Add value.
Inspire trust.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF CITY GAS DISTRIBUTION IN UDUPI, KARNATAKA

Client:
Adani Gas Limited

ET-05669

Date:
20/01/2020

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 Udupi district in the state of Karnataka 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- Karnataka
10. Tiruppur District- Karnataka
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 Udupi district in the state of Karnataka. 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 3,582 square kilometers of area. 11 CNG Stations, 1,10,099 PNG Connections and 569 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 Udupi districts in the state of Karnataka in India.

1.2 PROJECT BRIEF

Adani Gas Limited has been granted authorization for laying, building, operating or expanding the CGD Network in Udupi district in the state of Karnataka. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 3,582 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 Gas Limited has planned to lay 12”, 8” & 4” diameter steel pipeline, approx. 360 kms for the gas distribution throughout Udupi district. The pipeline runs from Gail Tap-off point in Indian Oil Tank farm behind Mangalore Chemical and Fertilizers Limited plant in Baikampady, Mangalore (Solapur-Mangalore Highway) to terminal point at Kundapura in their 4 years’ strategic goal which is divided in three phases.

The proposed project will provide 11 CNG stations throughout the project. There are total 3 charge areas for the entire project and 1.5-acre un-irrigated farmland for one LNG station has been identified and will be acquired on willing buyer-willing seller mode in in Indian Oil Tank farm behind Mangalore Chemical and Fertilizers Limited plant in Baikampady, Mangalore.

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 to understand its adequacy and efficacy

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 EIA study:

- Project Proponents:
  - Representatives from AGL - onsite
- Local Community:
  - Residents – Udupi district villages
  - PAP- Udupi 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 Karnataka hence no clearance is required. However, 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.

The 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 requires permission from irrigation department as the pipeline passes through rivers and canals.

The nearest pipeline starting point to the coast is at ~425 meter in Udupi. The project pipeline falls in the coastal zone area, CRZ-III and also crosses Udyaware river at Zone 2 and Zone 3 hence CRZ clearance is required.

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, KSPCB	No
2.	Coastal Regulation Zone, Under the Environment Protection Act, 1986 a notification February 1991, for regulation of activities in the coastal area by the Ministry of Environment and Forests (MoEF)	To maintain coastal ecological stability	As per the notification, the coastal land up to 500m from the High Tide Line (HTL) and a stage of 100m along banks of creeks, estuaries, backwater and rivers subject to tidal fluctuations, is called the Coastal Regulation Zone (CRZ). The above notification includes only the inter-tidal zone and land part of the coastal area and does not include the ocean part. The project does not fall within the above-mentioned distances from the coast.	KSPCB	Yes CRZ Clearance is required along with Intimation to KSPCB
3.	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 Karnataka (PWD)	Yes Application will be made
4.	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 Applicable for Railway Crossing on the route, if any
5.	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 will be made

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
2.	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
3.	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
4.	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
5.	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
6.	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	KSPCB	Yes
7.	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.	KSPCB	Yes

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
8.	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.	KSPCB	Yes
9.	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.	KSPCB	Yes
10.	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	KSPCB	Yes
11.	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	KSPCB	Yes
12.	Solid Waste Management Rules, 2016	Management and handling of solid waste	For disposal of solid waste generated during construction	KSPCB	Yes
13.	Construction and Demolition Waste Management Rules	Management of construction and demolition waste	For disposal of solid waste generated due to construction and demolition	KSPCB	Yes
14.	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	KSPCB	Yes

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
15.	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	KSPCB	Yes
16.	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
17.	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
19.	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 Karnataka	Ministry of Petroleum & Natural Gas & Karnataka State Govt	Yes

S. No.	Legal Instrument	Objective	Reason for Applicability	Authority	Applicable Yes/No
20.	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
21.	NOC from Gram Panchayat	As per Karnataka state Government Policy, NOC is required from the Gram Panchayat.	Karnataka Panchayats Act, 1958, Amended in 1994	Village Sarpanch	Application to village Panchayat falling in the stretch is to be made
22.	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

The 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 chapterized 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 Udupi district in the state of Karnataka. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 3,582 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	11
2	Number of domestic piped natural gas connections to be achieved within 8 years from 28th September, 2018	110099
3	Inch-km of steel pipeline to be laid within 8 years from 28th September, 2018	569
4	Total Population	11,77,361
5	Total Geographical Area (Sq Km)	3,582
6	Total Household	2,63,078
7	No. of Charge Area	3

Source: Adani Gas Limited

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 Gas Limited has planned to lay 12", 8" & 4" diameter steel pipeline, approx. 569 kms for the gas distribution throughout Udupi district. The pipeline runs from Gail Tap-off point in Indian Oil Tank farm behind Mangalore Chemical and Fertilizers Limited plant in Baikampady, Mangalore (Solapur-Mangalore Highway) to terminal point at Kundapura in their 4 years strategic goal which is divided in three phases.

The proposed project will provide 11 CNG stations throughout the project. There are total 3 charge areas for the entire project and 1.5 acre un-irrigated farmland for CGS has been identified and will be acquired on willing buyer-willing seller mode in in Indian Oil Tank farm behind Mangalore Chemical and Fertilizers Limited plant in Baikampady, Mangalore.

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

The project pipeline falls in the coastal zone area in Udupi hence CRZ clearance is required. The pipeline is passing through Zone 3. It also crosses Udyaware river at Zone 2 and Zone 3.

The 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 requires permission from irrigation department as the pipeline passes through rivers and canals.

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 Udupi district in the state of Karnataka. The authorized area for laying, building, operating, or expanding the proposed network shall cover an area of 3,582 square kilometers.

Adani has planned to lay 12”, 8” & 4” dia steel pipeline, approx. 569 kms for the gas distribution throughout Udupi district. The pipeline runs from Gail Tap-off point in point in Indian Oil Tank

farm behind Mangalore Chemical and Fertilizers Limited plant in Baikampady, Mangalore (Solapur-Mangalore Highway) to terminal point at Kundapura.

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.

Udupi district Stretch runs from Gail Tap off point at Baikampady where 1.5-acre unirrigated farm land has been identified for acquiring. 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	Karkala
CA 02	Kundapura
CA 03	Udupi

The map of Geographical Area of Udupi District in Karnataka approved by PNGRB shows the following loops of the proposed pipeline routes.

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

Loop Name	Road	Approximate Distance	Approximate Indication in Map
MCFL – Kundapura	NH -66	85.72 km	Blue Line
Padubidri – Karkala	SH- 1	28.50 km	Red Line
Udupi – Manipal	Sh-85	6.59 km	Green 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

The pipeline runs parallel along the man roads hence accessibility is not an issue. The project pipeline runs along major national and state highway connecting Udupi district. The route covers 77 villages in 3 talukas and 1 district.

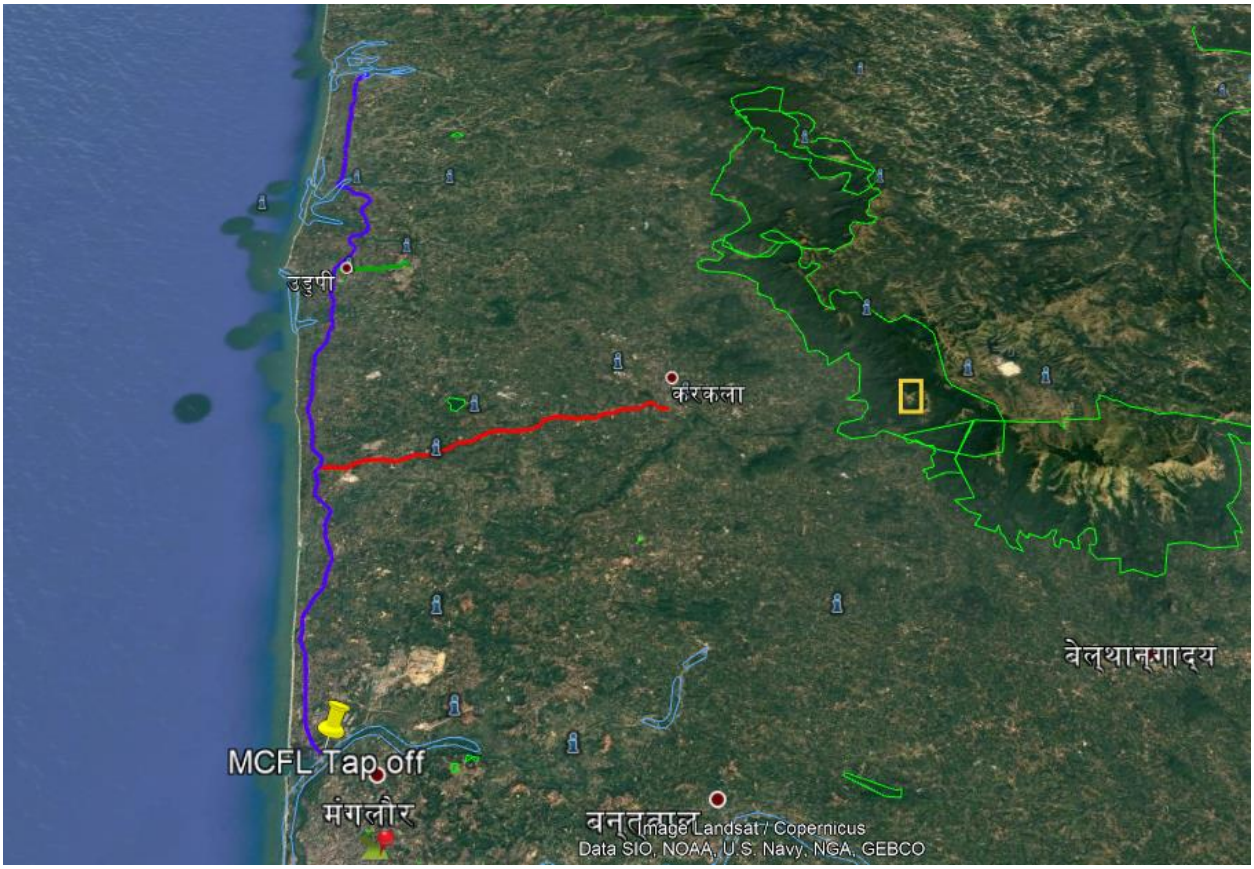
Table 2-5: List of villages, cities, talukas and districts of Udupi falling in the project area

S. No	City/ Village		Taluka	District	State
1	1. Baikimpady 2. Kulai 3. Mittothu Colony 4. Mukka 5. Pavanje 6. Haleyangadi 7. Saghu 8. Hajimadi 9. Karnad 10. Thenka 11. Yermal Thenka 12. Kaup 13. Kopalangadi 14. Kamala Mathu 15. Uliar Goli 16. Kote 17. Mudabettu 18. Katapady 19. Kinnymulki 20. CPC Layout 21. Adi Udupi 22. Tonse East 23. Tenka Bettu 24. Brahmavar 25. Kumargod 26. Sulkuduru 27. Kotathattu 28. Manoor 29. Kumbashi 30. Gopadi 31. Beejadi	32. Surathkal 33. Kuthethoor 34. Dodda Kopla 35. Srinivasnagar 36. Kolevailu 37. Kadike 38. Kallapu 39. Padupanmbur 40. Mulki 41. Nadsal 42. Bada 43. Uchila 44. Muloor 45. Pedu 46. Kothalguttu 47. Pangala 48. Bolje 49. Udyavara 50. Korangrapady 51. Kodankoor 52. Hanumatha Nagar 53. Ambagillu 54. Nayampally 55. Airody 56. Sasthan 57. Gudami Village 58. Saligrama 59. Kota 60. Tekkatte 61. Kanukure 62. Koteshwar 63. Kodladi	Mangalore Kantal	Udupi	Karnataka
2	1. Padubidri 2. Pedebettu 3. Belman 4. Kedinje 5. Nitte	6. Nandikur 7. Santhoor 8. Mukamar 9. Dupada Katte 10. Mathade Kere	Kundapura		
3	1. Adi Udupi 2. Kunjibettu	3. Hayagriva Nagar 4. Manipal			

Source: Primary Survey, TUV SUD

Figure 2-1: Location Map of Project Site

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



Source: Adani Gas Limited

Nandini River Crossing

Pangala River Crossing

Udyavara River Crossing

Pipeline Termination point at Kundapura

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

Sr. No	River/Canal/Rivulet	Project Phase
Udupi		
1	Nandini River	Blue Line
2	Shambhavi River	Blue Line
3	Pangala River	Blue Line
4	Udyavara River	Blue Line
5	Suvarna River	Blue Line
6	Sita River	Blue Line

Source: Primary Survey, TUV SUD

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

Sr. No	Railway Crossings	Project Phase
Udupi		
1	Konkan Railway crossing in Nandikur	Red Line
2	Konkan Railway crossing in Indrali River	Green 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
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)	12”, 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	3 LPE
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 top soil 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.

• 12”, 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 layer 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. 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.

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 summarizes 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 out 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 district comprises of three distinct physiographic units viz., (i) Narrow stretch of coastal tract (ii) Up land area (iii) The hilly terrain. The coastal areas exhibit coastal beach, spits and creeks and backwater swamps with the surface features of sandy strips and linear troughs. The coastal parallel troughs are seen around Parampalli, Kota and Manur. The area adjoining the coastal stretch exhibits forested high hilly topography with deep valleys. Most part of the district is rugged terrain and demarcates areas with slopes of less than 2%, 2 to 5% and more than 5%. About 50.68% of the district falls under 2 to 5% slope and remaining fall under more than 5% slope. Most part of Lateritic capped pediplains have an elevation ranging from 40 to 60 mamsl.

which is an important physiographic feature. Upland pediplain area intercepted with low hills between Western Ghats and the coast, which is moderately cultivated. Western ghats and forested area located on the eastern part of the district.

3.3 GEOMORPHOLOGY

The geomorphological formations in Study Area falling in Udupi district comprises of laterites, gneisses, granites, dolerite dykes and coastal sediments. Charnockites and acid volcanics such as dacites, rhyodacites, granophyre is restricted to a few places. These rocks belong to different periods of geological history from archean to recent age.

The geomorphological map is given in **Figure 3-1**.

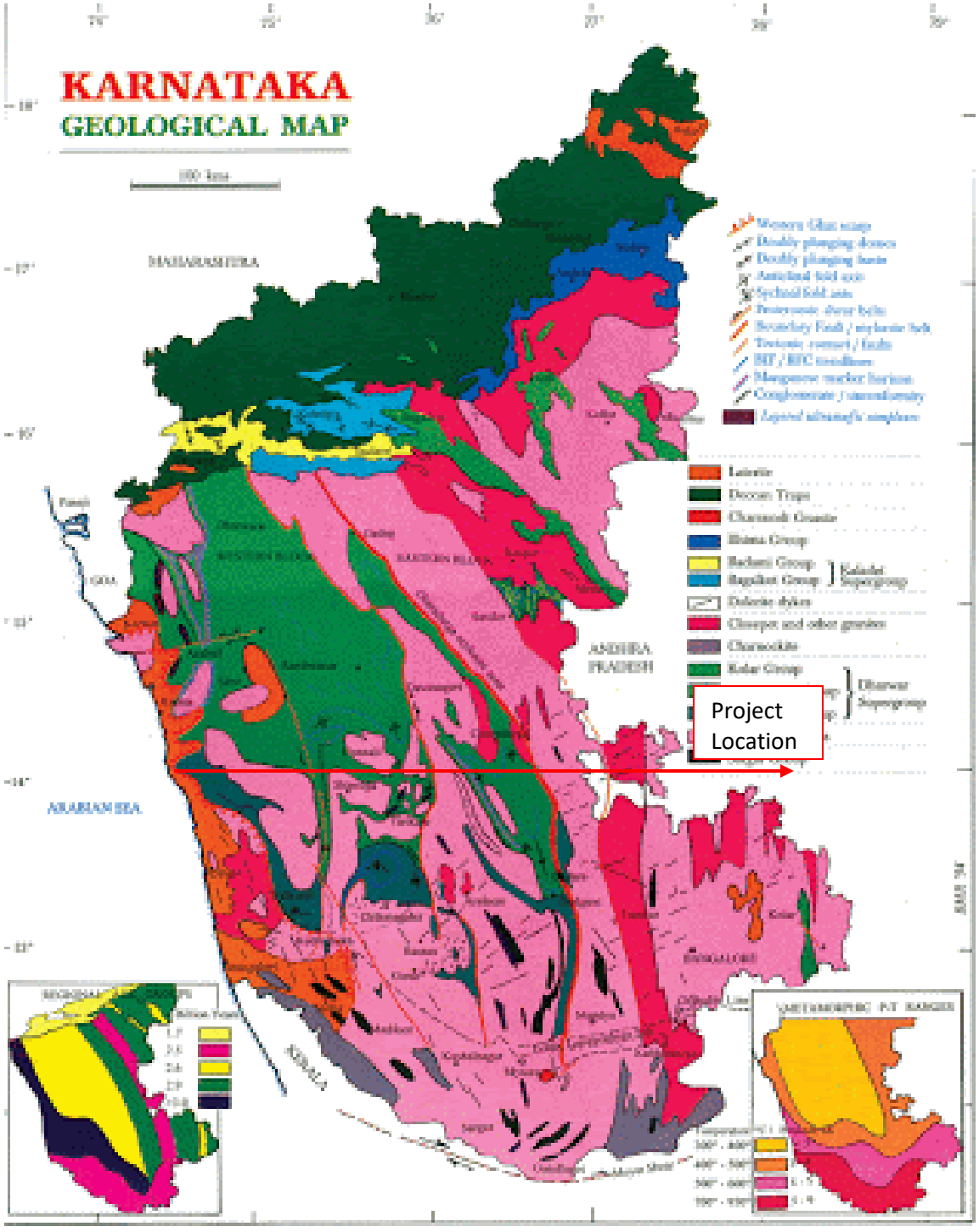


Figure 3-1 : Geomorphological Map of Udupi District

3.4 HYDROGEOLOGY

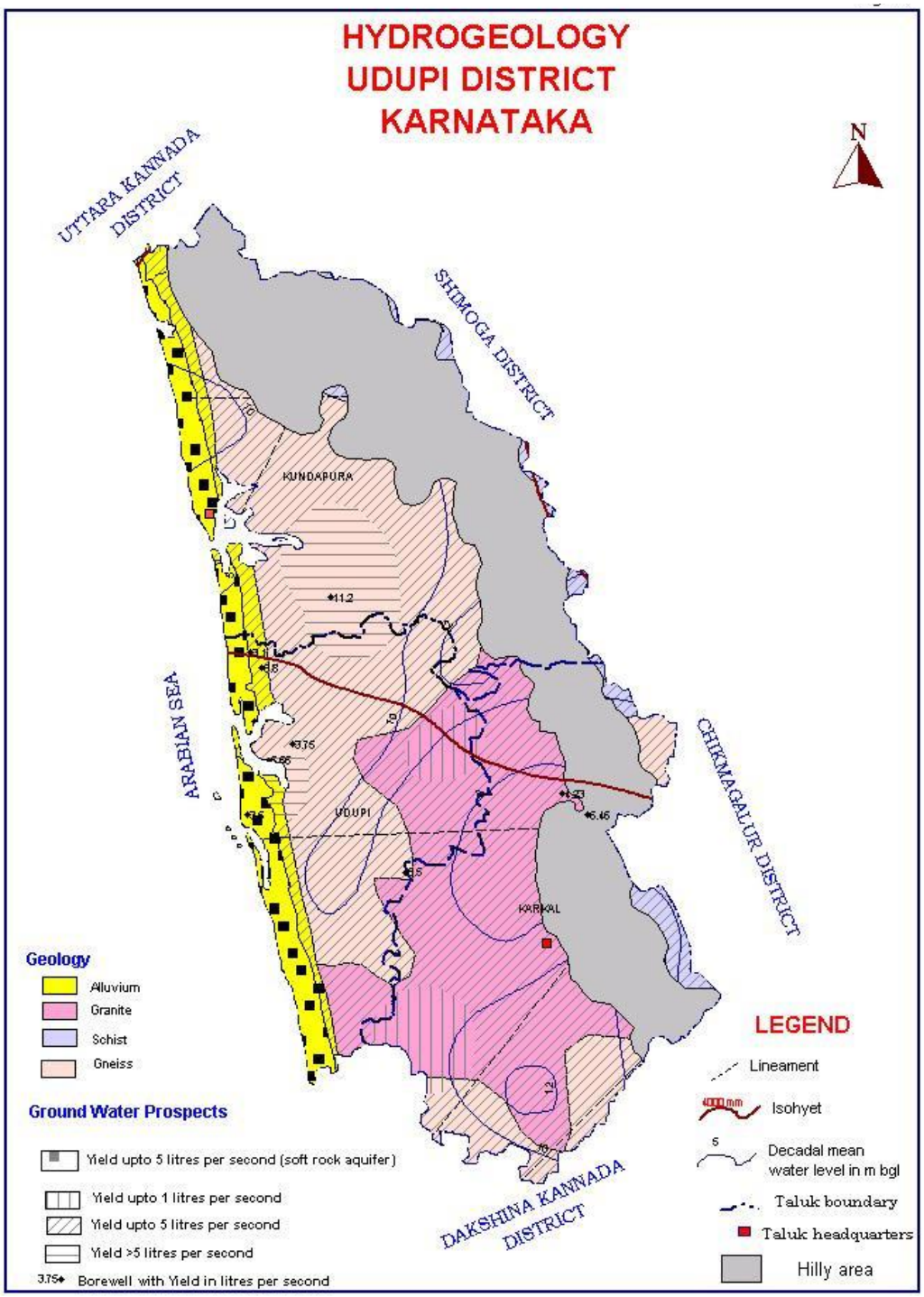
Ground water in the region mainly occur in various geologic formations like beach alluvium, coastal sediments, laterites and in weathered and fractured granitic gneisses under phreatic and semi-confined to confined conditions, but mainly under water table conditions. Coastal alluvium along with the laterites, which underlie them, occurs as an aquifer of phreatic nature. Ground water occurs in weathered mantle and fractured crystalline formations under semi confined to confined conditions. The ground water in and below the black clayey horizons of coastal sediments found with high salinity, which marks the index bed for saline water and freshwater interface. Dug wells are the most common groundwater abstraction structures encountered in lateritic terrain. Based on the morphogenitic and geological diversities and aquifer characteristics; Udupi district can be subdivided in to two broad hydrogeological units:

a) Hard and fissured formations in the pediplain

b) Porous unconsolidated formations in the coast.

The hydrogeological map is given in **Figure 3-2**.

Figure 3-2 : Hydrogeology Map of Udupi District



3.5 DEPTH TO WATER LEVELS

Ground water levels are essentially controlled by lithology, physiographic features, and rainfall distribution in space and time. Hence in pediplain areas, depth to water level is highly variable. The water level in general shows recession from November to May. The depth to water level for pre-monsoon and post monsoon for the year 2006 (Based on National Hydrology Survey data) is shown in Figure 3-2 and Figure 3-3 respectively. Behavior of ground water table during pre and post monsoon- 2006 and long-term water level trend in the last decade (1996-2006) is discussed below.

During Premonsoon, May 2006, the depth to water level varies between 1.55 to 12.33 mbgl in the district. Premonsoon water level is in the range of 5 to 10 mbgl mostly found in lateritic terrain. Depth to water level more than 10 mbgl occurs mainly in gneissic terrain as isolated patches. Water level less than 5 mgl occurs along the coastal belt.

Post monsoon water level for November 2006 varies between 1.37 to 10.33 mbgl in the district.

The depth to water levels during pre-monsoon and post-monsoon in Udupi district are given below in **Figure 3-3** and **Figure 3-4**.

Figure 3-3: Depth to Water Levels (Pre-Monsoon)

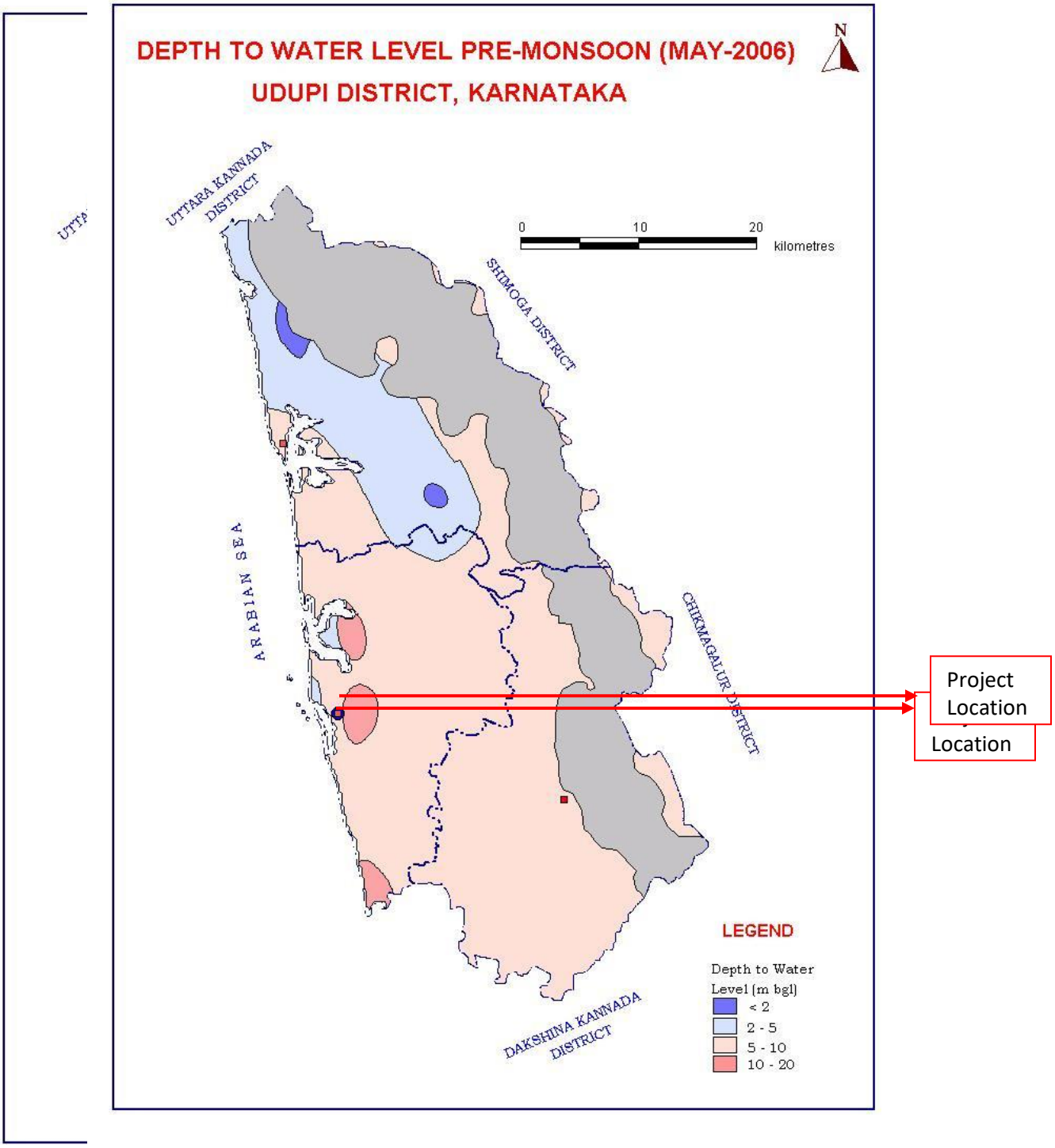


Figure 3-4: Depth to Water Levels (Post-Monsoon)

3.6 GEOLOGY

Geologically the rocks like Granitic gneisses with occasional laterite capping and unconsolidated river and marine sediments, occupy the area. The gneiss, which is widespread in the distinct outcrops at varying magnitude especially along river courses. Basic intrusives like dolerites and gabbros and acidic intrusives like pegmatite and quartz veins and pink porphyritic granites are found all over the district.

The recent alluvium and colluvial deposits occur along the riverbanks and seacoast. The exposures of crystalline rocks found as isolated hills along the shore and offshore. The black clayey marine sediments with a thickness of 0.30m to >1.00m occur as lenses along the coast and in the deltaic islands. Its occurrence is marked at a depth range of 5.00 to 6.00 mbgl.

3.7 WATER RESOURCES

3.7.1 SURFACE WATER

The coastal agro climatic west flow river basin is characterized by maritime climate. It covers parts of Mulki, Shirva, Swarna Yennehole, Madisala, Sita, Haladi, Chakravani, Kollur, Baindur and Sankadagudi hole sub basins. These rivers are perennial during normal rainfall years whereas tributaries and smaller streams become dry during summer. The prevailing high gradient in the hilly terrain and heavy rainfall brings great volume of water in these rivers during monsoon. These rivers join Arabian Sea and are prone to tidal effects to considerable lengths in the inland area. Drainage is shown in Figure below:

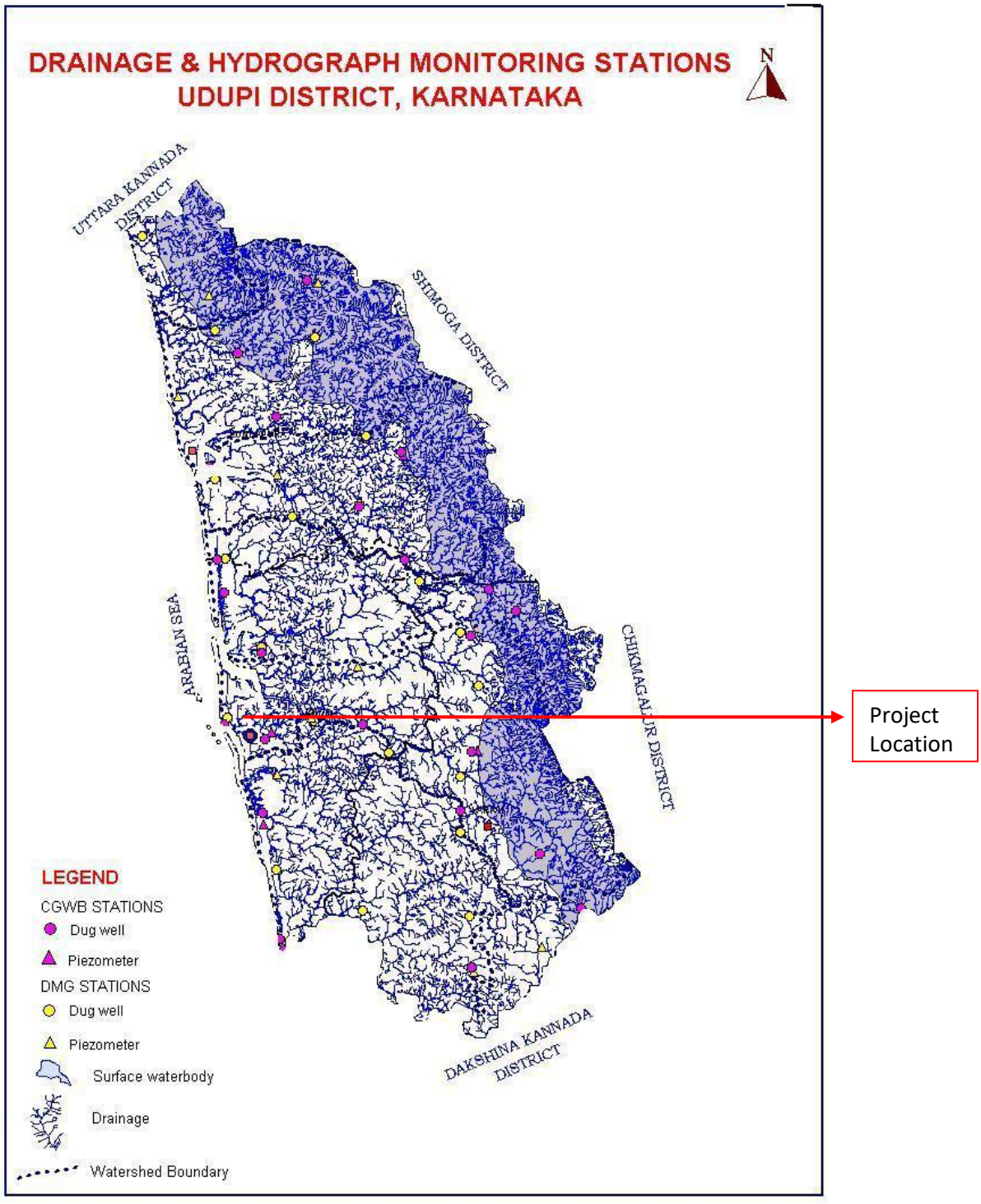


Figure 3-5 : Drainage Density Map of Udupi district

3.7.2 GROUND WATER

As per the occurrence and behavior of ground water, ground water system of the district is described under four zones in general.

a). Shallow zones up to 25m It generally comprises of weathered and fractured granites and gneisses. Ground water occurs in the pore spaces of weathered and fractured formation under phreatic condition. The granitic gneisses are traversed by intrusives of younger granites, pegmatities and quartz veins. In weathered granite and gneissic formations the specific capacity values ranges from 6 to 215 lpm/m and unit area specific capacity ranges from 0.2 to 19.5 lpm/m/m2 . Transmissivity of granite gneiss in dug well section ranges from 5 to 141 m2/day. Permeability ranges from 1.8 to 86 m2/d. Specific capacity for laterite ranges from 7 to 1724 lpm/m and permeability range from 5 to 354 m2/day. Yield of dug wells ranges from 18 to 297 m3/d for sand and 18 to 36 m3/d for clay

b). Moderately Deep zone (25-60 m) The aquifers in the depth range of 25 to 60m are grouped as moderately deep zone category. The aquifers of this category consist of weathered and fractured granitic gneisses. Ground water occurs in the pore spaces under semi-confined conditions. T value ranges from 3 to 72 m2/day. In general, the yield in the area is <2lps.

c). Deep zone (60-100m) The aquifer occurring between the depths of 60 to100 mbgl are grouped as deep zone category. Aquifers of this category also consist of semi-weathered and fractured granite and gneisses. The presence of productive fractures also seen in this zone. Ground water occurs in fractured and jointed formations under semi confined/confined conditions. In these aquifers transmissivity is in the range of 78 to 228 m2/d. In general the yield distribution is in the range of 2 to 4 lps.

d). Very Deep Zone (Beyond 100m) Aquifers of this category exist in semi-weathered and fractured granites and gneisses and ground water occurs under semi confined/ confined conditions in fractures and joints. In these aquifers transmissivity is in the order of 2 to 124 m2/day and yield is in the range of 2 to 4 lps.

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

Table 3-1: Ground Water Potential of Udupi District

Block	Net annual groundwater availability (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross ground water draft for domestic and irrigation water use(ham)	Existing gross groundwater draft for all uses (ham)	Provision for domestic & industrial water requirement supply to 2025 (ham)	Net annual ground water availability for future irrigation development (ham)	Average Crop Water Requirement (m)	Balance Ground Water Irrigation Potential Available
Udupi	15073	5811	833	6645	1180	8081	0.58	13933

Source: Groundwater Information Booklet, Udupi District, Karnataka, December 2008

3.8 CLIMATE

The area experiences a typical maritime climate with an average temperature of 26.5°C. Udupi district gets highest annual rainfall in Karnataka state, about 4000 mm. In this coastal district, bulk of the rainfall ie. over 85% occurs during monsoon season.

3.8.1 TEMPERATURE

As per the Indian Meteorological Department, Udupi (1981-2010) the mean annual daily maximum and minimum temperature recorded is 33.1ºC and 20.9ºC, The district experiences the highest temperature during the month of May whereas the lowest temperature during the month of January.

Table 3-2: Temperature details of IMD Udupi

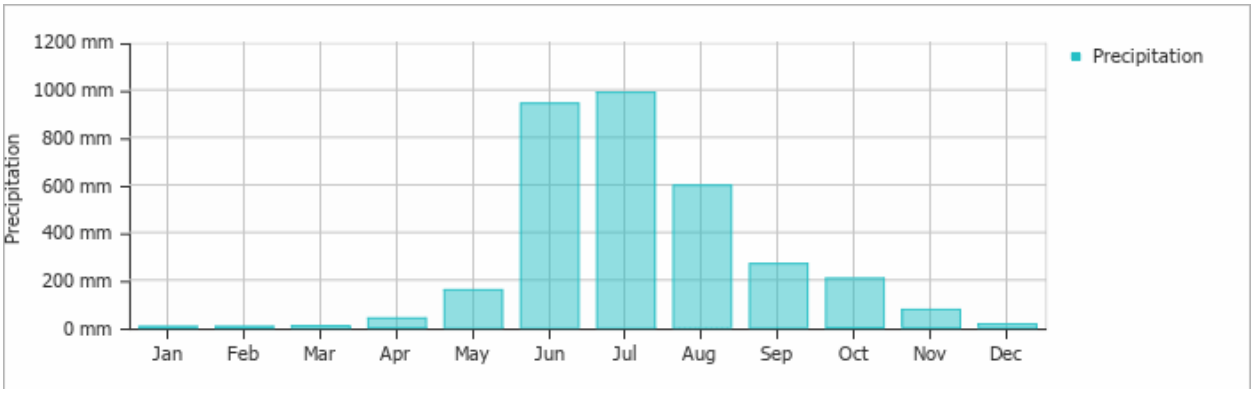
Months	Min. Temp.(ºC)	Max. Temp. (ºC)	Months	Min. Temp.(ºC)	Max. Temp. (ºC)
January	20.9	31.9	**July**	23.5	28.7
February	21.8	31.7	**August**	23.6	28.7
March	23.7	32.5	**September**	23.5	29.1
April	25.7	33.1	**October**	23.1	30.1
May	25.9	32.7	**November**	22.3	31.2
June	24.2	29.7	**December**	22.5	30.6

Source: Climatological Normals

3.8.2 RAINFALL

The 3575 sq km area of Udupi district has 3 rain gauge stations (1 station/1199 sq km). The temporal variation of rainfall is confined to 3 to 4 months in a year. The rainfall increases from west to east with co-efficient of variability ranging from 18.7 to 18.9%. Average Annual Rainfall is 4136.3 mm.

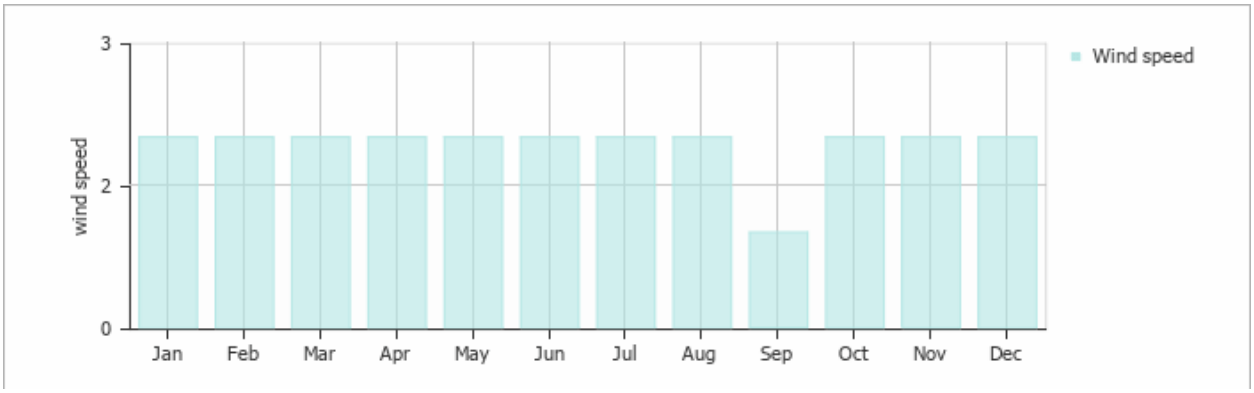
Table 3-3: Rainfall details of Udupi District (5 years)



Source: India Metrological Department

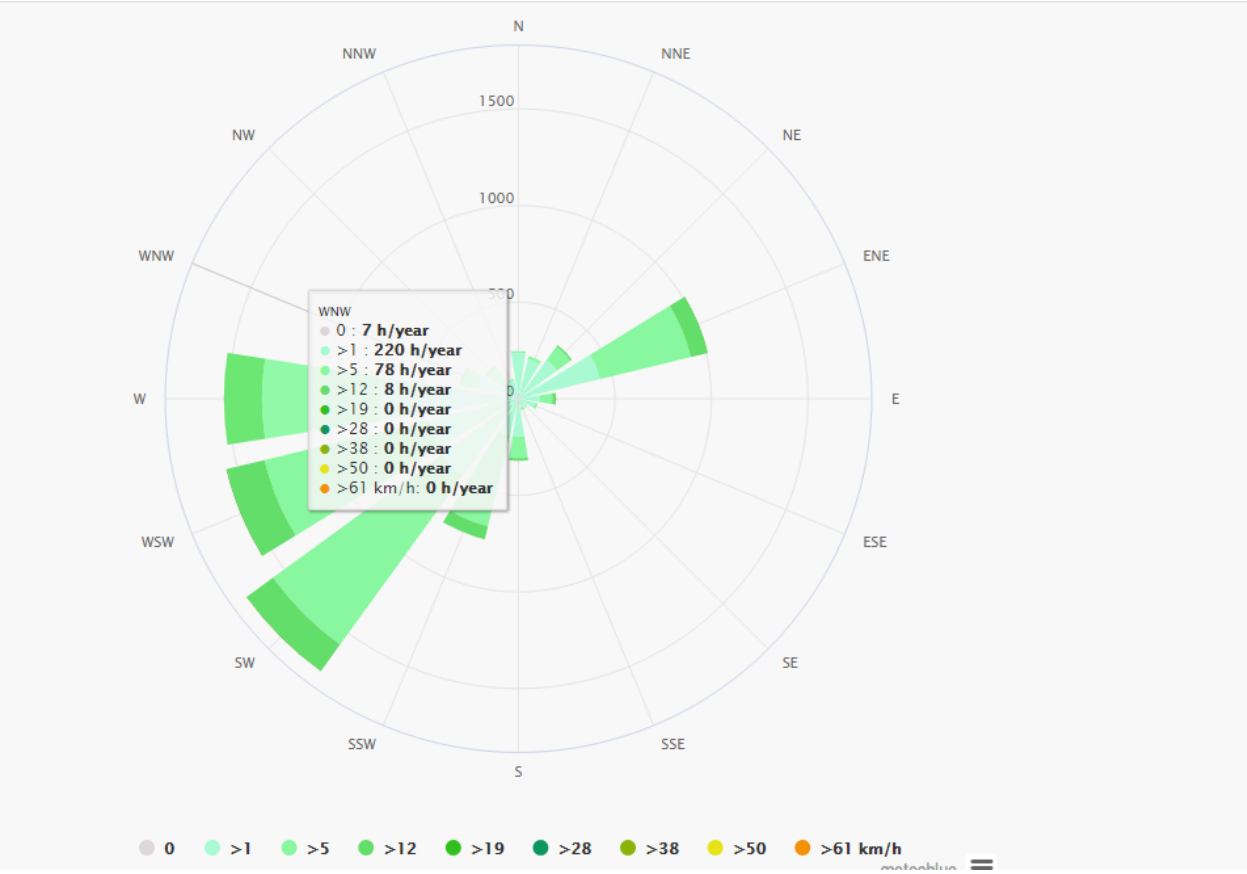
3.8.3 WIND

Table 3-4: Wind Speed (IMD Udupi)



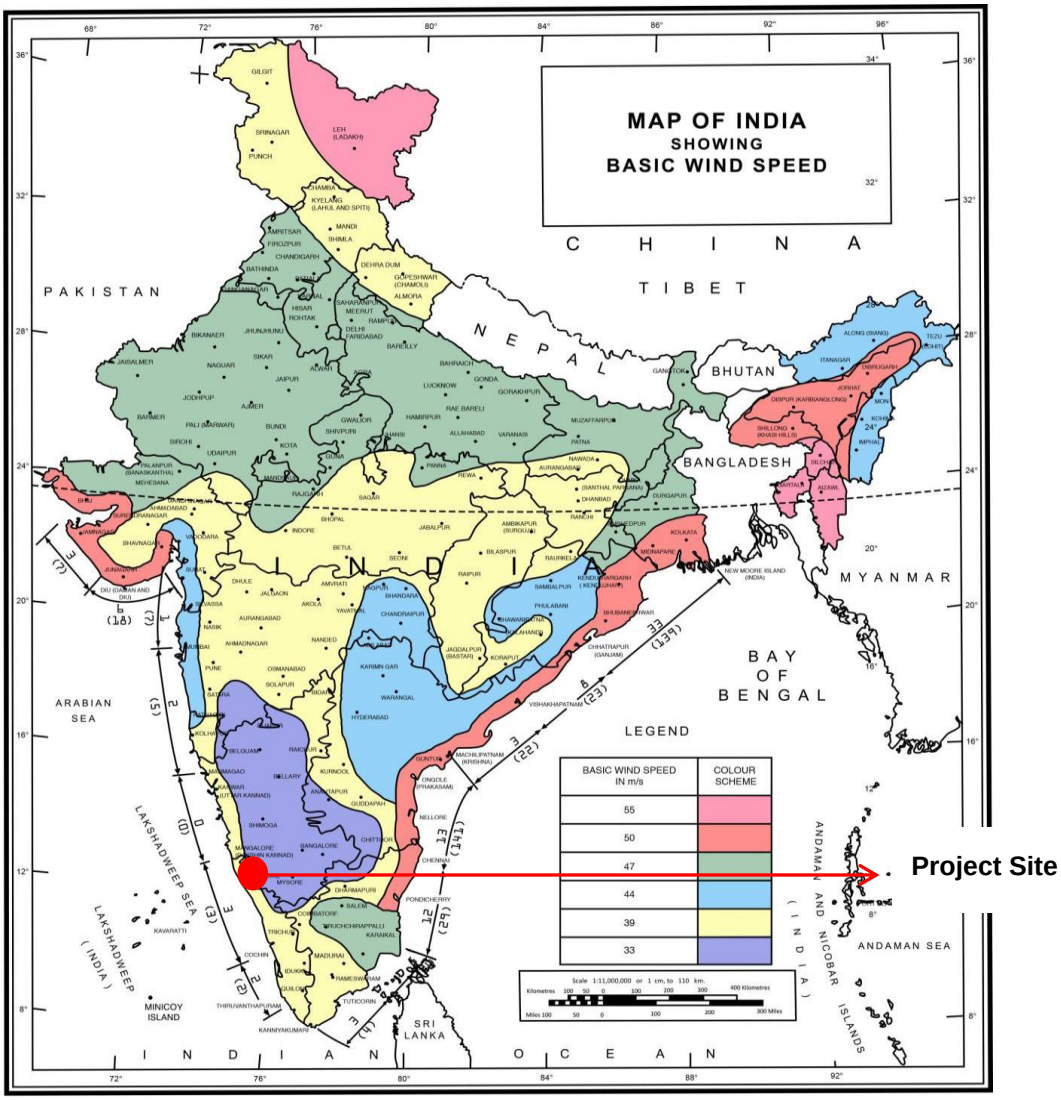
Source: Climatological Normals

Wind Rose Diagram of Udupi



Source: Climatological Normals

Figure 3-6: Wind Hazard Map showing Project Site



Source: Climatological Normals

3.8.4 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 Udupi Districts of Karnataka hence lies in seismic zone II (Least Damage Risk Zone (MSK VI) as shown in Figure 3-7 below.

Figure 3-7: Geological Map of India with Seismic Zonation showing Project Site

Source: Map of India, Secondary Research, TUV SUD

3.9 AMBIENT AIR QUALITY

Ambient Air Quality Monitoring (AAQM) was carried out at a frequency of once a week at 3 locations. 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 3-6** below.

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

S. 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

S.No.	Monitoring Location	Geographical Coordinates	Location
1	AAQ1	12°56'18.2"N 74°49'47.4"E	Baikampady, Mangalore
2	AAQ2	13°20'44.2"N 74°44'10.6"E	Heera Bagh, Udupi City

Table 3-7: Ambient Air Quality Monitoring Results

Parameter	Unit		AAQ1	AAQ2
PM_{10}	µg/m^3	NAAQS (24 hrs)	100	100
		Minimum	48	45
		Maximum	65	57
		Average	56.7	51.3
		98 percentile	64.2	56.7
$PM_{2.5}$	µg/m^3	NAAQS (24 hrs)	60	60
		Minimum	24	21
		Maximum	32	28

		Average	28.1	24.5
		98 percentile	38.1	27.6
SO_2	µg/m^3	NAAQS (24 hrs)	80	80
		Minimum	6.1	5.8
		Maximum	8.9	7.2
		Average	7.6	6.5
		98 percentile	8.8	7.1
NOx	µg/m^3	NAAQS (24 hrs)	80	80
		Minimum	10.8	11.6
		Maximum	13.2	14.3
		Average	12.1	13
		98 percentile	13	14.1
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 45 µg/m3 to 65 µg/m3 in two monitoring locations. The highest concentration of 65µg/m^3 was observed at Baikampady location and the lowest concentration of 45 µg/m3 was observed at Heera Bagh. However, the **$PM_{2.5}$**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 32 µg/m^3 was observed at Baikampady location and the lowest concentration of 21 µg/m3 was observed at Heera Bagh. 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 5.8 µg/m^3 to 8.9 µg/m^3 in two monitoring locations. The highest concentration of 8.9 µg/m^3 was observed at Baikampady location and the

lowest concentration of 5.8 µg/m3 was observed at Heera Bagh. 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 10.8 µg/m^3 to 14.3 µg/m^3 in two monitoring locations with average NOx concentration varying from 12.1 µg/m^3 to 13 µg/m3. The highest concentration of 14.3 µg/m^3 was observed at Baikampady location and the lowest concentration of 10.8 µg/m3 was observed at Heera Bagh. 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.

3.10 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 Udupi and Kundapura taluks have chloride concentration up to 4000 mg/l. Ground water quality of Udupi.

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.

3.10.1 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	13°20'44.2"N 74°44'10.6"E	Heera bagh, Udupi City
2	GW2	13°38'03.8"N 74°41'33.7"E	Kundapura Town

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 3-10** 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	3	3
2	Electrical Conductivity	--	uS /cm	292	205
3	Turbidity	1 (5)	NTU	1	1.9
4	pH	6.5-8.5	-	7.37	6.05
5	TDS	500 (2000)	mg/l	158	112
6	Total hardness	200 (600)	mg/l	120	88
7	Alkalinity	200 (600)	mg/l	28	56
8	Chlorides	200 (600)	mg/l	37	87
9	Sulphate	200 (400)	mg/l	6	15
10	Fluoride	1 (1.5)	mg/l	0.27	0.22
11	Boron	0.5 (1)	mg/l	BDL (<1)	BDL (<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	12	11
15	Magnesium	30 (100)	mg/l	2.6	5.8
16	Iron	0.3	mg/l	0.3	0.1
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	3	1
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 is 6.9-7.3
- 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.

3.10.2 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 3-11.

Table 3-10: Surface Water Quality Sampling Locations

S. No.	Monitoring Location	Geographical Coordinates	Distance and Direction

1	SW1	13°05'50.0"N 74°47'18.3"E	Shambhavi River, Old Jetty
2	SW2	13°27'21.0"N 74°42'54.4"E	Sita river

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	3
2	Electrical Conductivity	--	uS/cm	142	110
3	pH	6.5-8.5	-	7.09	7.16
4	DO	4	mg/l	7.0	7.1
5	BOD (27^0C for 3 days)	3.0	mg/l	BDL (<2)	BDL (<2)
6	Total Dissolved Solids		mg/l	55	71
7	Total hardness	200 (600)	mg/l	24	34
8	Alkalinity	200 (600)	mg/l	22	21
9	Chlorides	600	mg/l	34	12
10	Sulphate	200 (400)	mg/l	3	9
11	Fluoride	1.5	mg/l	0.34	0.33
12	Nitrate (as NO_3^-)	50	mg/l	BDL (<1)	BDL (<1)
13	Potassium (as K)		mg/l	2.1	3.4
14	Sodium (as Na)		mg/l	18	25
16	Calcium	75 (200)	mg/l	5	6
17	Magnesium	30 (100)	mg/l	2	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	121	67

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 as 7.09 and 7.16 indicating which indicates slightly alkaline nature
- The coliform count in SW-1 and SW-2 was observed as around 100 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.

3.11 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	12°56'18.2"N 74°49'47.4"E	Baikimpady, Mangalore

2	S2	13°38'03.8"N 74°41'33.7"E	Kundapura

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 3-15 below:

Table 3-13: Results of Soil Quality Analysis

S. No.	Parameter	Unit	S1	S2
1	Soil Type		Alluvial	Alluvial
2	pH	---	5.55	6.34
3	Electrical Conductivity	µS/cm	0.024	0.066
4	Potassium (as K)	mg/kg	255	324
5	Sodium (as Na)	mg/kg	0.81	0.67
6	Organic Matter	%	0.57	0.71
7	Sodium Absorption Ratio	meq/kg	0.81	0.68
8	Carbonate (as CO_3)	mg/kg	<20.0	<20.0
9	Chloride (as Cl-)	mg/kg	65.4	137.5
10	Phosphorus (as P)	mg/kg	27.6	46.7
11	Sulphate	mg/kg	69.6	147.7
12	Bulk Density	gm/cc	1.28	1.25
13	Moisture	%	0.54	0.68
14	Total N	mg/kg	50.5	124.2
15	Iron (as Fe)	mg/kg	20022	8143
16	Boron [as B]	mg/kg	8.66	<5.0
17	Copper (as Cu)	mg/kg	18.12	12.75
18	Zinc (as Zn)	mg/kg	25.1	7.9

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 soils samples ranged from 5.5 -6.7, showing normal to saline in nature;
- Electrical conductivity of SW-1 was observed as 0.024 and 0.066 mmhos/cm which indicates low EC values may be good to crops

3.12 NOISE ENVIRONMENT

Primary noise monitoring was carried out for continuous 24 hours at the two (02) 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 night time. The day and night time 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 day time 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 night time 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	12°56'18.2"N 74°49'47.4"E	Baikampady, Mangalore
2	N2	13°20'44.2"N 74°44'10.6"E	Heera Bagh, Udupi City

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 night time. The noise monitoring analysis results are given in Table 3-18.

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

S.No.	Parameters	Unit	N1	N2
1	Ambient Noise Level- Leq day	dB(A)	50.9	58
2	Ambient Noise Level- Leq Night	dB(A)	61.7	62.5

3.13 BIOLOGICAL ENVIRONMENT

3.13.1 FOREST AREA/ RESERVED FOREST/ NATIONAL PARKS & SANCTAURIES

Forest Cover of the State is 2,226 sq.km which is 57.37% of the State's geographical area. In terms of forest canopy density classes, the State has 11 sq.km (0.2 % of GA) very dense forest, 1432 sq.km (36.9% of GA) moderately dense forest and open forest and 783 sq.km (20.1% of GA) respectively. Figure 3.12 presents the Forest Cover Map of Karnataka state. Comparative details between the Project Districts & State forest Cover have been presented in below

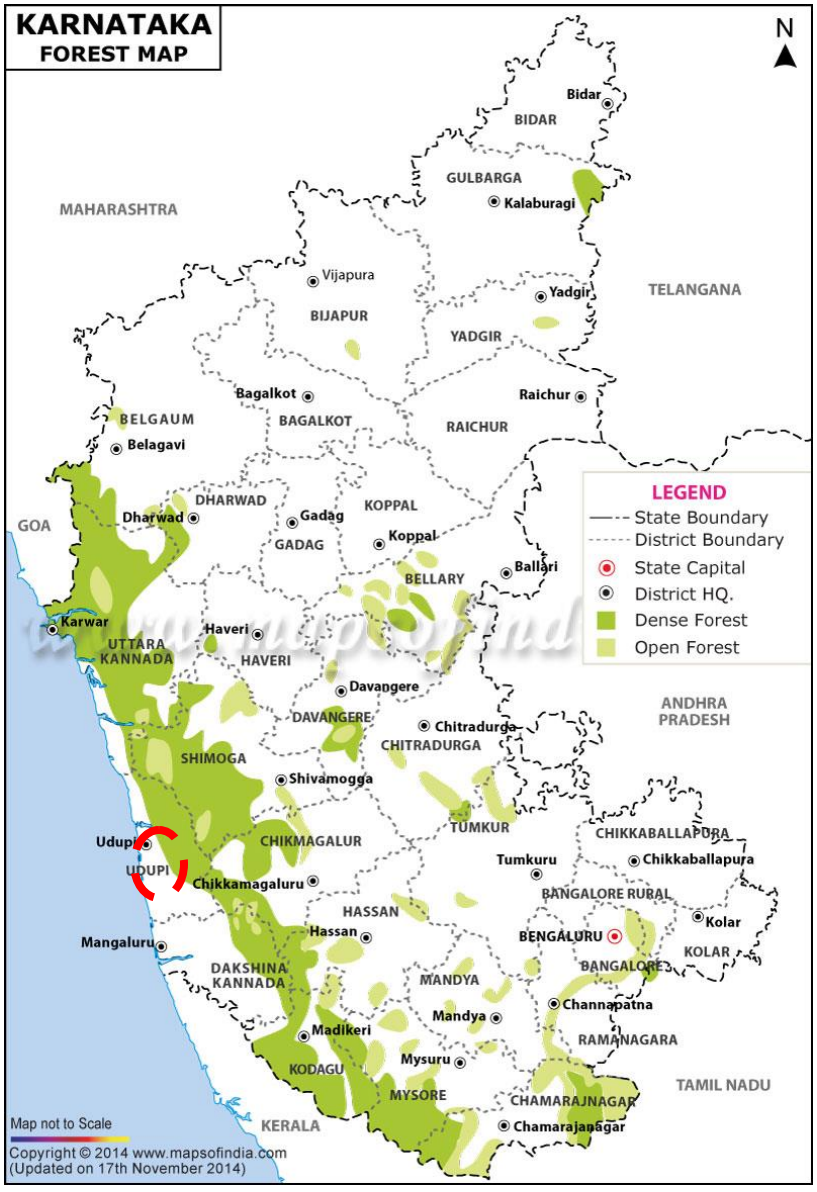
Table 3-17: Forest Cover in Project District and State

District / State	Area in Km^2					% of Geographical Area
	Geographical Area	**Very Dense Forest**	**Moderately Dense**	**Open Forest**	**Total**	

			Forest			
Udupi	3880	11	1,432	783	2,226	57.37

Source: India State of Forest Report, 2017

Figure 3-8: Forest Cover Map of Udupi State showing project location



Source: The Karnataka 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.

Primary and Secondary Survey

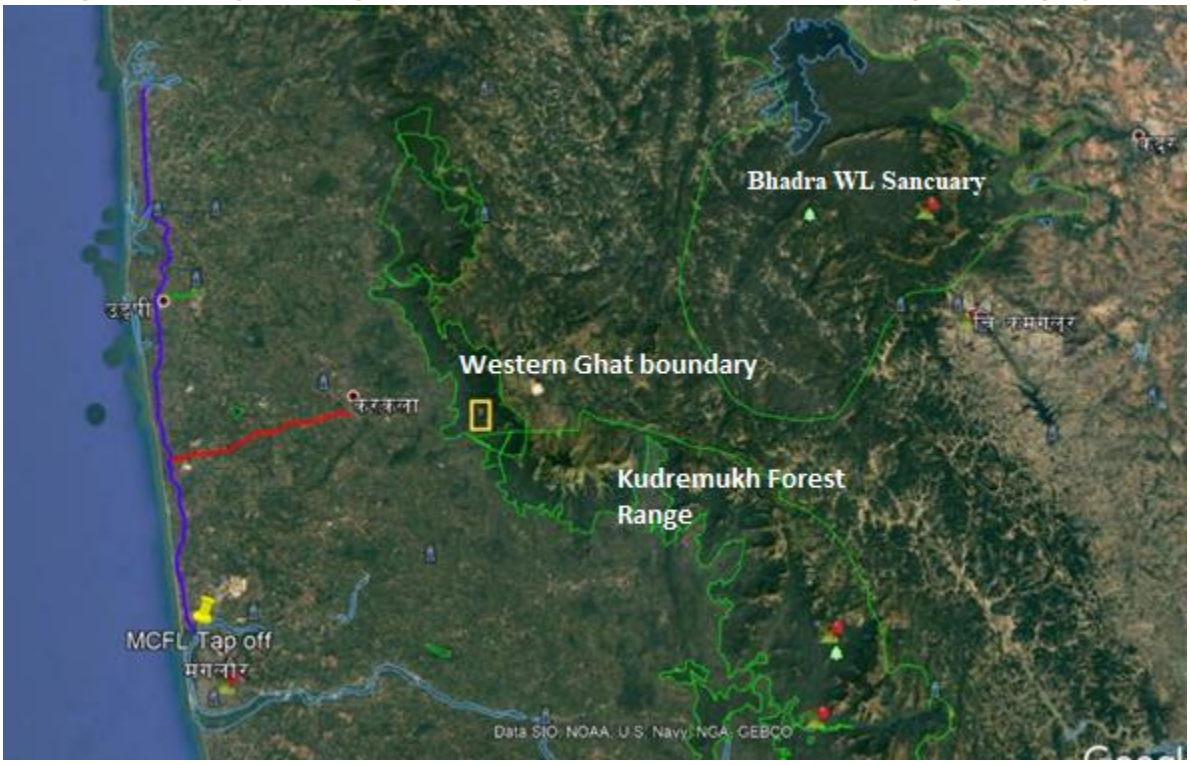
The primary surveys were undertaken to identify the ecological features of the area with particular reference to identify and quantify any sensitive ecological communities in the study area within 10 km radius of the proposed project. Secondary surveys Literature surveys were conducted to identify Rare, 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 from **16th January 2020 to 18th January 2020** (Three days). The relevant, observations noted in that assessment have been included in the current assessment and referenced accordingly.

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

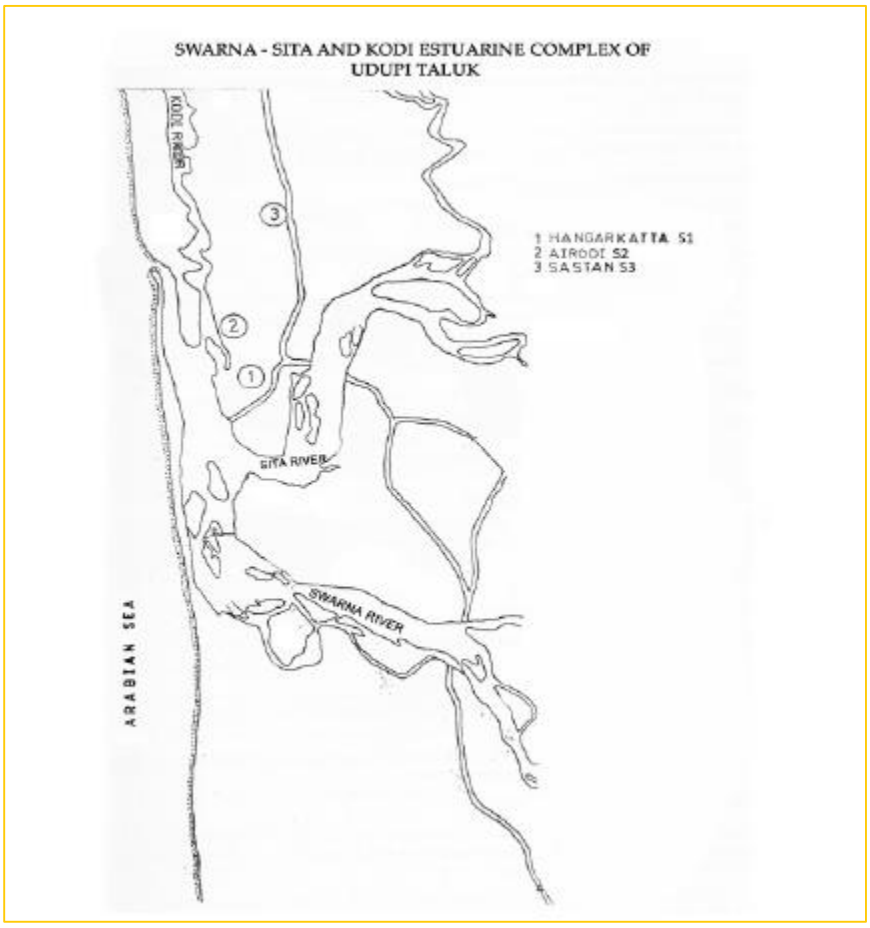
GPS point	Latitude	Longitude	Remarks	Distance
F1	13° 11.171'N	75° 9.195'E	Western Ghat boundary	16 Km from Karakal Loop
F2	13° 15.227'N	75° 8.481'E	Kudremukh Forest Range	13 km from Muthupet loop termination point
F3	13° 26.399'N	75° 34.489'E	Bhadra Wildlife Sanctuary	60 Km

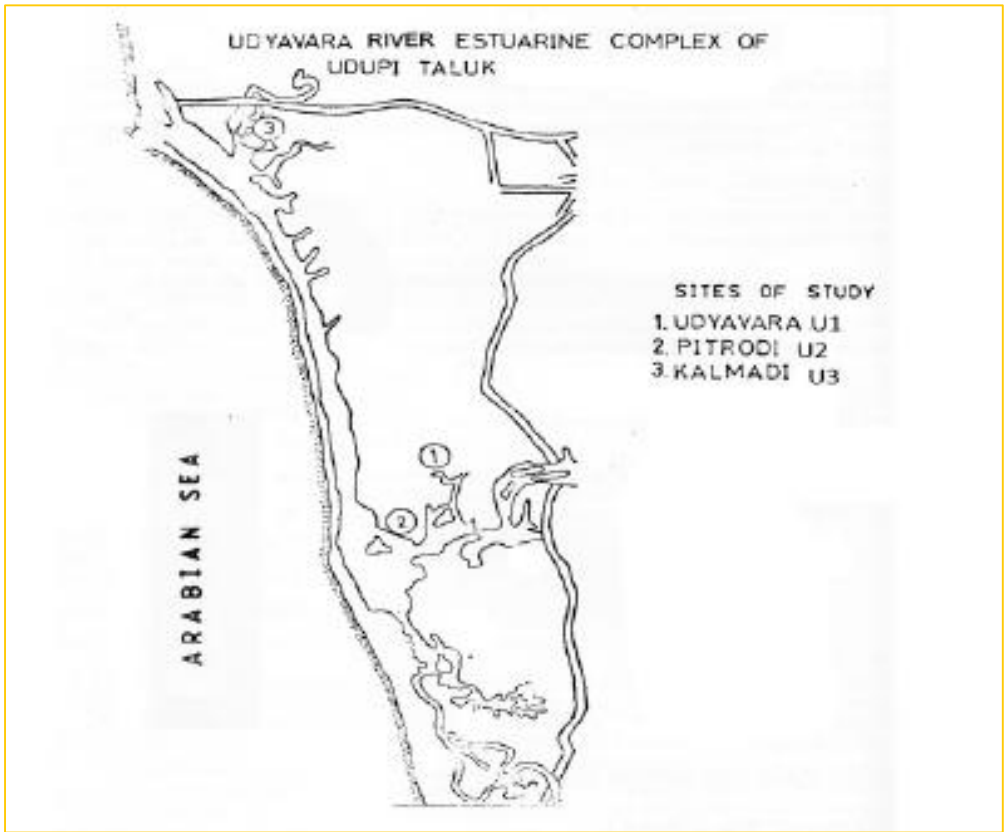
Figure 3-9: Map showing the eco-sensitive habitats identified in the proposed project area.

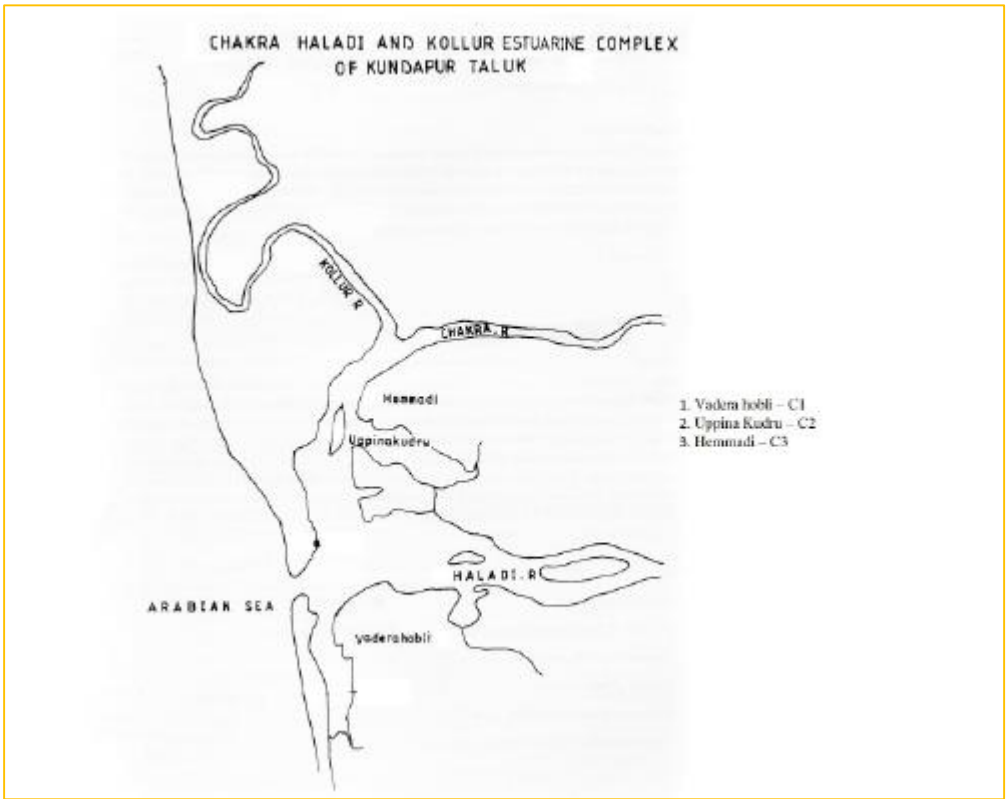


Ecological sensitive habitat	Direction and Distance from the project site.
National Parks/ Wildlife Sanctuary/ Biosphere reserves/ Elephant Reserve/ Any Other Reserve	Bhadra Wildlife Sanctuary, 60 Km at W Western Ghat boundary , 16 Km from Karakal Loop Kudremukh Forest Range, 13 km from Muthupet loop termination point
Reserved Forests	Nil
Wildlife Corridors & Routes	No notified wildlife corridors are present in 10 km vicinity.
Wetlands / Water bodies	Numerous rivers and natural nalas
Ramsar Site	NIL
Important Bird Habitats	Nil
Breeding/nesting areas of endangered species	Not present
Mangroves	Estuaries of Udupi taluk Udyavara river estuarine complex and Swarna –Sita and Kodi estuarine complex Estuary of Kundapura taluk Chakra Haladi and Kollur Estuarine river complex

Map of the areas of Mangroves in Estuaries near the project districts are given below




UDYAVARA RIVER ESTUARINE COMPLEX OF UDUPI TALUK
SITES OF STUDY
1. UDYAVARA U1
2. PITRODI U2
3. KALMADI U3
ARABIAN SEA



3.13.2 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.)*	Anacardiaceae	Tree	Rare	A	P

	Merr.					
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
202	*Eragrostis cilianensis*	Poaceae	Grass	Sparse	A	P
203	*Fimbristylis cymosa R.Br.*	Cyperaceae	Grass	Sparse	A	P
204	*Heteropogon contortus (L.)*	Poaceae	Grass	Common	P	P
205	*Ischaemum indicum*	Poaceae	Grass	Sparse	P	P
206	*Zizania latifolia*	Poaceae	Grass	Common	P	P
207	*Abrus precatorius L.*	Leguminosae	Climber	Dominant	P	P
208	*Asparagus racemosus Willd.*	Asparagaceae	Climber	Dominant	P	P
209	*Cissus quadrangularis L.*	Vitaceae	Climber	Dominant	P	P
210	*Clitoria ternatea L.*	Leguminosae	Climber	Sparse	P	P
211	*Cuscuta reflexa Roxb.*	Convolvulaceae	Climber	Sparse	P	P
212	*Dioscorea pentaphylla*	Dioscoreaceae	Climber	Sparse	A	P
213	*Hemidesmus indicus (L.) R. Br. ex Schult*	Apocynaceae	Climber	Dominant	P	P
214	*Ipomoea macrantha*	Convolvulaceae	Climber	Sparse	A	P
215	*Ipomoea nil (L.) Roth.*	Convolvulaceae	Climber	Dominant	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

3.13.3 FAUNA

Scientific Name	Common Name	IUCN	IWPA
Ahaetulla nasutus	Green whip snake	LC	
Naja naja	Indian Cobra	LC	II
Vipera russelli	Russel Viper	LR	II
Dendrelaphis tristis	Tree Snake	LC	

Ptyas mucosus	Common Rat snake	LC	II
Amphiesma stolata	Buffstriped keelback	LC	
Trimeresurus gramineus	Green pit viper	LC	IV
Typhlops hypomethes	Common blind snake	LC	IV
Enhydris enhydris	Common Smooth Water Snake	LC	
Varanus bengalensis	Common Indian monitor	LR	II
Chamaeleon zelanicus	Chameleon*	VU	II
Mabuya carinata	Common Skink*	LC	
Calotes rouxi	Forest Calottes*	LC	
Calotes versicolor	Common garden lizard*	LC	
Hemimidactylus brooki	House gecko*	LC	
Hemidactylus forenatus	Southern House Gecko	LC	

List of Amphibians either spotted or reported from the study area

Scientific Name	Common Name	IUCN	IWPA
Ahaetulla nasutus	Green whip snake	LC	
Naja naja	Indian Cobra	LC	II
Vipera russelli	Russel Viper	LR	II
Dendrelaphis tristis	Tree Snake	LC	
Ptyas mucosus	Common Rat snake	LC	II
Amphiesma stolata	Buffstriped keelback	LC	
Trimeresurus gramineus	Green pit viper	LC	IV
Typhlops hypomethes	Common blind snake	LC	IV
Enhydris enhydris	Common Smooth Water Snake	LC	
Varanus bengalensis	Common Indian monitor	LR	II
Chamaeleon zelanicus	Chameleon*	VU	II
Mabuya carinata	Common Skink*	LC	
Calotes rouxi	Forest Calottes*	LC	
Calotes versicolor	Common garden lizard*	LC	
Hemimidactylus brooki	House gecko*	LC	
Hemidactylus forenatus	Southern House Gecko	LC	

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

3.13.4 BIRDS

S.No	Common Name	*Scientific Name*	IUCN status	IWLP status
1	House Swift	*Apus affinis*	LC	Sch-IV
2	Asian Palm Swift	*Cypsiurus balasiensis*	LC	Sch-IV
3	Indian Night jar	*Caprimulgus asiaticus*	LC	Sch-IV
4	Black winged Stilt	*Himantopus himantopus*	LC	Sch-IV
5	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	LC	Sch-IV
6	Indian Skimmer	*Rynchops albicollis*	LC	Sch-IV
7	Red-wattled Lapwing	*Vanellus indicus*	LC	Sch-IV
8	Pond Heron	*Ardeola grayii*	LC	Sch-IV
9	Little Egret	*Egretta garzetta*	LC	Sch-IV
10	Medium Egret	*Egretta Intermedia*	LC	Sch-IV
11	Rock Pigeon	*Columba livia*	LC	Sch-IV
12	Spotted Dove	*Streptopelia chinensis*	LC	Sch-IV
13	Eurasian Collared Dove	*Streptopelia decaocto*	LC	Sch-IV
14	Common Kingfisher	*Alcedo atthis*	LC	Sch-IV
15	Pied Kingfisher	*Ceryle rudis*	LC	Sch-IV
16	Indian Roller	*Coracias benghalensis*	LC	Sch-IV
17	White-breasted Kingfisher	*Halcyon symensis*	LC	Sch-IV
18	Indian Cuckoo	*Cuculus micropterus*	LC	Sch-IV
19	Asian Koel	*Eudynamys scolopacea*	LC	Sch-IV
20	Black Eagle	*Ictinaetus malayensis*	LC	Sch-IV
21	Black Kite	*Milvus migrans*	LC	Sch-IV
22	Indian Peafowl	*Pavo cristatus*	LC	Sch-I
23	White breasted Waterhen	*Amauromis phoenicurus*	LC	Sch-IV
24	Common Coot	*Fulica atra*	LC	Sch-IV
25	Common Moorhen	*Gallinula chloropus*	LC	Sch-IV
26	Common Myna	*Acridotheres tristis*	LC	Sch-IV
27	Common Iora	*Aegithina tiphia*	LC	Sch-IV
28	Indian Shama	*Copsychus malerbaricus*	LC	Sch-IV
29	Oriental Magpie Robin	*Copsychus saularis*	LC	Sch-IV
30	House Crow	*Corvus splendens*	LC	Sch-V
31	Black Drongo	*Dicrurus adsimilis*	LC	Sch-IV
32	Indian Blue Robin	*Erithacus brunneus*	LC	Sch-IV

33	White-rumped Munia	*Lonchura striata*	LC	Sch-IV
34	Purple Sunbird	*Nectarinia asiatica*	LC	Sch-IV
35	House Sparrow	*Passer domesticus*	LC	Sch-IV
36	Small Minivet	*Pericrocotus cinnamomeus*	LC	Sch-IV
37	Indian Pitta	*Pitta brachyura*	LC	Sch-IV
38	Baya Weaver	*Ploceus philippininus*	LC	Sch-IV
39	Red-vented Bulbul	*Pycnonotus cafer*	LC	Sch-IV
40	Indian Robin	*Saxicoloides fulicata*	LC	Sch-IV
41	Common Babbler	*Turdoides caudatus*	LC	Sch-IV
42	Jungle Babbler	*Turdoides striatus*	LC	Sch-IV
43	White-bellied Woodpecker	*Dryocopus javensis*	LC	Sch-IV
44	Little Cormorant	*Phalacrocorax niger*	LC	Sch-IV
45	Little Grebe	*Podiceps ruficollis*	LC	Sch-IV
46	Rose-ringed Parakeet	*Psittacula krameri*	LC	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

3.13.5 LIST OF ZOOPLANKTONS

Sr. No.	Zooplankton
1	*Acartiadanae*
2	*Acartiaclause*
3	*Macrosetellagracilis*
4	*Labidoceraacuta*
5	*Acartiaerythraea*
6	*Metis jousseaumei*
7	*Microsetellarosea*
8	*Monostyla bulla*
9	*Oithonabrevicornis*
10	*Copepod nauplius*

11	*Microsetella norvegica*
12	*Bivalveveliger*
13	*Oithonarigida*
14	*Copiliavitrea*
15	*Favela species*
16	*Oithonabrevicornis*
17	*Corycaeusdanae*
18	*Oncaeavenusta*
19	*Euterpinaacutifrons*
20	*Brachionucalyciflorus*
21	*Calannsfinmarchicns*
22	*Brachionusurceolaris*
23	*Paracalanusparvus*
24	*Paracalanusparvus*
25	*Gastropodveliger*
26	*Globigerinaspecies*
27	*Tintinnopsis species*

3.14 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 Udupi;

- 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.

3.14.1 UDUPI DISTRICT PROFILE

An official Census 2011 detail of Udupi, a district of Karnataka has been released by Directorate of Census Operations in Karnataka. Enumeration of key persons was also done by census officials in Udupi District of Karnataka.

In 2011, Udupi had population of 1,177,361 of which male and female were 562,131 and 615,230 respectively. In 2001 census, Udupi had a population of 1,112,243 of which males were 522,231 and remaining 590,012 were females. Udupi District population constituted 1.93 percent of total Maharashtra population. In 2001 census, this figure for Udupi District was at 2.10 percent of Maharashtra population.

There was change of 5.85 percent in the population compared to population as per 2001. In the previous census of India 2001, Udupi District recorded increase of 7.14 percent to its population compared to 1991.

Udupi District Urban/Rural 2011

Out of the total Udupi population for 2011 census, 28.37 percent lives in urban regions of district. In total 334,061 people lives in urban areas of which males are 163,284 and females are 170,777. Sex Ratio in urban region of Udupi district is 1046 as per 2011 census data. Similarly child sex ratio in Udupi district was 952 in 2011 census. Child population (0-6) in urban region was 28,867 of which males and females were 14,787 and 14,080. This child population figure of Udupi district is 9.06 % of total urban population. Average literacy rate in Udupi district as per census 2011 is 92.13 % of which males and females are 95.22 % and 89.21 % literates respectively. In actual number 281,183 people are literate in urban region of which males and females are 141,395 and 139,788 respectively.

As per 2011 census, 71.63 % population of Udupi districts lives in rural areas of villages. The total Udupi district population living in rural areas is 843,300 of which males and females are 398,847 and 444,453 respectively. In rural areas of Udupi district, sex ratio is 1114 females per

1000 males. If child sex ratio data of Udupi district is considered, figure is 960 girls per 1000 boys. Child population in the age 0-6 is 74,293 in rural areas of which males were 37,902 and females were 36,391. The child population comprises 9.50 % of total rural population of Udupi district. Literacy rate in rural areas of Udupi district is 83.91 % as per census data 2011. Gender wise, male and female literacy stood at 89.85 and 78.65 percent respectively. In total, 645,246 people were literate of which males and females were 324,309 and 320,937 respectively.

All details regarding Udupi District have been processed by us after receiving from Govt. of India. We are not responsible for errors to population census details of Udupi District.

3.14.2 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 Udupi district. The route covers 77 villages in 3 talukas and 1 district.

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

S. No	City/ Village		Taluka	District	State
1	1. Baikimpady 2. Kulai 3. Mittothu Colony 4. Mukka 5. Pavanje 6. Haleyangadi 7. Saghu 8. Hajimadi 9. Karnad 10. Thenka 11. Yermal Thenka 12. Kaup 13. Kopalangadi 14. Kamala Mathu 15. Uliar Goli 16. Kote 17. Mudabettu 18. Katapady 19. Kinnymulki 20. CPC Layout 21. Adi Udupi 22. Tonse East 23. Tenka Bettu 24. Brahmavar 25. Kumargod 26. Sulkuduru 27. Kotathattu 28. Manoor	32. Surathkal 33. Kuthethoor 34. Dodda Kopla 35. Srinivasnagar 36. Kolevailu 37. Kadike 38. Kallapu 39. Padupanmbur 40. Mulki 41. Nadsal 42. Bada 43. Uchila 44. Muloor 45. Pedu 46. Kothalguttu 47. Pangala 48. Bolje 49. Udyavara 50. Korangrapady 51. Kodankoor 52. Hanumatha Nagar 53. Ambagillu 54. Nayampally 55. Airody 56. Sasthan 57. Gudami Village 58. Saligrama 59. Kota 60. Tekkatte	Mangalore Kantal	Udupi	Karnataka

	29. Kumbashi 30. Gopadi 31. Beejadi	61. Kanukure 62. Koteshwar 63. Kodladi	Kundapura		
2	1. Padubidri 2. Pedebettu 3. Belman 4. Kedinje 5. Nitte	6. Nandikur 7. Santhoor 8. Mukamar 9. Dupada Katte 10. Mathade Kere			
3	1. Adi Udupi 2. Kunjibettu	3. Hayagriva Nagar 4. Manipal			

Source: Primary Survey, TUV SUD

3.14.3 DEMOGRAPHIC DETAILS

The initial provisional data released by census India 2011, shows that density of Udupi district for 2011 is 329 people per sq. km. In 2001, Udupi district density was at 287 people per sq. km. Udupi district administers 3,582 square kilometers of areas.

Average literacy rate of Udupi in 2011 were 86.24 compared to 81.25 of 2001. If things are looked out at gender wise, male and female literacy were 91.41 and 81.58 respectively. For 2001 census, same figures stood at 88.23 and 75.19 in Udupi District. Total literate in Udupi District were 926,429 of which male and female were 465,704 and 460,725 respectively. In 2001, Udupi District had 810,584 in its district.

With regards to Sex Ratio in Udupi, it stood at 1094 per 1000 male compared to 2001 census figure of 1130. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 958 girls per 1000 boys compared to figure of 958 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 Udupi. There were total 103,160 children underage of 0-6 against 114,581 of 2001 census. Of total 103,160 male and female were 52,689 and 50,471 respectively. Child Sex Ratio as per census 2011 was 958 compared to 958 of census 2001. In 2011, Children under 0-6 formed 8.76 percent of Udupi District compared to 10.30 percent of 2001. There was net change of -1.54 percent in this compared to previous census of India.

In 2011, total 320 families live on footpath or without any roof cover in Udupi district of Karnataka. Total Population of all who lived without roof at the time of Census 2011 numbers to 953. This approximately 0.08% of total population of Udupi district.

Table 3-21: Demographic Profile of Project Districts

Udupi /Description	2011	2001
Population	11.77 Lakhs	11.12 Lakhs

Actual Population	1,177,361	1,112,243
Male	562,131	522,231
Female	615,230	590,012
Population Growth	5.85%	7.14%
Area Sq. Km	3,582	3,582
Density/km2	329	287
Proportion to Karnataka Population	1.93%	2.10%
Sex Ratio (Per 1000)	1094	1130
Child Sex Ratio (0-6 Age)	958	958
Average Literacy	86.24	81.25
Male Literacy	91.41	88.23
Female Literacy	81.58	75.19
Total Child Population (0-6 Age)	103,160	114,581
Male Population (0-6 Age)	52,689	58,509
Female Population (0-6 Age)	50,471	56,072
Literates	926,429	810,584
Male Literates	465,704	409,135
Female Literates	460,725	401,449
Child Proportion (0-6 Age)	8.76%	10.30%
Boys Proportion (0-6 Age)	9.37%	11.20%
Girls Proportion (0-6 Age)	8.20%	9.50%

Source: Census of India, 2011

Religion wise Demography details

The religion-wise demography profile indicates that maximum population belongs to Hindus (~85%) followed by Muslims (~8.00%) in all three districts and Christians (6%). 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/ Udupi	Total	Percentage
Hindu	1,009,179	85.72 %
Muslims	96,740	8.22 %
Christian	65,838	5.59 %
Sikh	232	0.02 %
Buddhist	161	0.01 %

Jain	4,534	0.39 %
Others	155	0.01 %
Not Stated	522	0.04 %

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.
- Ensuring equipment is maintained to manufacturers standards and that noise baffles are fitted.
- Reducing exposure times for people working near noisy machinery;
- 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

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

1. 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 12”, 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 Udupi. 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.

Figure 5-1: Photographs taken during the stakeholder consultations

Representatives of AGL

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

Discussions with Local Inhabitants Village 1

Name of the village	:	Padubidri	Date	: 27th Jan 2020	
Panchayat	:	Padubidri	Tehsil/Taluka	: Udupi	
District	:	Udupi			

Participants:

S.No.	Name	Village	Occupation	Land ownership/Local Inhabitants in vicinity of Project Site
1	Rama B	Padubidri	Farmer	--
2	George Matthias	Padubidri	Shop Owner	--
3	Chandra P S	Padubidri	Rental Business	--

Sr.No.	Questions	Responses
1	Total population of the area:	5200
2	Average Household Size:	5-6
3	Literacy rate:	89.50 %
4	Caste/tribe details:	Schedule Caste (SC) constitutes 4.79 % while Schedule Tribe (ST) were 1.15 % of total population.
5	Religion:	70 % Hindu, 10% Muslim, 10% Christian
6	Ethnic Group	South Asians
7	Major Occupation:	Farming, Service, Business
8	Crops Grown:	Rice
9	Land Holding details:	1-5 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	Mangalore Chemical and Fertilizers, Kudremuch Iron and Ore Company.

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 helps 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 · • Control of operating hours · • Appropriate selection and maintenance of plant, vehicles and access routes · • Appropriate selection of construction techniques · • Community liaison • Ensure environmental	• Review and approval of the contractors Transport management plan, Construction Camp Management Plan, Pollution Prevention Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan, Procurement and Supply	AGL	• Pre-construction

		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	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 Specific Measures)	• Risk assessment to be undertaken before any chemical additives are used in hydro test water • Controlled discharge of water to reduce soil erosion Testing and treatment of water before discharge • Responsible disposal of waste	• Review and approval of the contractors Pollution Prevention Management Plan, Procurement and Supply Management Plan, Waste Management Plan, Infrastructure and Services Management Plan and detailed construction method statements	AGL	• Pre-construction

		water; no disposal of incompatible water in areas of groundwater or surface water vulnerability	• 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 • 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	• 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 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-construction

		to minimise scour at the discharge point			
	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 drainage/irrigation management	• 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
	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	Contractor	• Throughout Construction Period

			application of mitigation 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
	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 spillage of hazardous materials (e.g. lubrication fluids, oils, paints, diesel etc.).	• Development and implementation of specific 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	• Review and approval of the contractors Pollution 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	AGL	• Pre-construction

		response equipment and spill response training Rapid response in event of spillage	• 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 • 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	• Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Liaison Management Plan and Community Safety Management Plan	Contractor	• Throughout Construction Period
			• 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 ·	• Review and approval of the contractor's management plans, detailed construction method statements and	AGL	• Pre-construction

		• Protection of soil surface in areas of soft ground · • Provision of appropriate drainage and regular regrading	Reinstatement Plan		
			• 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
	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	Contractor	• Throughout Construction Period

			application of mitigation measures		
			• 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 · • Ensure that where contaminated land is encountered it is effectively managed	• 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
			• 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)	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	Contractor	• Throughout Construction Period

		• Transport Management (including route selection) • Reinstatement Plan Additional ecological surveys and translocation programmes	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
			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	Review and approval of the contractors Community Safety Management Plan, Infrastructure	AGL	• Pre-construction

		and livestock exists · • Installation of soft plugs in ditch with sloped edges to allow animal egress	and Services Management Plan, 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
Social	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
	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	Review and approval of the contractors Transport Management Plan, Infrastructure and Services Management Plan, Community Safety Management Plan, Community Liaison Management Plan,	AGL	• Pre-construction

		to maintain access · • Institute temporary traffic control, where necessary · • Undertake community consultation	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
	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	Spot checks at ROW,	AGL	Monthly for first 3

		construction mitigation measures	construction sites and affected communities to ensure mitigation measures are being 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		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		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 disposed at new CNG facilities	Once in a month

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 minimized.

9.4 IMPACTS DURING OPEARTION 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

The Environmental and Social Assessment study for the proposed city gas distribution project in Udupi districts of Karnataka state has been undertaken in accordance with IFC's Performance Standards, World Bank's Environment Health and Safety (EHS) Guidelines.

The ESIA study aimed to identify and evaluate potential environmental impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, the evaluation of impacts identified by specialists, and the process of stakeholder consultation. The impacts due to the project is site specific and reversible owing to the construction activities and availability of land which is suitable for establishing the proposed project due to land use and lack of rainfall.

The project is assessed to generate limited environmental and social impacts owing to construction related activity which will not extend beyond city gas distribution Footprints. The entire pipeline is situated along major district roads, state and national highways of RoW basis and very little and leasing of private land based on' willing buyer-willing seller' for project

development is required. Mitigation measures for potential impacts on various environmental and socio-economic have been specified through:

- Follow up of best practice of compensation, stakeholder engagement, and grievance management;
- Planning & designing of gas distribution pipeline and charge stations, site preparation and access route, construction, drainage, traffic movement etc.;
- Application of standards for Health and Safety; and
- Clearances and permits required for each sub activity

The proposed Environmental and Social Management Plan describe implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. The implementation of the mitigation measures including monitoring schedule will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the Power Plant are taken care off. This ESIA study together with mitigation measures and follow up of recommendations on management actions will help AGL and the EPC contractor in complying with the environmental standards and meet the IFC performance standards.

The Project is a gas distribution project which is essentially a nonpolluting service sector project. It is environmentally friendly and carbon emission reducing project as it will replace conventional polluting and carbon emitting sources of energy in the project area. The project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and readily addressed through mitigation measures. The basis for categorization is as follows: The rationale for categorization being:

- The potential environmental impacts on surface and groundwater due to a change in drainage network on the site and potential spills of contaminants is assessed to be of negligible significance;
- Little amount of land required is procured based on ‘willing buyer-willing seller’ with compensation more than prevailing market rates;
- The project will bring positive impacts through the creation of direct employment and training opportunities which will induce economic benefits;
- The duration and extent of construction activities will also limited; thereby resulting in minimal environmental and social impacts;
- The potential environmental and social impacts of the Project are limited as the project is a clean project and does not involve any emission or rehabilitation issues;
- Village road is not used for movement of project components during construction and operation phase of the project; and

- Any adverse environmental and social impacts may be readily addressed through mitigation measures as outlined in the Environmental and Social Management Plan (ESMP).

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

adani
Adani Gas Limited

EMERGENCY RESPONSE & DISASTER MANAGEMENT PLAN (ERDMP)

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

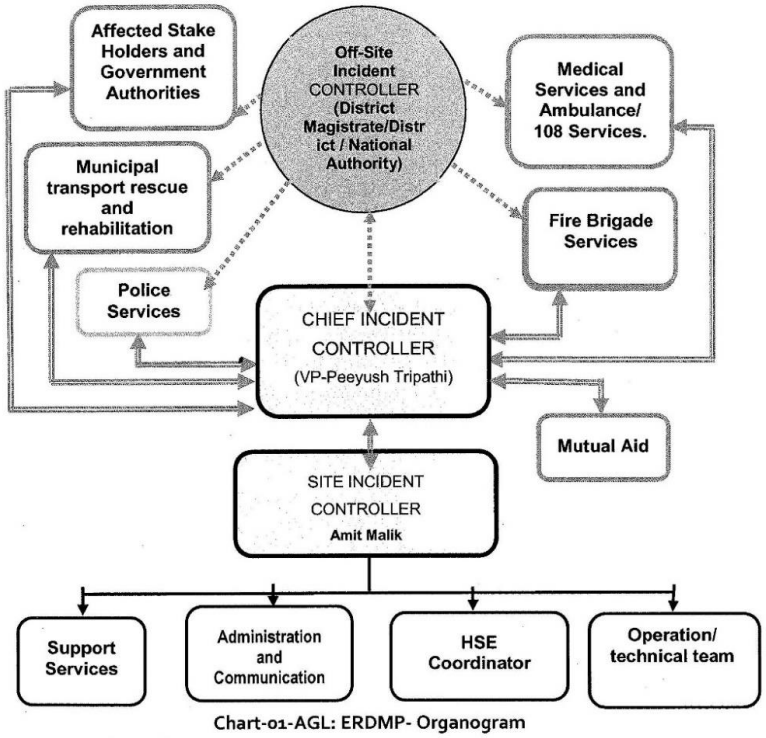


Chart-01-AGL: ERDMP- Organogram

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