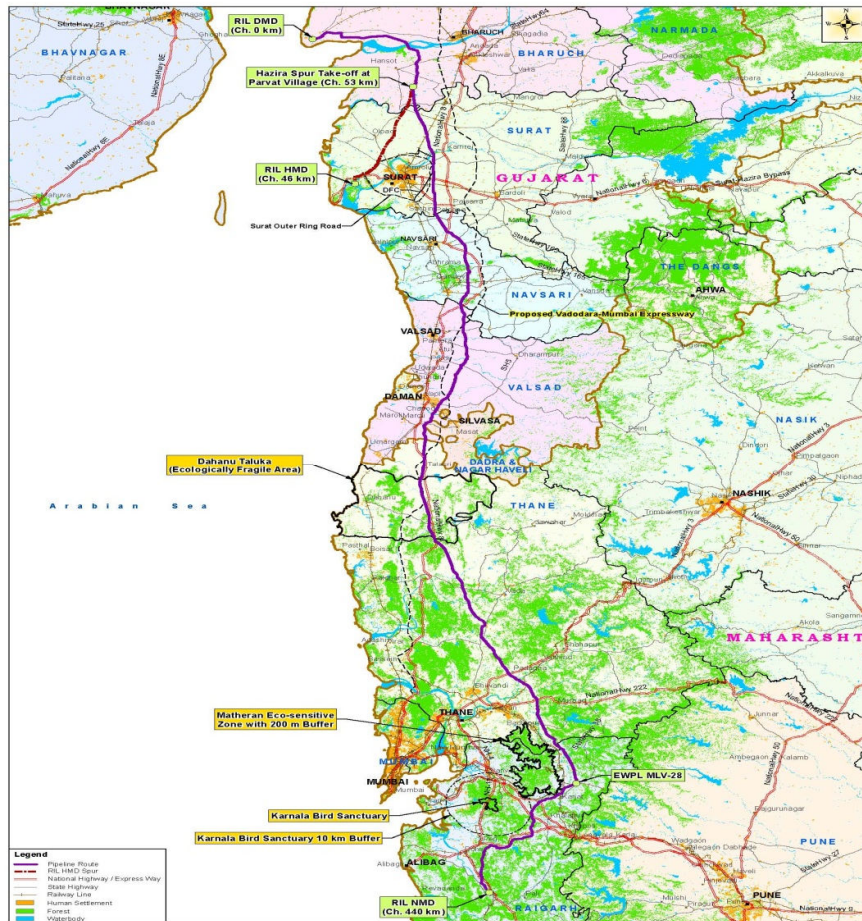


Executive Summary
of
Environmental Impact Assessment
for
DAHEJ NAGOTHANE ETHANE PIPELINE



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EXECUTIVE SUMMARY

1.0 INTRODUCTION

Reliance Gas Pipelines Limited (RGPL), a wholly owned subsidiary of Reliance Industries Limited (RIL), proposes to build and operate a 486 km long pipeline for transportation of liquid Ethane. The pipeline will transport liquid Ethane made available from RIL's Dahej Manufacturing Division (DMD) to RIL's Hazira Manufacturing Division (HMD) and to RIL's Nagothane Manufacturing Division (NMD). The dedicated pipeline network, named as Dahej Nagothane Ethane Pipeline (DNEPL) is designed to transport 1.4 MMTPA (i.e. 175 TPH; 98 TPH for NMD and 77 TPH for HMD) of liquid Ethane. Total Cost of the project is approximately Rs. 1,428 crores.

Out of 486 km proposed pipeline, approximately 26 km passes through Dahanu Taluka Eco- Fragile Area and therefore requires prior Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEFCC), New Delhi. RGPL has engaged M/s Bhagavathi Ana Labs Pvt. Ltd, Hyderabad, for undertaking Environmental Impact Assessment (EIA) studies for the project.

MoEFCC has issued Terms of Reference (ToR) vide letter no.J-11011/226/2015-IA II(I) dated 15th October, 2014 for conducting EIA studies for the proposed Dahej-Nagothane Ethane Pipeline Project. After completion of Public Hearing, the Final EIA / EMP would be prepared by incorporating the responses to the issues raised during public hearing for submission to MoEFCC for obtaining Environmental Clearance (EC).

This EIA report is prepared inline with the Generic Structure provided in the EIA Notification, 2006. It includes description of the baseline environment, anticipated environmental impacts with the mitigation measures, an analysis of alternatives, the proposed environmental monitoring program, risk assessment along with the disaster management plan, project benefits, environmental management plan and summary of the EIA study.

2.0 PROJECT LOCATION

DNEPL will originate from Dahej in Gujarat and terminate at Nagothane in Maharashtra with a spur pipeline to Hazira. The length of the mainline from DMD to NMD is ~440 km. The length of spur pipeline to HMD is about 46 km. Approximately 260 km of the pipeline passes through the state of Gujarat and approximately 230 km passes through the state of Maharashtra.

The pipeline passes through 4 districts in Gujarat viz. Bharuch, Surat, Navsari and Valsad and 3 districts in Maharashtra viz. Thane, Palghar & Raigad.

Except for approximately 89 km, the entire pipeline is proposed to be laid in the existing Right of Use (RoU) of RGTIL's (Reliance Gas Transportation Infrastructure Limited) East West Gas Pipeline (EWPL) and RIL's existing Hazira Dahej Pipeline (HDPL). For the new 89 km length of pipeline, 18-m wide RoU will be acquired under the provisions of Petroleum and Minerals, Pipelines (Acquisition of Right of User in Land) Act, 1962.

Out of the total pipeline length in Maharashtra State, approximately 26 km passes through Dahanu Taluka which has been declared as ecologically fragile area where the development activities are monitored by Dahanu Taluka Environment Protection Authority (DTEPA) constituted by MoEF. Pipeline within this area will be laid entirely

within the existing RoU of EWPL in forest as well as non-forest areas. Hence no fresh RoU will be acquired for the proposed pipeline passing through Dahanu Eco-fragile area.

The proposed pipeline route map is shown as **Figure E.1**.

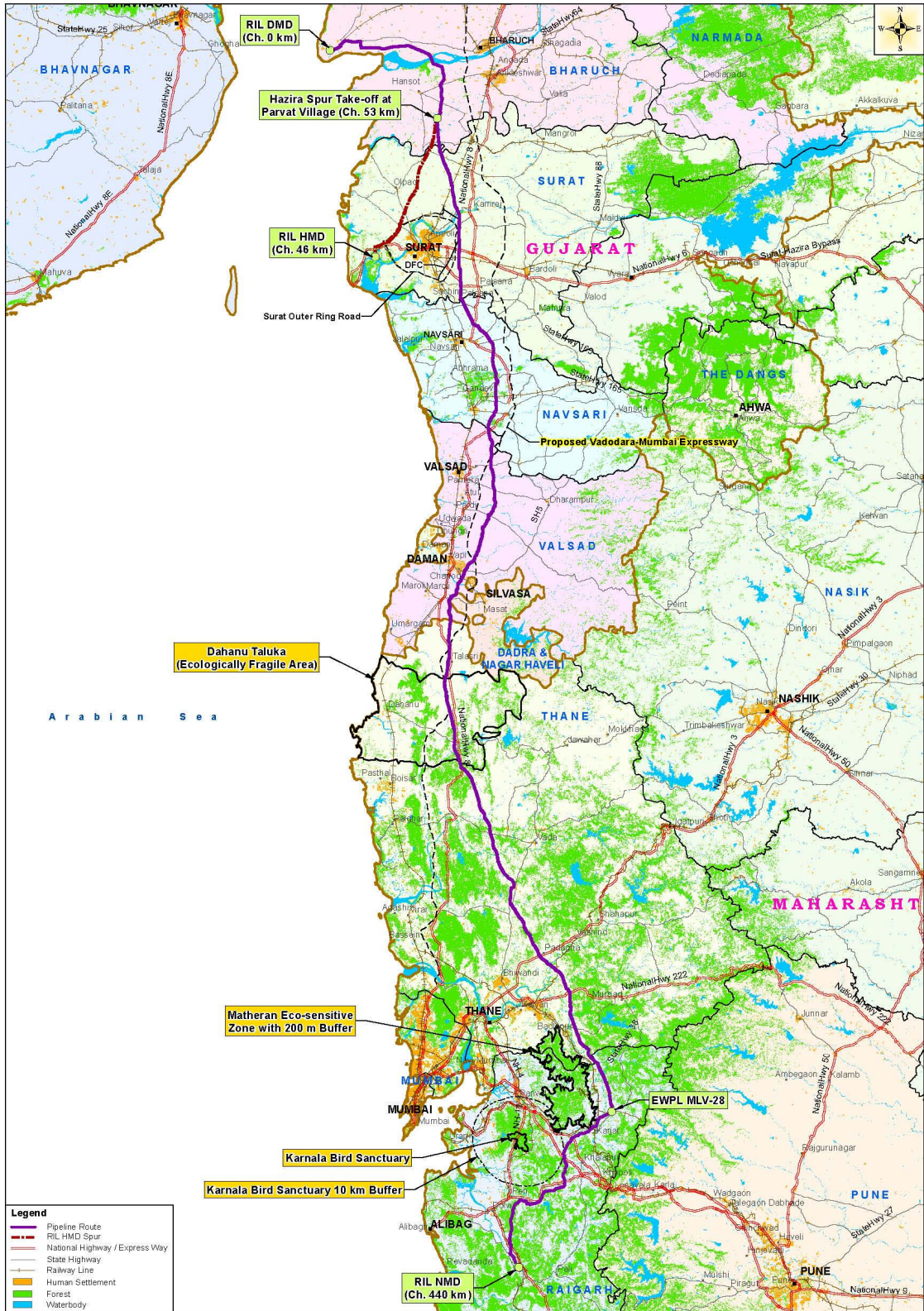


Figure E.1: Pipeline Route Map

Salient Features of the selected route is given in **Table E.1**.

Table E.1: District-wise Length of the proposed pipeline

State	District	Main Line (km)	Spur Line (km)	Total Length (km)
Gujarat	Bharuch	61	7	68
	Surat	45	39	84
	Navsari	41	-	41
	Valsad	63	-	63
	Total			256
Maharashtra	Palghar	89	-	89
	Thane	54	-	54
	Raigad	87	-	87
	Total			230
Grand Total				486

The proposed route crosses 9 nos. of rivers under tidal influence namely Bhukhi river (80 m), Narmada river (1,100 m), Mindhola river (50 m), Kim (Mainline) (80 m), Kim (Hazira Spur) (150 m), Purna River (110 m) in Gujarat, Nigade River (80m), Amba River (150m) and Amba Tributary (152m) in Maharashtra. In addition to this, the proposed route passes through other major rivers namely Tapi River (650 m), Ambika river (200 m), Bhatsai River (300 m) and Kalu River (250 m). Approximately 30 km of route length is passing through reserved and protected forest area.

This Pipeline route has been selected after review, analysis and comparison with alternate routes available. It completely avoids Buffer Zone of

- Karnala Bird Sanctuary,
- Matheran Eco-sensitive Zone
- Proposed Western Ghat Eco-sensitive Zone.

3.0 PROJECT DESCRIPTION

The DNEPL project comprises of 12" dia (NB) x 440 km mainline from DMD to NMD, 8" dia (NB) x 46 km spur pipeline to HMD, 1 Pump Station (PS) at DMD, 33 Mainline Valve Stations (MLV) including 01 no. Tap-off for HMD, 2 Intermediate Pigging Stations (IPS) and 2 Metering and Regulating (M&R) stations at NMD and HMD, Cathodic protection system, Supervisory Control and Data Acquisition (SCADA) system, dedicated optical fibre cable based telecommunication system, provision for flaring at MLVs/IPSs during any emergency, leak detection system / pipeline application software, pipeline intrusion detection system, flow measurement and control instrumentation, fire and gas detection system, fire protection system, control and auxiliary buildings and associated facilities.

Pipeline will be designed, engineered and implemented in accordance with OISD 214 (Cross – Country LPG pipelines) and American Society of Mechanical Engineers (ASME) Standard, B31.4 (Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids).

The design parameters considered for the DNEPL are given in **Table E.2**.

Table E.2: Design Parameters of the Proposed Pipeline

Dahej-Nagothane Ethane Pipeline Project – Salient Details		
Description	UoM	Details
Design Throughput	MMTPA	1.4 (175 TPH)
Pipeline Design Life (for Economic Evaluation)	Years	30
Diameter of the Pipeline	Inches	Main Line: 12” , Spur Line: 8”
Design Pressure	bar(g)	112
Pressure at the Pipeline Inlet Battery Limit at DMD	bar(g)	30 (Min)
Temperature at the Pipeline Inlet Battery Limit at DMD	° C	0
Delivery Pressure	bar(g)	56 (Min)
Delivery Temperature	° C	30(max)
Type of External Anti-corrosion Coating	-	High integrity three-layer polyethylene (3-LPE)
Pipeline Design Code	-	ASME B31.4, OISD-214
Entry Point Location	-	Mainline Pump Station at DMD, Gujarat
Exit (Delivery) Point Locations	-	Metering and Regulation Stations at HMD, Gujarat and NMD, Maharashtra
Mainline Valve Stations (MLVs)	No.	33
No. of Intermediate Pigging Station	No.	2

Mainline valves will be provided in line with the code requirements to isolate the pipeline sections during emergency or maintenance. Minimum depth of burial of the pipeline i.e. 1.2 m below the ground level will be maintained along its total length. At water body and other crossings, additional depth will be provided as per the requirement. At major rivers, special techniques viz. Horizontal Directional Drilling (HDD) will be adopted for non-intrusive crossings.

Patrolling of the pipeline will be undertaken on a periodic basis as per PNGRB Guidelines. Periodic mock drills will be conducted in association and in consultation with the local administrative bodies. In order to monitor and control the pipeline operation, SCADA system will be installed with its dedicated Optical Fibre Cable (OFC) based telecommunication system.

Pipeline Application Software (PAS) will be integrated with the SCADA system, for leak detection and location, pig tracking etc. Pipeline system will be equipped with pressure safety protection devices. Pipeline shutdown system will be activated through an Emergency Shutdown (ESD) system. Pipeline system will also be equipped with Pipeline Intrusion Detection System (PIDS) to alert the pipeline operator about any third party activity within the RoU. Adequate firefighting facilities along with gas detection and fire alarm system will be provided at the Pumping Station, Metering and Regulating Stations and remotely operated MLV stations.

The schematic diagram of DNEPL is shown in **Figure E.2 & E.3**.

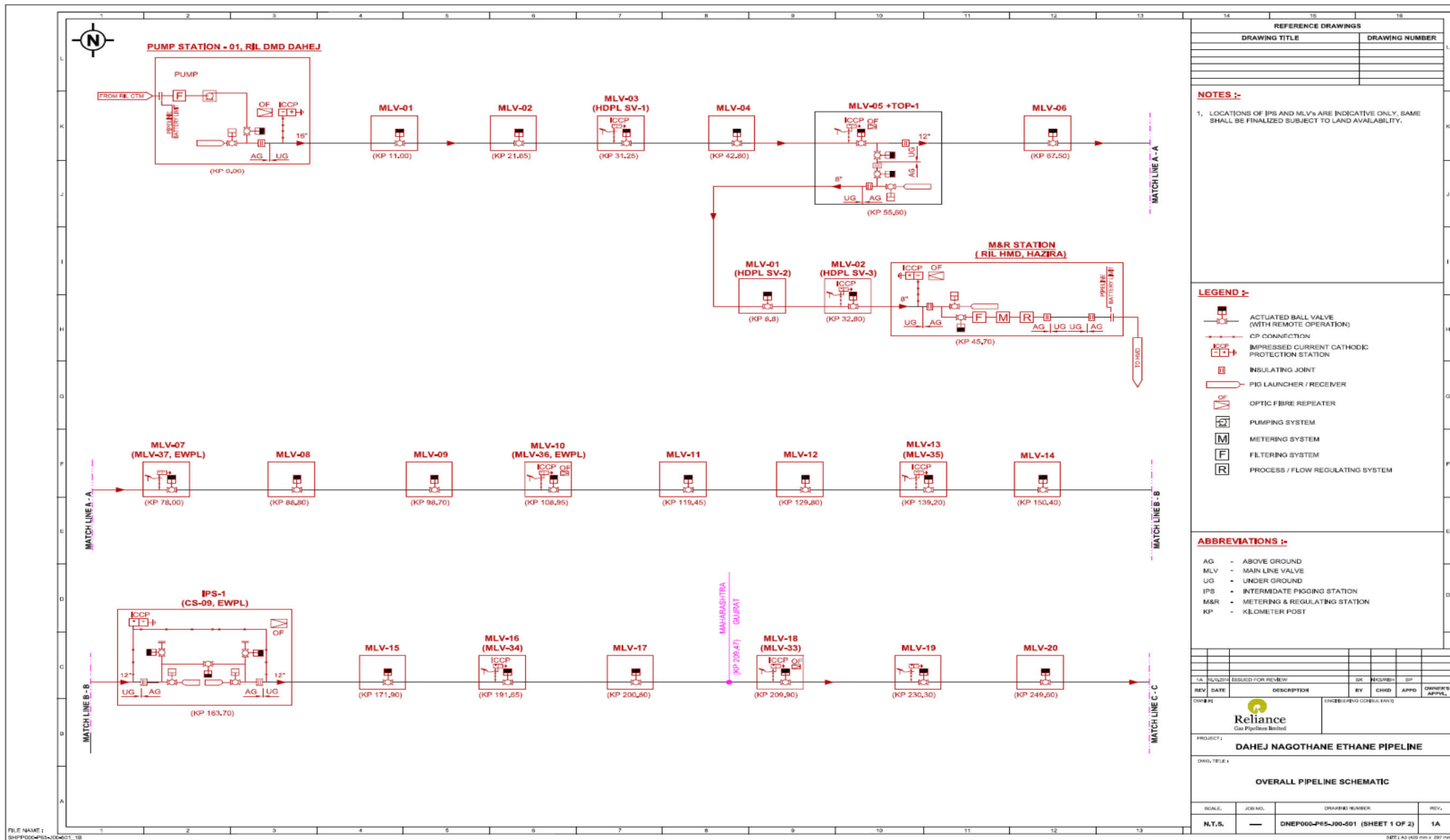


Figure E.2: Schematic Diagram of Proposed Pipeline (Part-1)

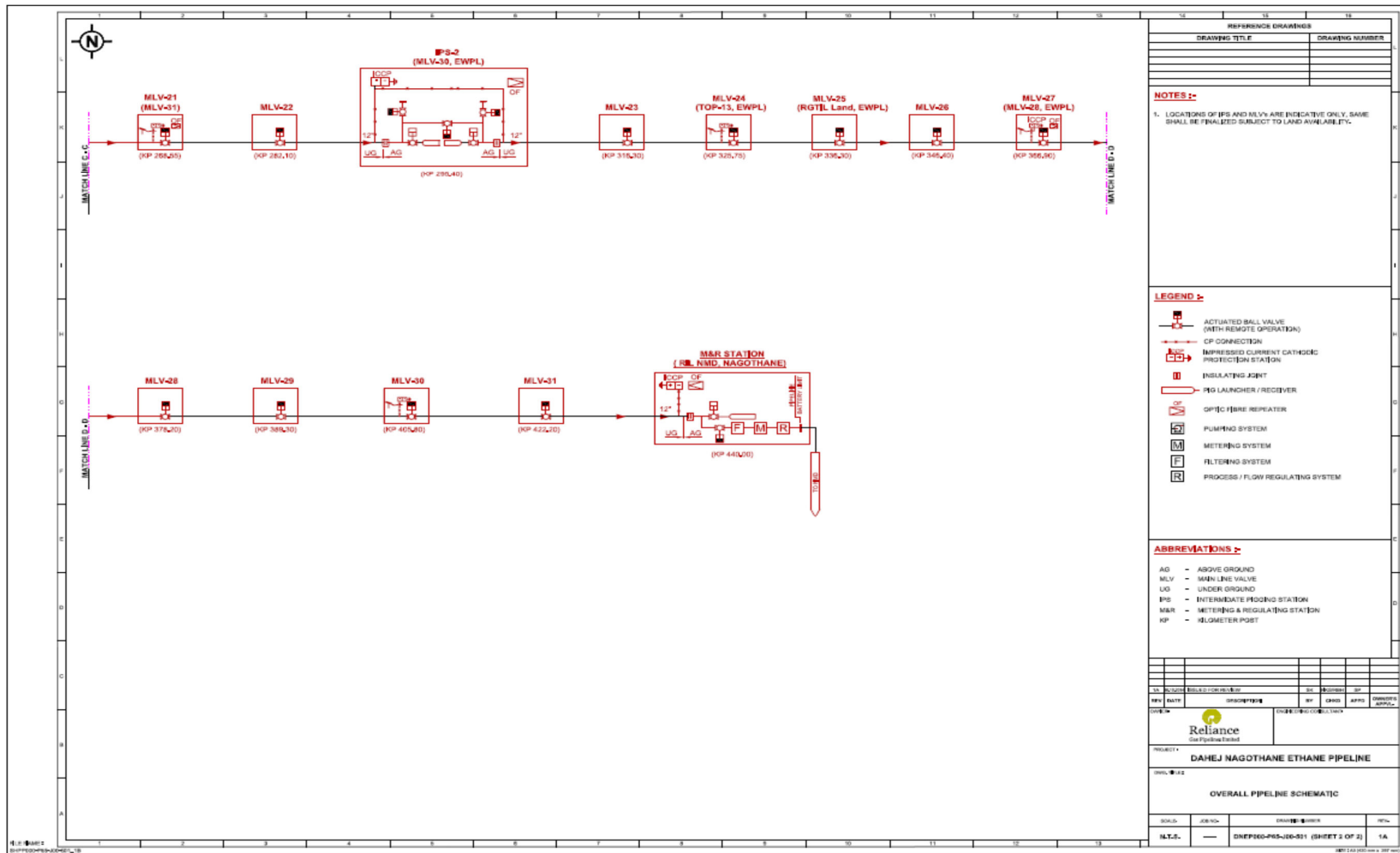


Figure E.2: Schematic Diagram of Proposed Pipeline (Part-2)

4.0 RESOURCE REQUIREMENT

4.1 Land Requirement

Major section of the pipeline will be laid within the existing Right of Use (RoU) of RGTIL's EWPL. New 18-m wide RoU will be acquired under the provisions of Petroleum and Minerals, Pipelines (Acquisition of Right of User in Land) Act, 1962 for the pipeline length of about 89 km. Apart from the RoU acquisition for pipeline laying, there is permanent land requirement of about 12.18 ha for setting up additional facilities such as Mainline Valve Stations & Intermediate Pigging Stations.

The land under RoU will be restored to near original condition after construction of the pipeline.

4.2 Water Resource

Water requirement during Construction Phase for laying of pipeline and construction of associated facilities is about 491KLD. Water requirement during construction phase will be met through local sources. Water required for Pump Station, MLVs and M&R during operation phase is estimated to be approximately 19 KLD. Water requirement at MLVs and IPSs will be primarily met by providing tube well at respective locations. There will be a one-time requirement of 4,800 m³ of water per section of hydrostatic testing (~ 30 km). This water will be sourced from approved local suppliers and reused in different test sections to an extent practically feasible.

4.3 Manpower Resources

It is estimated that about 2,700 people, including labour, will be deployed as peak work force during construction. Local manpower resources will be employed during construction phase to the extent they are found technically suitable. The pipeline operation being highly automated from safety considerations, the maximum deployment of skilled persons is expected to be of the order of 75. Outsourced work force for routine maintenance shall be of the order of 100. The total headcount will be spread across various facilities located along the pipeline route such as PS, MLV stations, IPS and M&R stations.

4.4 Material and Machineries

The major construction material required will be pipes and pipe fittings, welding materials and equipment required for welding operation, ready mix concrete, sealants etc. Different equipment, machinery like cranes, backhoe, truck-trailers, dozers, excavators, dumpers, pumps, DG sets, etc. would also be required. During the pipe installation process across tidal and major perennial rivers Horizontal Directional Drilling (HDD) or an equivalent technique will be used that would cause minimal interference and / or contamination of the water body.

4.5 Waste management

As the pipeline will be laid underground, excavated soil will be reused for back filling. Top soil will be reinstated on top layer as original. The primary source of solid wastes will be from construction camps. During construction, the solid waste generated will be mainly packaging and wrapping material, stubs of spent welding electrodes, used rags and house-keeping waste from the construction camps. Site contractors will be responsible for disposal/resale of these wastes, in an environmentally friendly and acceptable manner. Only domestic solid waste like paper and cardboard waste may be generated at the pumping station during operation phase. These will be sorted, sold for recycling or reused as possible. Canteen / food waste will be suitably managed. Liquid wastes will primarily consist of sewage pertaining to domestic

sanitation wastes from construction camps and at pumping station. The domestic wastewater will be discharged in the local sewer or in soak pit/septic tank.

5.0 Statutory Approvals

RGPL will obtain all statutory permissions from the concerned authorities as applicable. In addition to obtaining Environmental Clearance from MoEFCC, RGPL will also obtain Consent for Establishment under Air (Prevention and Control of Pollution Act), 1981 and Water (Prevention and Control of Pollution) Act, 1974 from Gujarat and Maharashtra State Pollution Control Boards. As part of the proposed pipeline (~26km) passes through Dahanu Eco-fragile area, a clearance from Dahanu Taluka Environmental Protection Agency (DTEPA) will also be obtained.

As the proposed pipeline project involves diversion of fresh forest land and re-diversion of already diverted forest land in Gujarat & Maharashtra states, permission under Forest Conservation Act, 1980 will be obtained. The proposals for both diversion and re-diversion of forest land for laying of 30.918 km (~45 ha) pipeline have been submitted to the concerned State Forest Departments which are under process.

The details of forest land proposed for diversion and re-diversion is shown in the **Table E.3.**

Table E.3: Details Of Forest Land Proposed For Diversion

State	District	Division	Proposed Re-diversion of forest land (ha)	Proposed Diversion of forest land (ha)
Gujarat	Valsad	Valsad (North & South)	0.8923	0.0564
	Bharuch	Bharuch	-	0.0216
	Surat	Surat	-	0.0828
	Navsari	Navsari	-	0.0456
Total Forest land in Gujarat			0.8923	0.2064
Maharashtra	Thane	Dahanu	24.124	-
		Jawhar	2.4435	0.6669
		Thane	7.2586	1.3869
	Raigad	Alibag	0.198	7.8851
Total Forest land in Maharashtra			34.0241	9.9389
Total proposed Forest land			34.9164	10.1453

The proposed project crosses through 9 tidally influenced water bodies namely Bhukhi, Narmada, Purna, Kim, Kim-Hazira, Mindhola in Gujarat, Amba, Amba Tributary and Nigade in Maharashtra. Clearance under CRZ Notification, 2011 will be obtained separately from State Coastal Zone Management Authorities of Gujarat and Maharashtra.

The statutes and guidelines governing the project are listed below:

- EIA Notification dated 14th Sep 2006 and its subsequent amendments;
- CRZ Notification, 2011;
- Environment (Protection) Act, 1986;
- Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2008;

- Forest Conservation Act, 1980;
- Air (Prevention and Control of Pollution) Act, 1981; and
- Water (Prevention and Control of Pollution) Act, 1974

Separate approvals from concerned authorities will be obtained for laying the pipeline within government land. Permission will also be obtained from various authorities having jurisdiction for the purpose of crossing of existing utilities, pipelines, roads, railway tracks, water courses etc.

6.0 DESCRIPTION OF ENVIRONMENT

The baseline data for all environmental components is collected through primary site investigation as well as from secondary sources. The understanding towards baseline environmental conditions helps in identifying the possible impact of the project on the environment. Furthermore, the primary data has also been analyzed from environmental monitoring surveys conducted at selected locations. The baseline data collection was carried out for one season from the September - December, 2014. Various environmental attributes that have been considered for formulating the baseline environmental conditions are given under **Table E.5**

Table E.5: Environmental attributes considered for Baseline Data Collection

Sr. No.	Attribute	Parameters	Sampling details
1	Meteorology	Temperature, Relative Humidity, Rainfall, Wind Speed and Wind Direction.	Onsite meteorological data collection at 4 locations and data collection from secondary sources
2	Ambient Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO, HC and VOC	Ambient air quality monitoring at 30 locations within 500-m on either side of pipeline route
3	Noise levels	Noise levels in dB (A)	Noise levels monitored at 30 locations within 1 km radius of pipeline route
4	Water Quality	Physical & Chemical Properties and Heavy Metals	Samples collected at 12 ground water locations and 12 surface water locations along the pipeline route
5	Soil and Geology	Soil Types, Geological History	Soil samples collected from 15 locations and data collected from secondary sources.
6	Sediment Quality	Physical, Chemical and Heavy Metals	Samples collected at 12 locations along the pipeline route
7	Land Use	Existing Land Use Pattern	Using Satellite Imagery over a 10 km buffer zone along the pipeline and 10-km radius around DMD, HMD and NMD and cross checked with ground truthing.
8	Ecology	Existing Terrestrial Flora and Fauna	Through primary field survey in 500-m on either side of the pipe line route and 10-km radius around DMD, HMD and NMD and secondary sources
9	Socio-economic aspects	Socio-economic characteristics of the affected area	Based on primary field surveys on 500-m either side of the pipe line route and 10-km radius around DMD, HMD and NMD and other secondary sources such as Census 2011 data

6.1 Meteorology

Temporary field meteorological stations were established at four locations viz. Dahej, Surat, Vapi and Nagothane. Monitoring of meteorological parameters comprising air temperature, relative humidity, wind speed, wind direction and rainfall were carried out.

The meteorological data collected during the study period is summarised in the **Table E.6**.

Table E.6: Status of Meteorology

Parameter	Status of Meteorology			
	Dahej (DMD Plant)	Surat	Vapi	Nagothane
Wind Direction	North-East	North-East	North-West	North-East
Wind Speed Range	0-4.4 m/s	0-5.1 m/s	0-4.8 m/s	0-5.3 m/s
Average Wind Speed	1.72 m/s	1.0 m/s	2.3 m/s	2.2 m/s
Temperature Range	21-40 °C	20-38 °C	23-41 °C	21-41 °C
Relative Humidity	19-90 %	14-98 %	26-87	17-88
Average Precipitation	3.7 mm	0.01 mm	0.0 mm	0.02 mm

6.2 Air Quality

A methodically designed Ambient Air Quality Monitoring (AAQM) network covering 30 sampling locations was established to assess the baseline environmental status in the study area during post monsoon season 2014. The sampling locations represent the ambient air quality at 500-m on either side of the pipeline across its length. Air quality was monitored as per CPCB guidelines (twice a week sampling and 24 hr continuous sampling each day). The sampling was done as per applicable IS standards. The ambient air quality observed along the pipeline route was found to be below the prescribed standards of CPCB. AAQ monitored in two villages in Dahanu Taluka (Dahigaon & Kolhan) and is within CPCB standards. The AAQ status in the study area is shown in **Table E.7**.

Table E.7: Ambient Air Quality Monitoring Results

Sr. No.	Parameter	Mean Range	CPCB Limits
1	Particulate Matter _{2.5} (PM _{2.5})	18.2 – 39.5 µg/m ³	60 µg/m ³
2	Particulate Matter ₁₀ (PM ₁₀)	55.2 – 67.3 µg/m ³	100 µg/m ³
3	Sulphur-di-oxide (SO ₂)	12.5 – 14.8 µg/m ³	80 µg/m ³
4	Oxides of Nitrogen (NO _x)	17.22 – 22.5 µg/m ³	80 µg/m ³
5	Carbon Monoxide (CO)	0.7 – 1.0 mg/m ³	2 mg/m ³
6	Hydrocarbons (HC)	<0.1 – 1.0 mg/m ³	-
7	Benzene (C ₆ H ₆)	<0.01 – 0.5 µg/m ³	5 µg/m ³

Sampling Time: 24 hours except for O₃ & CO (8-hrs) as per NAAQS standards dated 26.11.2009

6.3 Water Quality

Water samples were collected from 12 surface water bodies (out of which 9 are CRZ water bodies) and 12 ground water locations. Surface water samples were collected from the water bodies where proposed pipeline is crossing. Ground water samples were collected within 500-m distance on either side of the pipeline route along the 486 km stretch. These samples were examined for physico-chemical properties, heavy metals and bacteriological parameters in order to assess the baseline quality of surface and ground water. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA).

6.2.1 Ground Water Quality

The water samples results for the collected ground water shows that most of the water samples are within the permissible limits of IS: 10500 for drinking water. The pH values of the ground water samples were found to be in the range of 7.64 – 8.12, The Total dissolved solids of the ground water samples were found to be in the range of 530 - 1830 mg/l. The Total hardness value of the ground water samples were found to be in the range of 260 - 875 mg/l, Iron is in the range of 0.05-0.09 mg/l. Fluoride is in the range of 0.5 - 1 mg/l. All heavy metals were below detectable level.

6.2.2 Surface Water Quality

Observations made on the analytical results pertaining to all the locations reveal that the pH values of the surface water samples were found to be in the range of 7.11 – 8.63. The Total Dissolved Solids (TDS) of the surface water samples were found to be in the range of 119- 23,750 mg/l. The Total hardness value of the surface water samples were found to be in the range of 150- 4767 mg/l. The TDS value for Mindhola (23,750 mg/l) river is found to be high since it is tidal influenced water body.

6.4 Sediment Quality

The Sediment samples have been collected from 12 water bodies at crossings out of which 9 locations represent the tidally influenced water bodies (CRZ areas). These sediment samples have been analyzed for heavy metals and other physic-chemical properties. Petroleum Hydrocarbons were found to be <0.1 mg/kg. All the sediments majorly consist of sand, which is in the range of 84-95%. Heavy Metals such as Cobalt (Co), Nickel (Ni), Copper (Cu), Lead (Pb), Cadmium (Cd) and Mercury (Hg) are found in the range of 1.4-4.4 mg/kg, 0.4 – 1.4 mg/kg, 0.8 – 8.4 mg/kg, 4.3 – 7.6 mg/kg, 0.1 – 0.8 mg/kg and <0.1 mg/kg respectively.

6.5 Noise Level Survey

Ambient noise level measurement monitoring was carried out at 30 locations along the pipeline route. Noise monitoring was carried out in the study period for 24 hours. The noise levels measured in the study area are given in **Table E.8**.

Table E.8: Ambient Air Quality Monitoring Results

Parameter	L _{day} (Day Eq.) in dB(A)		L _{night} (Night Eq) in dB(A)	
	Observed Values	Limits	Observed Values	Limits
Industrial Area	62.4 – 71.5	75	53.6 – 64.5	70
Commercial Area	52.9 – 72.9	65	44.8 – 66.3	55
Residential Area	50.9 – 69.1	55	41.3 – 60.4	45

The Noise levels measured along the pipeline route were observed to be below the prescribed standards of CPCB except few villages. Noise levels at Mhaskal village (Lday:72.9 dB(A) & Lnight: 61.7dB(A)) are found to be high as there are many on-going building construction activities. Also, Noise levels were high at Mora village (Lday: 72.9 dB(A) & Lnight: 61.7dB(A)) as the village is close to Hazira Industrial Area. Noise levels in Dahanu Taluka are well within the standards.

6.6 Soil Environment

A total of 15 samples were collected within 1 km radius of the pipeline route and analyzed. Methodology adopted for sampling and analysis as per standard methods. It has been observed that the texture of soil is mostly clay and sandy loam soil in the study area. The common colour of the soil ranged from reddish brown to light brown. It has been observed that the pH of the soil quality ranged from 6.53 – 9.15. The soil has been found to be moderately alkaline in nature. The soil from the study area shows less to moderate fertility due to their NPK content.

6.7 Land Environment

The minimum and maximum elevation along the proposed pipeline route is 65 m above mean sea level (msl) and maximum elevation of 255 m above msl respectively. The average elevation is about 160 m above msl. The project is located on Seismic zone III which is categorized as moderate intensity zone. The present land use pattern of the study area (i.e. 10km radius of the pipeline route) has been assessed based on NRSA published IRS LISS III (1:50,000) data and validated from on field visit and data collection. The land use analysis show that the area is of predominantly agriculture land (61%), forest area (23%) and barren wastelands (11 %). The major landuse in Dahanu area is agriculture (45% and Forest (40%).

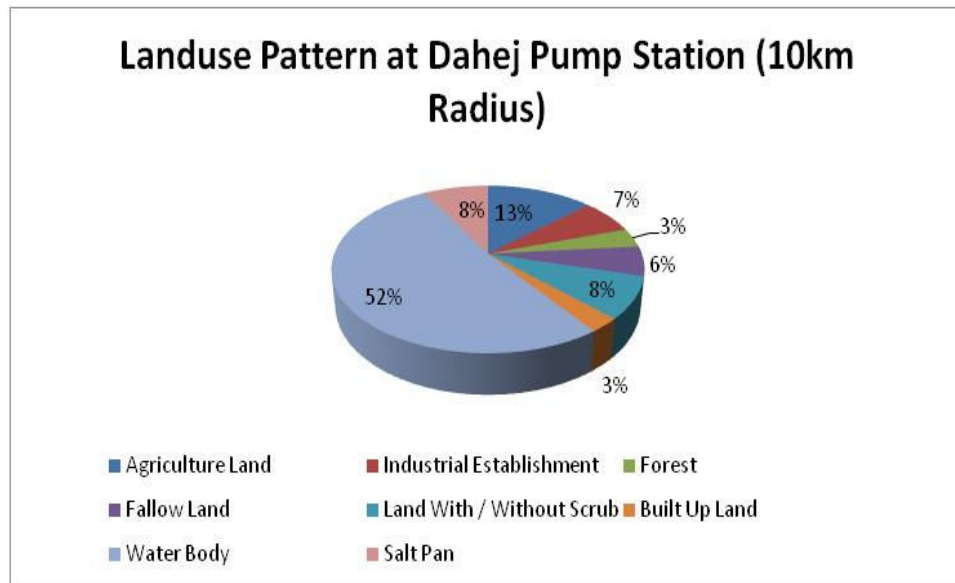


Figure E.3: Landuse Pattern at Dahej Pump Station

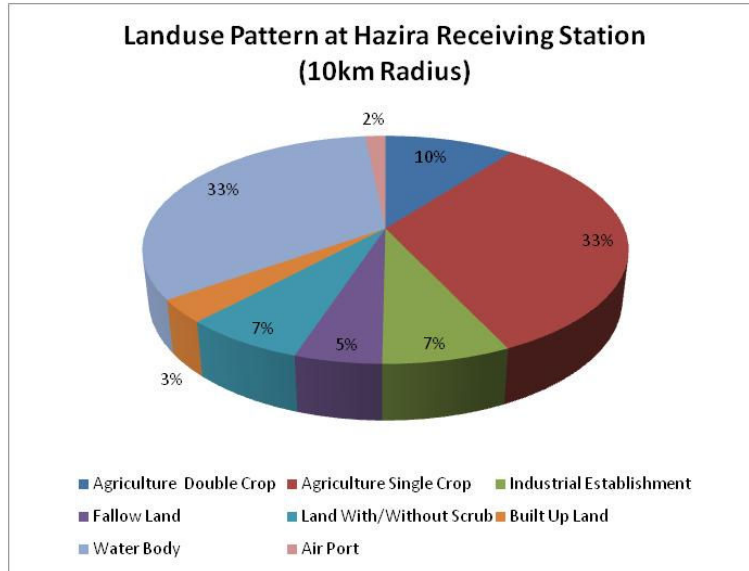


Figure E.4: Landuse Pattern at Hazira Receiving Station

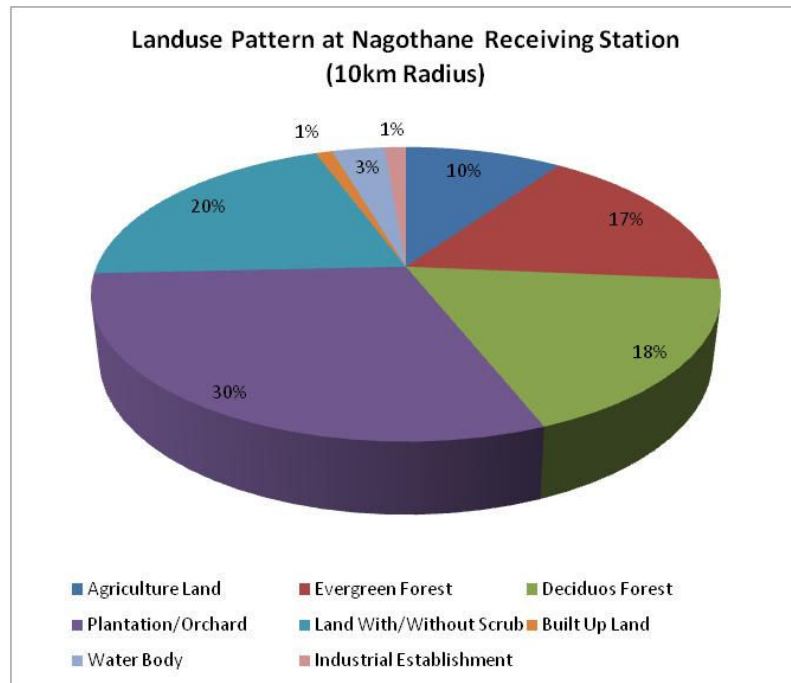


Figure E.5: Landuse Pattern at Nagothane Receiving Station

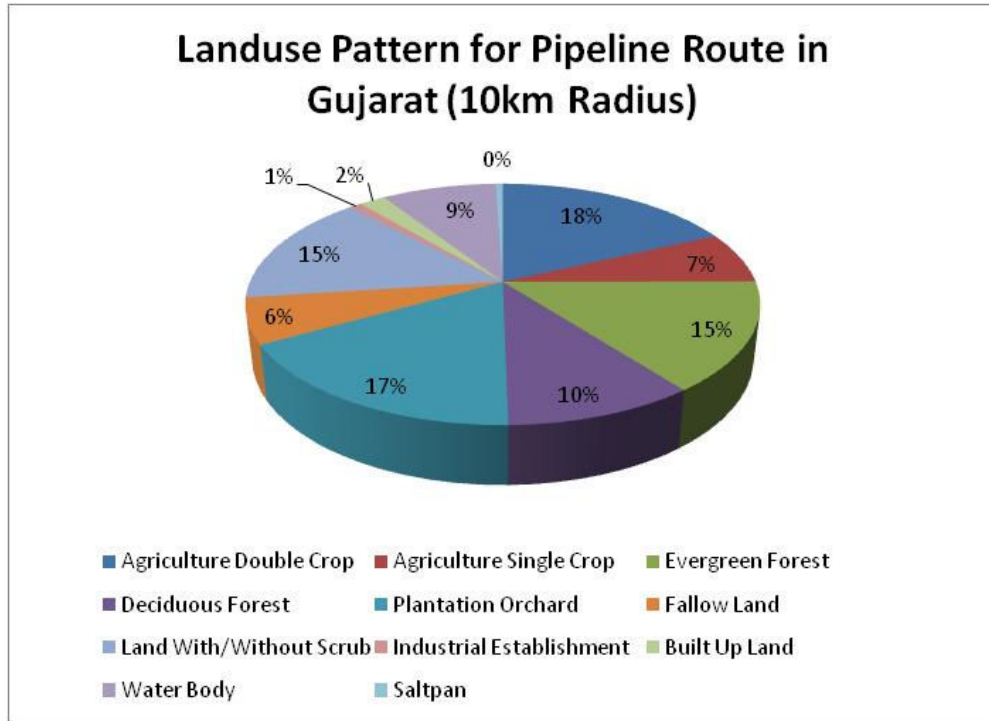


Figure E.6: Landuse Pattern for Proposed Pipeline in Gujarat

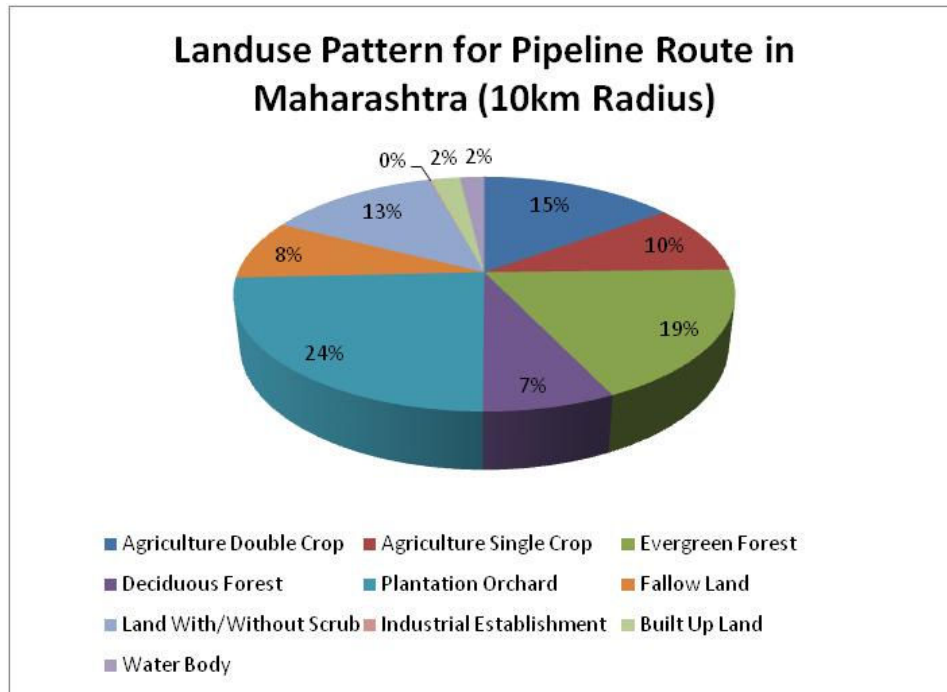


Figure E.7: Landuse Pattern for Proposed Pipeline in Gujarat

6.8 Biodiversity

The entire stretch covering Gujarat & Maharashtra is inherently rich in biodiversity. However, pipeline route avoids traversing through protected areas to the extent possible.

- The route completely avoids the buffer zones of Matheran Eco Sensitive Zone as well as Karnala Bird Sanctuary.
- The pipeline route also avoids the villages notified under Western Ghats Eco-sensitive Zone.

Flora and Fauna Studies

Floristic studies were conducted and also data studied from secondary sources to know the presence of endangered/threatened/ endemic plant species in proposed pipeline route. Based on the study carried out it was observed that around 146 species of trees, 63 species of Shrubs / Herbs, 36 Grass and 7 species of Mangroves are reported from the study area.

Out of 146 species of trees identified 4 species are having medicinal values, out of 63 species of shrubs including herbs 4 shrubs are having medicinal importance and 2 are endemic in nature. And out of 36 species of grasses identified in the study area 2 are endemic and one species is critically endangered.

Faunal studies reveal that there are 3 species of Mammals falling under schedule – II, 2 species under schedule-III, 1 species under schedule IV and 2 species under schedule V.

Among Aves, 29 species identified in project area falls under schedule IV and only one species i.e. Pavo cristatus falls under schedule – I which is endangered. Among reptiles, 4 species fall under schedule –II and 1 species under schedule IV.

6.9 Socio-Economics

The socio-economic status of the route was assessed through primary field surveys and through secondary data collected from census and other government sources. The socio-economics of the area was assessed for 450 villages falling within the 500m on either side of the pipeline and 10-km radius around the DMD, HMD and NMD. The socio-economics of the area was assessed for the employment, education, healthcare and other factors that affect the quality of life in the region.

A detailed socio-economic study has been carried out and is briefed below:

- Total no. of villages along the pipeline route in 500-m on either side are 450;
- Total number of households in study area is 6,48,844 with population of 27,72,431;
- The village has only 8.64% of scheduled caste population and 15.72% scheduled tribe population;
- Male literacy and female literacy rates in the study area are 54.57% and 45.43% respectively;
- The work participation rate in the village is found to be 35.4% with 4.3% marginal workers and 60.24% non-workers.
- Proposed project passes through 16 villages of Dahanu Taluka for a length of 26km.

7.0 IMPACT ASSESSMENT

7.1 Impact on Landuse

Construction Phase

Major section of the proposed pipeline is laid within the existing corridor/Right of User (RoU) of East West Gas Pipeline of RGTIL and Hazira Dahej Pipeline of RIL. Thus, there is no land use change for most of the length. For the new stretch of 89 km, where fresh RoU of 18 m width is acquired will be restored to near original conditions after pipeline construction activities are completed. Hence, the impact on land use is temporary.

Operation Phase

As the pipeline is buried underground, there is no disturbance to land during operation and maintenance of pipeline, impact on landuse is not envisaged during operation phase.

7.2 Impact on Soil vis-à-vis Solid Waste

Construction Phase

The impact on the soil along the pipeline corridor will be temporary as the excavated earth will be preserved and used for backfilling. All efforts will be made to restore the land to near original conditions. Top soil will be preserved during the excavation for laying of the pipeline. This soil cover will be restored after laying of the pipeline. Hence, no impact is envisaged on the top soil cover all along the pipeline alignment.

During construction, solid waste generated will include packaging and wrapping material, stubs of spent welding electrodes, used rags and housekeeping waste from the construction camps etc. which will be disposed off at Municipality or Local Body approved sites.

- Spent drilling mud (generated during Horizontal Directional Drilling activities for laying the pipeline below sensitive areas) is unlikely to be hazardous. However, prior to being disposed, the mud will be tested for its hazardous nature and disposed at nearest TSDF site accordingly.

Operation Phase

The solid waste generated during operation is restricted to maintenance which is in small quantities. The following wastes are generated during operations.

- Spent oils and other lubricants from equipment will be collected in enclosed container before disposing off to CPCB/ SPCB approved recyclers.
- Oily sludge, hydrocarbons and other wastes generated during pigging operations. However, considering the frequency of Pigging operations, the impact is temporary and insignificant.

Disposal of Hazardous Waste will be in compliance with the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules.

7.3 Impact on Air Quality

Construction Phase

During construction phase, dust will be the main pollutant, which would be generated from vehicular traffic, site clearing and construction activity, emissions from vehicles bringing materials to the site and from construction equipment and dust from

excavation of the area in the Right of Use (RoU) for laying pipeline. Dust emissions will be mitigated by minimising the period between clearing and restoration and limiting vehicle speeds on access tracks and easement.

Operation Phase

The impact on air quality during pipeline operation phase is negligible. Dust generation is likely from light motor vehicles and activities associated with the maintenance and monitoring of the pipeline which will be controlled by water sprinkling. Exhaust Emission from DG sets (emergency) will be complying the CPCB norms.

7.4 Impact on Noise Levels

Construction Phase

The noise generated during construction may have impact on the existing ambient noise levels temporarily. The major work will be carried out during the daytime. The construction equipment may generate high noise levels, which can affect the personnel operating the machines. Use of proper personal protective equipment will mitigate any adverse impact of the noise generated by such equipment. However, noise generation is temporary and is restricted only to construction phase.

Operation Phase

There may be marginal increase in noise levels in the immediate vicinity of the Pump Station. Such marginal increase in the resultant noise levels would not alter the noise environment significantly and the noise levels beyond the pumping station boundary would be below the permissible limits. Also use of proper personal protective equipment will mitigate any adverse impact of the noise generated by such equipment.

7.5 Impact on Hydrology

Construction Phase

Water requirement during construction phase is about 491KLD and is restricted to construction activities of about 9-11 months. Water requirement during construction phase will be met through local sources. Hence, the impact on groundwater table due to proposed project is negligible.

The proposed pipeline is passing through several water bodies (Rivers, Nallahs etc.). There are 9 nos. of tidally influenced water bodies across the proposed pipeline. Horizontal Directional Drilling (HDD) or an equivalent method will be used for laying the pipeline across major river crossings and CRZ crossings to avoid disturbance to aquatic ecology. Hence, the impact on aquatic environment is insignificant.

Operation Phase

During the operational phase, a small quantity of effluent will be generated mainly from the floor wash at the pumping station and it will be passed through oily water separator and disposed off to sewage drains. Separated Oil will be collected and disposed off to authorized recyclers. The domestic wastewater will be routed to septic tanks and soak pits.

As the project activity does not propose to dispose off hazardous or toxic material, which could leach down to water table, the impact on the ground water quality is not envisaged during the construction and operational phases of the project.

7.6 Impact on Ecology

Construction

The route passes through reserve/protected forests for a length of about 30-km. The forest blocks and water bodies through which the pipeline alignment is passing are Dahanu Eco-fragile area, Dahej RF, Ganapatpura RF, Morbe Reservoir and Kurze Reservoir.

There will be slight disturbance to ecosystem such as flora and fauna in the proximity of pipeline during construction phase. Hence, the impact is temporary and reversible.

There is no Wildlife Sanctuary, National Park, Biosphere Reserve or Wildlife Corridor within 10 km radius of the proposed pipeline.

Major section of the proposed pipeline will be laid within the existing Right of Use (RoU) of East West Gas Pipeline of RGTIL and Hazira Dahej Pipeline of RIL. Therefore no tree cutting in these areas is envisaged except for clearing of bushes. Where new RoU is being acquired, in forest and non-forest lands, tree cutting will be undertaken with due permission from agencies having jurisdiction. Compensatory Afforestation will be carried out for the equivalent forest land being diverted for non-forest use. There will not be any impact on Dahanu Taluka as the pipeline will be laid within existing RoU.

Operation Phase

After the construction is completed, the whole area will be reinstated to its near original conditions. There is no impact on ecosystem is envisaged during operation phase of the pipeline.

7.7 Demography and Socio-Economics

Construction & Operation Phase

Local manpower resources will be employed during construction phase to the extent they are found technically suitable. Hence, the impact is positive.

7.8 Analysis of Alternatives (Technology and Site)

Route engineering study was undertaken for assessment of possible alternate routes to finalize optimal pipeline route. Total of 2 possible pipeline routes were identified and analyzed.

The present route has been selected after thorough review, analysis based on the following criteria:

- i. Minimum area through reserved and protected forest.
- ii. It crosses minimum number of rivers.
- iii. It completely avoids the buffer zones of sanctuaries and national parks in the area.

8.0 ENVIRONMENT MANAGEMENT PLAN

The Environmental Management Plan (EMP) includes both generic good practice measures and site specific measures, the implementation of which is aimed at mitigating potential adverse impacts associated with the proposed activities. EMP describes the measures for minimizing impacts that are likely to arise during different phases of the project such as pre-construction, construction and operation.

Table E.9: Environmental Management Plan

Sr. No.	EMP Code	Potential Impact	Action	Parameters for Monitoring	Timing
1.	EMP 1	Route Finalization and Land Acquisition	It will be ensured that all necessary protocols are followed and legal requirements implemented.	Check list of legal documents and legal compliance registers / documents.	Pre-deployment of topographic survey team or site clearance crew.
				During finalization of route among various feasible options, specific attention will be given to guidelines / requirements / recommendation of SPCB, DOE – State Government, Forest Conservation Act and Rules.	
2.	EMP 2	Soil Erosion	Area extent of site clearance will be minimized by staying within the defined boundaries.	Site boundaries not extended / breached.	Prior to onset of site clearance.
			Topsoil stockpile will be protected wherever possible at edge of site.	Effective cover in place.	Duration of program until demobilization.
3.	EMP 3	Habitat disturbance of flora and fauna	Site boundaries will be marked.	Clear boundaries marks in place.	Prior to commencement of site clearance.
			For cleared area, topsoil will be retained in stockpile where possible on perimeter of site for subsequent re-spreading onsite during restoration.	Topsoil stockpile in place on site edge.	Duration of program until demobilization.
			All bulldozer operators involved in site preparation will be trained to observe the defined site boundaries.	Maintenance of integrity of boundary markers.	Duration of site preparation.

Sr. No.	EMP Code	Potential Impact	Action	Parameters for Monitoring	Timing
			Riverine areas will be protected whenever there are crossings.	To avoid any type of contamination/ discharge in river water.	At time of laying pipeline across rivers.
4.	EMP 4	Drainage and Effluent Management	Ensure drainage system and specific design measures are working effectively.	Design of pipeline facilities to incorporate existing drainage pattern and avoid disturbing the same.	Duration of program.
			Domestic wastewater (sewage) will be disposed off through septic tank/soak pit system adhering to the State Pollution Control Board (SPCB) norms.	SPCB norms	
			Wastewater generated if any, will be treated as per SPCB norms before disposal.	SPCB norms	
5.	EMP 5	Fuels and Lubricants Management	Strict inventory of all fuels and lubricants brought to the site will be maintained.	Up-to-date inventory in place.	Duration of program
			All fuels and lubricants will be placed in controlled storage.	Integrity of storage area	Duration of program
			All used and unused lubricants no longer required, will be transported offsite. Used lubricants will be sent to authorized re-processors.	Low inventory (or absence) of used / unused lubricants no longer required onsite.	Duration of program
			Re-fuelling operations will be undertaken over area with impervious flooring and surface drainage with oil interceptor.	Facilities installed	Duration of program

Sr. No.	EMP Code	Potential Impact	Action	Parameters for Monitoring	Timing
6.	EMP 6	Waste Management	Waste management plan will be implemented that identifies and characterizes every waste arising from the proposed activities and also identifies the procedures for collection, handling and disposal of each waste. Major wastes identified include (but may not be limited to) waste oils, pipe joint coating and cleaning materials, miscellaneous scrap, waste oil and sewage.	Comprehensive Waste Management Plan in place and available for inspection on-site. Hazardous waste disposal records.	Prior to site clearance.
				Solid waste is to be disposed off by sanitary land filling method at a site approved by the State Pollution Control Board.	Duration of program
7.	EMP 7	Site Contamination	Installation of impervious liners in place for: fuel, lubricants and wastes generated during pipeline construction.	Evidence of protective measures in place	Daily throughout the duration of program
8.	EMP 8	Water consumption and disposal and related impacts	Water consumption will be optimized and water reuse will be attempted.	Quantity of water consumed and wastewater generated	Construction and commissioning of pipelines
			No untreated discharge will be made to watercourse, ground water or soil.	No discharge hoses in vicinity of watercourses.	Duration of program with particular emphasis during site layout design and site construction.
			Wastewater generated will be treated to SPCB norms before disposal.	SPCB norms	Project program
9.	EMP 9	Noise and Vibration	List of all noise generating machinery onsite along with age will be maintained.	Equipment maintained in good working order.	Written record of maintenance for all equipment.

Sr. No.	EMP Code	Potential Impact	Action	Parameters for Monitoring	Timing
			List of age of all plant deployed under contract will be recorded.	Prior to commencement of work by contractors.	Written record of maintenance for all equipment.
			Generation of vehicular noise will be minimized.	Maintenance records of vehicles	program duration
			Good working practices (equipment selection and siting) will be implemented to minimize noise and also reduce its impacts on human health (ear mugs, safe distances and enclosures).	No machinery running when not required.	Duration of program
			Acoustic mufflers / enclosures for DG sets)	Mufflers / enclosures in place.	
10.	EMP 10	Air Emissions	All equipment will be operated within specified design parameters. (Construction and operational phases for all activities).	Proper maintenance of equipment to minimize the emissions	Duration of program
			Vehicle trips will be minimized to the extent possible.	Vehicle logs	
			Any dry, dusty materials (chemicals, etc.) will be stored in sealed containers.	Absence of stockpiles or open containers of dusty materials.	
			Dust suppression during pipeline laying and other construction activities with water sprinkling.	Construction logs	Construction activities, laying of pipelines
			DG sets will be provided with adequate stack height.	Stack monitoring	
			Diesel shall be utilized as a fuel in the DG Sets.	Quantity of fuel consumption	Duration of program

Sr. No.	EMP Code	Potential Impact	Action	Parameters for Monitoring	Timing
11.	EMP 11	River Hydraulics	Construction shall be expedited and use of equipment and mainline construction activities within rivers shall be limited to minimum.	Comprehensive Management Plan in place	Construction activities and laying of pipelines
			River crossings will be constructed as perpendicular to the axis of the river as far as practicable.		
			All material and structures related to construction shall be cleared from the river and it's vicinity after construction.		
			The mud and drilling fluids generated during the drilling operations shall be disposed-off in an approved manner.		
			Spill prevention and control measures shall be taken. No storage of oil or lubricants shall be located near river or drains feeding the rivers.		
12.	EMP 12	Non-routine events and accidental releases.	Emergency Response Plan will be drawn up.	The provisions of the Emergency Response Plan will be monitored.	program duration
			Utmost care will be taken in patrolling pipelines and ensuring prompt detection of leaks.	Pipeline monitoring records	program duration
13.	EMP 13	Emergency preparedness, such as fire fighting	Fire protection and safety measures to take care of fire and explosion hazards, will be assessed and steps taken for their prevention.	Mock drill records, on site emergency plan, evacuation plan	During operation phase

Sr. No.	EMP Code	Potential Impact	Action	Parameters for Monitoring	Timing
14.	EMP 14	Environmental Management Unit/Cell	The Environmental Management Cell/Unit will be set up to ensure implementation and monitoring of environmental safeguards and other conditions stipulated by statutory authorities.	A Letter from management indicating formation of Environment Management Cell	Duration of program

Table E.10: Location Specific EMPs

Sr. No.	Major Crossing	Environmental Concern	Relevant EMP Code
1	Water crossings	• Impact on aquatic flora and fauna	EMP 1, EMP 3, EMP 6, EMP 8, EMP 11 and EMP 12
2	Railway and Road crossings	• Impact on noise levels • Impact on air emissions	EMP 1, EMP 4, EMP 6, EMP 7, EMP 8, EMP 9 and EMP 10
3	Forest Area	• Impact on noise levels • Impact on air emissions • Impact on flora and fauna	EMP 1, EMP 2, EMP 3, EMP 4, EMP 6, EMP 7, EMP 8, EMP 9 and EMP 10
4	Agriculture land	• Impact on land • Impact on flora and fauna	EMP 1, EMP 2, EMP 4, EMP 6 and EMP 8

9.0 ENVIRONMENTAL MONITORING PROGRAM

The monitoring plans for environmental quality assessment during the different phases of the project are given in **Table E.11**. There would be an Environment Monitoring and Management Cell headed by a Director (Construction and Operations)-Pipelines to oversee the Environmental Monitoring and Management programs.

Table E.11: Environmental Monitoring Plan

	Monitoring Parameter		Location	Frequency
A	Pre-construction Phase			
1	Soil Fertility	Fertility parameters like pH, NPK ratio, Total Carbon	RoU, labor camp and material laydown area	Once during pre-construction stage
B	Construction Phase			
1	Ambient Air Quality	Measurement of PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO, HC.	Along the pipeline route	Seasonally
2	Ambient noise quality	Measurement of Noise Levels	Along the pipeline route	Seasonally
3	Groundwater	Analysis of Parameters	Water sourcing areas	Seasonally

	Monitoring Parameter		Location	Frequency
	Quality	as per IS standards		
4	Hydrotest water quality	pH, DO, TSS, Residual Free Chlorine	Hydrotest water storage	During hydrotesting
5	Soil Fertility	Fertility parameters like pH, NPK ratio, Total Carbon.	RoU , labor camp and material laydown area	Seasonally
C	Operational Phase			
1	Ambient Air Quality	Measurement of PM ₁₀ , PM _{2.5} , SO _x , NO _x , CO, etc.	At the pumping and Delivery Stations	Seasonally
2	Ambient Noise Quality	Measurement of Noise Levels	At the pumping and Delivery Stations	Seasonally
3	Ground Water Quality	Analysis of Parameters as per Indian standards	At the pumping and Delivery Stations	Seasonally
4	Soil Fertility	Fertility parameters like pH, NPK ratio, Total Carbon.	RoU , labor camp and material laydown area	Seasonally

9.1 Capital Investment for Environmental Management

The capital cost investment for laying the proposed Dahej Nagothane Ethane Pipeline Project is estimated to be Rs. 1428 Crores. Adequate budget has been allocated for pollution control, treatment and environment monitoring systems.

10.0 RISK ASSESSMENT

The objective of the Risk Assessment is to identify and assess the hazards associated with Dahej - Nagothane Ethane Pipeline Project in accordance with the following steps:

- Identify hazardous events.
- Determine the consequence of events;
- Determine the frequency of hazardous releases from process piping, equipment etc.
- Determine the risk to facility, personnel and surrounding population from such releases;
- Determine the risk to environment;
- Determine the Residual Individual and Societal Risk.
- Verify whether the assessed risks are acceptable on the basis of international risk criteria and, when needed, suggest risk reduction measures.

Composition (mole %) of Ethane envisaged to be imported is as under:

Liquid Ethane composition details	
Components	Volume in Mole (%)
Ethane	99.5
Methane	0.5

Other vital properties of Ethane are listed below:

Critical Pressure : 48.8 bar
Critical Temperature : 32.2 °C

The analysis is based on DNV's software modelling tool 'PHAST'. The outputs from PHAST in combination with Person in facility data is further analysed to determine Individual Risk (IR), and Societal Risk (SR).

The Qualitative Risk Assessment has been performed on 10 typical scenarios, selected, after review of the facility. The scenario selection is done precisely, so that the results of QRA are representative for all the critical areas & sections of the proposed pipeline.

All the scenarios are modeled using the initial (peak) flow rate of the release which is appropriate for immediate fatalities. All the scenarios are modeled as outdoors releases. Modeling of the following is detailed in this section.

- Flash fires;
- Jet fires;
- Vapour Cloud Explosions.

The scenarios are defined based on four different release sizes for process leaks:

- 5 mm;
- 25 mm;
- 100 mm;
- 150 mm (FBR).

For consequence modeling purpose, 1.5F and 5D weather conditions are modeled, the details of these conditions are as below;

- 1.5F: 1.5 m/s wind speed, Stable-night with moderate cloud and light/moderate wind;
- 5D: 5 m/s wind speed, Neutral – Little sun and high wind or overcast/windy night;

A brief overview of the study is as below:

1. The maximum overall risk to the DNEPL pipeline facility is found to be 1.0×10^{-5} / year which is in Acceptable region as per HSE UK risk acceptance criteria.
2. The societal risk for the overall DNEPL pipeline facility is observed to be in acceptable region as per HSE Risk acceptance criteria.
3. There is no impact of thermal radiation on adjacent buried pipelines due to adequate soil cover and separation distance between the pipelines.
4. The pipeline traverses through 16 villages of Dahanu Taluka. The number of dwellings in the vicinity of the pipeline is very less and the overall risk is within the acceptable region.

Based on the QRA study, it is found that there are no specific areas of process safety concern in the facility.

11.0 DISASTER MANAGEMENT PLAN

To tackle the consequences of a major emergency related to pipeline project, a Disaster Management Plan is to be formulated and this planned emergency document is called "Disaster Management Plan".

Following are the key elements of Disaster Management Plan, proposed by RGPL.

- Basis of the plan
- Accident prevention procedures/measures
- Accident/emergency response planning procedures
- Recovery procedure
- On-site & Off-site Crisis Management, Communication, Contact Information etc.

To tackle the consequences of a major emergency inside the pumping/ delivery station or immediate vicinity of the pumping/ delivery station, a comprehensive Disaster Management Plan has been formulated and this planned emergency document is called "Disaster Management Plan". On-site Emergency action plan consists of:

- First information;
- Responsibilities of Work Incident Controller;
- Responsibilities of Chief Incident Controller;
- Responsibilities for Declaration of Emergency;
- Responsibilities for Emergency Communication Officer;
- Responsibilities of key personnel;
- Responsibilities and action to be taken by essential staff and various teams during emergency; and
- Responsibilities for All Clear Signal.

Off-site Emergency Plan follows the On-site Emergency Plan. When the consequences of an emergency situation go beyond the plant boundaries, it becomes an off-site emergency. Off-site emergency is essentially the responsibility of the public administration. However, the PCIL management has plans to provide the public administration with the technical information relating to the nature, quantum and probable consequences.

A 3-tire Emergency Response Team will be established by RGPL to deal with the emergencies effectively.

12.0 OCCUPATIONAL SAFETY & HEALTH

Health and safety management planning to demonstrate that a systematic and structured approach to managing health and safety will be adopted and that controls are in place to reduce risks to as low as reasonably practical; that staff are adequately trained; and that equipment is maintained in a safe condition. The formation of a health and safety committee for the facility is recommended.

A formal Permit to Work (PTW) system will be developed for the facilities. The PTW will ensure that all potentially hazardous work is carried out safely and ensures effective authorization of designated work, effective communication of the work to be carried out including hazards involved, and safe isolation procedures to be followed before commencing work.

13.0 PROJECT BENEFITS

The proposed ethane pipeline project has the following benefits:

- The pipeline, during project and continuous operation phase will generate direct and in-direct employment as there shall be requirement of unskilled and skilled workers in site activities, supply of raw material, auxiliary and ancillary works, which would improve the economic status of the people in area.

- The project would help in increasing skills levels of personnel through exposure to site activities and state of the art technology and Corporate Social Responsibility (CSR) activities taken up by Reliance.
- The benefits of reduction in energy consumption due to pipeline mode of transportation of ethane and reduced transportation losses.
- Pipeline mode is the safest and reliable mode of transportation. Transit losses are the lowest in pipeline transportation. Pipelines can traverse highly difficult terrains where other modes of transport seem difficult. Vagaries of nature like floods, storm etc. do not disturb pipeline operations system.
- Pipeline being underground, provide no direct contact with the general public there by reducing its hazardous impact as well as providing better overall security. The pipeline system can't be easily damaged by weather or affected by weather conditions. The pipeline connectivity also improves the availability of the highway / railways for transporting other materials / goods as it helps in eliminating the movement of tankers resulting in de-congestion of roads and reducing noise and air pollution.

14.0 CONCLUSIONS

There will be a beneficial effect from pipeline project that will ensure long term, safe reliable and uninterrupted supply of feed to manufacturing plants 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 RGPL will have insignificant impact on environment.