse	P	P
82	*Caesalpinia pulcherrima (L.) Sw.*	Leguminosae	Shrub	Rare	A	P
83	*Calotropis gigantea (L.) Dryand.*	Apocynaceae	Shrub	Dominant	P	P
84	*Calotropis procera (Aiton) Dryand.*	Apocynaceae	Shrub	Dominant	P	P
85	*Capparis zeylanica L.*	Capparaceae	Shrub	Dominant	P	P
86	*Carissa carandas L.*	Apocynaceae	Shrub	Dominant	P	P
87	*Catunaregam spinosa (Thunb.) Tirveng.*	Rubiaceae	Shrub	Dominant	P	P
88	*Clerodendrum phlomidis L.f.*	Lamiaceae	Shrub	rare	A	P
89	*Decalepis hamiltonii*	Apocynaceae	Shrub	Rare	A	P
90	*Dodonaea viscosa Jacq.*	Sapindaceae	Shrub	Dominant	P	P
91	*Erythroxylon monogynum*	Erythroxylaceae	Shrub	Sparse	P	P
92	*Euphorbia cactus*	Euphorbiaceae	Shrub	Rare	P	P
93	*Euphorbia caducifolia Haines*	Euphorbiaceae	Shrub	Dominant	P	P
94	*Grewia flavescens Juss.*	Malvaceae	Shrub	Rare	A	P
95	*Helicteres isora L.*	Malvaceae	Shrub	Rare	P	P
96	*Indigofera spinosa Forssk*	Leguminosae	Shrub	Dominant	P	P
97	*Ipomoea carnea Jacq.*	Convolvulaceae	Shrub	Dominant	P	P
98	*Ixora coccinea*	Rubiaceae	Shrub	Sparse	P	P

99	*Jasminum roxburghianum Wall. ex C.B.Clarke*	Oleaceae	Shrub	Sparse	A	P
100	*Jatropha curcas L.*	Euphorbiaceae	Shrub	Sparse	A	P
101	*Jatropha glandulifera Roxb.*	Euphorbiaceae	Shrub	Common	P	P
102	*Lantana camara L.*	Verbenaceae	Shrub	Dominant	P	P
103	*Leonotis nepetifolia (L.) R.Br.*	Lamiaceae	Shrub	Sparse	P	P
104	*Morinda pubescens Sm.*	Rubiaceae	Shrub	Sparse	P	P
105	*Opuntia dillenii (Ker Gawl.) Haw.*	Cactaceae	Shrub	Common	A	P
106	*Phoenix acaulis*	Palmae	Shrub	Dominant	P	P
107	*Randia dumetorum*	Rubiaceae	Shrub	Dominant	P	P
108	*Senna auriculata (L.) Roxb.*	Leguminosae	Shrub	Dominant	P	P
109	*Senna occidentalis (L.) Link*	Leguminosae	Shrub	Dominant	P	P
110	*Solanum pubescens.Willd.*	Solanaceae	Shrub	Dominant	P	P
111	*Xanthium strumarium*	Asteraceae	Shrub	Dominant	P	P
112	*Ziziphus oenopolia (L.) Mill.*	Rhamnaceae	Shrub	sparse	P	P
113	*Azolla pinnata subsp. africana (Desv.)*	Salviniaceae	Hydrophyte	Sparse	A	P
114	*Eichornia crassipes Solms*	Pontederiaceae	Hydrophyte	Sparse	A	P
115	*Hydrilla Rich.*	Hydrocharitaceae	Hydrophyte	sparse	A	P
116	*Ipomoea aquatica*	Convolvulaceae	Hydrophyte	Common	A	P
117	*Lemna minor Hegelm.*	Araceae	Hydrophyte	Common	A	P
118	*Limnophila heterophylla R. Br.*	Plantaginaceae	Hydrophyte	Common	A	P
119	*Marsilea quadrifolia L.*	Marsileaceae	Hydrophyte	Sparse	A	P
120	*Neptunia oleracea Lour.*	Leguminosae	Hydrophyte	Common	A	P
121	*Operculina turpethum (L.) Silva Manso*	Convolvulaceae	Hydrophyte	Common	A	P
122	*Typha angustata*	Typhaceae	Hydrophyte	Dominant	A	P
123	*Vallisneria L.*	Hydrocharitaceae	Hydrophyte	Sparse	A	P
124	*Acalypha indica L.*	Euphorbiaceae	Herb	Dominant	A	P
125	*Achyranthes aspera L*	Amaranthaceae	Herb	Dominant	P	P
126	*Aerva lanata (L.) Juss*	Amaranthaceae	Herb	Dominant	P	P
127	*Aeschynomene aspera L*	Leguminosae	Herb	Dominant	P	P
128	*Ageratum conyzoides (L.) L.*	Asteraceae	Herb	Dominant	P	P
129	*Aloe vera*	Tiliaceae	Herb	Rare	A	P
130	*Alternanthera sessilis (L.) R.Br. ex DC.*	Amaranthaceae	Herb	Sparse	P	P
131	*Amaranthus spinosus L.*	Amaranthaceae	Herb	Sparse	P	P
132	*Amaranthus viridis L.*	Amaranthaceae	Herb	Sparse	P	P
133	*Argemone mexicana L.*	Papaveraceae	Herb	Dominant	P	P
134	*Barleria prionitis L.*	Acanthaceae	Herb	Sparse	A	P
135	*Blumea mollis (D. Don) Merr.*	Asteraceae	Herb	Dominant	P	P
136	*Boerhavia diffusa L.*	Nyctaginaceae	Herb	Dominant	P	P

137	*Borreria hispida Spruce ex K.Schum.*	Rubiaceae	Herb	Sparse	P	P
138	*Catharanthus roseus (L.) G.Don*	Apocynaceae	Herb	Dominant	P	P
139	*Celosia virgata Jacq.*	Amaranthaceae	Herb	Common	P	P
140	*Cleome aspera J.König ex DC*	Cleomaceae	Herb	Common	P	P
141	*Cleome viscosa L.*	Cleomaceae	Herb	Dominant	P	P
142	*Crotalaria juncea L*	Leguminosae	Herb	Common	P	P
143	*Croton bonplandianus Baill.*	Euphorbiaceae	Herb	Dominant	P	P
144	*Desmodium dichotomum (Willd.) DC.*	Leguminosae	Herb	Sparse	A	P
145	*Eclipta alba (L.) Hassk.*	Asteraceae	Herb	Sparse	A	P
146	*Euphorbia antiquorum*	Euphorbiaceae	Herb	Common	P	P
147	*Euphorbia hirta L.*	Euphorbiaceae	Herb	Dominant	P	P
148	*Evolvulus alsinoides (L.) L*	Convolvulaceae	Herb	Dominant	P	P
149	*Gomphrena serrata L.*	Amaranthaceae	Herb	Common	A	P
150	*Hygrophila auriculata (Schumach.) Heine*	Acanthaceae	Herb	Dominant	P	P
151	*Hyptis suaveolens (L.) Poit.*	Lamiaceae	Herb	Dominant	P	P
152	*Indigofera hirsuta L.*	Leguminosae	Herb	Common	P	P
153	*Indigofera linnaei Ali*	Leguminosae	Herb	Common	P	P
154	*Justicia procumbens L.*	Acanthaceae	Herb	Sparse	P	P
155	*Leucas aspera*	Lamiaceae	Herb	Dominant	P	P
156	*Ludwigia perennis L.*	Onagraceae	Herb	Common	A	P
157	*Mimosa pudica*	Leguminosae	Herb	Dominant	P	P
158	*Mollugo cerviana (L.) Ser.*	Molluginaceae	Herb	Sparse	P	P
159	*Ocimum canum Sims*	Lamiaceae	Herb	Dominant	P	P
160	*Oldenlandia umbellata L.*	Rubiaceae	Herb	Dominant	A	P
161	*Oxalis corniculata*	Oxalidaceae	Herb	Dominant	P	P
162	*Parthenium hysterophorus L.*	Asteraceae	Herb	Dominant	A	P
163	*Pavonia zeylanica Cav.*	Malvaceae	Herb	Common	P	P
164	*Phyllanthus amanus*	Euphorbiaceae	Herb	Sparse	A	P
165	*Phyllanthus maderaspatensis L.*	Phyllanthaceae	Herb	Sparse	P	P
166	*Plumbago zeylanica L*	Plumbaginaceae	Herb	Common	P	P
167	*Portulaca oleracea L.*	Portulacaceae	Herb	common	P	P
168	*Rhynchosia beddomei Baker*	Leguminosae	Herb	Sparse	P	P
169	*Ruellia tuberosa L.*	Acanthaceae	Herb	Dominant	P	P
170	*Scoparia dulcis L.*	Plantaginaceae	Herb	Common	P	P
171	*Sida acuta Burm.f.*	Malvaceae	Herb	Dominant	P	P
172	*Sida cordifolia L.*	Malvaceae	Herb	Dominant	P	P
173	*Sida spinosa L.*	Malvaceae	Herb	Common	P	P
174	*Solanum surattense Burm. f.*	Solanaceae	Herb	Dominant	P	P
175	*Sonchus oleraceus (L.) L.*	Compositae	Herb	Dominant	P	P

176	*Sphaeranthus indicus L.*	Asteraceae	Herb	Dominant	P	P
177	*Tephrosia purpurea (L.) Pers.*	Leguminosae	Herb	Dominant	P	P
178	*Tribulus terrestris L*	Zygophyllaceae	Herb	Dominant	P	P
179	*Tridax procumbens (L.) L.*	Asteraceae	Herb	Dominant	P	P
180	*Triumfetta pentandra A.Rich.*	Malvaceae	Herb	Dominant	P	P
181	*Urena lobata L.*	Malvaceae	Herb	Dominant	P	P
182	*Vanda tessellata*	Orchidaceae	Herb	Dominant	P	P
183	*Vernonia cinerea (L.) Less.*	Compositae	Herb	Dominant	P	P
184	*Waltheria indica L.*	Malvaceae	Herb	Dominant	P	P
185	*Ziziphus nummularia*	Rhamnaceae	Herb	Dominant	P	P
186	*Aeluropus lagopoides*	Poaceae	Grass	Sparse	P	P
187	*Apluda mutica L.f.*	Poaceae	Grass	Sparse	P	P
188	*Aristida adscensionis*	Poaceae	Grass	Common	P	P
189	*Aristida funiculata*	Poaceae	Grass	Common	P	P
190	*Aristida hystrix L.f.*	Poaceae	Grass	Common	A	P
191	*Chloris barbata Sw.*	Poaceae	Grass	Common	A	P
192	*Chloris virgata Sw.*	Poaceae	Grass	Common	P	P
193	*Chrysopogon fulvus*	Poaceae	Grass	Sparse	A	P
194	*Chrysopogon lancearius (Hook.f.) Haines*	Poaceae	Grass	Sparse	A	P
195	*Cymbopogon citratus*	Poaceae	Grass	Common	A	P
196	*Cymbopogon martinii*	Poaceae	Grass	Sparse	A	P
197	*Cynodon dactylon*	Poaceae	Grass	Sparse	P	P
198	*Cyperus castaneus*	Poaceae	Grass	Common	P	P
199	*Cyperus difformis*	Poaceae	Grass	Common	P	P
200	*Cyperus flavidus*	Cyperaceae	Grass	Sparse	A	P
201	*Cyperus rotundus L.*	Cyperaceae	Grass	Sparse	P	P
216	*Ipomoea obscura (L.) Ker Gawl.*	Convolvulaceae	Climber	Sparse	P	P
217	*Merremia tridentata (L.) Hallier f.*	Convolvulaceae	Climber	Rare	A	P
218	*Mucuna pruriens (L.) DC.*	Leguminosae	Climber	common	A	P
219	*Passiflora edulis Sims.*	Passifloraceae	Climber	Rare	A	P
220	*Pergularia daemia (Forssk.) Chiov.*	Apocynaceae	Climber	Dominant	P	P
221	*Rivea hypocrateriformis Choisy.*	Convolvulaceae	Climber	Dominant	P	P
222	*Tinospora cordifolia (Willd.) Miers.*	Menispermaceae	Climber	Sparse	A	P

LC-Least Concern, DD-Data deficient, CR-Critically Endangered, VU-Vulnerable, NE-Not Evaluated, NA-Not assessed, EN- Endangered, NT-Near Threatened, EW- Extinct in the Wild

3.12.3 FAUNA

List of Amphibians either spotted or reported from the study area

Sr. No.	Technical Name	English Name / Local Name	Wildlife Act (1972)
	Reptiles		
1	*Hemidactylus sp*	House Lizard	Sch-IV
2	*Calotes versicolor*	Garden Lizard	Sch-IV
3	*Sitana pondiceriana*	Green Lizard	Sch-IV
4	*Chameleon zeylanicus*	Lizard	Sch-IV
5	*Draco sps*	Draco	Sch-IV
6	*Varanus benghalensis*	Monitor Lizard	Sch-IV
7	*Nerodia piscator*	Fresh water snake	Sch-III
8	*Dendrophis sps*	Tree snake	Sch-III
9	*Dendrolaphis sps*	Green tree snake	Sch-III
10	*Naja naja*	Cobra	Sch-II
11	*Hemibungarussps*	Indian coral snake	Sch-II
	Bungarus candidus	Krait	Sch-III
12	*Vipera russeli*	Viper	Sch-II
13	*Trimeresurus meacrolepis*	Pit viper	Sch-II
14	*Groemyda bijuga*	Fresh water tortoise	Sch-III
15	*Testudo travencoriana*	Land tortoise	Sch-III
16	**Butterflies**		
17	*Triodes minos*	Southern Birdwing	Sch-IV
18	*Papilo demoleus*	Lime butterfly	Sch-IV
19	*Graphium agamemnos*	Tailed jay	Sch-IV
20	*Papilo polymnstor*	Blue Mormon	Sch-IV
21	*Neptis hylas*	Common sailor	Sch-IV
	Amphibians		
22	*Rana hexadactyla*	Frog	Sch-IV
23	*Rana tigrina*	Bull frog	Sch-IV
24	*Cocopus sps*	Burrowing frog	Sch-IV
25	**Mammals**		
26	*Lepus nigricollis*	Hare	Sch-III
	Hyaena hyaena	Hyaena	Sch-III
27	*Canis auries*	Jackal	Sch-III
28	*Funambulus spp.*	Squirrel	Sch-IV
29	*Sus sucrofa*	Wild pig	Sch-III
30	*Rattus norvegicus*	Field mouse	Sch-IV
31	*Herpestes edwardii*	Common mongoose	Sch-IV
32	*Bandicota indica*	Bandicoot	Sch-IV

LC-Least Concern, DD-Data deficient, CR-Critically Endangered, VU-Vulnerable, NE-Not Evaluated, NA-Not assessed, EN- Endangered, NT-Near Threatened, EW- Extinct in the Wild

3.12.4 BIRDS

Sr. No.	Technical Name	English Name / Local Name	Wildlife Act (1972)
1	*Milyus migrans*	Common Kite	Sch-IV
2	*Quills contronix*	Grey quail	Sch-IV
3	*Corvus splendens*	House crow	Sch-IV
4	*Turdoides striatus*	White headed babbler	Sch-IV
5	*Aegithina tiphia*	Iora	Sch-IV
6	*Pycnonotus cafer*	Red vented bulbul	Sch-IV
7	*Pycnonotus jokokus*	White browed Bulbul	Sch-IV
8	*Saxicoloides fulicata*	Indian robin	Sch-IV
9	*Columbus livibus*	Rock Pigeon	Sch-IV
10	*Copsychus saularis*	Magpie Robin	Sch-IV
11	*Tchitrea paradisi*	Paradise Fly catcher	Sch-IV
12	*Tephrodornis pondiceraianus*	Common Wood shrike	Sch-IV
13	*Lalage sykesi*	Black headed cuckoo Shrike	Sch-IV
14	*Artamus fuscus*	Ashy Swallow Shrike	Sch-IV
15	*Dicrurus macrocerus*	Black Drongo	Sch-IV
16	*Dicrurus longicaudatus*	Grey Drongo	Sch-IV
17	*Dissemurus paradiseus*	Rackete tailed Drongo	Sch-IV
18	*Oriolus oriolus*	Indian Oriole	Sch-IV
19	*Black Headed Oriole*	Oriolus xanthornus	Sch-IV
20	*Temenuchus pagodarum*	Brahmny Myna	Sch-IV
21	*Acridotheres tristicus*	Common myna	Sch-IV
22	*Ploceus philippines*	Weaver bird	Sch-IV
23	*Uroloncha striata*	Spotted munia	Sch-IV
24	*Passer domisticus*	House Sparrow	Sch-IV
25	*Redrumped Swallow*	Hirundo daurica	Sch-IV

26	*Cinnyris asiatica*	Purple Sunbird	Sch-IV
27	*Brachypternus bengalensis*	Malabar Golden backed wood	Sch-IV
28	*Megalaima merulinus*	Indian Cuckoo	Sch-IV
29	*Hierococys varius*	Common Hawk Cuckoo	Sch-IV
30	*Eudynamis scolopaceus*	Koel	Sch-V
31	*Centropus sinensis*	Crow Pheasant	Sch-IV
32	*Psittacula Krammeri*	Rose ringed parakeet	Sch-IV
33	*Coryllis vaeralis*	Lorikeet	Sch-V
34	*Coracias benghalensis*	Indian Roller	Sch-IV
35	*Merops orinetalis*	Common Bee Eater	Sch-IV
36	*Alcedo atthis*	Common Kingfisher	Sch-IV
37	*Halcyon smyrensis*	White breasted kingfisher	Sch-IV
38	*Microfus affinis*	House swift	Sch-IV
39	*Cyprirus parvus*	Palm swift	Sch-IV
40	*Caprimulgus asiaticus*	Common Indian jar	Sch-IV
41	*Tylo alba*	Barn Owl	Sch-IV
42	*Haliastur indus*	Brahmny kite	Sch-IV
43	*Milvus migrans*	Pariah kite	Sch-IV
44	*Circus aeruginosus*	Marsh harrier	Sch-IV
45	*Chalcophaps indica*	Emerald Dove	Sch-IV
46	*Lobvanella indicus*	Redwattled Lapwing	Sch-IV
47	*Lobpluvia malabaraica*	Yellow wattled lapwing	Sch-IV
48	*Anhinga melanogaster*	Darter	Sch-V
49	*Egretta garzetta*	Little Egret	Sch-IV
50	*Bubulcus ibis*	Cattle Egret	Sch-IV
51	*Ardeola grayii*	Pond Heron	Sch-IV
52	*Anas querquedula*	Gangney Teal	Sch-IV
53	*Anas acuta*	Common Teal	Sch-IV
54	*Aythya feroma*	White eyed Pochard	Sch-IV
55	*Gallinula chlorpus*	Moorhen	Sch-IV
56	*Sterna albifrons*	Indian River Tern	Sch-IV
57	*Galerida malabarica*	Malabar Crested Lark	Sch-IV

LC-Least Concern, DD-Data deficient, CR-Critically Endangered, VU-Vulnerable, NE-Not Evaluated, NA Not assessed, EN- Endangered, NT-Near Threatened, EW- Extinct in the Wild

3.12.5 LIST OF ZOOPLANKTONS

Sr. No	Phytoplankton	Zooplankton
1	*Gyrosigma sp.*	*Keratella monospina*
2	*Achananthes affinis*	*Brachirous caudatus*
3	*Gyrosigma accuminatus*	*Asplancha brighwell*
4	*Pandorina sp.*	*Colpidium colpoda*
5	*Ankistrodesmus falcatus*	*Daphnia sp.*
6	*Ankistrodesmus sp.*	*Ceriodaphnia reticulate*
7	*Pediastrum boryanum*	*Mesocyclops leuckarti*
8	*Scenedesmus bijuga*	*Mesocyclops hyalinus*
9	*Melosira granulate*	*Coleps hirsutus*
10	*Cyclotella meneghiana*	*Arcella sp.*
11	*Microcystis sp.*	*Actinophyros sp.*
12	*Navicula gracilis*	*Asplancha sp.*
13	*Nitzschia gracilis*	*Ceriodaphnia sp.*
14	*Chroococcus minutes*	*Mesocyclops sp.*
15	*Spirulina princepes*	
16	*Pinnularia braunii*	
17	*Synedra tabulate*	
18	*Ophora sp.*	
19	*Cymbella sp.*	
20	*Navicula radiosa*	

3.13 DEMOGRAPHY & SOCIO-ECONOMICS

A meeting with the project proponent was initially conducted to develop a common understanding of the project activities, land acquisition for tap off point and status of payment of compensation to the affected PAP, and to identify a continuous point of contact for all future correspondence.

The baseline information included aspects like demographic information, economic activities, literacy profile, land use, infrastructure resource, economic facilities, cultural heritage, lifestyle and other value system.

The following methods were used as a benchmark to collate the baseline information:

- Stakeholders consultation meeting which included the Project Influenced and benefitted Population in Tiruppur;
- Consultations with along the pipeline route to understand the socio-economic status, education facilities and the literacy levels.

The delineation of Preliminary Stakeholders were based on the following points,

- The type of stakeholders, and;
- Their connection and influence levels on the project.

An open ended questionnaire was prepared for the focus group discussions prior to the start of the consultation process to obtain the information from the population. Different stakeholder groups were consulted to understand the concerns/ issues, expectations/ benefits and other advantages that they have on the project.

3.13.1 TIRUPPUR DISTRICT PROFILE

An official Census 2011 detail of Tiruppur (Tirupur), a district of Tamil Nadu has been released by Directorate of Census Operations in Tamil Nadu. Enumeration of key persons was also done by census officials in Tiruppur District of Tamil Nadu.

In 2011, Tiruppur had population of 2,479,052 of which male and female were 1,246,159 and 1,232,893 respectively. In 2001 census, Tiruppur had a population of 1,920,154 of which males were 978,349 and remaining 941,805 were females. Tiruppur District population constituted 3.44 percent of total Maharashtra population. In 2001 census, this figure for Tiruppur District was at 3.08 percent of Maharashtra population.

There was change of 29.11 percent in the population compared to population as per 2001. In the previous census of India 2001, Tiruppur District recorded increase of 25.34 percent to its population compared to 1991.

Tiruppur District Urban/Rural 2011

Out of the total Tiruppur population for 2011 census, 61.36 percent lives in urban regions of district. In total 1,521,111 people lives in urban areas of which males are 766,850 and females are 754,261. Sex Ratio in urban region of Tiruppur district is 984 as per 2011 census data. Similarly, child sex ratio in Tiruppur district was 954 in 2011 census. Child population (0-6) in urban region was 161,564 of which males and females were 82,665 and 78,899. This child population figure of Tiruppur district is 10.78 % of total urban population. Average literacy rate in Tiruppur district as per census 2011 is 84.53 % of which males and females are 90.06 % and 78.93 % literates respectively. In actual number 1,149,249 people are literate in urban region of which males and females are 616,189 and 533,060 respectively.

As per 2011 census, 38.64 % population of Tiruppur districts lives in rural areas of villages. The total Tiruppur district population living in rural areas is 957,941 of which males and females are 479,309 and 478,632 respectively. In rural areas of Tiruppur district, sex ratio is 999 females per 1000 males. If child sex ratio data of Tiruppur district is considered, figure is 949 girls per 1000 boys. Child population in the age 0-6 is 79,787 in rural areas of which males were 40,947 and females were 38,840. The child population comprises 8.54 % of total rural population of

Tiruppur district. Literacy rate in rural areas of Tiruppur district is 69.61 % as per census data 2011. Gender wise, male and female literacy stood at 78.34 and 60.91 percent respectively. In total, 611,317 people were literate of which males and females were 343,434 and 267,883 respectively.

3.13.2 VILLAGES FALLING UNDER STUDY AREA

Pipeline runs parallel along the man roads hence accessibility is not an issue. Project pipeline runs along major national and state highway connecting Tiruppur district. The route covers 33 villages in 7 talukas and 1 district.

Table 3-20: List of villages, cities, talukas and districts of Tiruppur falling in the project area

S. No	City/ Village		Taluka	District	State
1	1. Baikimpady 2. Kulai 3. Mittothu Colony 4. Mukka 5. Pav 6. Thenka 7. Yermal Thenka 8. Kaup 9. Kopalangadi 10. Kamala Mathu 11. Uliar Goli 12. Kote 13. Mudabettu 14. Katapady 15. Kinnymulki 16. Beejadi Kodladi	17. Korangrapady 18. Kodankoor 19. Kota 20. Tekkatte 21. Kanukure 22. Koteshwar 23. CPC Layout 24. Adi Tiruppur 25. Tonse East 26. Tenka Bettu 27. Brahmavar 28. Kumargod 29. Sulkuduru 30. Kotathattu 31. Manoor 32. Kumbashi 33. Gopadi	Tiruppur	Tiruppur	Tamil Nadu

Source: Primary Survey, TUV SUD

3.13.3 DEMOGRAPHIC DETAILS

The initial provisional data released by census India 2011, shows that density of Tiruppur district for 2011 is 478 people per sq. km. In 2001, Tiruppur district density was at 370 people per sq. km. Tiruppur district administers 5,187 square kilometers of areas.

Average literacy rate of Tiruppur in 2011 were 78.68 compared to 71.08 of 2001. If things are looked out at gender wise, male and female literacy were 85.49 and 71.82 respectively. For 2001 census, same figures stood at 80.44 and 61.37 in Tiruppur District. Total literate in Tiruppur District were 1,760,566 of which male and female were 959,623 and 800,943 respectively. In 2001, Tiruppur District had 1,222,628 in its district.

With regards to Sex Ratio in Tiruppur, it stood at 989 per 1000 male compared to 2001 census figure of 963. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 952 girls per 1000 boys compared to figure of 957 girls per 1000 boys of 2001 census data.

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Tiruppur. There were total 241,351 children under age of 0-6 against 200,168 of 2001 census. Of total 241,351 male and female were 123,612 and 117,739 respectively. Child Sex Ratio as per census 2011 was 952 compared to 957 of census 2001. In 2011, Children under 0-6 formed 9.74 percent of Tiruppur District compared to 10.42 percent of 2001. There was net change of -0.68 percent in this compared to previous census of India.

In 2011, total 434 families live on footpath or without any roof cover in Tiruppur district of Tamil Nadu. Total Population of all who lived without roof at the time of Census 2011 numbers to 1,185. This approx 0.05% of total population of Tiruppur district.

Table 3-21: Demographic Profile of Project Districts

Tiruppur /Description	2011	2001
Population	24.79 Lakhs	19.20 Lakhs
Actual Population	2,479,052	1,920,154
Male	1,246,159	978,349
Female	1,232,893	941,805
Population Growth	29.11%	25.34%
Area Sq. Km	5,187	5,187
Density/km2	478	370
Proportion to Tamil Nadu Population	3.44%	3.08%
Sex Ratio (Per 1000)	989	963
Child Sex Ratio (0-6 Age)	952	957
Average Literacy	78.68	71.08
Male Literacy	85.49	80.44
Female Literacy	71.82	61.37

Total Child Population (0-6 Age)	241,351	200,168
Male Population (0-6 Age)	123,612	102,298
Female Population (0-6 Age)	117,739	97,870
Literates	1,760,566	1,222,628
Male Literates	959,623	704,738
Female Literates	800,943	517,890
Child Proportion (0-6 Age)	9.74%	10.42%
Boys Proportion (0-6 Age)	9.92%	10.46%
Girls Proportion (0-6 Age)	9.55%	10.39%

Source: Census of India, 2011

Religion wise Demography details

The religion-wise demography profile indicates that maximum population belongs to Hindus (92%) followed by Muslims (5.00%) in all three districts and Christians (3%). The details of religion-wise demography status o are given below in Table 3-24.

Table 3-22: Religion-wise demographic Profile as per Census data, 2011

District/ Tiruppur	Total	Percentage
Hindu	2,278,835	91.92 %
Muslims	123,983	5.00 %
Christian	70,015	2.82 %
Sikh	455	0.02 %
Buddhist	198	0.01 %
Jain	371	0.01 %
Others	119	0.00 %
Not Stated	5,076	0.20 %

Source: Census of India, 2011

4 ANTICIPATED ENVIRONEMENTAL IMPACTS & MITIGATION MEASURES

This section of the report provides an assessment of the potential impacts on different identified environmental components, which are likely to occur during the laying of pipeline and supply of Petroleum products through the pipeline. However, by adopting appropriate management measures, the majority of the assessed impacts can be mitigated.

The major potential impacts associated with the proposed project are impact on soil, impact on water resources and area drainage, air quality degradation, noise impacts, impact on ecological environment, impact on agriculture, land use changes, impact on health and safety, impact on socio-economic features, impact on community activities, impact on cultural heritage and impact on aesthetics. These impacts can occur at any one of the three stages i.e. planning or design stage, the construction stage and the operation stage.

The identified impacts due to the proposed project can be mitigated through the incorporation of appropriate measures at different stages of the project. This will ensure the best design with minimal damage to or loss of significant or sensitive features such as roadside vegetation, local water resources, etc.

4.1 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

The environmental impacts associated with the proposed project on various environmental components such as air, water, noise, soil, flora, fauna, land, socioeconomic, etc. has been identified using Impact Identification Matrix.

Table 4-1: Impact Identification matrix for the proposed pipeline route and the CNG stations

	Physical				Biological		Socio-Economic		
	Ambient Air Quality	Ground/Surface Water (Quantity/Quality)	Ambient Noise	Land (Land use, Topography, drainage, soil)	Flora	Fauna	Livelihood and Occupation	Infrastructure	Health & Safety
Augmentation of Facilities									
Construction Phase									

Civil and mechanical works	●	●	●	●	●	●	●	●	
Movement of vehicles	●		●			●		●	●
Hydro testing									●
Waste generation, handling and disposal				●					●
Operation Phase									
Operation of pumps and compressors	●	●	●						
Storage of Gas/ Crude	●								
Cleaning & maintenance		●		●					
Movement of vehicles	●		●			●		●	●
Waste generation, handling and disposal		●		●					
Laying of New Pipeline									
Construction Phase									
Preparation of Right of way	●		●	●		●	●	●	●
Pipe laying	●			●					●
Chemical use/handling		●		●					
Movement of vehicles	●		●			●		●	●
Hydro testing		●							●
Waste generation, handling and disposal				●					●
Operation Phase									
Operation of compressors	●		●						
Cleaning & maintenance		●		●					
Waste generation, handling and disposal			●						
Movement of vehicles	●		●			●		●	●
CNG Stations									
Construction Phase									
Civil and mechanical works	●		●	●	●		●		●
Movement of vehicles	●	●	●			●			●
Waste generation, handling and disposal		●		●	●			●	●
Operation Phase									
Movement of vehicles	●		●						●
Waste generation, handling and disposal		●	●						●
Leakage from Pipeline	●	●							

Leakage due to corrosion, equipment failure, accidents, human error and as a result of third party interference	●	●							

4.2 IMPACT AND MITIGATION MEASURES- CONSTRUCTION PHASE

4.2.1 AIR ENVIRONMENT

The air quality along the project stretch may get affected during the construction period. Particulate matter will be the predominant pollutant affecting the air quality during the construction phase. As the construction activities are likely to generate dust. Mostly the additional automobile traffic and construction machineries involved during construction activities will generate petroleum pollutants. However, this will not lead to any tangible effect, as the additional traffic volume related to construction activities will be low.

a. Impacts

Potential emissions sources during construction phase include the following:

- Deterioration of air quality due to fugitive dust emissions from construction activities (especially during dry season) like excavation, back-filling and dumping of earth materials, from construction spoils, vehicular movements along unpaved roads, loading / unloading and transportation of construction materials
- Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO2, NOX, and particulate matter
- Operation of equipment and machinery for earth-moving, grading, pipeline laying and civil works at pipeline ROW and other sites
- Operation of temporary Diesel Generator (DG) sets, emission of PM, CO, NOx, & SOx

b. Mitigation Measures

During construction phase of the proposed project appropriate mitigative measures have to be implemented to ameliorate the anticipated air quality problems. The following mitigative measures will be employed during construction period to reduce the pollution level to acceptable limits

- Proper and prior planning, appropriate sequencing and scheduling of all major construction activities have to be done, and timely availability of infrastructure supports needed for construction to be ensured to shorten the construction period vis-à-vis reduce pollution.

- Construction materials to be stored in covered godowns or enclosed spaces to prevent the windblown fugitive emissions.
- Stringent construction material handling / overhauling procedures to be followed.
- Adequate dust suppression measures such as regular water sprinkling on unpaved haul roads, at vulnerable areas of construction sites to be undertaken to control fugitive dust during material handling and hauling activities particularly near habitations especially in dry seasons.
- The construction material delivering vehicles to be covered in order to reduce spills.
- Low emission construction equipment, vehicles and generator sets to be used
- It has to be ensured that all construction equipment and vehicles are in good working conditions, properly tuned and maintained to keep emission within the permissible limits and engines tuned off when not in use to reduce pollution
- Vehicles and machineries to be regularly maintained so that emissions confirm to standards of Central Pollution Control Board (CPCB)
- Monitoring of air quality at regular intervals to be conducted during construction phase
- Construction workers to be provided with masks to protect them from inhaling dust.

4.2.2 NOISE ENVIRONMENT

During construction phase, noise will be generated due to movement of vehicles, and operation of light and heavy construction machineries including pneumatic tools (hot mixer, dozer, tipper, loader, excavator, grader, scrapper, roller, concrete mixer, generator, pump, vibrator, crane, compressor, HDD etc.). During construction the noise generating range will be approximately between 55-70 dB(A). The main sources of noise during construction period are:

- Movement of vehicles during the construction period for procurement of construction material.
- During site preparation, surface preparation, pipeline laying etc.

Noise generated from sources mentioned above will be mostly during daytime. Moreover, villages / settlements being near to the route, significant impact on local people is apprehended (as a few congested human habitations are along the site), as the noise generated will be a problem. However, the workers are likely to be exposed to high noise levels that may affect them.

a. Impacts

- Increase in noise level due to construction activities like operation of construction equipment and vehicular traffic

- Operation of construction machinery will lead to rise in noise level to the range between 80-100 dB(A). The magnitude of impact from noise will depend upon types of equipment used, construction methods and also on work scheduling.
- Since there is a mix of residential, commercial and industrial area in the vicinity of the project, noise have to be kept in check.
- The impacts will be significant on construction workers, working close to the machinery.

b. Mitigation Measures

- Construction camp and temporary labour sheds will be located away from the immediate vicinity of construction sites and major road traffic.
- Protective gears such as earplugs, etc. will be provided to construction personnel exposed to high noise levels as preventive measures.
- It will be ensured that all the construction equipment and vehicles used are in good working condition, properly lubricated and maintained to keep noise within the permissible limits and engines tuned off when not in use to reduce noise.
- Construction activities carried out near residential locations will be scheduled to the daytime (i.e. from 10.00 a.m. to 6.00 p.m.) only so as to have minimum disturbance to the residents.
- Whenever possible static noisy machinery will be placed on vibration isolators or temporary sheeting will be provided to check noise propagation.

Noise level will be monitored at regular intervals during construction phase, which will help in taking appropriate action to maintain it within the prescribed limit

4.2.3 WATER ENVIRONMENT

Small quantity of water will be used during construction process and hydro testing of the pipeline. Wastewater from construction activities would mostly contain suspended impurities. Other pollutants, which may find their way to it, will be insignificant concentrations and may not cause significant impact on the receiving water bodies. The deterioration of water quality during construction phase is expected due to wastewater disposal from the workers camp and sludge generated from construction sites. If adequate arrangements are not made to ensure proper drainage of wastewater from construction sites, such waters may form stagnant pools and aggravate soil erosion. Stagnant pools of water promote breeding of mosquitoes and create generally unsanitary conditions.

a. Impacts

- Increase of sediment / silt load in the runoff from construction sites / earth moving activities and increase in turbidity in receiving stream / water bodies.

- Erosion of soil into the water bodies due to removal of vegetation.
- Contamination by fuel and lubricants by spills from machineries.
- Contamination of water bodies due to improper sanitation and disposal of wastes at the construction Camps.
- Contamination of water bodies due to water from Hydrotesting of the pipeline.
- Impact on ground water quality due to leachates from the solid waste dumpsites.

b. Mitigation measures

- Quality of construction wastewater emanating from the construction site to be controlled through suitable drainage system with sediment traps (silting basin as water intercepting ditch) for arresting the silt / sediment load before its disposal into the main natural drainage system around the site.
- The trench shall be excavated only so far in advance of pipe laying that it do not causes increased soil erosion and silting of water bodies.
- The discharge of the trench de-watering pumps shall be conveyed either to drainage channel or to natural drains after passing through a catch pit for settling the silt.
- The trench shall be excavated to the exact gradient specified so that no making of the sub-grade by back filling is required and the concrete bed, where required, may be prepared with greatest ease giving a uniform and continuous bearing and support for the pipe.
- All the construction and preparatory activities to be carried out during dry seasons only.
- Construction materials to be stacked together by fencing it with brick or earth in order to prevent spillage into the water bodies, also these materials to be stacked away from the water bodies.
- Proper sanitation facilities to be provided at the construction site to prevent health related problems due to water contamination.
- Waste disposal and sanitation to workers in the construction camp to be properly maintained or taken care off in order to check their entry into the water bodies like ponds, streams etc.
- Vehicle maintenance and refueling to be confined to areas near construction camps designed to trap discarded lubricants and fuel spills from entering into the water bodies;
- Drinking water supply for the workers in the construction camps to meet the Indian National Standards. In order to assess the portability of the supplied water to the construction labour camps water quality to be periodically monitored.
- Garbage to be collected in tanks and disposed off daily in order to check the solid wastes entering into the ponds, streams etc

4.2.4 LAND & SOIL ENVIRONMENT

The construction activities such as earth moving may lead to reduction in vegetal cover on ground thus leading to soil erosion. During the construction period the movement of heavy vehicles will result in compaction of soil by making it hard and impermeable. The erosion at construction stretches will result in increased sediment load in recipient streams. Any leakage of lubricants in equipment yard will cause soil contamination. Solid waste disposal along roadside also adds to impact on the land environment during the construction. During construction activity for laying of pipeline cutting of existing land will be done and the dug material generated will be replaced back after laying of the pipes.

a. Impacts

- Loss of topsoil from excavation areas.
- Loosening of topsoil and loss of vegetative cover (land clearing) along the route and construction areas due to excavation and back filling which lead to enhance soil erosion.
- Compaction of alluvial soils by earth moving equipment.
- Solid waste disposal along the route also adds to impact on the land environment during the construction phase.

b. Mitigation measures

- During excavation, care will be taken to see that the topsoil and the subsoil are stored separately. Topsoil (50cm) of route pits will be conserved and restored after excavation is over and will be replaced back for filling of the pit areas. Whereas the top soil (25cm) stripped from agricultural field and forest area will be stacked separately as top soil dump of not more than 1m in height and the same will be redistributed to the pit after laying of pipeline. During refilling, care will be taken to see that the topsoil is replaced back at the top while refilling after laying of pipeline. This will help grasses growing earlier on the surface, to grow back. Also, the less fertile soil of lower horizon will not be placed on the top thus avoiding degradation of land.
- Back filling shall be carried out immediately after the pipeline has been laid in the trench. On no account the topsoil from ROW shall be used for this purpose. The backfill material shall not contain any extraneous material and/or hard lumps of the soil. After the initial backfill has been placed into the trench to a level slightly above the surrounding ground, the backfill material shall be compacted.
- When the trench has been dug through driveways or roads all backfills shall be executed with sand or a suitable material and shall be thoroughly compacted
- Trench excavated in dykes which are the property of the railways or which is part of main road shall be graded and backfilled in their original profile and condition

- Also necessary contour bunding, gully plugging and staggered trenching shall be carried out wherever required in the pipeline corridor and in areas where excavated soil will be dumped to check soil erosion
- Stone pitching will be provided at the slopes near the irrigation and natural drainage / rivers to prevent silting of soil into these water bodies.

4.2.5 ECOLOGICAL ENVIRONMENT

The initial construction work at the pipeline route involves land clearance, but it would not include clearing of trees. However, the pipeline runs along/ in the protected forest area as well as the ecologically sensitive region.

All the construction work will be carried out in the premises of the pipeline boundary and the CNG station boundary only. Development of Green belt all around the stations will be started along with the construction activities to contain the dust and noise due to construction activities within the boundary. Therefore, no impact on the ecological environment is proposed due to the construction activity of the project.

a. Impacts

- The proposed pipeline passes through notified protected forest land, but no vegetation clearance will be undertaken as part of the pipeline route laying activity.
- The proposed project may not cause any impacts on fauna and wildlife of the study area during construction phase.
- No wildlife corridor and migratory routes comes in the pipeline route. Construction activity during monsoon and post monsoon period may not cause any impact on the movement of wildlife.

b. Mitigation measures

- No vegetation clearance will be undertaken in the pipeline route as well as the CNG stations plot boundary
- While planning / selection of route care to be taken to route the pipeline alignment in such a way to avoid areas with trees and shrubs and thus no major impact of loss of vegetation is anticipated.

4.2.6 SOCIO-ECONOMIC ENVIRONMENT

The project will provide either direct or indirect job opportunities to the local population as far as possible. There will be some migration of skilled labor force from outside the project area during construction phase, which may put some pressure on the local settlements and resources. Considering the size and type of construction activities envisaged the immigration of work force

for construction phase (including contractor' labours) would have marginal impact on demography (e.g. changes in total population, sex ratio, literacy level, main workers etc.) of the immediate vicinity area.

In addition, Traffic volume might will increase on nearby roads and the project roads due to movement of heavy vehicles during the construction phase, which may cause public inconvenience. This will have minimal affect considering the size and nature of the Project.

a. Impacts

- Strain on civic amenities (like road, transport, communication, water supply and sanitation, health care and recreational utilities etc.) due to increase in floating population.
- Increase in traffic volume and congestion in the areas and roads.
- Increase in employment opportunity to non-workers in the project area as nonskilled and semi-skilled workers.

b. Mitigation Measures

- It is difficult to assess the above impacts quantitatively on a measurable scale. However, most of these impacts will be short term and limited to the construction period only.
- Development of traffic management plan to ease the situation.
- Transport of construction materials and machineries shall be carried out during lean traffic period of the day or during night.

4.3 IMPACTS & MITIGATION MEASURES- OPERATION PHASE

The impact during the operation phase will be continuous in nature. For a gas-based pipeline and CNG station the potentials for imparting adverse impacts is not high. However whatever impact on environment is present will be minimized through incorporation of efficient technologies for pollution control measures.

4.3.1 AIR ENVIRONMENT

a. Impacts

- The pipeline will be 1.2-2 m below the ground and thus no air pollution due to operation of the project is anticipated.
- Some vehicular emission from maintenance is anticipated during maintenance phase, which will be temporary
- The impacts of the operational CNG station would not have any impacts on Air pollution of the area. The increased frequency of the vehicles at the station would not lead to any increased air pollution.

b. Mitigation Measures

Not Required

4.3.2 NOISE ENVIRONMENT

a. Impacts

- The pipeline will be 1.2 m below the ground and thus no noise pollution due to operation of the project is anticipated
- The residents / staff may be exposed to high noise levels during maintenance phase, which will be temporary.
- Noise and vibration during operations will be gas engine, various major and large compressors, air compressor, ventilation fans and miscellaneous equipment's for the CNG stations

b. Mitigation Measures

- In the stations, a closely spaced green belt to be planted all around the premises to attenuate noise
- Machinery to be maintained and lubricated as per manufacturers' guidelines to reduce noise generation.
- Personnel deployed in compressor stations will be issued personal noise protection equipment (ear plugs, ear muffs)
- If necessary, their duty hours will be regulated to keep noise exposure levels within standards.
- All equipment in the station would be designed / operated to have a noise level not exceeding 85dB, as per the requirement of Operational and Safety and Health Administration Standard (OSHA).
- Adopting modern design and the use of sound-absorbing materials will minimize noise and vibration from the station.

4.3.3 WATER ENVIRONMENT

a. Impacts

- The material/product to be transported is compressed gas, so during the operation period, the expected impacts on the water resources are not anticipated.
- The aquatic biological environment in the vicinity of the proposed project pipeline will not be affected, as no discharge is proposed form the CNG stations. Hence, there will be no impact on aquatic ecosystem due to operation of the project.

b. Mitigation Measures

- The discharge from the toilets from the stations will be routed to through the sewage pipelines to the nearest treatment plant, No open discharge will be done.

4.3.4 ENVIRONMENT, HEALTH AND SAFETY

a. Impacts

There could be impacts on environment, health and safety due to leakage from pipelines from likely external physical forces, e.g. seismicity, floods, landslides, permafrost, vegetation;

Mitigation Measures

- Leak Detection and Control System shall be in place
- SCADA monitoring shall be carried out by AGL
- Mock Drills shall be conducted at regular intervals in line with Emergency Response and Disaster Management Plan of AGL

Prevent leaks by

- Installing positive pipe corrosion control measures, for example, coatings, cathodic protection, chemical additives, heaters;
- Ensuring that the SCADA is well maintained and used correctly to control flow and pressure.
- Detect leaks by installing leak detection equipment, e.g. monitoring the flow in the pipe through pressure sensors connected to alarms and automatic pump shutdown systems;
- Continuous metering to provide a comparison between input and output for leak detection;

- **Emergency response**

- Introduce accident, fire and explosion precautions and emergency response procedures;
- These should be tested and drills should occur regularly with appropriate reporting on response times etc.;
- Introduce environment, health and safety training for all employees and contractors;
- Plan the route of the pipeline to reduce the impact on the surrounding area;
- Bury pipelines along the entire length to a minimum of 1m to the top wherever possible;
- Schedule periodic inspection and maintenance to avoid disturbance/disruption of sensitive habitats;
- Good housekeeping should be maintained at all times in all areas of the site; and
- Prevent unauthorised or unintentional intrusion to protected areas through fencing or flagging

5 ADDITIONAL STUDIES

5.1 QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment (QRA) study should be undertaken for the proposed 8" & 4" diameter underground pipeline for the transfer of compressed natural gas. The aim of QRA study will be to identify potential hazards, assess the consequences and frequency of hazards and evaluate the risk to personnel, property and public. To assess the relative level of risk posed by the proposed project, a comparison will be made with risk criteria that is considered tolerable (ALARP) for similar operations

The overall approach and methodology employed for the study will be based on the guidelines given in IS 15656: 2006, Indian Standard – Hazard Identification and Risk Analysis – Code of Practice, May 2006, using PHAST Software/Correlations.

The pipeline system will be provided with state of the art safety systems like protection system, SCADA, leak detection system / pipeline application software, Fire and gas detection systems, etc. The proposed transfer of gas will be examined for inherent hazards or the potential to result in an unplanned event or sequence of events at different sections along the pipeline route. Several hazards that can cause failure of pipelines will be identified. These included loss of integrity/ damage due to interference from third parties, corrosion, accidents, human error, sabotage, etc., during normal operation. Analysis of past accidents are to be used to establish the credibility of accident scenarios.

5.2 GUIDELINES FOR EMERGENCY RESPONSE PLAN

Emergency response plan will be developed with the resources available within the company. The important stages of the response plan are declaration of an emergency, identification of resources & manpower, ending of an emergency and rehearsal of the plan. Declaration of an emergency would involve recognizing a leak and reporting to Station in charge of nearest compressor station.

Other features are summarized below:
Emergency Response Structure: An emergency response structure will be developed for effective response to the emergency. The structure defines the main functions of the decision makers and the individual roles as well.

Roles & Responsibilities of Team: Emergency response team (ERT) to respond to fire, accidents and technical emergencies will be constituted from operations personnel, who can be called upon 24 hours a day, supported by senior management field personnel as and when required. The ERT will receive specific training for their roles and exercised on a regular basis. The proposed functions of employees that are planned to be deployed will be finalized prior to commissioning.

Operations Control: The pipeline operation will be monitored and controlled through Local control system and POC in command which will have the provision for emergency shut down or isolation of Pipeline. Security: Surveillance of the entire pipeline will be held periodically through ground patrolling. Using operators with knowledge of local area will be deployed for ground patrolling of the pipeline route.

Medical and First Aid: All arrangements will be made available at SHPPL site offices and camps for medical and first-aid. First–Aid facility will be provided at compressor stations, master pipeline operation center/ local control center, MLVs and M&Rs. Adequate first-aid training will be provided to employees at these locations.

Communication: Responsibility for external and internal communication will be assigned at each station. Dedicated fiber optic cable based communication system will be provided for quick communication between the control stations, dispatch and delivery station(s) of the pipeline. The backup system will consist of appropriate combination of fixed telephone lines/data-bandwidth of the local service provider, mobile phones, VHF sets etc.

Emergency control room: A safe location will be designated as emergency control room (ECR) within the compressor stations.

Emergency Procedures: SHPPL will evolve easy-to-follow procedures for responding to the identified situation. The plan will be rehearsed once in three months.

Ending of an emergency: After controlling an emergency, the site ERT Leader will declare as “All Clear”. The siren will be sounded for 2 minutes to indicate that the Emergency is over.

The basic elements for an effective plan have been included in the development. Prior to the commissioning of the project, copies of the plan are to be given to the authorities.

5.3 STAKEHOLDER CONSULTATIONS

Stakeholder Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

Consultations were done at all districts of the projects, along the pipeline route. These meeting included the Project Influenced and benefitted Population in Tiruppur. This was undertaken to understand the socio-economic status, education facilities and the literacy levels of the population as well as their interest in the upcoming project in their area.

The delineation of Preliminary Stakeholders were based on the following points,

- The type of stakeholders, and;
- Their connection and influence levels on the project.

An open ended questionnaire was prepared for the focus group discussions prior to the start of the consultation process to obtain the information from the population. Different stakeholder groups were consulted to understand the concerns/ issues, expectations/ benefits and other advantages that they have on the project.

Representatives of AGL

Sr. No.	Name	Project Site/Corporate Office	Department
1	Mr. Giridhari	Project Site	Project

Discussions with Local Inhabitants Village 1

Name of the village	:	Avinashi	Date	: 19th Jan 2020	
Panchayat	:	Avinashi	Tehsil/Taluka	: Tiruppur	
District	:	Tiruppur			

Participants:

S.No.	Name	Village	Occupation	Land ownership/Local Inhabitants in vicinity of Project Site
1	Ramaswamy	Avinashi	Farmer	--
2	Palani Swamy	Avinashi	Farmer/Shop Owner	--

Sr.No.	Questions	Responses
1	Total population of the area:	28000
2	Average Household Size:	5-6
3	Literacy rate:	87.50 %
4	Caste/tribe details:	Schedule Caste (SC) constitutes 15.44 % while Schedule Tribe (ST) were 0.05 % of total population in Avanashi (TP)
5	Religion:	92 % Hindu, 4 % Muslim, 4 % Christian
6	Ethnic Group	South Asians
7	Major Occupation:	Farming, Service, Business
8	Crops Grown:	Main crop is paddy, millets and pulses. The nonfood or commercial crops in the district are cotton, oil seeds and coconut.
9	Land Holding details:	1-50 Acres
10	Type and number of livestock per household:	Cows, Bulls, Goat
11	BPL Holders/Other government scheme:	10%
12	Educational facilities:	Higher Secondary School
13	Transport facilities:	State Bus
14	Health care facilities:	Hospital
15	Water Supply facilities:	Tap and handpump
16	Electricity facilities:	24 Hrs
17	Role of Women:	Household work
18	Veterinary facility	Yes
19	Fertilizer shop	Yes
20	Fair price shop	Yes
21	NGO working in the area	None
22	Government scheme	MNREGA
23	Cultural Site	None

Summary of Responses received from locals residing in area

Questions	Summary of responses received from affected parties
What is the present mode of cooking (Fuelwood/ LPG/Kerosene Stove)	Fuelwood/ LPG Cylinder
Is there any piped gas supply in the vicinity?	No
Any apprehensions/concerns/odour/safety issues w.r.t. present project in the area	Yes, about fire and explosion safety. Suggests that a demo to be given to the village about the safety aspects of gas pipeline

Are people contended with fuel switchover from present mode to Piped Gas Supply?	Yes, very much willing. Had heard of the project and are eagerly waiting as it will help in business and residential proliferation.
Are the people contended with the present upcoming project in the area?	No
Have any of the locals objected so far/raised Grievance related to similar projects/proposed project?	No
What is the general perception about CGD projects?	Very positive
Other projects nearby or any other industry	Tiruppur is a major textile and knit wear hub contributing to 90% of total cotton knit wear exports from India.

Summary of Responses received from land sellers (near to Tap Off Station in case of Pvt. Land Parcel)

Questions	Summary of responses received from affected parties
What is the Land Use of the project site?	Non irrigated farmland. Exact land is not yet decided.
Has any land from local villages been acquired for the project?	--
Are the land disbursers contended with the remuneration received?	--
Have any of the landowners who sold their land for the project gone landless?	--
What is the general perception about CGD Projects?	Positive
Other projects nearby or any other industry	The CGD project is coming in the major towns of the district. There are no other gas distribution project in the districts.

Source: TUVSUD Primary Survey

6 ANALYSIS OF ALTERNATIVES

Route selection is a process of identifying constraints, avoiding undesirable areas and maintaining the economic feasibility of the pipeline. Diversion of pipeline around obstacles can be very costly. The ideal route, of course, would be a straight line from the origin to the terminal point. However, physiographic, environmental, design and construction constraints usually alter the route

The pipeline route should be optimized based on the following considerations:

- Safety of public lives and property and safety of the pipeline from engineering and other considerations.
- Shortest pipeline length.
- Easy and favorable terrain condition free of large water bodies, low lying marshy lands, obstacles like ravines, depressions and unstable grounds, meandering rivers, etc.
- Ground profile for pipeline hydraulics and avoidance of steep rising and falling ground, hills and valleys having sloping right of way.
- Availability of infrastructure and access to the pipeline route during construction and maintenance.
- Environmental impact and avoidance of environmentally sensitive lands, such as reserved forests, marine parks, built-up areas, places of worship, burial and public events.
- Minimum crossing of existing pipelines, transmission lines, parallel alignment, etc.
- Minimum road, rail, river and canal crossings.
- Avoidance of rugged and intricate grounds with hard strata, exposed rocks, boulders and quarries.
- Existing and future developments in the region, such as roads, rail lines, canal network, reservoirs, townships, industrial units, etc.
- Scope for future expansion of the pipeline.
-

The Petroleum and Natural Gas Regulatory Board (PNGRB) was constituted under The Petroleum and Natural Gas Regulatory Board Act, 2006 (NO. 19 OF 2006) notified via Gazette Notification dated 31st March, 2006. The Act provide for the establishment of Petroleum and Natural Gas Regulatory Board to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas and to promote competitive markets and for matters connected therewith or incidental thereto.

Further as enshrined in the act, the board has also been mandated to regulate the refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas excluding production of crude oil and natural gas so as and to ensure uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country. Hence the project was acquired through the bidding process and the area, number of customers, total CNG stations were already mentioned in it. So the route selection was done within the allotted area.

The options for applying and analysis for alternatives was not a feasible option, as the deadlines have been already mentioned and the work was supposed to start from the date of signing the document. Since all the requirements in the projects were predefined, scope for alternate analysis was quite slim, as to which the route passes through mix and heavily populated area, eco-sensitive zones and the notified protected forest zones.

Currently the project is in conceptual stage and pipeline route are still being assessed and finalized.

7 PROJECT BENEFITS

7.1 CONTRIBUTION TO NATIONAL ENERGY SECURITY

Energy is the key input for economic growth and Indian Energy sector play a vital role in country's Economy. Energy is a key input to the production processes that transform inputs to goods and services. India became the third largest energy consumer in the world after United States and China. Key drivers for increasing energy demand in India are population growth, industrialization and urbanization. Energy security and sustainability are interdependent because emissions from energy consumption contributes to climate change in greater extend globally. Indian government is also committed to increase the share of natural gas in country's energy mix up to 15% by 2030 and Ministry of Petroleum and Natural Gas intervening with policy reforms in natural gas sector. India requires a sustained supply of energy to support its ambitious growth and welfare targets for the coming years. In a survey by NITI Aayog, it was noted that India's energy consumption will reach 2,300 million tonnes of oil equivalent (mtoe) by 2047 out of which natural gas will contribute 173 mtoe under the determined effect scenario.

According to the International Energy Agency(IEA), Indian gas market is considered one of the most growing energy markets in the world, the Agency expected that Indian gas demand will increase in the coming decades at 5.4% per annum over 2007-30 (IEA ,2009) reaching 132 BCM by 2030. India had about 43.8 TCF of proved natural gas reserves by the end of 2012; production of natural gas arrived in 2011, 2012 to 47.559 BCM, India was self-sufficient in natural gas until 2004, where it began to import liquefied natural gas from Qatar to meet the growing needs where India occupied the sixth rank globally in the import of natural gas. In spite of the Indian increase production of gas in 2010, an increase of up to more than 44%, but India and because of the high economic growth has increased the import at an annual rate of 10 % from 2001-2011. In 2011, India consumed 2.3 trillion cubic feet (TCF) which is equivalent to a quarter of the Indian natural gas needs. Qatar is India's main supplier of liquefied natural gas, where the parties signed long-term contracts to supply India around 7.5 million tons of LNG every year from Qatar for 25 years and the first shipments has reached to India in 2004.

With the growing need for oil and gas in India since the nineties of the last century, the Indian government has worked to develop the oil and gas sector through the development of mechanisms of action and the issuance of new regulatory laws, 1993, private investors have been allowed to import and market liquefied petroleum gas (LPG) and kerosene freely, private investment is also allowed in lubricants, which are not subject to price controls. In the 11th Five

Year Plan, the Indian government has focused in particular on the energy sector in order to self-reliance for energy resources, particularly oil and gas by encouraging of exploration and extraction operations and reduce dependence on overseas. The government also worked on the development of oil and gas infrastructure such as pipelines, refinery, ports, and railways. India currently has 22 refineries with a capacity (215.066 MMTPA),17 refineries under public sector and 3 under private sector. The Indian government is also working to improve of the oil and gas pipelines, and in spite of networks of gas and oil pipelines are still weak but the government is seeking to develop it, in collaboration with private sector companies.

7.2 REDUCED RISKS & COSTS

Natural gas pipeline has been regarded as the most cost effective and safest channel of gas transportation and has extraordinary strategic significance for the country. Pipeline is regarded as the most cost effective and safest channel to transport the oil and gas from upstream oil field or port to the downstream users or refineries. The gas is significantly replaced by oil in all sectors i.e. power generation, domestic and transportation due to price hike in oil prices globally and cheaper availability of natural gas. During the last five years the oil import has reduced by 8 %. The other reason for that may be the availability of cheaper, safe and durable mode of gas transportation system (main and distribution network of pipeline), which is continuously expending.

The gas pipeline projects help in reducing the travel cost in comparison to other resources and it is also very safe and cheaper for domestic, commercial and industrial uses. The proposed pipeline project would be very feasible and cost effective as it is totally underground and there will be continuous access to the gas for the use.

7.3 SOCIO- ECONOMIC DEVELOPMENT

The proposed project will create socio-economic development across the pipeline route and in the near vicinity as well. The project will provide employment during construction and operation phase to the local labours. Further, it also helps in the development across the project area by providing the CNG stations along the roads and gas pipeline supplies to the households and commercial establishments. The proposed project will provide 40 CNG stations and 01 LNG station throughout the project route due to which the local community can easily access the cheapest way for their transportation.

8 ENVIRONMENTAL MANAGEMENT & MONITORING PROGRAM

8.1 INTRODUCTION

The Environmental Management Plan (EMP) provides an essential link between predicted impacts and mitigation measures during implementation and operational activities. EMP outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or mitigate adverse environmental impacts, and the actions needed to implement these measures. The likely impacts on various components of environment due to the project during developmental activities have been identified and measures for their mitigation are suggested. The EMP lists all the requirements to ensure effective mitigation of every potential biophysical and socio-economic impact identified in the EIA. For each attribute, or operation, which could otherwise give rise to impact, the following information is presented:

- A comprehensive listing of the mitigation measures
- Parameters that will be monitored to ensure effective implementation of the action.
- Timing for implementation of the action to ensure that the objectives of mitigation are fully met

The EMP comprises a series of components covering direct mitigation and environmental monitoring, an outline waste management plan and a project site restoration plan. Therefore, environmental management plan has been prepared for each of the above developmental activities.

8.2 ENVIRONMENT MANAGEMENT PLAN

Table 8-1: Environment Management Plan

Aspect	Impacts	Mitigation Procedure	Monitoring Action	Responsibility	Timing
Air Pollution	Dust generation	• Access limited to demarcated ROW and specified access roads. · Strict enforcement of project speed limits · • Reinstatement as early as practical · • Damping down of ROW · • Identification of areas of particularly sensitive receptors (e.g., villages or crops)	• Review and approval of the contractors Transport management plan, Pollution Prevention Management Plan, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction

	Metal Vapour Emissions	Ensure adequate ventilation and dispersion of vapours Ensure welding is undertaken by appropriately trained personnel	• Review and approval of the contractors Employment and Training Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Combustion gases (CO2, CO, NO2, NO, SO2, PM, CH4, VOCs)	• Maintenance of all vehicles and plant to meet relevant international standards and manufacturer's recommendations· • Monitoring of vehicle and plant emissions · • Optimization of plant running time (where appropriate)	• Review and approval of the contractors Transport management plan, Pollution Prevention Management Plan, Construction Camp Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period

			• Spot checks on the contractor's performance • Routine review of discharge monitoring data	AGL	• Throughout Construction Period
	Vehicle movements	• Selection of appropriate routes for vehicles using public road network and project access roads · • Provision of environmental training for vehicle drivers and equipment operators · • Control of operational speeds and operating times · • Maintenance of vehicles and plant	• Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan and Employment and Training Management Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of traffic management and training processes	Contractor	• Throughout Construction Period
			• Collection and review of incident and near miss data	Contractor	• Throughout Construction Period
			• Spot checks on procurement and waste management processes Routine review of incident and near miss reports	AGL	• Throughout Construction Period
Noise Pollution	Noise emissions	• Control of vehicle and plant noise generation ·	• Review and approval of the contractors Transport management plan,	AGL	• Pre-construction

		• Control of operating hours · • Appropriate selection and maintenance of plant, vehicles and access routes · • Appropriate selection of construction techniques · • Community liaison • Ensure environmental considerations are incorporated into the siting and design of camps · • Implement workforce education with respect to minimising disruptive activities. • Incorporate into the project induction training· • Implementation of camp rules including restrictions on noisy activities	Construction Camp Management Plan, Pollution Prevention Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan, Procurement and Supply Management Plan and detailed construction method statements.		
			• Routine monitoring, documentation and review of application of mitigation measures	Contractors	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-monitoring
Water Pollution	Disposal of liquid wastes/water (Hydro test	• Risk assessment to be undertaken before any chemical additives are used in	• Review and approval of the contractors Pollution Prevention Management Plan,	AGL	• Pre-construction

	Specific Measures)	hydro test water • Controlled discharge of water to reduce soil erosion Testing and treatment of water before discharge • Responsible disposal of waste water; no disposal of incompatible water in areas of groundwater or surface water vulnerability	Procurement and Supply Management Plan, Waste Management Plan, Infrastructure and Services Management Plan and detailed construction method statements		
			• Routine monitoring, documentation and review of application of mitigation measures	Contractors	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Abstraction of Ground Water	• Sampling and analysis of water from existing boreholes · • Adherence to national and local licensing policy for abstractions · • Test-pumping of new abstractions and monitoring of impacts on existing abstractions · • Monitoring of water levels in wetlands	• Review and approval of the contractors Pollution Prevention Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation	Contractors	• Throughout Construction Period

		• Ensure appropriate consolidation of backfill · • Implementation of erosion control measures • Ensure that groundwater disposal is undertaken in accordance with the Construction Environmental Management Plan· • Filter discharge if contains visible suspended solids · • Use of appropriate measures to minimise scour at the discharge point	measures		
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Disruption of drainage / irrigation channels	• Undertake pre-construction surveys of irrigation and drainage systems as necessary to identify existing systems and devise temporary replacement measures if required, · • Undertake liaison with land owners/land occupiers/land users · • Include provisions for	• Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period

		drainage/irrigation management	• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Increased flood risk	• Ensure that gaps are left in topsoil stacks to allow floodwater through · • Ensure the continued viability of pre-existing drainage and irrigation systems throughout the project	• Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction

	Disposal of trench-water	• Ensure that trench-water disposal is undertaken in an appropriate manner	• Review and approval of the contractors Pollution Prevention Management Plan, Waste Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Sediment release	• Avoid open cut river crossings during monsoon season· • Include environmental considerations in the selection of crossing design and choice of methodology	• Review and approval of the contractors Pollution Prevention Management Plan, Emergency Response Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period

	Modified river flow		• Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
Land & Soil	Use of raw materials & natural resources	• Development and implementation of procurement, supply and waste management procedures	• Review and approval of the contractors Procurement and Supply Management Plan and Waste Management Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of procurement and waste management processes	Contractor	• Throughout Construction Period

			• Spot checks on procurement and waste management processes	AGL	• Throughout Construction Period
	Railway Crossing	• Mitigation measures to be formulated in conjunction with local railway department	• Review and approval of the contractors Transport management plan, Infrastructure and Services Management Plan, Community Liaison Management Plan, Community Safety Management Plan and Procurement and Supply Management Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Throughout Construction Period
	Potential for accidental	• Development and implementation of specific	• Review and approval of the contractors Pollution	AGL	• Pre-construction

	spillage of hazardous materials (e.g. lubrication fluids, oils, paints, diesel etc.).	procedures for hazardous materials management • Minimisation of acquisition and storage of hazardous materials Training of personnel in safe use & handling of hazardous materials • Provision of appropriate spill response equipment and spill response training Rapid response in event of spillage	Prevention Management Plan, Employment and Training Management Plan, Transport Management Plan, Procurement and Supply Management Plan, Waste Management Plan, Emergency Response plan, and construction method statements		
			• Recording and regular review of incidents and near misses	Contractor	• Throughout Construction Period
			• Routine monitoring, documentation and review of training, procurement, storage and waste management processes	Contractor	• Throughout Construction Period
			• Spot checks on contractor performance and record keeping Routine review of incident and near miss data.	AGL	• Throughout Construction Period
	Disturbance of land surface & vegetation	• Vehicle movements confined to defined access routes • Provision of environmental training to drivers and plant operators	• Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Liaison	Contractor	• Throughout Construction Period

		• Community liaison to discourage local use of ROW as road Common access routes to be used for pipeline were practical Traffic movements to be preceded by an assessment of ground conditions	Management Plan and Community Safety Management Plan		
			• Routine monitoring, documentation and review of traffic management and community liaison processes	Contractor	• Throughout Construction Period
			• Spot checks on traffic management, training and community liaison processes. • Routine review of access route condition and adherence to defined access routes.	AGL	• Throughout Construction Period
	Soil compaction	• Protection of soil storage areas from vehicle movements · • Protection of soil surface in areas of soft ground · • Provision of appropriate drainage and regular regrading	• Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and	AGL	• Pre-construction

			development of mitigation actions for sensitive sites		
	Soil erosion	• Implementation of erosion control measures · • Compaction of soil stack surface to minimize erosion · • Preparation & implementation of approved crossing methods	• Review and approval of the contractors Pollution Prevention Management Plan, Reinstatement Plan and detailed construction method statements (with specific attention to those concerning river crossings)	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Loss of soil structure and fertility	• Ensure appropriate segregation, storage, management and reinstatement of stripped soil	• Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction

			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Loss of viability of soil seed bank	• Undertake an environmental review of the route to identify areas where preconstruction seed collection, harvesting of seeds from surrounding areas and/or the establishment of nursery crops should be carried out · • Ensure appropriate segregation, storage, management and reinstatement of topsoil	• Review and approval of the contractor's management plans, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
	Modified topography	• Ensure that reinstatement is sympathetic to existing contours	• Review and approval of the contractors Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction

			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
	Disposal of surplus subsoil	• Ensure that the generation of surplus soil is minimised and that disposal is conducted appropriately · • Ensure that any potential subsoil disposal sites and disposal plans are subject to an environmental review prior to their adoption	• Review and approval of the contractors Waste Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary additional assessments and development of appropriate mitigation actions	AGL	• Pre-construction
	Disturbance of known/unknown contaminated land	• Avoid construction in areas of known or suspected contamination as far as is practical ·	• Review and approval of the contractors Pollution Prevention Management Plan, Waste Management Plan,	AGL	• Pre-construction

		• Ensure that where contaminated land is encountered it is effectively managed	Reinstatement Plan and detailed construction method statements		
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			• Spot checks on completion of all necessary additional assessments and development of appropriate mitigation actions	AGL	• Pre-construction
	Potential for drilling fluid breakout/spillage (During HDD)	• Adequate geotechnical survey work conducted during design · • Risk assessment to be undertaken before drilling in vicinity of sensitive surface waters · • Storage of drilling muds in bunded area · • Avoid use of toxic chemicals in drilling fluid	• Review and approval of the contractors Pollution Prevention Management Plan, Emergency Response Plan, Waste Management Plan and detailed construction method statements	AGL	• Pre-construction
			• Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			• Spot checks on the contractor's performance	AGL	• Throughout Construction Period

			• Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
Ecology	Loss of habitat	Development and implementation of: · • Environmental management plans· • Construction method statements (including clearance) • Transport Management (including route selection) • Reinstatement Plan Additional ecological surveys and translocation programmes	Review and approval of the contractor's management plans, detailed construction method statements and reinstatement plan	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout Construction Period
			Spot checks on the contractor's performance	AGL	• Throughout Construction Period
			Spot checks on completion of all necessary pre-construction assessments and development of mitigation actions for sensitive sites	AGL	• Pre-construction
			Routine monitoring of species translocation programmes	AGL	Pre-construction and during construction in sensitive areas

	Impeded movement of wild animals, and domestic herds	• Ensure that gaps are left in soil stacks at strategic locations · • Leave gaps in welded strings at critical locations to allow passage of domestic herds · • Minimise interval between welding and ditching	Review and approval of the contractors Community Liaison Management Plan, Infrastructure and Services Management Plan, detailed construction method statements and Reinstatement Plan	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout construction period
			Spot checks on the contractor's performance	AGL	• Throughout construction period
	Public & animal safety	• Erection of warning barriers where significant risk to public and livestock exists · • Installation of soft plugs in ditch with sloped edges to allow animal egress	Review and approval of the contractors Community Safety Management Plan, Infrastructure and Services Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout construction period
			Spot checks on the contractor's performance	AGL	• Throughout construction period
Social	Vehicle	• Selection of appropriate	Review and approval of the	AGL	• Pre-construction

	Movements	routes for vehicles using public road network and project access roads · • Provision of environmental training for vehicle drivers and equipment operators · • Control of operational speeds and operating times · • Maintenance of vehicles and plant	contractors Transport Management Plan, Infrastructure and Services Management Plan and Employment and Training Management Plan		
			Routine monitoring, documentation and review of traffic management and training processes	Contractor	• Throughout construction period
			Collection and review of incident and near miss data	Contractor	• Throughout construction period
			Spot checks on procurement and waste management processes Routine review of incident and near miss reports	AGL	• Throughout construction period
	Partial road closure	• Use non-open trench crossing techniques for major roads · • Minimise duration of closure of roads and provide temporary access where necessary · • Use steel plates across trench to maintain access · • Institute temporary traffic control, where necessary · • Undertake community consultation	Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Safety Management Plan, Community Liaison Management Plan, Reinstatement Plan and detailed construction method statements	AGL	• Pre-construction
			Routine monitoring, documentation and review of application of mitigation measures	Contractor	• Throughout construction period

			Spot checks on the contractor's performance	AGL	• Throughout construction period
	Loss of boundaries	• Reinstatement of boundaries following construction · • Ensure consultation with landowners, occupiers and users	Review and approval of the contractors Infrastructure and Services Management Plan, Community Liaison Management Plan and Reinstatement Plan	Contractor	• Throughout construction period
			Routine monitoring, documentation and review of traffic management and community liaison processes	Contractor	• Throughout construction period
			• Spot checks on community liaison processes. • Routine review of access route condition and adherence to defined access routes.	AGL	• Throughout construction period
	Grievance Redressal Mechanism	Community Grievance Process	Spot follow up of complaints recorded in complaints register to assess whether process has been carried out correctly.	AGL	• Monthly during Construction period
		Implementation of general construction mitigation measures	Spot checks at ROW, construction sites and affected communities to ensure mitigation measures are being	AGL	Monthly for first 3 months. If implementation of mitigation measures is

			implemented. This will look specifically at: · • Implementation of measures to avoid disruption to infrastructural services such as telecoms, electricity, gas and water. · • Implementation of community safety measures (fencing near residential areas, fencing on public trench crossings, warning lights and warning signs at open areas of trench). • Suitable diversions are in place where necessary · • Dust and noise mitigation measures are in place · • Alternative water sources are provided as appropriate		proceeding appropriately, reduce monitoring to bimonthly with review of written activity reports submitted on a weekly basis.
Health and Safety		Community Safety	• Spot monitoring of health and safety incidence rates for community members and full review of any serious incidents. • Spot monitoring of community traffic safety meetings	AGL	Monthly Two to three times in first four months and if training is seen as acceptable, revert to once every six months. If training is not of sufficient quality, then

					continue at two to three every four months.
		General Safety Measures during	Spot monitoring of implementation of safety measures during construction as outlined in 'Implementation of general construction mitigation measures', General Construction Impacts section above.	AGL	Monthly for first three months. If implementation of mitigation measures is proceeding appropriately, reduce monitoring to bimonthly with review of written activity reports submitted on a weekly basis
		Health and safety training	Monitor HR records to ensure training is provided to all workers and spot monitor all courses (general health and safety, safe driving training, job specific health and safety) provided to ensure training is adequate	AGL	

8.3 MONITORING SCHEDULE

The objectives of monitoring are:

- To check effectiveness of mitigation measures
- To evaluate the adequacy of Environmental Impact Assessment
- To assess status of compliance to legal requirements
- To assess if the Environmental Management Plan needs revisions/ updating.

The proposed environmental monitoring program during both construction and operation phases of the project are given in Table below:

Table 8-2: Environment Monitoring program- Construction & Operation Phase

S. No	Component	Location	Parameters	Frequency
Construction Phase				
1	Stack emission characteristics	Stacks attached to emission sources (e.g. DG sets)	Stack monitoring for PM, SOx, NOx and HC	Once in a month
2	Ambient air quality	Nearest Residential Areas, and busy commercial locations	Ambient air quality parameters as per NAAQS viz. PM10, PM2.5,SOx, NOx, CO	Once in a month
3	Ground water quality (used as source of domestic water)	Point used for drinking water	Parameters listed in ISO:10500	Once in a month
4	Effluent quality	Discharge header of hydrotested pipeline/ tank	According to general discharge standards	As per requirement
5	Waste (including hazardous)	Construction sites and camps	Quantity/ volume generated and disposed	Once in a day
6	Equipment noise levels	1 m from DG set	dB(A)	Once in a month
7	Ambient noise levels	Nearest residential areas/ Silent zones etc	Ambient noise levels (Leqday & Leqnight)	Once in a month
Operation Phase				
8	Greenbelt development		Plant density, health, growth and survival rate	Once in 6 months
9	Waste (including hazardous)	At CNG stations	Quantity/ volume generated and	Once in a month

			disposed at new CNG facilities	
10	Effluent quality	At CNG stations	Monitoring of treated water from outlets of ETP & STP	Once in 6 months

9 SUMMARY & CONCLUSIONS

9.1 SUMMARY OF IMPACTS

Among the pipeline lifecycle stages of construction and operations, due to temporary nature of the pipeline laying/construction, most impacts are likely to be short term and reversible in nature. The impacts that shall be most significant and of primary concern are summarized in the subsequent sections.

9.2 IMPACT DUE TO PIPELINE ROUTE SELECTION

The proposed pipeline route has been so selected such that there are:

- Shortest length of the pipeline between source and destination points
- Avoidance of sensitive areas such as national parks, sanctuaries and wildlife corridors
- Minimum impact to reserve forests and other sensitive areas
- Minimum number of water crossings
- Minimum impact to the environment
- Avoidance of populated areas/ industrial area
- Easy access to the route during construction, operation and maintenance of the pipeline.

9.3 IMPACTS DURING CONSTRUCTION OF PIPELINE

- There will be no impact along any stretch as the pipeline route is not falling near any sensitive ecological area.
- Earth work excavation, embankment formation, transport of construction materials, handling, laying and jointing of pipelines - These activities would cause a general increase in levels of dust and suspended particulate matter in the ambient air. However, this increase in concentration would be of temporary nature and localized.
- Movement of vehicles for transportation of construction material – These activities would cause a marginal increase in the levels of oxides of nitrogen, carbon monoxide and hydrocarbons.
- Impact from sediments being washed into the water bodies while the pipeline is laid across them. The pipeline will not be laid in rainy season, which will avoid adverse impacts on water body.
- Drinking water for base camps will be made available through local supply system. The domestic sewage from the construction camps will be either disposed off into the local sewage system and if required, will be treated in soak-pits and septic tanks.

- Water consumption during hydro-testing of pipeline - Efficient use of water will be made to reuse test water in different test sections. Water will be tapped from different sources along the pipeline route, without unduly disturbing its normal users.
- At major crossings, Horizontal Directional Drilling (HDD) method will be deployed so there will be no disturbance to the natural water flow or cause any pollution to the water body. Hence there will not be any obstruction/damage to fishing, recreational and navigation activities. The pipeline will be laid at a minimum depth of 2.5 meter below the bed level of water crossings.
- The pipeline will be buried all along its length hence impact on land use pattern will be marginal and reversible.
- Some quantity of earth excavated for pipeline laying will become surplus after installation of the pipeline and may be required for disposal.
- However, as this excess of earth will be taken to low lying area for filling purpose, the aesthetics of the pipeline and soil quality will not be affected.
- Noise Generation - The major human settlements are along the pipeline route where the noise levels due to construction activities are estimated to be around 70-90 dB(A). Such onetime exposure is not expected to last for more than few weeks and shall not exceed the stipulated standards. The pipeline laying work would be done in night only as there is lots of traffic in day time and creates disturbance to the locals.
- Selection of the pipeline route has been done in such a way that eco-sensitive areas which may be affected during the construction of the pipeline are minimised.

9.4 IMPACTS DURING OPERATION OF PIPELINE

- No impact on any ecological sensitive area is envisaged during operation
- No air emissions will be generated during the operation phase.
- The compressing station enroute will be kept in a built-in-area that will reduce the noise level to minimum. The incremental noise level in the nearest village due to the proposed operations will be minimal.
- There will be no significant impact on ecological environment during the operational phase of the project.
- The probability of leakage will be significantly reduced by adoption of appropriate safety measures and SCADA system.
- The probability of leak from a pipeline is remote. Pipeline will be buried minimum 1.5 m in the cross-country section and 2.5 meter below the bed level at major crossings.

9.5 MITIGATION AND ENVIRONMENTAL MANAGEMENT PLAN

General

The mitigation measures to reduce environmental impacts, described in this EIA, can be divided into the following categories:

- Those which can be regarded as good working practice.
- Project decisions taken by AGL with environmental protection in mind.
- Such measures are designed to avoid, eliminate or reduce potential impacts that may occur to the environment in the course of the proposed activities.

Post Monitoring Program

The implementation of mitigation measures during construction and operation phases will be monitored. The monitoring plan would provide for periodic revision, if necessary, in light of the baseline status to indicate progress in project implementation and changing environmental conditions so as to provide a basis for evaluation of project impacts. The post monitoring program would include the following:

- Approved means of leak detection would be employed as per the provisions of Schedule I -E of PNGRB Regulations, 2008 and as per ASME B 31.8, Appendix - M.
- Regular and adequate patrolling of pipeline particularly at crossing locations and settlements.
- Monitoring of pressure, coating conditions and cathodic protection

9.6 CONCLUSIONS

There will be a beneficial effect from pipeline project that will directly and indirectly boost the living standards of the people, save foreign exchange and with increase in industrial activities, create more jobs in the local economy. Thus, it can be concluded on a positive note that after the implementation of the mitigation measures and EMP, the proposed activities of AGL will have negligible impact on environment and will improve economy of the nation.

Annexures

Annexure 1: AGL QHSE Policy

adani
Gas

QUALITY, HEALTH, SAFETY & ENVIRONMENT POLICY

We, at **ADANI GAS LIMITED (AGL)** engaged in providing energy solution to the nation with efficient, environment friendly, safe & cost effective fuel.

"Safety first in everything we do at AGL" is an integral part of AGL culture

AGL firmly believes that all types of injuries, illness & incidents are preventable.

We at AGL are committed to ensure continuity of natural gas supply & reliability of services to the customers and also committed to demonstrate continual improvement in our Quality, Occupational Health, Safety & Environmental (QHSE) management performance by:

- Assessing needs & expectations of Interested Parties and satisfying them with continual improvement effort;
- Continual Improvement by reviewing and monitoring Organizational Context & Strategic Direction by use of process approach and risk based thinking;
- Adopt and implement the best available technology and systems from design to the delivery of gas to customers and also the work practices to reduce the QHSE risks as low as reasonably practicable and minimize the impact on environment; public and assets
- Integrate QHSE aspects in all our business processes;
- Pro-actively comply with all applicable legislation & other requirements; Establish, review and strengthen our QHSE Management Systems and CGD network integrity in an ongoing and auditable manner;
- Institutionalize practices for pollution prevention, waste avoidance an prevention of injury & ill health;
- Enhancing the competencies and commitment of employees through suitable training programs, involvement and motivation

We shall make this policy available to all our stakeholders.

Date: 05-11-2018

Suresh P Manglani
Chief Executive Officer

Annexure 2: EHS Organogram of AGL

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Adani Gas Limited

EMERGENCY RESPONSE & DISASTER MANAGEMENT PLAN (ERDMP)

Doc. No. :HSE-102
Rev No : 01
Eff. Date: 01.03.15

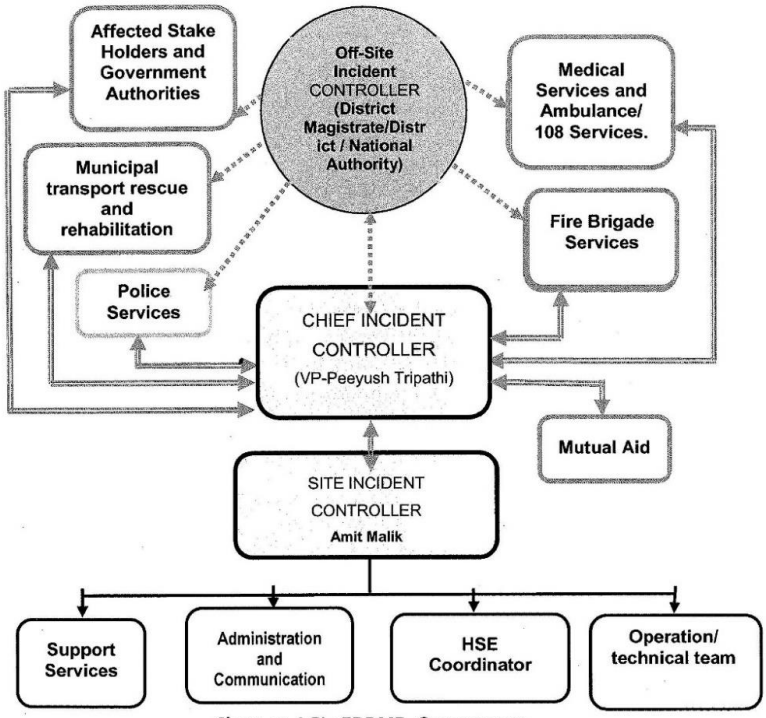

Chart-01-AGL: ERDMP- Organogram

Level – I
Level II
Level III

Page 21 of 100

Annexure 3: Mock Drill Format of AGL

adani Adani Gas Limited	EMERGENCY RESPONSE & DISASTER MANAGEMENT PLAN (ERDMP)	Doc. No. :HSE-102 Rev No : 00 Eff. Date: 01/03/15

adani Adani Gas Ltd.

EMERGENCY PREPAREDNESS MOCK DRILL RECORD

Mock Drill Date & Time : Mock Drill No. :

Sr. No.	Item Description	Standard Time	Time Start	Time End	Total Time Taken
1	Emergency Hooter / Operation of manual call points Started at [Time]	0 sec			
2	Evacuation started to Assembly Point at [Time]	60 sec			
3	Last person arrived at Assembly point at	Within 60 sec			
4	Activation of emergency control center	30 sec			
5	Information of incident to Emergency Team	10 sec			
6	Information to all key members at Perticular Location	45 sec			
7	Safe shut down activities in the plant	45 sec			
8	Fire Mitigation started by Security/members at [Time]	55 sec			
9	Fire Mitigation completed at [Time]	Within 55 sec			
10	Emergency vehicle arrival at entrance	Actual			
11	Head count started at [Time]				
12	Head count completed at [Time]				
13	Total Head Count				
14	Nearest Fire station distance from the site.				
15	Nearest hospital distance from the site				
16	Hooter for returning back to work started at				
17	Last person returned to work at				

Observations on overall preparedness effectiveness :

Area of Improvement of the Mock-drill exercise:

Action Planned to mitigate the draw backs:

Target Date	Person Responsible	Action Taken	Review By	Remarks [if any]

Report Prepared by: Report Reviewed by:

Annexure 4: Geographical Area and project detail