

# Environmental and Social Due Diligence Report

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Project Number: 47083-004  
January 2022

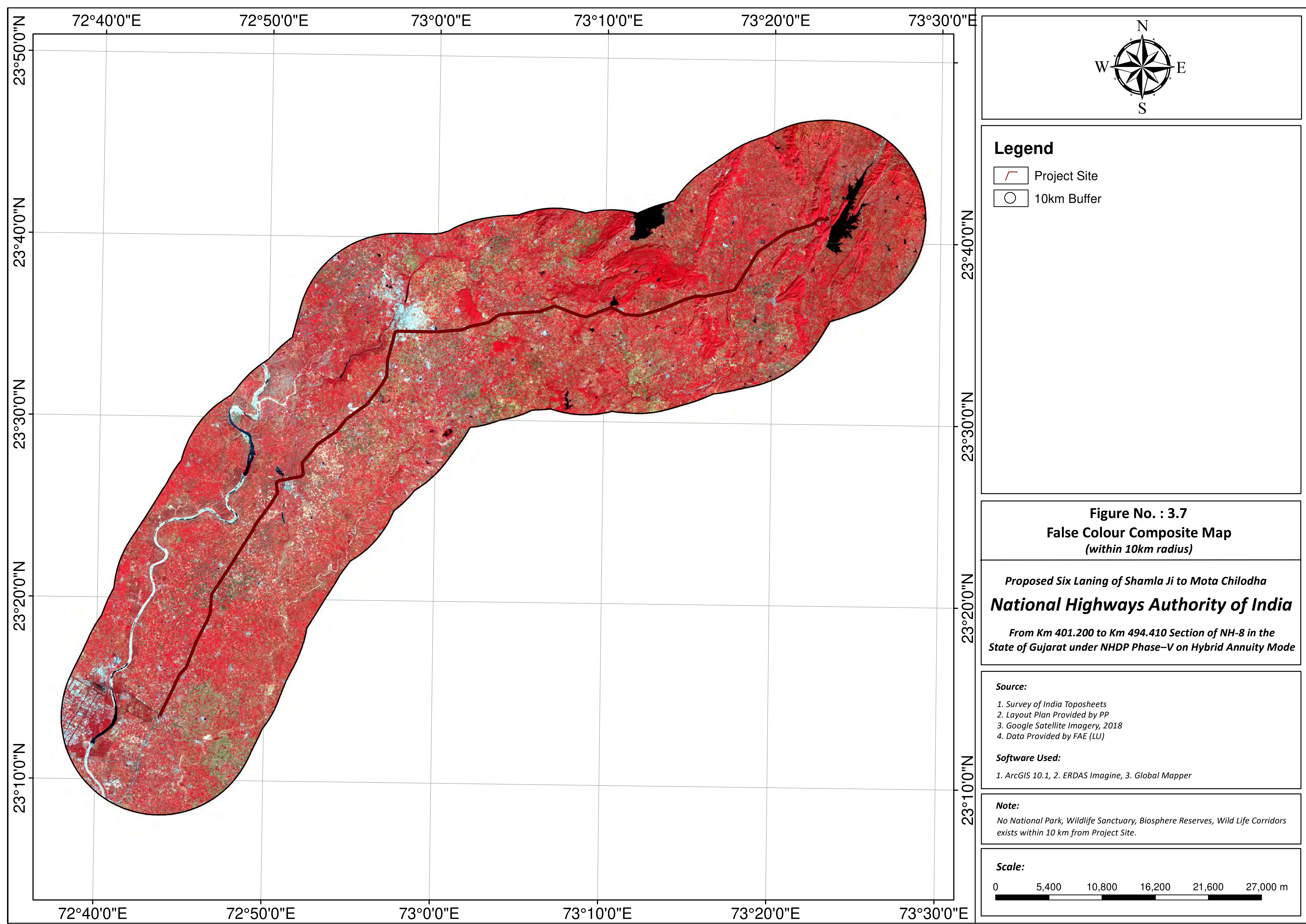
## INDIA: Accelerating Infrastructure Investment Facility in India – Tranche 3 Shamlaji Expressway Private Limited (Part 5 of 34)

Prepared by India Infrastructure Finance Company Limited for the India Infrastructure Finance Company Limited and the Asian Development Bank.

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## D. NIMAR SANDSTONE

These occur SE of Pavagadh hill and were used in the construction of the Champaner Fort at the foot of Pavagadh. The rocks are Pinkish sandstone with Jasper pebbles associated with ferruginous conglomeratic beds containing pebbles of quartz and chalcedony. Contour map and Slope / Elevation map of the study area are shown as **Figure 3.4** and **Figure 3.5**.

## 3.8. LAND-USE DETAILS

The objective of assessing the land use details of the area is to know the existing land use pattern of the area and to know about the land that can be used for the proposed development activities in the study area. It also enables to envisage the scenario emerging due to the increase in demand for land with increase in population and the impacts arising due to the interface with various project activities.

**Methodology:** The land use / land cover map is prepared by adopting the interpretation techniques of the satellite image in combination with collateral data such as Survey of India topographical maps and census records. Image classification has been done by using visual interpretation techniques and digital classification using the image processing software's. The various activities for preparation of Land-use (LU)/Land cover (LC) include pre-processing, rectification, enhancements and classifying the satellite data for assessing the change in LU/LC due to proposed developmental activities. The imagery is interpreted, and ground verification was done for corrections. The final map is prepared after ground truthing of the study area. The different land use/land cover categories in the study area has been carried out based on the NRSC land use / land cover classification system.

**Interpretation Technique:** Standard on screen visual interpretation procedure was followed. The various Land use / Land cover classes interpreted along with the Survey of India topographical maps during the initial rapid reconnaissance of the study area. The physiognomic expressions conceived by image elements of Color, tone, texture, size, shape, pattern, shadow, location and associated features are used to interpret the FCC imagery. Image interpretation keys were developed for each of the LU/LC classes in terms of image elements.

FCC imagery (Digital data) of April 2017 was used for interpretation for the relevant land use classes. On screen visual interpretation coupled with supervised image classification techniques are used to prepare the land use classification.

- Digitisation of the study area (10 km radius from the plant site) from the Survey of India Toposheet maps.
- Satellite Data Selection: In the present study the Landsat satellite image with Toposheet no. F43A10, F43A11, F43A12, F43A14, F43A15, F43A16, F43B1, F43B2, F43B3, F43B5, F43B6, F43B7, F43B9, F43B10 have been procured and interpreted using the ERDAS imaging software adopting the necessary interpretation techniques.
- Satellite data interpretation and vectorization of the resulting units.
- Field checking and ground truth validation

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Composition of final LU/LC map

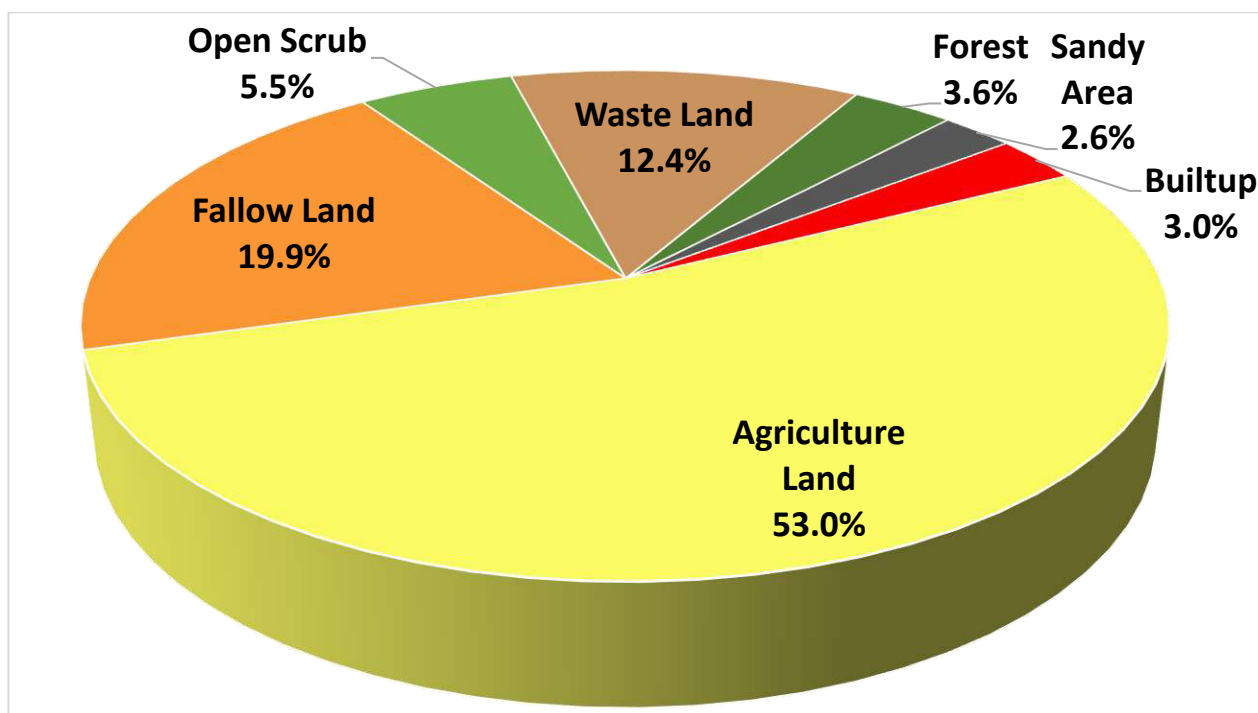
### 3.9. LAND-USE OF THE STUDY AREA

The 10.0 km land-use map is given in **Figure 3.6** with superimposed on FCC Imagery and shown as **Figure 3.7**. and pie-diagram of the study area is shown as **Figure 3.8**.

**Table 3-2: Land-use Classification of the Study Area**

S. No.	Land-use Classification	Area in Hectare	Area in %
1.	Forest	7945	3.6
2.	Sandy Area	5624	2.5
3.	Built-up	6556	3.0
4.	Agriculture Land	115414	52.3
5.	Fallow Land	43297	19.6
6.	Open Scrub	12026	5.5
7.	Waste Land	26993	12.2
8.	Waterbody	2761	1.3
<b>Total</b>		<b>220616</b>	<b>100.0</b>

Source: SOI Toposheet-F43A10, F43A11, F43A12, F43A14, F43A15, F43A16, F43B1, F43B2, F43B3, F43B5, F43B6, F43B7, F43B9, F43B10 and Satellite Imagery of Project Area, Landsat LISS-III Satellite Imagery, Google earth Inc., USA



**Figure 3.8 Pie-diagram of Study Area (10.0 km radius)**

Source: SOI Toposheet-F43A10, F43A11, F43A12, F43A14, F43A15, F43A16, F43B1, F43B2, F43B3, F43B5, F43B6, F43B7, F43B9, F43B10 and Satellite Imagery of Project Area, Landsat LISS-III Satellite Imagery, Google earth Inc., USA

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### 3.10. SOIL ENVIRONMENT

To assess the baseline status of soil quality in the study area for tree plantation, filtration/percolation of water, ground water scenario etc. total 3 soil samples were collected. The samples were collected by ramming an augur into the soil up to 30-cm depth. The sealed samples were sent to laboratory for analysis. Soil samples were analyzed as per the standard methods prescribed in “Soil Chemical Analysis” (M.L. Jackson, 1967). The soil quality as analyzed from the collected samples is given in **Table 3.3** and the locations are shown in **Figure 3.9**.

**Table 3-3: Soil Quality of the Study Area**

Parameters	Unit	Chiloda	Pantij	Shamlaji
<b>Location Code →</b>		<b>S-1</b>	<b>S-2</b>	<b>S-3</b>
<b>Coordinates →</b>		<b>23° 13' 34.7" N 72° 44' 05.0" E</b>	<b>23° 26' 46.7" N 72° 50' 50.5" E</b>	<b>23° 40' 53.2" N 73° 23' 33.1" E</b>
pH	----	7.42	8.01	7.59
Electrical Conductivity	µmhos /cm	369.2	482.1	615.2
Moisture	%	13.2	15.1	19.5
Soil texture	----	Sandy Loam	Sandy Loam	Sandy Clay Loam
Clay	%	13	15	21
Silt	%	23	29	13
Sand	%	64	56	66
Infiltration Rate	cm/hr	1.53	1.54	1.49
Bulk density	gm/cm <sup>3</sup>	1.47	1.46	1.51
Porosity	%	44.7	45.1	43.2
Nitrogen as N	kg/ha	169	158	187
Phosphorus as P	kg/ha	36	54	62
Potassium as K	kg/ha	117	132	127
Organic Carbon	%	0.19	0.27	0.50
Organic matter	%	0.32	0.46	0.87

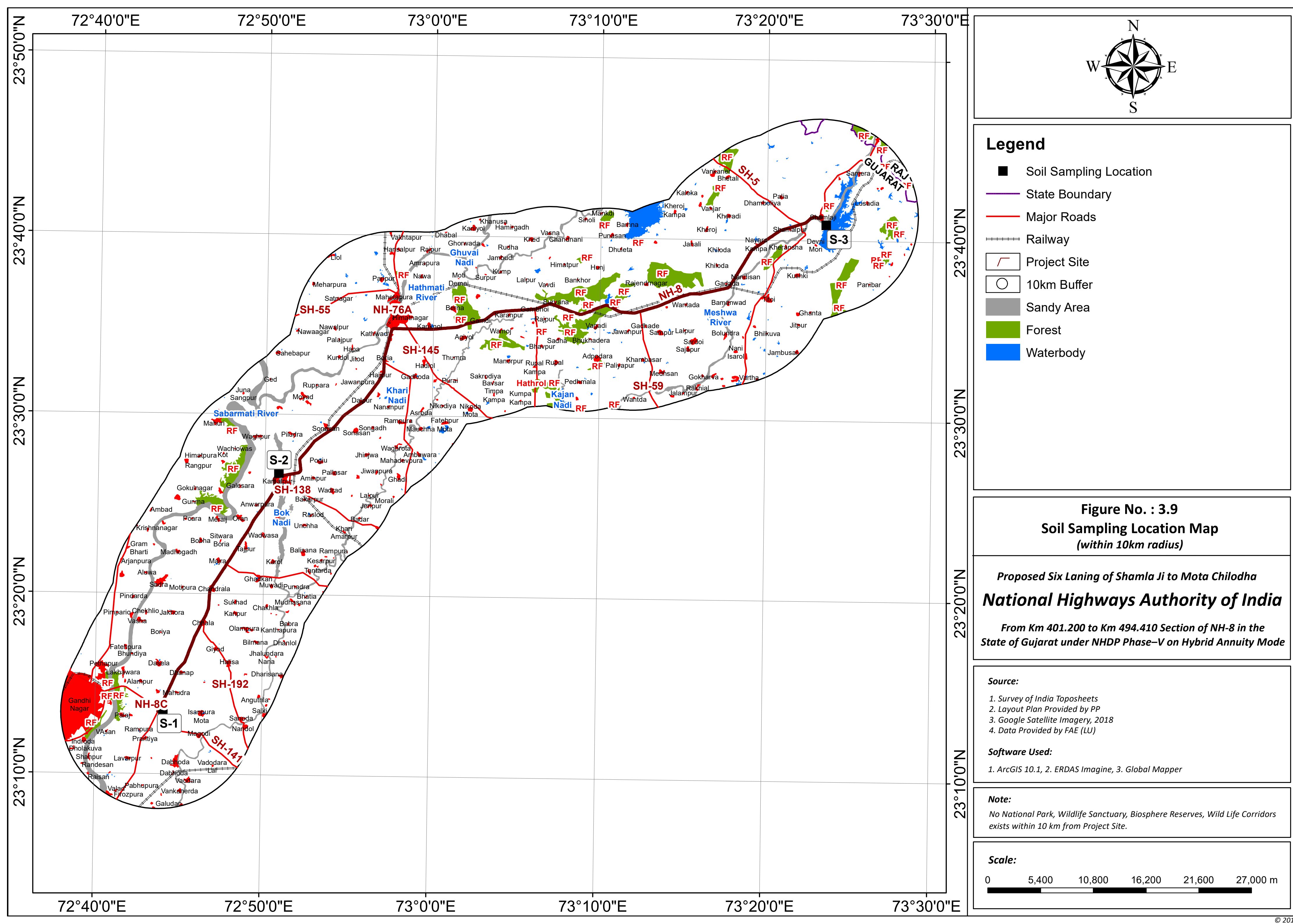
Source: Rajasthan Environmental Testing Lab, Bhiwadi Alwar

The samples were analysed as per the standard methods prescribed in Department of Agriculture & Cooperation Ministry of Agriculture, Government of India” & IS 2720. The important properties analysed for soil are bulk density, porosity, infiltration rate, pH and organic matter, kjehldal Nitrogen, Phosphorous and Potassium. The standard classification of soil and physico-chemical characteristics of the soils is presented below in **Table 3.4**.

**Table 3-4: Soil Standards**

Sl. No.	Soil Test	Classification
1.	pH	<4.5 Extremely acidic 4.51- 5.50 Very strongly acidic

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Sl. No.	Soil Test	Classification
		5.51-6.0 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (mmhos/cm) (1 ppm = 640 mmho/cm)	Upto 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon	Upto 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (Kg/ha)	Upto 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (Kg/ha)	Upto 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (Kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Handbook of Agriculture, Indian Council of Agriculture Research, New Delhi

**Observations:** The soil was Sandy Loam to Sandy Clay Loam in the study area. The pH was ranges 7.42 to 8.01 which was slightly alkaline to moderately alkaline as per ICAR guideline. The conductivity was varying from 369.2  $\mu$ mhos/cm to 615.2  $\mu$ mhos/cm in the study area which is meeting

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to average soil quality. The organic carbon of the study area was less to sufficient in term of fertility. Overall the soil quality was good having the good bulk density, porosity and infiltration rate. The land was good in term of fertility for leguminous plants.

### 3.11. WATER ENVIRONMENT

#### 3.11.1. HYDRO-GEOLOGY OF THE STUDY AREA

*The hydrogeology has been taken from the Technical Report Series, Ground Water, Brochure Gandhinagar District Gujarat Compiled by R. K. Verma, Assistant Hydrogeologist, Government of India Central Ground Water Board West Central Region Ahmedabad, March 2014 and Technical Report Series, Ground Water, Brochure Sabarkantha District Gujarat Compiled by K. M. Nayak, Assistant Hydrogeologist, Government of India Central Ground Water Board West Central Region Ahmedabad, April 2014.*

The district forms a part of Cambay basin and is occupied by quaternary alluvium comprising mainly of sand, gravel, silt clay and Kankar etc. The ONGC has established that the thickness of alluvium in the North Gujarat is about 700 m. However. As per the studies carried out by CGWB under UNDP Project the Miocene formations were encountered within 611 m at the deepest borehole drilled in the district at Sardhao. There is a sequence of alternating layers of granular sandy and clayey horizons, the uppermost granular zone varies in thickness from 5 to 65 m. it is underlain by a thick clay bed followed by alternating sequence of arenaceous and argillaceous horizons. The granular horizons occurring at various depths forms potential aquifers. The aquifer system of the district is described below. Aquifer System Geological survey of India during its studies had identified three confined aquifers within a depth of 600 m in the adjoining Mahesana district. These were designated as “A”, “B” and “C” aquifers. Subsequently, the studies carried out by CGWB under UNDP project, which also covered the northern part of Gandhinagar district, a multi-aquifer system was established. A total of 7 aquifers zones, each separated by aquiclude of varying thickness, were identified as “A”, “B”, “C”, “D”, “E”, “F” and “G”. Of these first five i.e. “A to E” represents Quaternary alluvium, whereas, last two i.e. “F & G” represents Miocene sediments. A brief discussion of these aquifers is given in table. The thickness of quaternary alluvium is limited in the eastern part and all the aquifers are not developed in this part. Moreover, identification of different aquifers also becomes very difficult in the eastern part due to limited thickness of aquiclude. However, the aquifer system is well developed in the western part. The aquifers in the entire district are the southward and eastward extension of those identified in the UNDP Project area.

The aquifer “A” in the district occurs as phreatic and semi-confined aquifer. The thickness varies from less than 25 m in the east to more than 80 m in the western part. Most of the dug wells and shallow tubewells tap this aquifer. However, over the years it has gone dry and at present occurs as saturated zone only near Sabarmati River and in the eastern parts of Dahegam & Gandhinagar Talukas. The aquifer “B” and “C” which occurs within a depth of about 225 m, are the most exploited aquifer in the

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district and most of the tubewells constructed tap these aquifers. Aquifer “D” is also being developed in some parts of the district particularly in Mansa and Kalol Talukas. The deeper aquifers, i.e., “E”, “F” and “G” are required to be properly explored and tested for future use. The depth of most prolific and most exploited aquifers in the district range from about 50 m to more than 300 m. The depth of tubewells gradually increases from east to west. The Dug-cum-bore wells and shallow tubewells (<100m) are feasible in the eastern part. However, in the western part only deep tubewells are feasible. The feasible depth of tube wells ranges from less than 100 m in the eastern part to more than 300 m in parts of Mansa Taluka. The tubewells tap all potential zones upto the depth constructed. The aquifers being tapped are “B and/or C” in major part of the district. However, aquifer “A” and “D” are also being developed either in isolation or in combination of other aquifers in the eastern and western parts respectively.

Geologically, Sabarkantha district is the manifestation of diverse geological extension from Lower Proterozoic to Holocene. The oldest formation in the area is Aravallis Supergroup comprises of various meta-sediments belongs to Lower Proterozoic. The rock types encountered in the area are sedimentary, meta-sedimentary, volcanic and metamorphic rocks. Among the different rock types, the rocks of Aravallis and Delhi Super group cover a large area in the northern and eastern part of the district. The regional stratigraphic is established by the Geological Survey of India is as follows. (Geological map of Sabarkantha district)

### THE ARAVALLI SUPERGROUP

The rocks of the Aravalli Supergroup occupy by mainly the eastern part of the district and are represented by the Goran and the Shamlaji Formation of the Jharol Group and Kadana formation of the Lunavada Group. These comprises of highly folded Phyllite, chlorite-mica schist, quartzite, garnetiferous mica schist, calc-amphibolite schist, feldspathic-mica schist and meta graysubwacke.

At places, serpentinite and talc-carbonate rocks of the Rakhabdev Ultramafic suite are seen. Around Vadali, Khedbrahma and Golwada many hills of Calc-gneisses trend north, north-east to south, south west. These are generally complicated in their formation and bending. General strikes are NNE-SSW and dip is steep. At places, gneisses are intruded by aplite veins. Crystalline dolomites occur as an intercalated sequence within the meta sediments and constitutes an important lithological unit. They have restricted occurrence at Bhanmer, Kendon valley and Jesangpur. Dolomitic limestone occurs as a narrow band within mica schist around Bamanwada and Sunak.

The quartzites are fine grained to medium grained and thin bedded. The quartzites occur as scattered isolated outcrops near Meru, Bhanmer and Kheradi. Mica schists, chlorite schist and biotite gneisses are exposed east of Golwada. Phyllites are thinly foliated and hard to friable.

### DELHI SUPERGROUP

The northern part of the district is mainly occupied by the rocks belonging to the Kelwara and Antalia Formation of Gogunda group and Todgarh Formation of the Kumbhargarh Group of the Delhi

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Supergroup. They comprise of quartzite, biotite schist, calc-biotite schist, phyllite, calc-gneiss, calc-schist, marble and biotite gneiss/migmatite.

The rocks belonging to Aravalli and Delhi Super groups are strongly deformed under atleast three phases of deformation. The regional trend of the beds and foliation vary from NNE – SSW to NE – SW with steep dips on either side. Epidiorite, hornblende schist, amphibolites, pyroxene granulite and gabbro of the Phulad Ophiolite suites are found north of the Songarh. The area in the north is intruded by the Sendra – Ambaji granite. Godhra granite (CA 955 Ma) is exposed in the central part, granite, quartz vein and quartz porphyry, quartz vein and dolerite belonging to the Malani Igneous suite are observed around Idar.

### **HIMMATNAGAR FORMATION**

Conglomerate, variegated sandstone, shale, clay stone, and chert belonging to the Himmatnagar formation of Mesozoic age are found in and around Himmatnagar. They are exposed up to Arsodia, in south they occur as scattered outcrop, especially near Wantra, Viravada etc on the hill top.

The conglomerate is not always seen at the base of the Himmatnagar formation. It is however well exposed in the river cuttings near Arsodia. The pebbles in the conglomerate are mostly of quartzites pebbles. Near Arsodia, between the basal conglomerate and Himmatnagar sandstone, there are several band of variegated clays. Sandstones are generally loosely aggregated, but at several places it is also compact. There are several bands of shale with in sandstones.

### **LAMETA FORMATION**

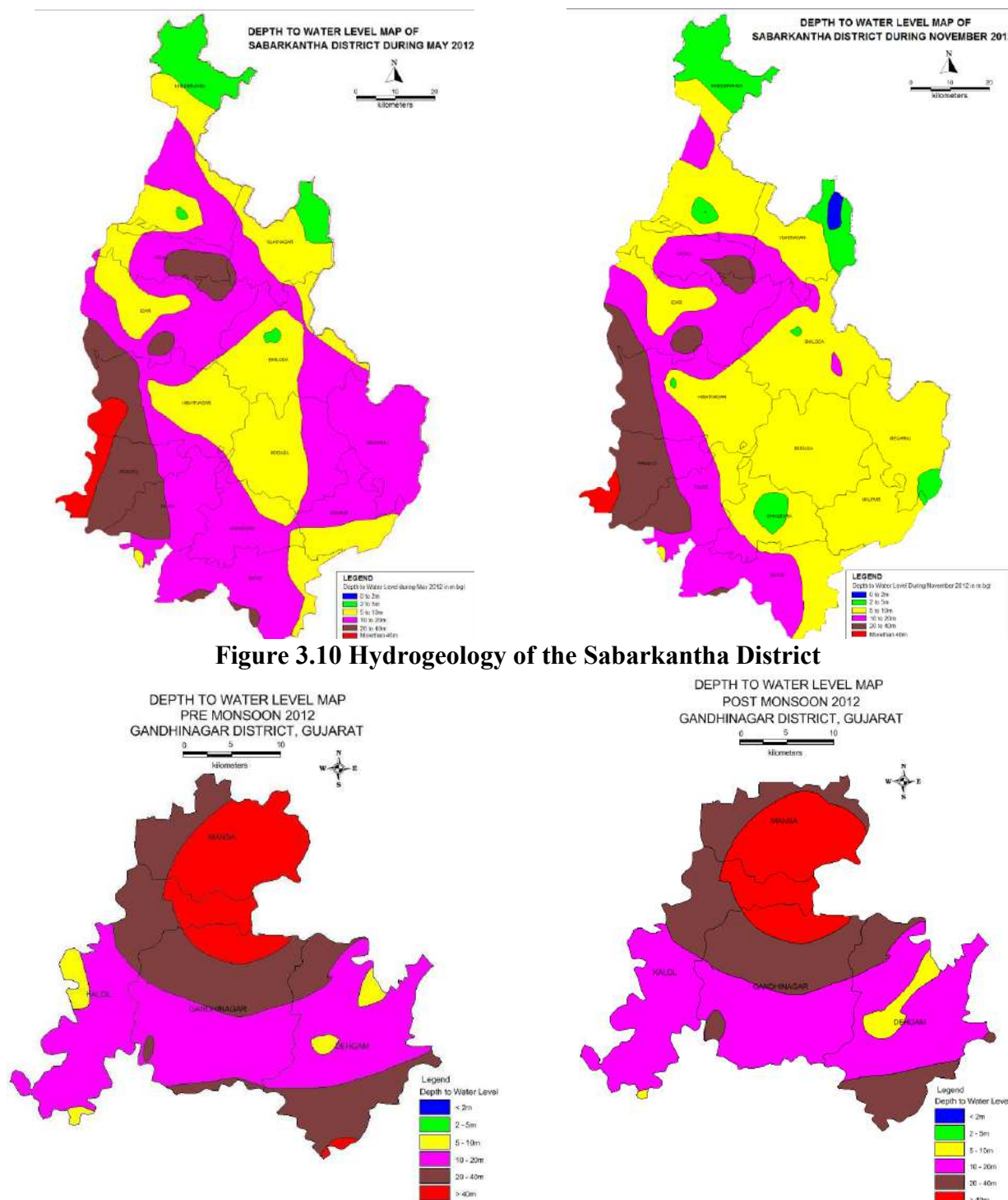
Lameta formation, consisting of variegated clay, banded chert and limestone of upper cretaceous age are seen in the southern and southeastern part of the district.

### **3.11.2. AQUIFER PARAMETERS**

During exploratory drilling in vindhyan limestone (upper Bhander limestone) are also not promising as in village Garhakota, a 58.3-meter-thick zone of Bhander limestone was encountered in the depth range of 18.7 to 77.0 mbgl. This was underlain by 107.70-meter-thick Ganurgarh shales followed by Rewa sandstone up to the drilled depth of 185 mbgl.

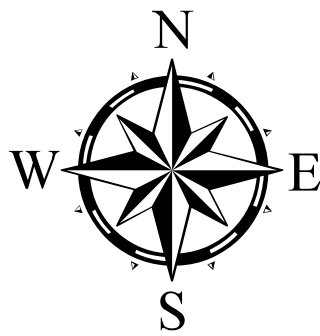
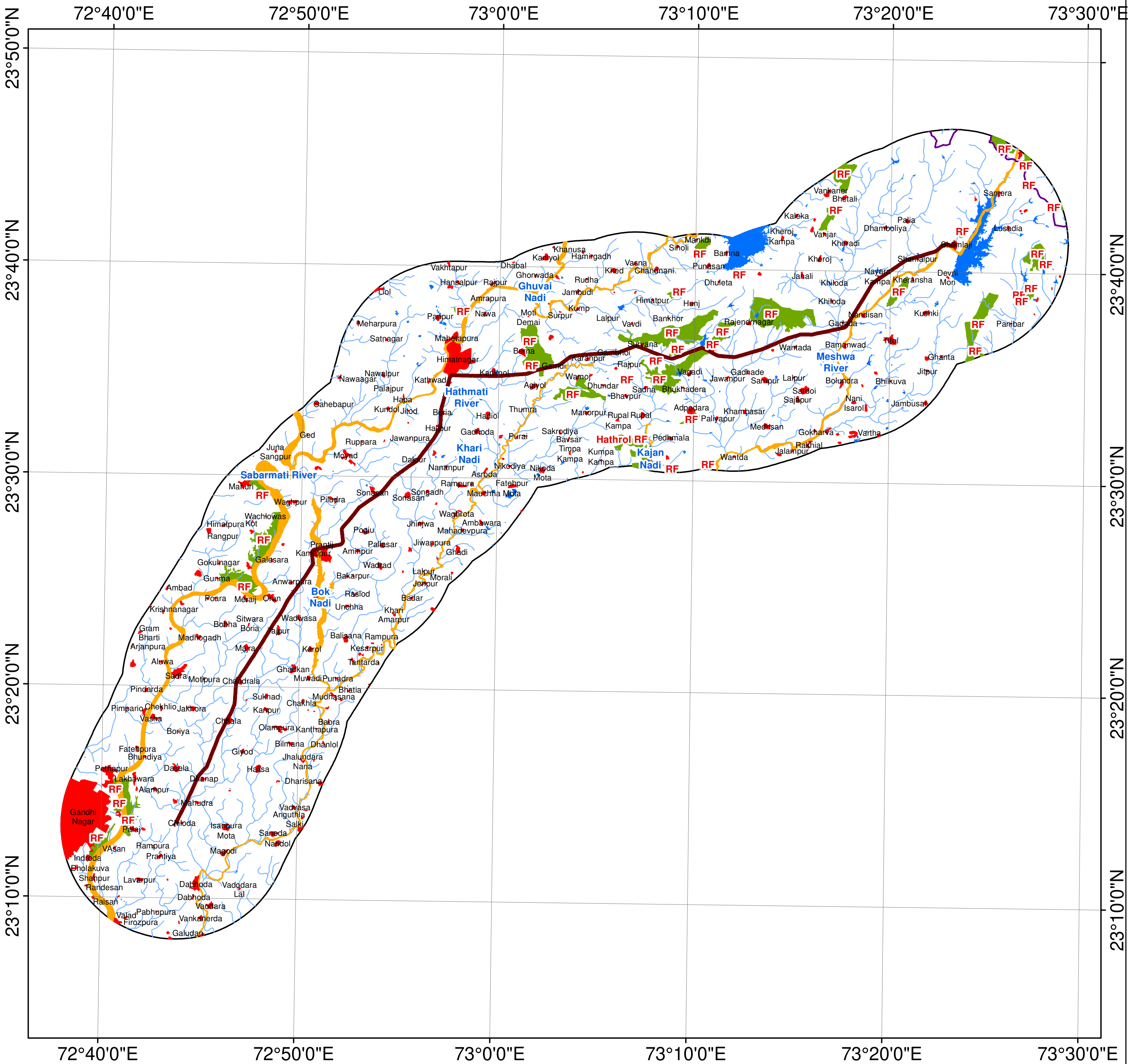
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Source: Technical Report Series, Ground Water, Brochure Gandhinagar District Gujarat Compiled by R. K. Verma, Assistant Hydrogeologist, Government of India Central Ground Water Board West Central Region Ahmedabad, March 2014 and Technical Report Series, Ground Water, Brochure Sabarkantha District Gujarat Compiled by K. M. Nayak, Assistant Hydrogeologist, Government of India Central Ground Water Board West Central Region Ahmedabad, April 2014

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**Legend**

- Streams
- State Boundary
- Project Site
- 10km Buffer
- Builtup
- Sandy Area
- Waterbody
- Forest

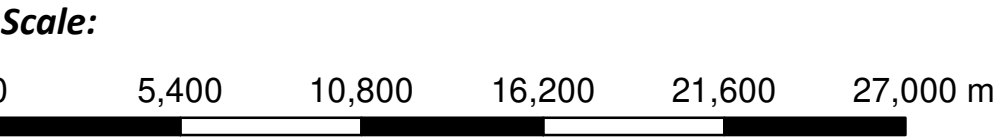
**Figure No. : 3.12**  
**Drainage Pattern Map**  
(within 10km radius)

*Proposed Six Laning of Shamla Ji to Mota Chilodha*  
**National Highways Authority of India**  
*From Km 401.200 to Km 494.410 Section of NH-8 in the State of Gujarat under NHDP Phase-V on Hybrid Annuity Mode*

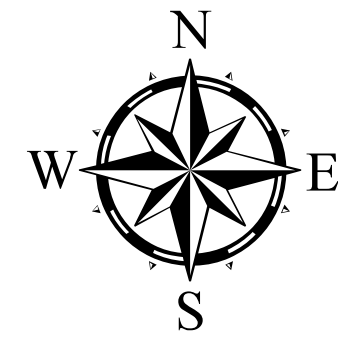
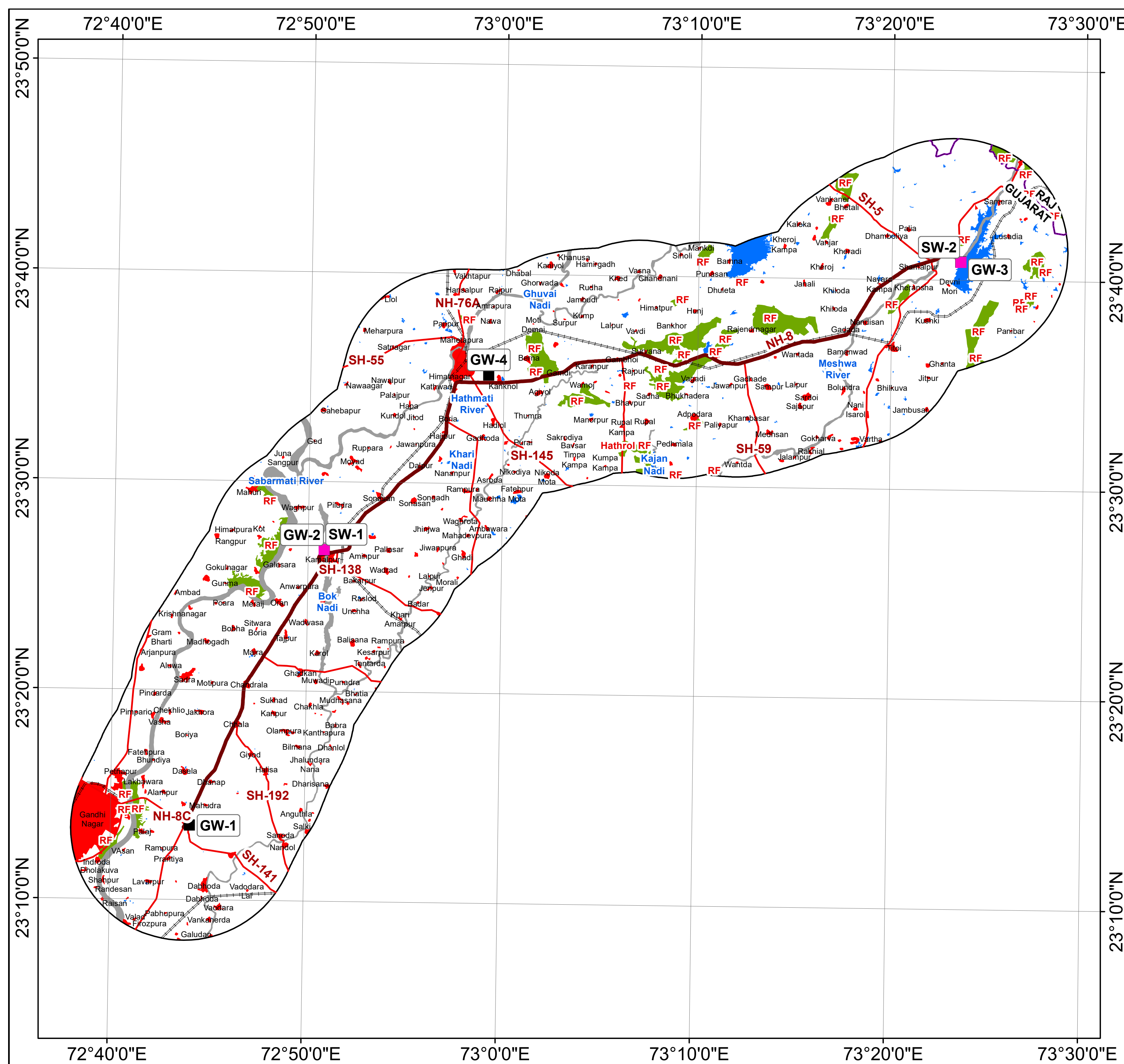
- Source:**
1. Survey of India Toposheets
  2. Layout Plan Provided by PP
  3. Google Satellite Imagery, 2018
  4. Data Provided by FAE (HG)

- Software Used:**
1. ArcGIS 10.1, 2. ERDAS Imagine, 3. Global Mapper

**Note:**  
No National Park, Wildlife Sanctuary, Biosphere Reserves, Wild Life Corridors exists within 10 km from Project Site.







**Legend**

- Ground Water Sampling Location
- Surface Water Sampling Location
- State Boundary
- Major Roads
- Railway
- Project Site
- 10km Buffer
- Sandy Area
- Forest
- Waterbody

**Figure No. : 3.13**  
**Water Sampling Location Map**  
*(within 10km radius)*

**Proposed Six Laning of Shamla Ji to Mota Chilodha**  
**National Highways Authority of India**

**From Km 401.200 to Km 494.410 Section of NH-8 in the State of Gujarat under NHDP Phase-V on Hybrid Annuity Mode**

**Source:**

- Survey of India Toposheets
- Layout Plan Provided by PP
- Google Satellite Imagery, 2018
- Data Provided by FAE (LU)

**Software Used:**

- ArcGIS 10.1, 2. ERDAS Imagine, 3. Global Mapper

**Note:**

No National Park, Wildlife Sanctuary, Biosphere Reserves, Wild Life Corridors exists within 10 km from Project Site.

**Scale:**

0 5,400 10,800 16,200 21,600 27,000 m



There were several shale bands in the depth range of 30 and 52 m bgl in the limestone. The limestone also contained solution cavities in the depth range of 18-22 m bgl. A well assembly tapping the zone between 53 and 69 m bgl was lowered in the bore hole. During PYT, the discharge obtained was only 0.7 lps for a drawdown of 28.21 meters after 100 minutes.

All the zones were in jointed/amygdaloidal basalt. The yield of the first and second zones tested together was only 3.2 lps. The transmissivity was 36.3 m<sup>2</sup>/day. The yield of the second and third zones tested together was 16.3 lps and the transmissivity was 432/day.

The borehole at Nirtala was drilled down to 88.68 m bgl and the vindhyan sandstone were struck at 52 m bgl. water was struck at two depths, between 42-42.5 m bgl in jointed basalt and at the basalt vindhyan contact at 52-52.5 m bgl. these zones tested together yielded 0.64 lps of water and the transmissivity value was only 0.3 m<sup>2</sup>/day. Similarly, at Sabda the depth drilled was 85-94 m bgl. the vindhyan basement was struck at 54.2 m bgl. the water bearing zones were at 48.0 -57.3 m bgl in jointed basalt and at 54.2-54.7 m bal at the basalt vindhyan contact.

### **3.12. WATER LEVELS**

#### **3.12.1. PRE-MONSOON (MAY 2012)**

The ground water level during the pre-monsoon period (May 2012) ranged from 7.55 to 59.40 mbgl. The shallowest Water level of 7.55 mbgl was recorded at Dahegam and the deepest water level of 59.4 m was recorded at Amrapur. The range of ground water level in the district is given as below.

#### **3.12.2. POST- MONSOON (NOV. 2012)**

The ground water level during the post-monsoon period (November 2012) ranged from 6.27 to 59.17 mbgl. The shallowest Water level of 6.27 mbgl was recorded at Dahegam and the deepest water level of 59.17 m was recorded at Amrapur.

### **3.13. DRAINAGE PATTERN**

The entire district is a part of North Gujarat Alluvial plain with neither hill features nor any prominent natural water bodies. The Sabarmati, the Khari and the Meshwo are important rivers of the district. One of the most important feature of the drainage of the district is lack of any definite drainage system in the western part and other is artificial drainage i.e. The Narmada Canal System. The Sabarmati River, which flows through the district in north- south direction, is the principal river of the district. The Sabarmati flows through the central part of Gandhinagar taluka. The Sabarmati was once a perennial river, however, after construction of dam near Dharoi, it is generally dry during lean periods except for a small channel of flow due to water released from Dharoi dam. Recently water from Narmada canal is being fed to the river and the river retains water downstream of Narmada canal. The drainage pattern will be according to the elevation as depicted in drainage pattern map given (**Figure 3.12**).

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### 3.14. METHODOLOGY FOR SAMPLING & ANALYSIS

Two surface water samples were collected from the available identified water bodies during the Post-Monsoon Season (November 2018). Four ground water sources were examined for physico-chemical and heavy metals to access the effect of the already ongoing activities on surface and ground water. Water sampling locations are depicted in **Figure 3.13**. Analyses of the samples were carried out as per established standard methods and procedures prescribed by CPCB, IS 3025 Codes and APHA 22<sup>nd</sup> edition, 2012. Samples for chemical analysis were collected in glass/plastic sterilized water bottles. Samples collected for metal content were acidified with 1 ml HNO<sub>3</sub>. Parameters like dissolved oxygen (DO) and pH were analyzed at the time of sample collection. The basic precautions were taken care to avoid any contamination during the sampling. The analysis methodology is given in **Table 3.5**.

**Table 3-5: Analytical Procedure**

S. No.	Parameters	Analytical Method	Reference
1	pH	pH meter	IS: 3025 (Part-11)
2	Turbidity	Nephelo Meter	IS: 3025 (Part-10)
3	Conductivity (at 25 C)	Conductivity meter	APHA 22st edition, 2510 B:2012
4	Total Dissolve Solids	Gravimetric	IS: 3025 (Part-16)
5	Alkalinity as CaCO <sub>3</sub>	Titrimetrically	IS: 3025 (Part-23)
7	Total Hardness as CaCO <sub>3</sub>	Titrimetrically	IS: 3025 (Part-21)
8	Calcium as Ca	Titrimetrically	IS: 3025 (Part-40)
9	Magnesium as Mg	Calculation	APHA 22st edition, 3500 Mg B:2012
10	Sodium	Flame Photometric	APHA 22nd edition, 3500 Na B:2012
11	Potassium	Photometric	APHA 22nd edition, 3500 K- B:2012
12	Chloride as Cl	Argentometric	IS: 3025 (Part-32)
13	Sulphate as SO <sub>4</sub>	Turbidimetric	IS: 3025 (Part-24)
14	Nitrate as NO <sub>3</sub>	Spectrophotometric	IS: 3025 (Part-34)
15	Phosphate	Spectrophotometric	IS: 3025 (Part-31)
16	Fluoride as F	Ion-meter	APHA 22nd edition, 4500 F- D:2012
17	Phenolic compound as C <sub>6</sub> H <sub>5</sub> OH	Spectrophotometric	IS: 3025 (Part-43)
18	Cyanide	Spectrophotometric	IS: 3025 (Part-27)
19	Dissolve Oxygen	Winkler Method	IS: 3025 (Part-38), RA, 2009
20	Oil & Grease	Gravimetric	IS: 3025 (Part 39), 1991 (RA, 2003)
21	Arsenic	AAS	IS: 3025 (Part-37)
22	Cadmium	AAS	IS: 3025 (Part-41)
23	Total Chromium	AAS	IS: 3025 (Part-52)
24	Iron	AAS	IS:3025 (Part-53), RA, 2009
25	Copper	AAS	IS: 3025 (Part-42)
26	Lead	AAS	IS: 3025 (Part-47)

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S. No.	Parameters	Analytical Method	Reference
27	Manganese	AAS	IS: 3025 (Part-59)
28	Mercury	AAS	IS: 3025 (Part-48)
29	Zinc	AAS	IS: 3025 (Part-49)
30	Dissolved Oxygen	-	IS: 3025 (Part-38) 1989 (RA-2009)
31	Chemical Oxygen Demand	-	IS: 3025 (Part-58) 1989 (RA-2012)
32	Biological Oxygen Demand	-	IS: 3025 (Part-44) 1989 (RA-2009)
33	Total Coliform	MPN Method	IS: 1622: 1981

Source: Rajasthan Environmental Testing Lab, Bhiwadi Alwar

The error in ion-balance computation, considering the relationship between the total cations ( $\text{Ca}^{++}$ ,  $\text{Mg}^{++}$ ,  $\text{Na}^{+}$ ,  $\text{K}^{+}$ ) and the total anions ( $\text{NO}_3^{-}$ ,  $\text{SO}_4^{-}$ ,  $\text{HCO}_3^{-}$  and  $\text{Cl}^{-}$ ) for each set of complete analyses of water sample, is observed to be within the range of acceptability ( $\pm 2\%$ ) used in most laboratories (APHA 22ndEdtn). The analyze details of ground water is given in **Table 3.6**.

**Table 3-6: Ground Water Characteristics**

Parameters	Unit	Chiloda	Pranjit	Motipura	Shamlaji	IS 10500 :2012	
Location ➡		GW-1	GW-2	GW-3	GW-4	Acceptable limits	Permissible limits
Co-ordinates ➡		23° 13' 34.7" N 72° 44' 05.0" E	23° 26' 46.7" N 72° 50' 50.5" E	23° 40' 53.2" N 73° 23' 33.1" E	23° 35' 13.6" N 72° 59' 12.2" E		
pH	--	7.82	7.69	7.64	7.92	6.5-8.5	NR
Conductivity	µS/cm	1163.0	1052.0	958.4	989.5	\$	\$
Total Dissolve Solids	mg/l	712	642	591	612	500	2000
Alkalinity as CaCO <sub>3</sub>	mg/l	324.6	306.5	298.5	248.5	200	600
Total Hardness as CaCO <sub>3</sub>	mg/l	344.1	316.8	298.6	322.0	300	600
Calcium as Ca	mg/l	97.5	91.5	87.5	71.0	75	200
Magnesium as Mg	mg/l	24.5	21.5	19.5	35.2	30	100
Sodium	mg/l	68	56	42	47	\$	\$
Potassium	mg/l	6	9	12	11	\$	\$
Bicarbonate	mg/l	324.6	306.5	298.5	248.5	\$	\$
Chloride as Cl	mg/l	159.5	141.2	109.5	165.4	250	1000
Sulphate as SO <sub>4</sub>	mg/l	10.5	8.5	11.2	24.1	200	400
Nitrate as NO <sub>3</sub>	mg/l	16.4	2.3	1.6	1.9	45	NR
Fluoride as F	mg/l	0.64	0.16	0.16	0.31	1.00	1.5
Phenolic compound as C <sub>6</sub> H <sub>5</sub> OH	mg/l	BDL	BDL	BDL	BDL	0.001	0.002
Cyanide	mg/l	BDL	BDL	BDL	BDL	0.05	NR
Aluminum	mg/l	BDL	BDL	BDL	BDL	0.03	0.2
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Parameters	Unit	Chiloda	Pranjit	Motipura	Shamlaji	IS 10500 :2012	
Location →		GW-1	GW-2	GW-3	GW-4	Acceptable limits	Permissible limits
Co-ordinates →		23° 13' 34.7" N 72° 44' 05.0" E	23° 26' 46.7" N 72° 50' 50.5" E	23° 40' 53.2" N 73° 23' 33.1" E	23° 35' 13.6" N 72° 59' 12.2" E		
Arsenic	mg/l	BDL	BDL	BDL	BDL	0.01	0.05
Cadmium	mg/l	BDL	BDL	BDL	BDL	0.003	NR
Chromium as Cr <sup>+6</sup>	mg/l	BDL	BDL	BDL	BDL	0.05	NR
Iron	mg/l	0.15	0.18	0.18	0.21	0.3	NR
Copper	mg/l	BDL	BDL	BDL	BDL	0.05	1.5
Lead	mg/l	BDL	BDL	BDL	BDL	0.01	NR
Manganese	mg/l	BDL	BDL	BDL	BDL	0.1	0.3
Mercury	mg/l	BDL	BDL	BDL	BDL	0.001	NR
Zinc	mg/l	2.6	1.6	2.1	1.2	5	15

Source: Rajasthan Environmental Testing Lab, Bhiwadi Alwar

## OBSERVATIONS & INTERPRETATIONS:

The physical parameters were meeting to the acceptable limits of drinking water as TDS was varying from 591 mg/l to 712 mg/l. Parameters as pH, Na, K are also complying to acceptable limit of drinking water standard 10500:2012. The chemical parameters were analyzed as alkalinity, calcium, hardness, chloride, Sulphate, fluoride and nitrate etc. all the parameters were meeting to the permissible limits of drinking water standards IS 10500:2012 at all locations. The heavy metals were also analyzed, only metals were detected as iron & zinc which was meeting to the acceptable limits of drinking water standard 10500:2012 and other metals were below to the detection limits of laboratory.

### 3.15. SURFACE WATER QUALITY

The analyze details of surface water is given in **Table 3.7**.

**Table 3-7: Surface Water Characteristics**

Parameters	Unit	Prantij	Shamlaji	Water Quality Criteria as per CPCB
Location Code →	-	SW-1	SW-2	
Co-Ordinates →	-	23° 26' 47.3" N 72° 50' 49.4" E	23° 40' 52.4" N 73° 23' 34.2" E	
Turbidity	NTU	24	31	\$
pH	--	7.28	8.94	Class A
Conductivity	µS/cm	876.5	1098	\$
Total Dissolve Solids	mg/l	492	765	\$
Alkalinity as CaCO <sub>3</sub>	mg/l	92.3	210.8	\$

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Parameters	Unit	Prantij	Shamlaji	Water Quality Criteria as per CPCB
Location Code →	-	SW-1	SW-2	
Co-Ordinates →	-	23° 26' 47.3" N 72° 50' 49.4" E	23° 40' 52.4" N 73° 23' 34.2" E	
Total Hardness as CaCO <sub>3</sub>	mg/l	109.9	102.7	\$
Calcium as Ca	mg/l	31.5	21.2	\$
Magnesium as Mg	mg/l	7.6	12.1	\$
Sodium	mg/l	97	168	\$
Potassium	mg/l	6	13	\$
Bicarbonate	mg/l	92.3	210.8	\$
Chloride as Cl	mg/l	168.5	194.5	\$
Sulphate as SO <sub>4</sub>	mg/l	22.6	52.8	\$
Nitrate as NO <sub>3</sub>	mg/l	1.9	2.4	\$
Fluoride as F	mg/l	0.32	0.18	\$
Phenolic compound as C <sub>6</sub> H <sub>5</sub> OH	mg/l	BDL	BDL	\$
Cyanide	mg/l	BDL	BDL	\$
Aluminium	mg/l	BDL	BDL	\$
Arsenic	mg/l	BDL	BDL	\$
Cadmium	mg/l	BDL	BDL	\$
Chromium as Cr <sup>6+</sup>	mg/l	BDL	BDL	\$
Iron	mg/l	0.19	0.31	\$
Copper	mg/l	BDL	BDL	\$
Lead	mg/l	BDL	BDL	\$
Manganese	mg/l	BDL	BDL	\$
Mercury	mg/l	BDL	BDL	\$
Zinc	mg/l	3.2	1.9	\$
Dissolve Oxygen	mg/l	5.1	5.7	Class B & C
COD	mg/l	10.2	8.7	\$
BOD, 27°C 3 days	mg/l	4.2	6.1	Below E
Total Coliforms	MPN/100ml	>950	>950	Class B & C

Source: Rajasthan Environmental Testing Lab, Bhiwadi Alwar \$- Not Specified Standard

The water quality criteria as per CPCB is given in **Table 3.8**.

**Table 3-8: CPCB Water Quality Criteria**

Designated Best Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less
		pH between 6.5 and 8.5
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Designated Best Use	Class of water	Criteria
		Dissolved Oxygen 5mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less
		pH between 6 to 9
		Dissolved Oxygen 4mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5
		Dissolved Oxygen 4mg/l or more
		Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5
		Electrical Conductivity at 25°C micro mhos/cm Max.2250
		Sodium absorption Ratio Max. 26
		Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

### OBSERVATIONS & INTERPRETATIONS:

The physical parameters were analyzed as turbidity, pH, TDS, Na and K. The turbidity was observed very good in both ponds & rivers/nallahs. The chemical parameters were analyzed for Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Bicarbonate, Sulphate, Nitrate, Fluoride, DO and COD were analyzed. Dissolved oxygen & BOD were observed accorded to Class B & E as per CPCB water quality criteria. The heavy metals were also analyzed in the surface water. Only iron & zinc were detected. Other parameters were below to the detection limits. Total coliform was meeting to the Class C of water quality criteria as defined by CPCB.

### 3.16. METEOROLOGICAL CONDITION

Post-Monsoon Season starts from middle of November to end of February. March to May constitute summer season and the monsoon season starts from second week of June to end of September. Maximum rainfall occurs along the south western boundary of the district and decreases towards the north and slightly towards the east. The normal annual rainfall of the district is 740.6 mm. During Post-Monsoon Season the January is the coldest months with the temperature falling as low as 12.0°C and max up to 28.1<sup>0</sup> C. During the month of May, temperature goes up to 38.7<sup>0</sup> C (max.).

The meteorological data was taken from Ahmedabad IMD station for the study period is very useful for proper interpretation of the baseline information as well as for input prediction models for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region.

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### 3.17. METEOROLOGICAL DATA RECORDED AT IMD, AHMEDABAD

The meteorological data is collected from the IMD station at Ahmedabad, which is the nearest IMD station to the project site. The data collected from IMD includes wind speed, wind direction (recorded in sixteen directions), temperature, relative humidity, atmospheric pressure; rainfall and cloud cover over a period of 30 years from the year 1971 to 2000. All these parameters were recorded twice a day viz at 08.30 and 17.30 hours. The monthly maximum, minimum and average values are collected for all the parameters like wind speed, rainfall, temperature are presented in **Table 3.11** and wind-rose pattern is given as **Figure 3.14** as per IMD, Ahmedabad.

**Table 3-9: Climatology and Meteorology of Study Area as per IMD, Ahmedabad (1971-2000)**

Month	Temp (°C) (Daily)			Humidity (%)		Rainfall	Wind Speed
	Max	Min.	Average	08:30	05:30	mm	kmph
January	28.1	12.0	20.1	64	35	1.9	6.0
February	30.5	14.0	22.3	57	28	1.0	6.4
March	35.7	19.1	27.4	50	21	0.5	7.0
April	39.7	23.7	31.7	57	22	2.7	8.0
May	41.6	26.5	34.1	66	25	10.2	11.3
June	38.7	27.3	33.0	75	45	95.1	11.8
July	33.5	25.7	29.6	85	69	281.3	10.0
August	32.0	24.9	28.5	87	71	234.6	8.7
September	33.8	24.3	29.1	82	60	95.8	7.2
October	35.7	21.3	28.5	67	41	12.3	4.8
November	32.8	16.6	24.7	58	37	4.3	4.8
December	29.4	13.2	21.3	61	37	0.8	5.5
<b>YEAR</b>	<b>34.3</b>	<b>20.7</b>	<b>27.5</b>	<b>67</b>	<b>41</b>	<b>740.6</b>	<b>7.6</b>

Source: Climatological Table 1971 – 2000, Indian Meteorological Department, Govt. of India, New Delhi

**Table 3-10: Wind Variability of Study Area as per IMD, Ahmedabad (1971-2000)**

Month	N/360	NE/45	E/90	SE/135	S/180	SW/225	W/270	NW/315	CALM/0	SEASON
DEC	12	27	33	1	0	0	0	3	24	Winter
	24	17	17	2	1	1	1	15	22	
JAN	16	21	22	1	1	0	2	7	30	
	31	16	10	2	1	2	4	25	9	
FEB	13	16	16	2	0	1	4	17	31	
	24	10	9	2	3	5	11	30	6	
<b>Total</b>	<b>120</b>	<b>107</b>	<b>107</b>	<b>10</b>	<b>6</b>	<b>9</b>	<b>22</b>	<b>97</b>	<b>122</b>	Summer
MAR	10	8	12	2	1	2	11	33	21	
	15	5	4	2	2	8	18	39	7	
APR	6	1	4	1	3	8	21	45	11	
	9	1	1	2	4	13	30	34	6	

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Month	N/360	NE/45	E/90	SE/135	S/180	SW/225	W/270	NW/315	CALM/0	SEASON
MAY	2	0	0	2	8	28	30	28	2	
	4	1	1	2	10	29	31	20	2	
<b>Total</b>	<b>46</b>	<b>16</b>	<b>22</b>	<b>11</b>	<b>28</b>	<b>88</b>	<b>141</b>	<b>199</b>	<b>49</b>	
JUN	1	0	1	5	15	40	23	9	6	Monsoon
	1	0	1	5	24	36	21	7	5	
JUL	0	0	0	2	14	52	17	4	11	
	0	1	1	5	18	41	19	5	10	
AUG	1	0	0	1	8	45	26	8	11	
	2	0	1	3	11	38	23	8	14	
SEP	2	1	2	3	6	19	28	25	14	
	5	2	2	3	9	25	21	15	18	
<b>Total</b>	<b>12</b>	<b>4</b>	<b>8</b>	<b>27</b>	<b>105</b>	<b>296</b>	<b>178</b>	<b>81</b>	<b>89</b>	
OCT	10	8	14	6	2	2	5	16	37	P. Monsoon
	14	9	10	6	4	6	5	14	32	
NOV	13	21	29	3	1	0	0	3	30	
	20	13	19	3	1	1	2	9	32	
DEC	12	27	33	1	0	0	0	3	24	
	24	17	17	2	1	1	1	15	22	
<b>Total</b>	<b>93</b>	<b>95</b>	<b>122</b>	<b>21</b>	<b>9</b>	<b>10</b>	<b>13</b>	<b>60</b>	<b>177</b>	
<b>YEAR</b>	7	9	11	2	5	16	14	16	20	Annual
	12	6	6	3	7	17	16	19	14	
<b>Total</b>	<b>19</b>	<b>15</b>	<b>17</b>	<b>5</b>	<b>12</b>	<b>33</b>	<b>30</b>	<b>35</b>	<b>34</b>	

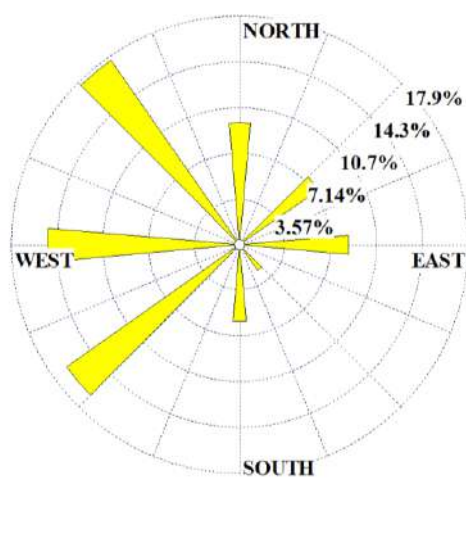
**Rainfall:** The total average annual rainfall was found to be 740.6 mm of which average 7.0 mm rainfall during the winter period, 13.4 mm for summer period, 706.8 mm for monsoon period and 17.4 mm for post monsoon period in a year.

**Temperature:** The area showed moderate temperature through the all seasons, with the maximum average temperature recorded at 41.6°C in the month of May and the minimum average temperature of 12.1°C in January.

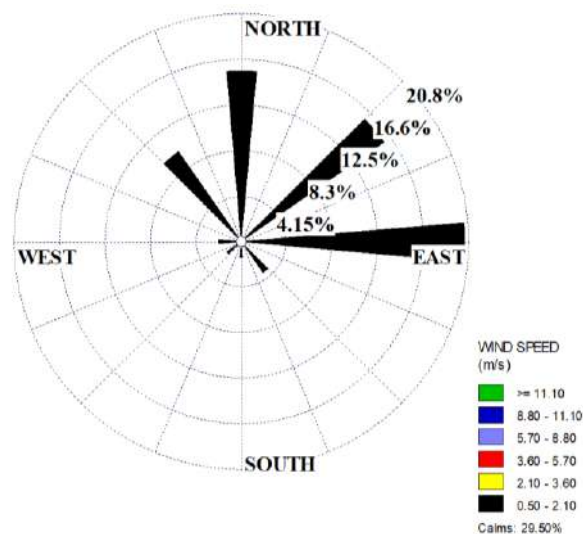
**Relative Humidity:** The Relative Humidity was maximum during the monsoon season with the month of August recording the highest average at 87%.

**Wind Speed and Direction:** The maximum wind speed was found to be 11.8 kmph in the month of June and minimum wind speed was found to be 4.8 kmph in the month of October & November. The predominant wind direction at the IMD station was from NE followed by SW and W.

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**Annual Wind Patterns**



**Post Monsoon Wind Patterns**

**Figure 3.14 Wind Pattern Variability as per IMD-Ahmedabad (Gujarat)**

### 3.18. AIR ENVIRONMENT

The baseline studies on air environment include identification of specific air pollution parameters and their existing levels in ambient air. The ambient air quality with respect to the core and buffer zone of 10 km radius around the proposed project site forms the baseline information. The sources of air pollution in the region are mostly due to vehicular traffic, dust arising from unpaved village road and domestic fuel/biomass burning. The quantification of impacts of the proposed solar project on the ambient air quality requires to evaluate the existing ambient air quality of the area.

Monitoring was conducted for the following parameters: (i) Particulate Matter 10 (PM<sub>10</sub>), (ii) Particulate Matter (PM<sub>2.5</sub>), (iii) Sulphur Dioxide (SO<sub>2</sub>), (iii) Nitrogen Dioxide (NO<sub>2</sub>) and (iv) Carbon Monoxide (CO).

It was ensured that the equipment was placed at a height of at least 3m to 4m above the ground level at each monitoring station, for negating the effects of windblown ground dust. Also, distance of the sampler to any air flow obstacle i.e. buildings, must be more than two times the height of the obstacle above the sampler has been ensured. The equipment was placed at open space free from trees and vegetation which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. Monitoring has been carried out as per the latest CPCB and MoEF&CC guidelines and notifications.

### 3.19. POLLUTION & PREVENTIVE MEASURES

The sampling locations for ambient air quality were established based on the following considerations:

- (i) **Meteorological conditions including wind direction;**
- (ii) **Topography of the study area; and**
- (iii) **Representativeness of regional background air quality for obtaining baseline status;**

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Five Ambient Air Quality Monitoring (AAQM) Stations were selected. Criteria used for designing the network were principally governed by the wind rose pattern & coverage factor calculation of windblown for Post-Monsoon Season and the accessibility of the selected sites. Attempts were made to locate most of the AAQ stations in predominant downwind direction with respect to the project site. Logistic considerations such as accessibility, security, and availability of reliable power supply etc. were also examined while finalizing the stations. Monitoring Locations are marked in **Figure 3.15**.

### 3.19.1. DURATION OF SAMPLING

The monitoring has been carried out at a frequency of two samples per week at each of five locations, adopting a continuous 24-hour continuous schedule for Particulate Matter, Sulphur Dioxide and Nitrogen Dioxide except CO for one hour.

### 3.19.2. SAMPLING & ANALYSIS TECHNIQUES

With a view to collect the samples, Envirotech Make Calibrated Respirable Dust Samplers (RDS-APM 460 BL) along with Gaseous attachment and Fine Particulate Matter (FPS-APM 550) were used. The instruments were well capable of drawing air at a flow rate of 1 to 1.3 m<sup>3</sup>/min with very little pressure drop for RDS and the impactor system of FPS is designed to operate at an air flow rate of 1m<sup>3</sup>/hr. Filter papers (8"x10" GF for PM10 and 46.2 dia. PTFE for PM2.5) were used for the collection of PM10 and PM2.5. SO<sub>2</sub> was collected by drawing air at a flow-rate of 0.5 liters per minute (lpm) through an absorbing solution i.e., Sodium tetrachloromercurate (TCM) (West and Gaeke Method) and NO<sub>2</sub> was collected by drawing air at a flow rate of 0.4 lpm through the mixture of absorbing solutions i.e. sodium hydroxide and sodium arsenite (Jacobs and Hochheiser Method). Carbon Monoxide samples were collected on 1 hourly base in Mylar bags and analyzed by Non-Dispersive Infra-Red Spectroscopy (NDIR). This is to allow a comparison with the present revised standards mentioned in the latest Gazette Notification of the Central Pollution Control Board (November 2009). The analysis methodology for relevant parameters is given in **Table 3.13**. **Table 3.14** is shown the monitoring locations.

**Table 3-11: Sampling and Analytical Methodology**

Sl. No.	Parameter	Methodology
1	Particulate Matter 10 (µg/m <sup>3</sup> )	IS 5182, Part 23, Respirable Dust Sampler 460 BL (Gravimetric method)
2	Particulate Matter 2.5 (µg/m <sup>3</sup> )	CPCB Guideline, APM 550 Fine Particulate Sampler (Gravimetric method)
3	Sulphur Dioxide (µg/m <sup>3</sup> )	West and Gaeke Method
4	Nitrogen Dioxide (µg/m <sup>3</sup> )	IS 5182, Part 6, Jacob & Hochheiser modified
5	Carbon monoxide (mg/m <sup>3</sup> )	IS 5182, Part 10, Non-dispersive Infrared Absorption method

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### 3.20. AIR QUALITY

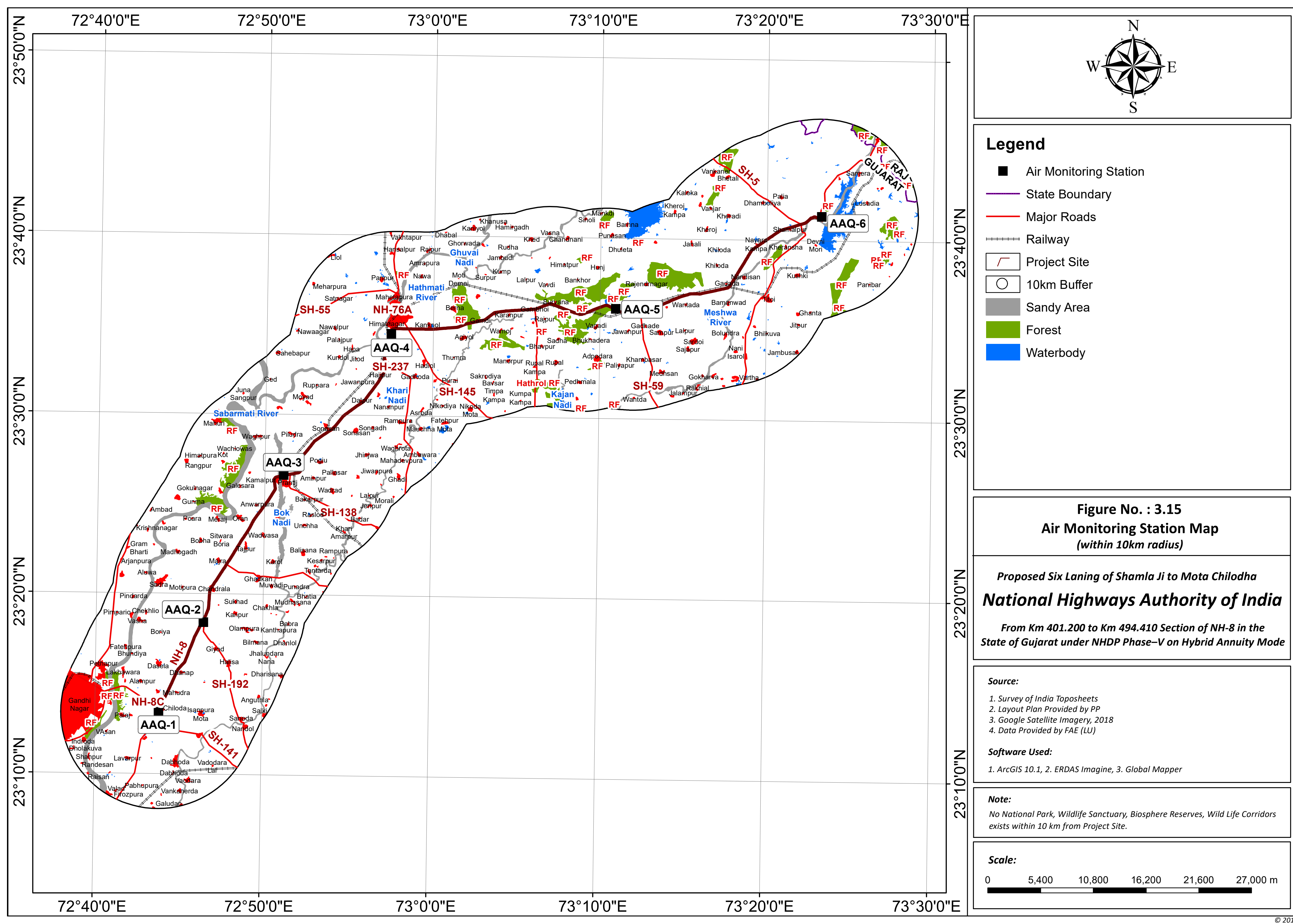
Consolidated values of ambient air quality for the said parameters is given in **Table 3.12 & 3.13**. The locations-wise air quality details are given in separate document which is enclosed as **Annex 3.4**.

**Table 3-12: Statistical Values of AAQ**

Location Code	Parameter	Minimum	Maximum	Standard Deviation	Percentile 98	Mean
AAQ1	<b>Particulate Matter 10 PM<sub>10</sub> (µg/m<sup>3</sup>)</b>	127.5	148.5	7.7	148.3	137.8
AAQ2		119.5	144.5	8.5	144.0	133.0
AAQ3		122.5	157.5	11.4	156.2	139.0
AAQ4		118.2	135.5	5.2	135.0	127.7
AAQ5		124.0	146.2	8.2	145.5	134.7
AAQ6		118.7	135.2	5.4	134.8	128.0
AAQ1	<b>Particulate Matter 2.5 PM<sub>2.5</sub> (µg/m<sup>3</sup>)</b>	48.5	57.5	3.5	57.4	53.1
AAQ2		45.5	57.5	3.7	57.1	51.1
AAQ3		48.5	62.5	4.7	61.8	54.4
AAQ4		45.0	56.5	3.3	56.0	51.1
AAQ5		48.5	57.5	3.8	57.5	53.3
AAQ6		46.5	55.5	3.0	55.2	51.1
AAQ1	<b>Sulphur Di Oxides SO<sub>2</sub> (µg/m<sup>3</sup>)</b>	8.5	13.2	1.7	13.2	11.3
AAQ2		7.5	13.4	2.1	13.4	11.2
AAQ3		7.9	14.8	2.3	14.6	10.9
AAQ4		9.8	13.2	1.3	13.2	11.8
AAQ5		9.1	12.4	1.3	12.4	10.7
AAQ6		9.3	12.4	1.1	12.3	10.5
AAQ1	<b>Oxides of Nitrogen NO<sub>x</sub> (µg/m<sup>3</sup>)</b>	13.9	18.5	1.8	18.5	16.5
AAQ2		14.5	19.5	1.5	19.3	17.2
AAQ3		13.2	19.5	2.1	19.4	16.4
AAQ4		14.5	20.1	1.8	20.0	17.4
AAQ5		13.2	17.5	1.5	17.5	15.8
AAQ6		12.7	19.5	2.0	19.2	16.0
AAQ1	<b>Carbon Monoxide CO (mg/m<sup>3</sup>)</b>	0.69	1.34	0.22	1.33	1.05
AAQ2		0.78	1.31	0.19	1.30	1.06
AAQ3		1.11	1.48	0.12	1.46	1.26
AAQ4		1.07	1.36	0.10	1.35	1.21
AAQ5		1.08	1.32	0.09	1.32	1.21
AAQ6		0.97	1.24	0.09	1.24	1.12

**Table 3-13: Consolidated 98<sup>th</sup> Percentile Values of AAQ**

Location Code	Location Name	Location Co-Ordinates	PM <sub>10</sub> (µg/m³)	PM <sub>2.5</sub> (µg/m³)	SO <sub>2</sub> (µg/m³)	NO <sub>x</sub> (µg/m³)	CO (mg/m³)
AAQ-1	Chiloda	23° 13' 29.2" N	148.3	57.4	13.2	18.5	1.33
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Location Code	Location Name	Location Co-Ordinates	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	SO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>x</sub> (µg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )
		72° 43' 49.6" E					
AAQ-2	Chhala	23° 18' 26.1" N 72° 46' 26.2" E	144.0	57.1	13.4	19.3	1.30
AAQ-3	Motipura	23° 26' 39.6" N 72° 51' 07.5" E	156.2	61.8	14.6	19.4	1.46
AAQ-4	Prantij	23° 34' 34.2" N 72° 57' 28.7" E	135.0	56.0	13.2	20.0	1.35
AAQ-5	Raigarh	23° 36' 07.3" N 73° 10' 57.0" E	145.5	57.5	12.4	17.5	1.32
AAQ-6	Shamlaji	23° 41' 20.8" N 73° 23' 16.6" E	134.8	55.2	12.3	19.2	1.24
<b>Standards for 24 Hours Monitoring except CO for 1 Hour Monitoring</b>							
<b>NAAQS 2009</b>			100	60	80	80	4

Source: Rajasthan Environmental Testing Lab, Bhiwadi Alwar,

Source: Gazette of India Notification, dated 18th Nov 2009

\* Annual Arithmetic Means of minimum 104 measurements in a year at a site taken twice a week 24 hourly at uniform intervals, \*\* 24 hourly or 8 hourly or 1 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed the limits but not on two consecutive days of monitoring, For CO 1 hourly standard is being considered.

### 3.20.1. INTERPRETATION

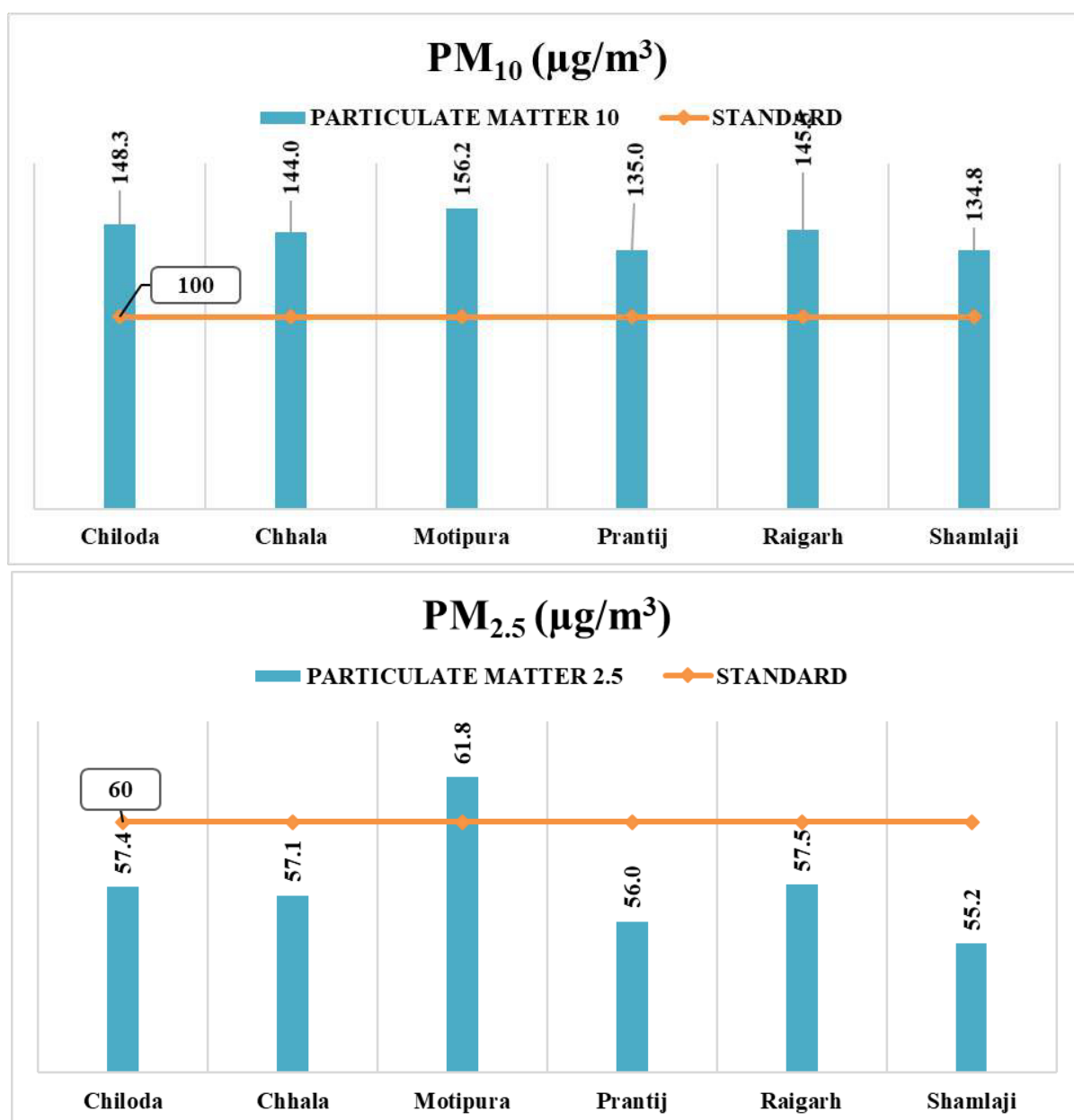
The observations & interpretations are given in **Table 3.16**. **Figure 3.16** is shown Graphical Representation of Air pollutants of the monitoring locations of the project site.

**Table 3-14: Baseline Interpretation**

S. No.	Parameters	Baseline Status
1.	Particulate Matter (PM <sub>10</sub> & PM <sub>2.5</sub> )	The particulate matters size not greater than 10 µm in diameter is collectively referred to as PM <sub>10</sub> . Due to their small sizes, PM <sub>10</sub> can be inhaled readily and can penetrate deep into the human body. In study area particulate matter 10 varying from 134.8 µg/m <sup>3</sup> to 156.2 µg/m <sup>3</sup> . PM <sub>2.5</sub> was observed 55.2 µg/m <sup>3</sup> to 61.8 µg/m <sup>3</sup> . Overall particulate matter was observed near to standards or exceeding from the standards because of the road construction activities as going on for road development which normal & will reduce long time air pollutants as the work will be complete.
2.	Gaseous Pollutants (SO <sub>2</sub> , NO <sub>x</sub> & CO)	The source of SO <sub>2</sub> in the study area is mainly from burning fuels containing sulphur or emissions from biomass depending on the sulphur content in the material. Other anthropogenic sources are high vehicular moment. The

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S. No.	Parameters	Baseline Status
		<p>primary sources of NO<sub>2</sub> in the study area are motor vehicles, electric utilities and residential sources that burn fuels.</p> <p>SO<sub>2</sub> was varying from 12.4 µg/m<sup>3</sup> to 14.6 µg/m<sup>3</sup> &amp; NO<sub>x</sub> was observed 17.5 µg/m<sup>3</sup> to 20.0 µg/m<sup>3</sup> in study area. CO was observed from 1.24 mg/m<sup>3</sup> to 1.46 mg/m<sup>3</sup> in study area.</p> <p>All the parameters are complying to the standards as defined by CPCB.</p>



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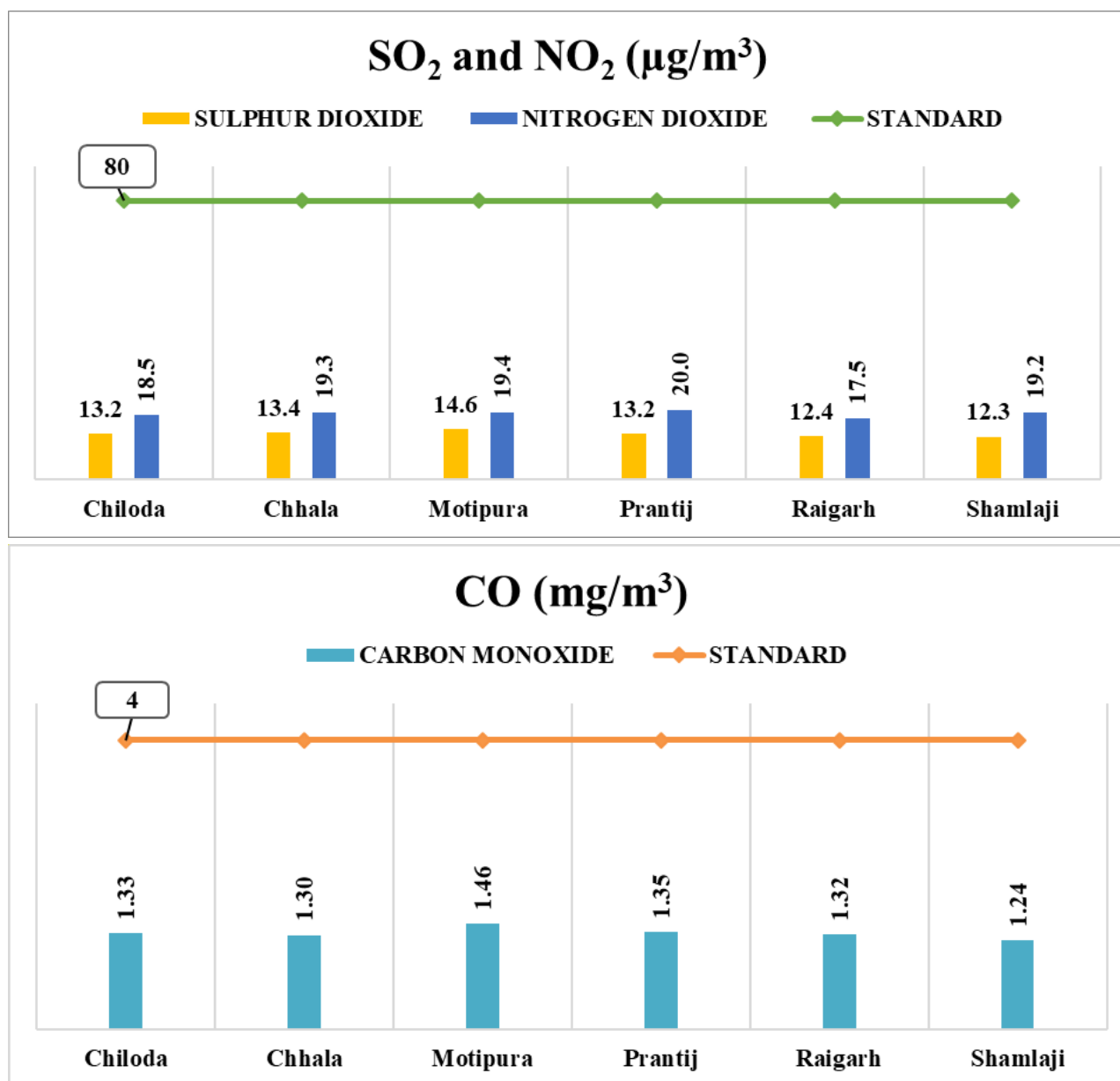


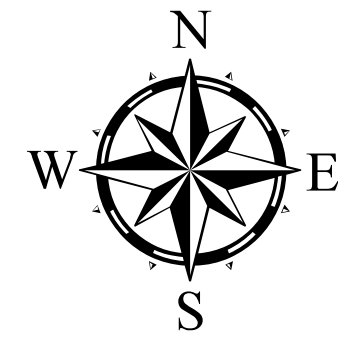
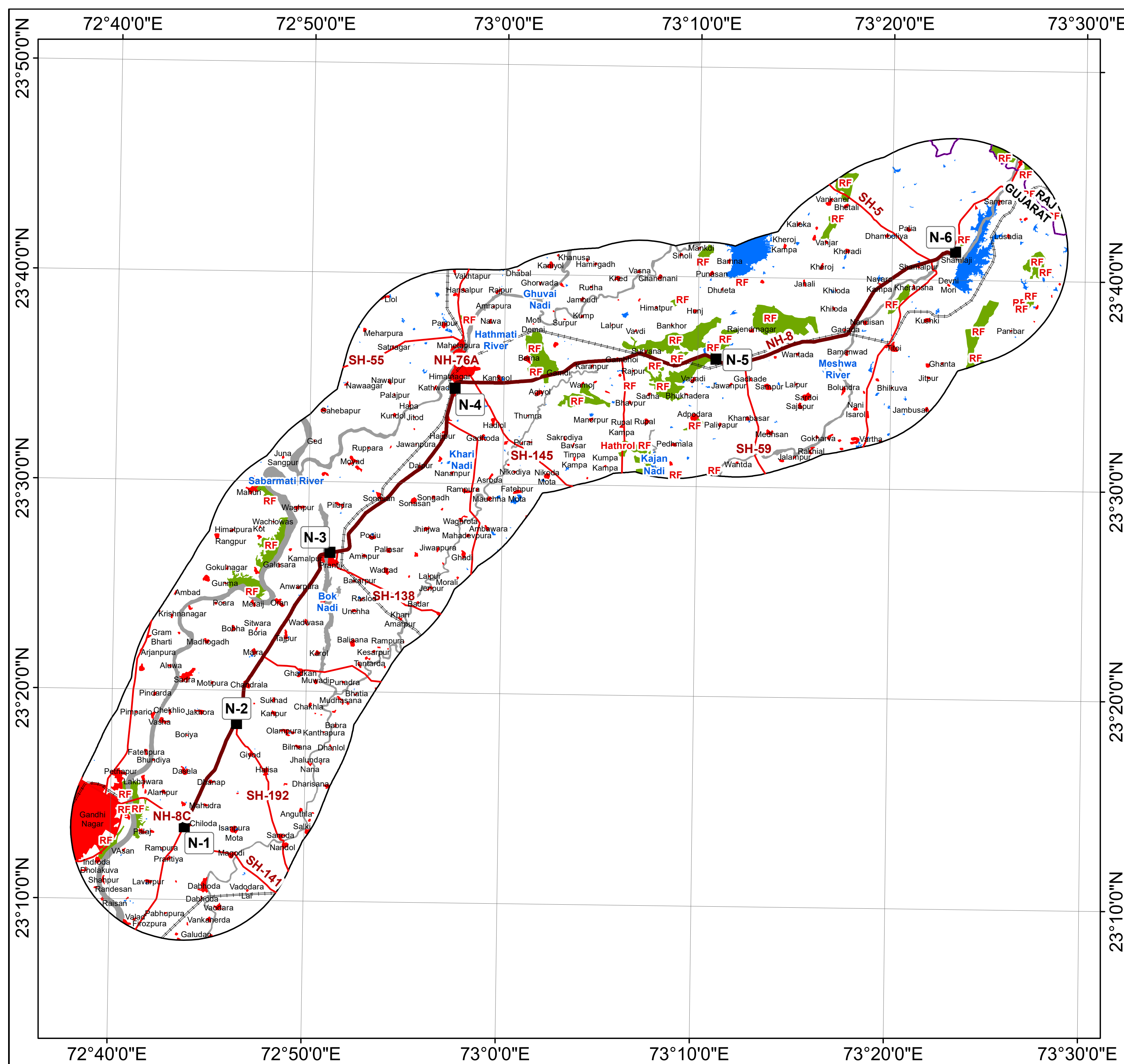
Figure 3.16 Graphical Representation of Air Pollutants

### 3.21. NOISE ENVIRONMENT

#### 3.21.1. AMBIENT NOISE LEVEL MONITORING STATIONS

In the present study, sound pressure levels (SPL) was measured by a sound level meter (Model: Envirotech Make SLM 100). Since loudness of sound is important for its effects on people, the dependence of loudness upon frequency must be considered in noise impact assessment. This has been achieved using A-weighting filters in the noise measuring instrument which gives a direct reading of approximate loudness. A-weighted equivalent continuous sound pressure level (Leq) values have been computed from the values of A-weighted sound pressure level measured with the help of noise meter.

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**Legend**

Noise Monitoring Station

State Boundary

Major Roads

Railway

Project Site

10km Buffer

Sandy Area

Forest

Waterbody

Figure No. : 3.17

Noise Monitoring Station Map

(within 10km radius)

Proposed Six Laning of Shamla Ji to Mota Chilodha

**National Highways Authority of India**

From Km 401.200 to Km 494.410 Section of NH-8 in the State of Gujarat under NHDP Phase-V on Hybrid Annuity Mode

Source:

1. Survey of India Toposheets

2. Layout Plan Provided by PP

3. Google Satellite Imagery, 2018

4. Data Provided by FAE (LU)

Software Used:

1. ArcGIS 10.1, 2. ERDAS Imagine, 3. Global Mapper

Note:

No National Park, Wildlife Sanctuary, Biosphere Reserves, Wild Life Corridors exists within 10 km from Project Site.

Scale:

0

5,400

10,800

16,200

21,600

27,000 m

### 3.21.2. FREQUENCY & PARAMETERS OF SAMPLING

Noise levels were recorded continuous for 24 hours at an interval of 60 minutes during the day and night times to compute the day equivalent, night equivalent and day-night equivalent level. The noise level was monitored once during the study period at each monitoring location. The noise level is recorded in dB(A). The important parameters measured are  $L_{eq}$ ,  $L_{day}$ , and  $L_{night}$ .

### 3.21.3. NOISE MONITORING LOCATIONS

Assessment of ambient noise levels is an important parameter in preparation of impact assessment report. Noise levels are more annoying in the night time particularly in the residential area. The environmental impact of noise can have several effects varying from annoyance to hearing loss depending on loudness of noise levels. The monitoring for noise levels were done in five locations keeping considering the population and traffic of the area. These locations are given in **Figure 3.17**.

### 3.21.4. METHOD OF MONITORING

At each location, noise monitoring has been carried out once during study period over a period of 24 hours to obtain  $L_{eq}$  values at uniform time intervals of 1 hour. In each hourly time interval  $L_{eq}$  values have been computed from SPL readings taken at uniform time intervals of 10 minutes. For each location, day and night time  $L_{eq}$  values have then been computed from the hourly  $L_{eq}$  values such that comparison could be made with the national ambient noise standards. Day time  $L_{eq}$  was computed from the hourly  $L_{eq}$  values between 6.00AM - 10.00PM and night time  $L_{eq}$  from the hourly  $L_{eq}$  values between 10.00PM- 6.00AM. The Noise standards is given in **Table 3.15**.

**Table 3-15: Ambient Noise Standards**

Area Code	Type of Area	Limits in dB(A) $L_{eq}$ *	
		Day (06:00hrs to 20:00hrs)	Night (20:00hrs to 06:00hrs)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

\* Silence zone is defined as an area up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority

### 3.21.5. AMBIENT SOUND PRESSURE LEVEL IN STUDY AREA

An analysis of the different  $L_{eq}$  data obtained during the study period has been made. Variation was noted during the day-time as well as night-time. The results are presented in **Table 3.16**.

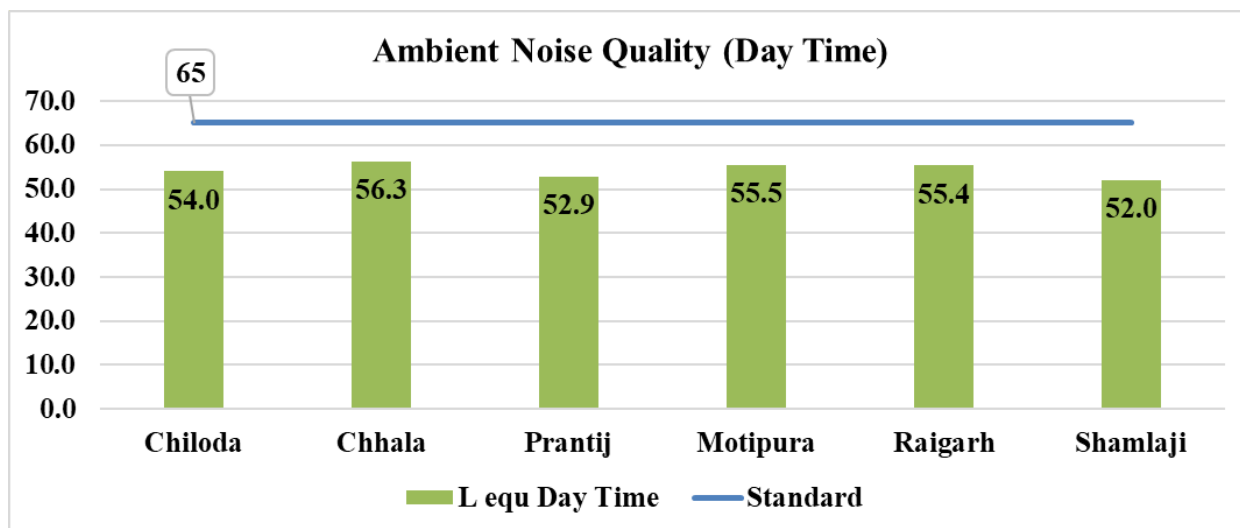
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**Table 3-16: Ambient Noise Quality of Study Area**

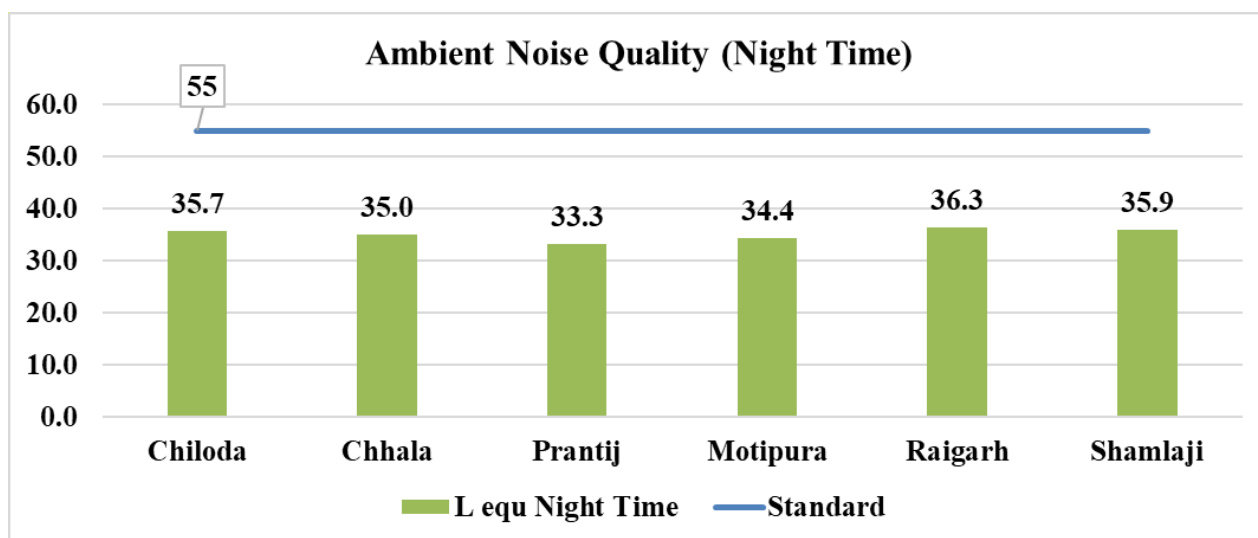
Noise Locations/Codes		Co-Ordinates	Category of Area	Day Time in dB(A)			Night Time in dB(A)		
				L Max	L Min	L eq	L Max	L Min	L eq
Chiloda	N-1	23° 13' 29.2" N 72° 43' 49.6" E	Res./Com.	60.2	39.2	54.0	39.9	29.1	35.7
Chhala	N-2	23° 18' 26.1" N 72° 46' 26.2" E	Res./Com.	62.1	40.1	56.3	38.3	30.2	35.0
Prantij	N-3	23° 26' 39.6" N 72° 51' 07.5" E	Res./Com.	58.9	32.6	52.9	35.4	29.8	33.3
Motipura	N-4	23° 34' 34.2" N 72° 57' 28.7" E	Res./Com.	60.8	38.2	55.5	38.1	29.2	34.4
Raigarh	N-5	23° 36' 07.3" N 73° 10' 57.0" E	Res./Com.	58.5	38.3	55.4	39.7	29.4	36.3
Shamlaji	N-6	23° 41' 20.8" N 73° 23' 16.6" E	Res./Com.	56.0	33.9	52.0	38.8	29.0	35.9

Source: Rajasthan Environmental Testing Lab, Bhiwadi Alwar

The Sound Pressure Level recorded during the daytime on all locations varies from 52.0 dB(A) to 56.3 dB(A) and during night-time varying from 33.3 dB(A) to 36.3 dB(A). The noise level was found well within prescribed standards due to absence of any major noise generating activities in the area.







**Figure 3.18 Noise Quality (Day Time & Night Time) in Study Area**

### 3.22. BIOLOGICAL ENVIRONMENT

Biological environment comprises all biotic components of an area including flora and fauna in the region, details of forests and wildlife sanctuaries in the region, with list of endangered species. Flora and fauna consist information on various species of trees, plants, shrubs, crops and natural vegetation, animal, birds etc. Flora and fauna are important components of the environment. They are organized into natural communities with natural dependencies among their members and show various responses and sensitivities to anthropogenic activities.

Ecological study of an area is essential to assess the viability of the environment in terms of its resources or habitat and helps to understand that how organisms contribute to sustain the ecology of the area. In Environment Impact Assessment (EIA) the main objective of such ecological study is to assess the degree of effect by the proposed project on the biological environment and report for the project and to formulate mitigation measures for the possible impacts, if any on biological environment.

#### 3.22.1. FOREST IN THE STUDY AREA

The proposed project area falls in Rajasthan & Gujarat Plain and Hill Regions zone which possess Semi-arid to dry sub humid. Such climatic conditions provide opportunity to the flora for the. Such environment forces vegetation and animal to adapt to reduce moisture loss from the surface with the changes in the morphological structures as per the climate of the region.

#### 3.22.2. METHODOLOGY

The study of floral diversity was carried out to assess the available plant resources and obtaining a broad representation of the existing floristic variations in the study area. From the view point of the assessment of the impact of the proposed project on the ecological setting, observations are made

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within study area of the project. This biodiversity assessment was carried out in the form of a reconnaissance survey to enlist the flora and fauna of the study area.

All species of plants were identified and listed with the help of the residents to know their vernacular names and further available literatures from forest department and other secondary resources were also consulted.

In case of fauna, mammals were recorded through direct sighting in the area during the survey. Nocturnal animals were listed through indirect reporting like sign survey, pellets observation etc. Birds were identified through direct sighting and calls. Moreover, secondary resources from forest department were also studied as well as the local people were enquired about the presence of faunal species of the area.

### **3.23. DESCRIPTION OF BIODIVERSITY OF THE STUDY AREA**

#### **3.23.1. FLORA**

The project road starts from Rajasthan/Gujarat Border at Km 401+200 of NH-8 and ends near Ahmedabad (km 494+400 of NH 8). The road passes through the Aravali, Sabarkantha, Gandhinagar and Ahmedabad District of Gujarat. The existing road is part of the NH-8 from km 401+200 to km 494+400 near Ahmadabad. The widening of existing two lane section to six lane will be concentric with 3 lanes of 3.5m width and 1.5m paved shoulder on each side and a median.

To assess the existing baseline ecological status and the likely impact of on biological resources, terrestrial ecological survey of the project corridor have been carried out with reference to listing of species and ecological conditions of the corridors.

As per revised classification of the Indian Forest by Champion and Seth, the natural Forest of the tract (except that of Aravallis) has been placed in sub-ground 6-B i.e. Northern Tropical Thorn Forest. The major plant species along the road are Babul, Lucina, Khair, Neem, Amaltas, Khejri, Shisham, Kikar, Safeda etc., but survival rates are very poor. It is also found that road side plantation in the state of Rajasthan is declared as protected forest, so that permission from the forest department is mandatory for felling of any tree along the road.

There is no endangered /endemic flora or fauna within the study area.

Roadside trees will have an important impact pertaining to this project. This adverse implication needs to be taken into consideration with compensatory plantation along the proposed alignment. The road stretch has multiple rows of various species on either side such as Babool, Lucina, Neem, Siris, Shisham, Kikar, Safeda etc. and dominant species is Lucina. Entire linear plantation along the road (within ROW) is notified as protected forest. The project road also passes through some blocks of Reserve Forest and notified protected forest.

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The flora in the study corridor is represented by social forestry in the agriculture land, trees along the project road. As per the Govt. of India Forest (Notifications), section, 29 of the Indian Forest Act, 1927, strips of forest or waste lands whether under trees grow or not on either side of the all roads, canals and railways are declared as protected forest. Under this notification all strips of Government waste lands have been demarcated by boundary pillars for the management and maintenance of trees, grow or not as either side of all Roads, Canals and Railways. The natural vegetation of the study area may be broadly noted under three types i.e.

- The vegetation along water bodies
- Avenue trees exist along the project road
- Social Forestry in agriculture land

The project site falls in tropical dry deciduous forest of Aravalli range. The forest vegetation includes the grasses, shrubs and thorny trees. A detailed survey of trees falling along the project has been conducted with respect to girth size, type of species in 60-meter-wide strip to assess the degree of impacts on the flora due to widening of six lanes of existing four lane highway. The list of common tree species in the project area is given below.

**Table 3-17: List of Flora along Project Road**

S No.	Tree	Common name	Family
1	<i>Acacia auriculiformis</i> Benth.	Australian acacia	Fabaceae
2	<i>Acacia catechu</i>	Khair	Fabaceae
3	<i>Acacia nilotica</i> (Benth.) Brenan	Baval	Mimosoideae
4	<i>Aegle marmelos</i>	Bili	Rutaceae
5	<i>Ailanthus excelsa</i> Roxb.	Arduso	Simaroubaceae
6	<i>Albizia lebbek</i> (L.) Benth.	Kalo siris	Mimosoideae
7	<i>Alstonia scholaris</i> (L.) R. Br.	Saptaparni	Apocynaceae
8	<i>Annona squamosa</i> L.	Sitaphal	Annonaceae
9	<i>Azadirachta indica</i> A.Juss.	Limdo	Meliaceae
10	<i>Bauhinia purpurea</i>	Kachnar	Fabaceae
11	<i>Bauhinia racemosa</i>	Ashitro	Fabaceae
12	<i>Bismarckia nobilis</i>	Bismarck Palm	Arecaceae
13	<i>Bombax ceiba</i>	Shimdo	Malvaceae
14	<i>Butea monosperma</i> (Lam.) Taub.	Kesudo	Fabaceae
15	<i>Carica papaya</i> L.	Papaya	Caricaceae
16	<i>Cassia fistula</i> L.	Garmalo	Subfamily:
17	<i>Casuarina equisetifolia</i> L.	Saru	Casuarinaceae
18	<i>Cocos nucifera</i> L.	Nariyal	Arecaceae
19	<i>Delonix elata</i> (L.) Gamble	Pilo gulmohar	Caesalpinioideae
20	<i>Ehretia laevis</i> Roxb.	Datrango	Ehretiaceae
21	<i>Ficus benghalensis</i> L.	Vad	Moraceae
22	<i>Ficus religiosa</i>	Pipdo	Moraceae
23	<i>Hyophorbe lagenicaulis</i> (L.H.Bailey) H.E.Moore	Bottle Palm	Arecaceae

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S No.	Tree	Common name	Family
24	<i>Leucaena leucocephala</i> (Lam.) de Wit	Pardesi baval	Mimosoideae
25	<i>Madhuca longifolia</i> (J. Konig) J. F. Macbr.	Mahudo	Sapotaceae
26	<i>Millettia peguensis</i>	Moulmein rosewood	Faboideae
27	<i>Moringa oleifera</i> Lam.	Saragavo	Moringaceae
28	<i>Murraya koenigii</i> (L.) Spreng.	Mitho limdo	Rutaceae
29	<i>Peltophorum pterocarpum</i> (DC.) K. Heyne	Sonmohar	Caesalpinioideae
30	<i>Phoenix sylvestris</i> (L.) Roxb.	Khajuri	Arecaceae
31	<i>Pongamia pinnata</i> (L.) Pierre	Karanj	Faboideae
32	<i>Prosopis cineraria</i> (L.) Druce	Khijado	Mimosoideae
33	<i>Prosopis juliflora</i> (Sw.) DC.	Gando baval	Mimosoideae
34	<i>Psidium guajava</i> L.	Jamphal	Myrtaceae
35	<i>Pterospermum acerifolium</i> (L.) Willd.	Muchkund	Malvaceae
36	<i>Senna siamea</i> (Lam.) H. S. Irwin & Barneby	Kaashid	Caesalpinioideae
37	<i>Spathodea campanulata</i> P. Beauv.	Spathodea	Bignoniaceae
38	<i>Syzygium cumunii</i>	Jambudo	Myrtaceae
39	<i>Tabebuia rosea</i> DC.	Pink Tabebuia	Bignoniaceae
40	<i>Tamarindus indica</i> L.	Amli	Caesalpinioideae
41	<i>Tectona grandis</i> L. f.	Saag	Verbenaceae
42	<i>Terminalia catappa</i> L.	Deshi badam	Combretaceae

**Table 3-18: Shrubs found in the Study Area**

SN	Botanical Name	Local Name	Family
1	<i>Alternanthera dentata</i> L.	Lal menhdi	Amaranthaceae
2	<i>Calotropis gigantea</i> (L.) Dryand.	Safed Ankdo	Apocynaceae
3	<i>Calotropis procera</i> (Aiton) Dryand.	Ankdo	Apocynaceae
4	<i>Capparis decidua</i> (Forssk.) Edgew.	Kerdo	Capparaceae
5	<i>Dendrophthoe falcata</i> (L. f.) Ettingsh	Vaando	Loranthaceae
6	<i>Euphorbia neriifolia</i> L.	Thor	Euphorbiaceae
7	<i>Hibiscus rosa-sinensis</i> L.	Jasud	Malvaceae
8	<i>Ipomoea carnea</i> Jacq.	Naphatio	Convolvulaceae
9	<i>Ixora coccinea</i> L.	Ixora	Rubiaceae
10	<i>Jatropha integerrima</i> Jacq.	Spicy Jatropha	Euphorbiaceae
11	<i>Lantana camara</i> L.	Tantaniyu	Verbenaceae
12	<i>Lawsonia inermis</i> L.	Mendhi	Lythraceae
13	<i>Nerium oleander</i> L.	Lal Karan	Apocynaceae
14	<i>Opuntia elatior</i> Mill	Hathio thor	Opuntiaceae
15	<i>Pandanus odorifer</i> (Forssk.) Kuntze	Kevda	Pandanaceae
16	<i>Ricinus communis</i> L.	Divel	Euphorbiaceae
17	<i>Tabernaemontana divaricata</i> (L.) R. Br.	Chandni	Apocynaceae
18	<i>Tecoma stans</i> (L.) Juss. Ex Kunth.	Tecoma	Bignoniaceae
19	<i>Thuja occidentalis</i> L.	Vidya	Cupressaceae
20	<i>Ziziphus nummularia</i> (Burm. f.) Wight & Arn.	Chani bor	Rhamnaceae

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**Table 3-19: Herbs & Grasses found in the Study Area**

SN	Botanical Name	Local Name	Family
1	<i>Abelmoschus moschatus Medik.</i>	Jungli bhindo	Malvaceae
2	<i>Abutilon indicum (L.) Sweet</i>	Kanski	Malvaceae
3	<i>Achyranthes aspera L.</i>	Anghedi	Amaranthaceae
4	<i>Asparagus racemosus Willd</i>	Satavari	Asparagaceae
5	<i>Barleria prionitis L.</i>	Pilo kantasheliyo	Acanthaceae
6	<i>Catharanthus roseus (L.) G.Don</i>	Barmasi	Apocynaceae
7	<i>Chorchorus capsularis L.</i>	Chunch	Malvaceae
8	<i>Cyanthillium cinereum (L.) H.Rob.</i>	Sahdevi	Asteraceae
9	<i>Datura innoxia Mill.</i>	Dhaturo	Solanaceae
10	<i>Datura metel</i>	Ganthoval	Solanaceae
11	<i>Eclipta prostrata (L.) L.</i>	Bhangro	Asteraceae
12	<i>Euphorbia hirta L.</i>	Dudhli	Euphorbiaceae
13	<i>Gaillardia pulchella Foug</i>	Gaillardia	Asteraceae
14	<i>Hymenocallis littoralis(Jacq.) Salisb.</i>	Spider lily	Amarylildaceae
15	<i>Indigofera linnaei Ali.</i>	Gali	Faboidae
16	<i>Parthenium hysterophorus</i>	Gazargas	Asteraceae
17	<i>Sida cordifolia L.</i>	Bala	Malvaceae
18	<i>Tephrosia purpurea (L.) Pers.</i>	Sarphankho	Faboidae
19	<i>Tridax procumbens (L.)</i>	Pardeshi bhangro	Asteraceae
20	<i>Typha angustifolia L.</i>	Gha Bajariyu	Typhaceae
21	<i>Xanthium strumarium L.</i>	Gadariyu	Asteraceae

**Table 3-20: Agricultural Crops found in Study Area**

SN	Scientific Name	Family	Vernacular Name
1	<i>Triticum aestivum</i>	Poaceae	Gehu
2	<i>Oryza sativa</i>	Poaceae	Chokha
3	<i>Sorghum vulgare</i>	Poaceae	Bajra
4	<i>Sorghum bicolor</i>	Poaceae	Jowar
5	<i>Gossypium herbaceum</i>	Malvaceae	Kapas
6	<i>Cuminum cyminum</i>	Apiaceae	Jiru

### 3.23.2. FAUNA OF THE STUDY AREA

**Table 3-21: Mammals in Study Area**

SN	Common Name	Scientific Name	Vernacular Name	Status
1	Blue bull	<i>Boselaphus tragocamelus</i>	Nilgai	LC/ III
2	Jackal	<i>Canis aureus</i>	Makadi	LC/ II
3	Five striped palm squirrel	<i>Funambulus penanti</i>	Khiskoli	LC
4	Chinkara	<i>Gazella bennettii</i>	Chinkara	LC
5	Indian Hare	<i>Lepus nigricollis</i>	Khargosh	LC/ IV
6	Pale Hedgehog	<i>Paraechinus micropus</i>	-	LC/ II
7	Indian Flying fox	<i>Pteropus giganteus</i>	Udan lomdi	LC/ V
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SN	Common Name	Scientific Name	Vernacular Name	Status
8	Hanuman langur	<i>Semnopithecus entellus</i>	Vandra	LC/ II
9	Grey musk shrew	<i>Suncus murinus</i>	Chhuchhundar	LC/ IV
<b>Status</b> IUCN Status/Schedule as per Wildlife Protection Act, 1972 <b>Abbreviations:</b> LC = Least Concerned; NT = Near Threatened,				

**Table 3-22: Birds Species found in the Study Area**

SN	Common Name	Scientific Name	Vernacular Name	Status
1	Shikra	<i>Accipiter badius</i>	-	LC/ R/ I
2	Common myna	<i>Acridotheres tristis</i>	-	LC/ R/ IV
3	Common Kingfisher	<i>Alcedo atthis</i>	Lagothi	LC/ R/ IV
4	House Swift	<i>Apus affinis</i>	-	LC/ R
5	Pond heron	<i>Ardeola grayii</i>	-	LC/ R / IV
6	Cattle egret	<i>Bulbucus ibis</i>	-	LC/ R/ IV
7	Crow- pheasant	<i>Centropus sinensis</i>	-	LC/ R
8	Oriental Magpie Robin	<i>Copsychus saularis</i>	Daiyad	LC/ R
9	Indian Roller	<i>Coracias benghalensis</i>	Nilkant	LC/RM
10	Common crow	<i>Corvus splendens</i>	Kagdo	LC/ R/ V
11	Indian tree pie	<i>Dendrocitta vagabunda</i>	Khakhedo	LC/ R/ V
12	Black drongo	<i>Dicrurus adsimilis</i>	-	LC/ R/ IV
13	Little egret	<i>Egretta garzetta</i>	-	LC/ R/ IV
14	Black winged kite	<i>Elanus caeruleus</i>	-	LC/ R
15	Indian koel	<i>Eudynamys scolopaceus</i>	Koyal	LC/ R
16	White throated	<i>Halcyon smyrensis</i>	-	LC/ R/ IV
17	Blank-winged stilt	<i>Himantopus himantopus</i>	-	LC/ R/ IV
18	Coppersmith barbet	<i>Megalaima haemacephala</i>	-	LC/ R/ IV
19	Median Egret	<i>Mesophoyx intermedia</i>	-	LC/ R
20	Black kite	<i>Milvus migrans</i>	-	LC/ R
21	White Wagtail	<i>Motacilla alba</i>	-	LC/M
22	Yellow wagtail	<i>Motacilla flava melanogrisea</i>	Matano pilakya	LC/M
23	Purple sunbird	<i>Nectarinia asiatica</i>	Phul chakli	LC/ R
24	Golden oriole	<i>Oriolus oriolus</i>	Peelak	LC/ R
25	Tailor bird	<i>Orthotomus sutorius</i>	Darjido	LC/ R
26	House sparrows	<i>Passer domesticus</i>	-	LC/ R
27	Rose ringed	<i>Psittacula krameri</i>	-	LC/ R/ IV
28	Red vented bulbul	<i>Pycnonotus cafer</i>	Bulbul	LC/ R/ IV
29	Indian robin	<i>Saxicoloides fulicatus</i>	-	LC/ R
30	Spotted dove	<i>Streptopelia chinensis</i>	Vana holi	LC/R
31	Indian ring dove	<i>Streptopelia decaocto</i>	Dhol	LC/R
32	Common babbler	<i>Turdoides caudatus</i>	Sheradi	LC/R
33	Jungle babbler	<i>Turdoides striatus</i>	Vana laledo	LC/ R/ IV

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SN	Common Name	Scientific Name	Vernacular Name	Status
34	Red-wattled lapwing	<i>Vanellus indicus</i>	Titodi	LC/ R
<b>*Status:</b> IUCN Status/ Migratory Status/ Schedule as per Wildlife Protection Act, 1972 <b>Abbreviations:</b> R = Resident; M = Migrant; RM = Resident Migrant, LC = Least Concerned ; NT = Near Threatened				

**Table 3-23: Reptiles in the Study Area**

SN	Common Name	Scientific Name	Vernacular Name	Status
1	Common skink	<i>Mabuya carinata</i>	Sani mashi	LC/ IV
2	Indian cobra	<i>Naja naja</i>	Nag	NT/ II
3	Checkered keelback	<i>Xenochrophis piscator</i>	Dendu	LC/ II
4	Sand Boa	<i>Eryx johnii</i>	-	LC/ IV
5	Common rat snake	<i>Ptyas mucosus</i>	Dhaman	LC/ IV
6	Fan-throated lizard	<i>Sitana ponticeriana</i>	-	NT
11	Common skink	<i>Mabuya carinata</i>	Sani mashi	LC/ IV
<b>*Status:</b> IUCN Status/ Migratory Status/ Schedule as per Wildlife Protection Act, 1972 <b>Abbreviations:</b> R = Resident; M = Migrant; RM = Resident Migrant, LC = Least Concerned; NT = Near Threatened				

**Table 3-24: Amphibians in the Study Area**

Sl	Scientific Name	Common Name	Schedule
1	<i>Euphlyctis cyanophlytis</i>	Skipper Frog	IV
2	<i>Bufo melanostictus</i>	Common Indian Toad	IV
<b>*Status:</b> IUCN Status/ Migratory Status/ Schedule as per Wildlife Protection Act, 1972 <b>Abbreviations:</b> R = Resident; M = Migrant; RM = Resident Migrant, LC = Least Concerned; NT = Near Threatened			

**Table 3-25: Butterflies in the Study Area**

SN	Scientific Name	Common Name
1	<i>Acraea violae</i>	Tawny coster
2	<i>Catopsilia pomona</i>	Common emigrant
3	<i>Cepora Nerissa</i>	Common Gull
4	<i>Graphium doson</i>	Common Jay
5	<i>Papilio demoleus</i>	Common Lime
6	<i>Papilio polytes</i>	Common Mormon
7	<i>Pachliopta aristolochiae</i>	Common Rose
8	<i>Pareronia hippia</i>	Common wanderer
9	<i>Chilades parrhasius</i>	Indian cupid
10	<i>Delias eucharis</i>	Indian Jezebel
11	<i>Lampides boeticus</i>	Pea blue
12	<i>Danaus chrysippus</i>	Plain tiger

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SN	Scientific Name	Common Name
13	<i>Danaus genutia</i>	Striped tigers
14	<i>Graphium agamemnon</i>	Tailed Jay
15	<i>Ixias marianne</i>	White Orange tip
16	<i>Ixias pyrene</i>	Yellow Orange tip

**Table 3-26: Insects in Study Area**

SN	Scientific Name	Common Name
1	<i>Mylabris sp.</i>	Beetle
2	<i>Camponotus compressus</i>	Black ant
3	<i>Gryllus bimaculatus</i>	Field cricket
4	<i>Conocephalus sp.</i>	Grasshopper
5	<i>Apis dorsata</i>	Honey bee
6	<i>Gryllus domestica</i>	House cricket
7	<i>Musca domestica</i>	House fly
8	<i>Anopheles sp.</i>	Mosquito
9	<i>Acridium sp.</i>	Pigmy locust
10	<i>Oecophylla smaragdina</i>	Red ant
11	<i>Orthetrum sp.</i>	Skimmer dragonfly
12	<i>Gerris lacustris</i>	Water strider

**Table 3-27: Inland Water Fishes**

SN	Local Name
1	Catla
2	Rohu
3	Mrigal
4	Kalbasu
5	Murrel
6	Mullet
7	Fel
8	Levta
9	Hilsa

Source: As reported by local fishermen





**Casia tora**



**Flacourtia indica**



**Barleria cuspidata**



**Anaphalis contortis**



**Capparis grandis**



**Butea monosperma**





**Sonchus arvensis**



**Parthenium hysterophorus**



**Ziziphus nummularia**



**Calotropis procera**



**Acacia nilotica**





*Acridotheres tristis*



*Sturnus pagodarum*




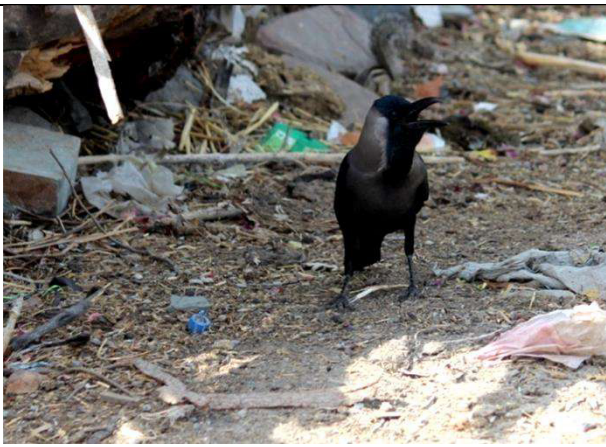




*Passer domesticus*



*Ardeola grayii*





<i>Vanellus indicus</i>	<i>Pycnonotus cafer</i>
	
<i>Merops orientalis</i>	<i>Corvus splendens</i>
	
<i>Upupa epops</i>	<i>Streptopelia senegalensis</i>
	
<i>Psittacula krameri</i>	<i>Dendrocitta vagabunda</i>

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### 3.23.3. FOREST

The project road passes through the Aravali, Sabarkantha, Gandhinagar and Ahmedabad District of Gujarat. The forest covers of the state of Rajasthan, based on satellite data of the year 2003, is 15,826 sq. Km in a whole which constitute 4.62 % of total geographical area of the state and the forest cover of the Gujarat is 14946 sq. km which constitute 7.62 % of the total geographical area of the state.

As the project site exiting in the eastern part of Gujarat and part of section in South-eastern of Rajasthan, therefore, entire project site have the vegetation endemic to dry region. There is no Mangrove vegetation and areas of sand dunes along the project road are reported.

### 3.23.4. NATIONAL PARKS, WILDLIFE SANCTUARIES & BIOSPHERE RESERVE

The road does not traverse through any wildlife Sanctuary, National Park or Biosphere in the study area.

## 3.24. SOCIO-ECONOMIC ENVIRONMENT

### 3.24.1. ARCHAEOLOGICAL / HISTORICAL / RELIGIOUS STRUCTURES

There are no archaeological sites / monuments or historical places in the project area within 60 m of corridor. The project highway traverses through a number of settlements and is dotted with religious and cultural properties, which though not of archaeological significance are nevertheless, very significant to the community. A View of religious structure presence along the project corridor is depicted in Figure.



**View of Religious and Cultural Property along Project Road**

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### **3.24.2. SEISMICITY**

The project area does not have any history of severe earthquake damage. As per state wise seismic zonation (Seismic Zoning Map IS: 2000), the project road falls in Ajmer Aravali, Saharkantha, Gandhinagar and Ahemdabad districts. The project area falls under seismic zone I, II and III, means that project road falls under very low to moderate damage risks zone.

### **3.24.3. HUMAN HEALTH**

The survey of human health problems along the road suggests that inhabitants of urban areas mostly complain about the increase in respiratory illness in the form of asthma, recurrence of cold and cough. There was no acute diseases are reported in the project area due to road construction and operation.

### **3.24.4. GENERAL ECONOMIC CONDITION**

The project area represents rural as well as industrial and economy is mainly based on agricultural/ industries. The main cereal crops are wheat, barley, maze, millet, gram and Pulses. Majority of people living in the project area belong to the middle and lower middle class. Caste hierarchy seems to exist in the social strata. Primary occupation of the people living along the project highway is agriculture/industries and transport related activities. Activities also include services like small workshops, dhabas, spare parts of automobile etc.

### **3.24.5. ANIMAL HUSBANDRY**

Cows, buffaloes, goats and sheep's are the main livestock of the project area.

### **3.24.6. ROAD SAFETY**

Human safety is an important issue along the road as road is used by pedestrians, cyclists, animals, herdsmen as well as bullock carts, scooters, cars, buses, vehicles carrying hazardous industrial goods and trucks. These combinations create hazardous conditions for all the road users. Poor pavement structure and lack of warning / informatory signs and incidental parking particularly in urban stretches seem to be the reasons for accidents on the road. The number of serious accidents is correlated with the total number of accidents involving heavy vehicles. It has been observed that accidents involving trucks and buses constitute about 80% of the total accidents.

### **3.24.7. ECONOMIC DEVELOPMENT**

#### **3.24.7.1. MINERAL DEVELOPMENT**

No mining or mineral development activities found along the project corridor.

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### 3.24.7.2. SOCIAL IMPACT ASSESSMENT

The preceding exercise has helped in identifying the potential social issues along the corridor. The outputs coupled with the results of preliminary community consultation, which was carried out at selected locations along the project corridors helped in identifying the potential social issues.

### 3.24.7.3. PROJECT INFLUENCE STATE – RAJASTHAN

Located in northwest India, Rajasthan borders Punjab in the north, Haryana and Uttar Pradesh in the northeast, Madhya Pradesh in the east and Gujarat in the south. On the western side, it shares a long stretch of border with the neighboring country Pakistan. Demographic profile of Rajasthan State is given in Table 3.28.

**Table 3-28: Demographic Profile of Rajasthan State**

Description	Total		
	Total	Rural	Urban
No. of Household	9317675	7054434	2263241
Total Population	56507188	43292813	13214375
Total Population (Male)	29420011	22426640	6993371
Total Population (Female)	27087177	20866173	6221004
Population (0-6 years) (Total)	10651002	8587389	2063613
Population (0-6 years) (Male)	5579616	4486277	1093339
Population (0-6 years) (Female)	5071386	4101112	970274
Schedule Caste (Total)	9694462	7739926	1954536
Schedule Caste (Male)	5067679	4042156	1025523
Schedule Caste (Female)	4626783	3697770	929013
Schedule Tribe (Total)	7097706	6717830	379876
Schedule Tribe (Male)	3650982	3445719	205263
Schedule Tribe (Female)	3446724	3272111	174613
Literate (Total)	27702010	19205424	8496586
Literate (Male)	18047157	12946326	5100831
Literate (Female)	9654853	6259098	3395755
Illiterate (Total)	28805178	24087389	4717789
Illiterate (Male)	11372854	9480314	1892540

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Description	Total		
	Total	Rural	Urban
Illiterate (Female)	17432324	14607075	2825249
Total Worker (Total)	23766655	19856423	3910232
Total Worker (Male)	14695802	11379536	3316266
Total Worker (Female)	9070853	8476887	593966
Main Worker (Total)	17436888	13962042	3474846
Main Worker (Male)	12841318	9771540	3069778
Main Worker (Female)	4595570	4190502	405068
Main Worker Cultivator (Total)	9582029	9407373	174656
Main Worker Cultivator (Male)	6210884	6089141	121743
Main Worker Cultivator (Female)	3371145	3318232	52913
Main Worker Agricultural Laborer (Total)	1008417	965480	42937
Main Worker Agricultural Laborer (Male)	654162	623075	31087
Main Worker Agricultural Laborer (Female)	354255	342405	11850
Main Worker Household Industry (Total)	501312	317220	184092
Main Worker Household Industry (Male)	373083	235591	137492
Main Worker Household Industry (Female)	128229	81629	46600
Main Other Worker (Total)	6345130	3271969	3073161
Main Other Worker (Male)	5603189	2823733	2779456
Main Other Worker (Female)	741941	448236	293705
Marginal Worker (Total)	6329767	5894381	435386
Marginal Worker (Male)	1854484	1607996	246488
Marginal Worker (Female)	4475283	4286385	188898
Marginal Worker Cultivator (Total)	3558037	3514001	44036
Marginal Worker Cultivator (Male)	851842	842224	9618
Marginal Worker Cultivator (Female)	2706195	2671777	34418
Marginal Worker Agricultural Laborer (Total)	1515302	1471086	44216

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Description	Total		
	Total	Rural	Urban
Marginal Worker Agricultural Laborer (Male)	401170	386076	15094
Marginal Worker Agricultural Laborer (Female)	1114132	1085010	29122
Marginal Worker Household Industry (Total)	176679	129471	47208
Marginal Worker Household Industry (Male)	46445	33689	12756
Marginal Worker Household Industry (Female)	130234	95782	34452
Marginal Other Worker (Total)	1079749	779823	299926
Marginal Other Worker (Male)	555027	346007	209020
Marginal Other Worker (Female)	524722	433816	90906
Non Worker (Total)	32740533	23436390	9304143
Non Worker (Male)	14724209	11047104	3677105
Non Worker (Female)	18016324	12389286	5627038

Source: Census Record 2001

### 3.24.8. DEMOGRAPHIC PROFILE

Rajasthan is the eighth largest State in India. According to the Census Records 2001, population of Rajasthan is 56507188 contributing to 5.49% of the total country's population. Of this, 43292813 are males and 13214375 are females. Percentage of Scheduled Caste and Scheduled Tribe population is 17.16 per cent and 12.56 per cent, respectively. Similar, proportion at India level is 17.16% and 8.2%, respectively. Sex ratio i.e. number of females per 1000 males for the State is 921 as compared to 933 at India level.

The population density of Rajasthan is 165 persons per sq.km, little less than half of that of India. Rajasthan ranks 24th in population density amongst all the States in India.

#### 3.24.8.1. PROFILE OF PROJECT INFLUENCE DISTRICT

##### 3.24.8.1.1. ARAVALLI DISTRICT

The district has been named for the Aravalli Hills that run across Gujarat and Rajasthan. It is one of 7 new districts in the state whose formation has been approved by the Government of Gujarat. The Aravalli district consists of the talukas of Khedbrahma, Idar, Vadali, Bhiloda and Vijaynagar talukas of Sabarkantha district and the newly constituted taluka of Poshina. The district is predominantly tribal and its formation, announced in the run up to the Assembly elections in Gujarat in 2012, was seen as an attempt by the ruling Bharatiya Janata Party government to woo tribal voters Aravalli District (also Aravali) is a district in the state of Gujarat in India that came into being on January 26, 2013, becoming the 29th district of the state.

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Aravalli district is carved out of Sabarkantha district having geographical area of 3,217.19 sq. km. and became twenty ninth district of Gujarat State on August 15, 2013. Aravalli district consists of Modasa, Malpur, Dhansura, Meghraj, Bhiloda and Bayad taluka of former Sabarkantha district. The headquarter offices are located at Modasa. Meghraj, Malpur and Bhiloda are tribal dominated talukas. The district includes 676 villages and 295 village panchayats. Geographically it lies over the Ahmedabad district, which comes between 23.20° to 23.62° degree at Northern latitude and 73.24° to 73.37° degree at Eastern latitude side.

**Table 3-29: Important Statistics of Aravalli District**

Description	Details	Gujarat State	Aravalli District
Number of Villages	Total	18,225	676
	Inhabited	17,843	NA
	Uninhabited	382	NA
Number of Towns	Statutory	195	2
	Census	153	10
	Total	348	12
Number of Households	Normal	1,22,48,428	1,89,008
	Institutional	36,925	NA
	Houseless	NA	NA
Population Total	Persons	6,04,39,692	9,54,384
	Males	3,14,91,260	4,88,112
	Females	2,89,48,432	4,66,272
<b>Rural</b>	Persons	3,46,94,609	9,13,404
	Males	1,77,99,159	4,66,981
	Females	1,68,95,450	4,46,423

**Table 3-30: Demographic Profile of Gujarat State**

Description	Details	Gujarat State	Gandhinagar District
Urban	Persons	2,57,45,083	40,980
	Males	13692101	21,131
	Females	1,20,52,982	19,849
Percentage Urban		42.59632	12.17

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Description	Details	Gujarat State		Gandhinagar District	
Population					
Area (in sq Km.)		196244		3,217	
Density of population (Persons per sq Km.)		308		323	
Sex Ratio (Number of females per 1000 males)	Total	919		953	
	Rural	949		NA	
	Urban	880		NA	
Literates		Number	%	Number	%
	Persons	4,10,93,358	78.03164	6,81,672	65.5505
	Males	2,34,74,873	85.75022	4,00,281	38.4915
	Females	1,76,18,485	69.67531	2,81,391	27.0589
Scheduled Castes	Persons	40,74,447	6.741343	57,593	5.5382
	Males	21,10,331	6.701323	29,574	2.8439
	Females	19,64,116	6.784879	28,019	2.6943
Scheduled Tribes	Persons	89,17,174	14.75384	2,11,488	20.3370
	Males	45,01,389	14.29409	1,06,102	10.2046
	Females	44,15,785	15.25397	1,05,368	10.1324
Total Workers (Main and Marginal)		Number	%	Number	%
	Persons	2,47,67,747	40.97927	4,48,209	46.9632
	Males	1,80,00,914	57.16162	2,71,961	28.4960
	Females	67,66,833	23.37547	1,76,248	18.4672
(i) Main Workers		Number	%	Number	%
	Persons	2,03,65,374	82.22538	3,14,049	30.1994
	Males	1,65,67,695	92.03808	2,36,036	22.6976
	Females	37,97,679	56.12196	78,013	7.5018
(ii) Marginal Workers		Number	%	Number	%
	Persons	44,02,373	17.77462	1,34,160	14.0572
	Males	14,33,219	7.961923	35,925	3.7642

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Description	Details	Gujarat State		Gandhinagar District	
	Females	29,69,154	43.87804	98,235	1.2930
Non-Workers	Persons	3,56,71,945	59.02073	5,06,175	53.0368
	Males	1,34,90,346	42.83838	2,16,151	22.6482
	Females	2,21,81,599	76.62453	2,90,024	30.3887
Category of Workers	Persons	54,47,500	21.99433	1,60,330	15.4176
(i) Cultivators	Males	42,44,449	23.57907	1,42,915	13.7429
	Females	12,03,051	17.77864	17,415	1.6747
(ii) Agricultural Labourers	Persons	68,39,415	27.6142	65,773	6.3248
	Males	36,49,591	20.27448	41,781	4.0177
	Females	31,89,824	47.1391	23,992	2.3071
(iii) Workers in household industry	Persons	3,43,999	1.388899	2,531	2.2434
	Males	2,10,561	1.169724	1,712	0.1646
	Females	1,33,438	1.971942	819	0.788
(iv) Other Workers	Persons	1,21,36,833	49.00257	85,415	8.2136
	Males	98,96,313	54.97673	49,628	4.7723
	Females	22,40,520	33.11032	35,787	3.4413

**Table 3-31: Important Statistics of Gujarat State**

Industrial Scenario during 2014-15	Type of Enterprises		
(Enterprises including Manufacturing & Service Sector)	No. of Registered units	Total Investment Rs. In Lacs	Employment
Micro	11	326.57	148
Small	8	2764.56	110
Medium	2	3104.50	26

### 3.24.8.1.2. SABARKANTHA DISTRICT

#### General Characteristics of the District

The district is situated between 23.03 and 24.30 North Latitude and between 72.43 to 73.39 East longitude. the district is bounded by Panchmahals district in the east, by Ahmedabad, Kheda and

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Gandhinagar district in the South and Banasakantha and Mehsana in the West and Rajsthan state in the North. total geographical area of the district is 7390 Sq.Km which is 4.2% of the Gujarat state.

**ADMINISTRATIVE SET UP** - The headquarter of Sabarkantha district is at Himatnagar and two sub division Himatnagar & modasa. There are 8 township, 13 taluks and 1372 villages in the district. the district collector is the overall administrative head. major Deptt., & Offices situated at district headquarter at Himatnagar taluka.

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

In 2011, Sabarkantha had population of 2,428,589 of which male and female were 1,244,231 and 1,184,358 respectively. In 2001 census, Sabarkantha had a population of 2,082,531 of which males were 1,069,554 and remaining 1,012,977 were females. Sabarkantha District population constituted 4.02 percent of total Maharashtra population. In 2001 census, this figure for Sabarkantha District was at 4.11 percent of Maharashtra population.

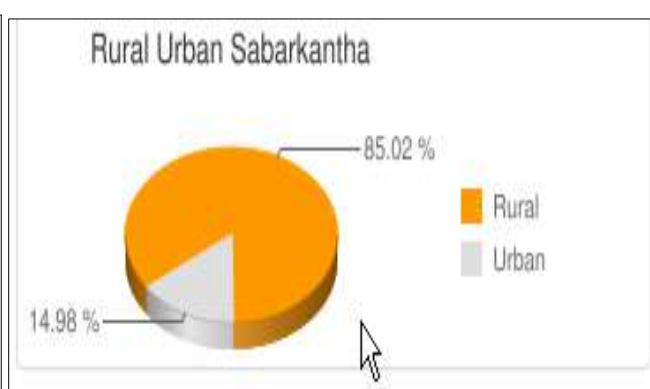
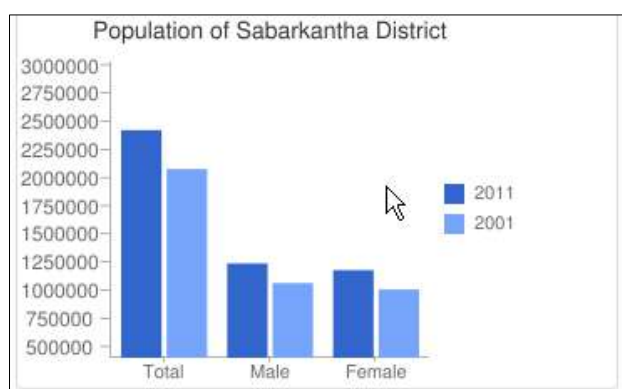
There was change of 16.62 percent in the population compared to population as per 2001. In the previous census of India 2001, Sabarkantha District recorded increase of 18.25 percent to its population compared to 1991.

**Table 3-32: Demographic Profile of Sabarkantha District**

Description	2011	2001
Population	24.29 Lakhs	20.83 Lakhs
Actual Population	2,428,589	2,082,531
Male	1,244,231	1,069,554
Female	1,184,358	1,012,977
Population Growth	16.62%	18.25%
Area Sq. Km	7,394	7,394
Density/km2	328	282
Proportion to Gujarat Population	4.02%	4.11%
Sex Ratio (Per 1000)	952	947
Child Sex Ratio (0-6 Age)	903	879
Average Literacy	75.79	66.65
Male Literacy	86.44	80.42
Female Literacy	64.69	52.30

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Description	2011	2001
Total Child Population (0-6 Age)	345,490	324,716
Male Population (0-6 Age)	181,529	172,786
Female Population (0-6 Age)	163,961	151,930
Literates	1,578,734	1,171,555
Male Literates	918,625	721,203
Female Literates	660,109	450,352
Child Proportion (0-6 Age)	14.23%	15.59%
Boys Proportion (0-6 Age)	14.59%	16.15%
Girls Proportion (0-6 Age)	13.84%	15.00%



### Sabarkantha District Literacy rate

Average literacy rate of Sabarkantha in 2011 were 75.79 compared to 66.65 of 2001. If things are looked out at gender wise, male and female literacy were 86.44 and 64.69 respectively. For 2001 census, same figures stood at 80.42 and 52.30 in Sabarkantha District. Total literate in Sabarkantha District were 1,578,734 of which male and female were 918,625 and 660,109 respectively. In 2001, Sabarkantha District had 1,171,555 in its district.

### Sabarkantha District sex ratio

With regards to Sex Ratio in Sabarkantha, it stood at 952 per 1000 male compared to 2001 census figure of 947. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 903 girls per 1000 boys compared to figure of 879 girls per 1000 boys of 2001 census data.

### Sabarkantha District Child population

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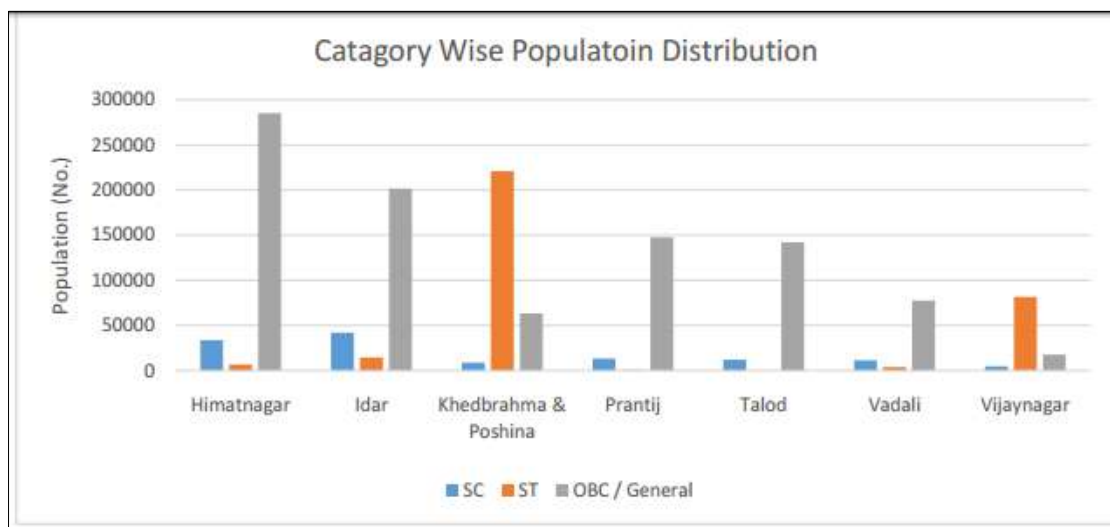
In census enumeration, data regarding child under 0-6 age were also collected for all districts including Sabarkantha. There were total 345,490 children under age of 0-6 against 324,716 of 2001 census. Of total 345,490 male and female were 181,529 and 163,961 respectively. Child Sex Ratio as per census 2011 was 903 compared to 879 of census 2001. In 2011, Children under 0-6 formed 14.23 percent of Sabarkantha District compared to 15.59 percent of 2001. There was net change of -1.36 percent in this compared to previous census of India.

### **Sabarkantha District Houseless**

In 2011, total 1,343 families live on footpath or without any roof cover in Sabarkantha district of Gujarat. Total Population of all who lived without roof at the time of Census 2011 numbers to 7,096. This approx 0.29% of total population of Sabarkantha district.

### **Category wise Population distribution**

The total number of SC and ST family members in the district are 1,25,462 and 3,28,243 respectively. In Khedbrahma & Poshina, the ST populace is to the tune of 15.91% (of total population in the district), highest of all the talukas, followed by Vijaynagar (05.86%). In case of SC population, the maximum persons are in Idar taluka (03.00%) followed by Himatnagar (02.43%). Other tehsils have less than 01% of SC population.



#### **3.24.8.1.3. GANDHINAGAR DISTRICT**

Gandhinagar district lies between 72.3`-73.7` East (Longitude) to 23.0`-23.6` North (Latitude) on the World Map. Geographical area of the district is 2,163.48 sq. km.

Gandhinagar is a capital city of Gujarat State. And, it is hardly 20 km away from Ahmedabad city. It is well connected with Ahmedabad city by rail, road and international airport. It has seven Special Economic Zones and ten Industrial Estates along with creative IT Park and Gujarat International

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Finance Tech City (GIFT); which are backbone and peacock feathers which keep pulses of economic heart of the district for persistent economic growth and in improving the living standard in the district.

### Population

Gandhinagar district is the 20th most populated district in the State. In Gandhinagar district, Sub-district Gandhinagar has the highest population (560497) whereas sub-district Mansa has the lowest (206567). Among villages of Gandhinagar district, Dabhoda village of Subdistrict Gandhinagar is the most populated villages with population 13891 and Rampura village of Kalol sub-district has the lowest population of 227.

### Sex Ratio

Gandhinagar district has a sex ratio of 923 (no. of females per 1000 males). Among sub-districts, Dehgam has the highest sex ratio (950) and Kalol has the lowest sex ratio (906). Gandhinagar has child sex ratio of 847. Dehgam has the highest child sex ratio of 879 and Mansa has the lowest child sex ratio of 823.

### Literacy

Average literacy rate of Gandhinagar in 2011 were 84.16 compared to 76.59 of 2001. If things are looked out at gender wise, male and female literacy were 92.01 and 75.76 respectively. For 2001 census, same figures stood at 87.74 and 64.58 in Gandhinagar District. Total literate in Gandhinagar District were 1,030,494 of which male and female were 582,686 and 447,808 respectively. In 2001, Gandhinagar District had 879,834 in its district.

### Economic Activity

The economy of the district is basically dependent on agriculture as 43.65% workers are engaged in agricultural activities. Food processing, Electronics and textiles are major industries concentrating in Gandhinagar district in which workers are engaged in Gandhinagar is a potential hub for IT sector.

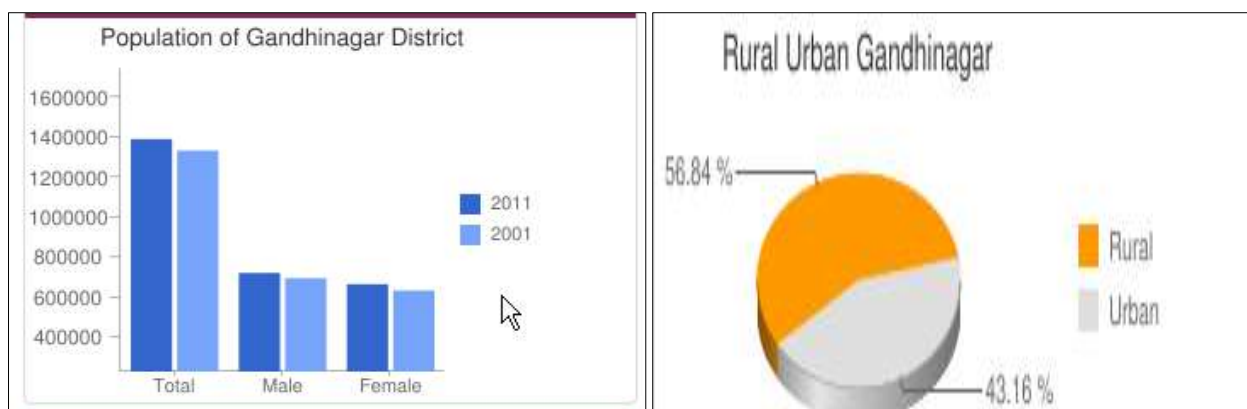
**Table 3-33: Demographic Profile of Gandhinagar District**

Description	2011	2001
Population	13.92 Lakhs	13.34 Lakhs
Actual Population	1,391,753	1,334,455
Male	723,864	697,999
Female	667,889	636,456
Population Growth	4.29%	21.73%
Area Sq. Km	2,140	2,140
Density/km <sup>2</sup>	650	617
Proportion to Gujarat Population	2.30%	2.63%

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Description	2011	2001
Sex Ratio (Per 1000)	923	912
Child Sex Ratio (0-6 Age)	847	813
Average Literacy	84.16	76.59
Male Literacy	92.01	87.74
Female Literacy	75.76	64.58
Total Child Population (0-6 Age)	167,377	185,696
Male Population (0-6 Age)	90,604	102,406
Female Population (0-6 Age)	76,773	83,290
Literates	1,030,494	879,834
Male Literates	582,686	522,575
Female Literates	447,808	357,259
Child Proportion (0-6 Age)	12.03%	13.92%
Boys Proportion (0-6 Age)	12.52%	14.67%
Girls Proportion (0-6 Age)	11.49%	13.09%



#### 3.24.8.1.4. AHMEDABAD DISTRICT

Ahmedabad District is one of the developed district of the Vibrant Gujarat. It is located in the middle region of Gujarat and lies between 21°-58' to 23°-3' North latitudes, 71°-37' to 72°-50' East Longitudes. The District is surrounded on the north by Mehsana and Gandhinagar district, on the South by Gulf of Cambay and Bhavnagar district, on the East by Kheda district and on the West by Surendranagar district. The total Geographical area of Ahmedabad District is 8087.59 Sq.K.M.

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

Ahmedabad district is located in Central Gujarat. It comes under Seismic Zone- III. Ahmedabad is one of the industrially developed district in the state of Gujarat having Large, Micro, Small and medium scale industries of various types. A large number of industries related to textiles, chemicals, machinery, metal products, pharmaceutical, engineering, plastics, electrical appliances, electronics, passenger cars etc. are located in the district. A well developed infrastructure, prudent industrial policy of the state government and a peaceful industrial atmosphere have been the vital factors which have contributed to the industrial growth in the district.

In 2011, Ahmadabad had population of 7,214,225 of which male and female were 3,788,051 and 3,426,174 respectively. In 2001 census, Ahmadabad had a population of 5,816,519 of which males were 3,074,556 and remaining 2,741,963 were females. Ahmadabad District population constituted 11.94 percent of total Maharashtra population. In 2001 census, this figure for Ahmadabad District was at 11.48 percent of Maharashtra population.

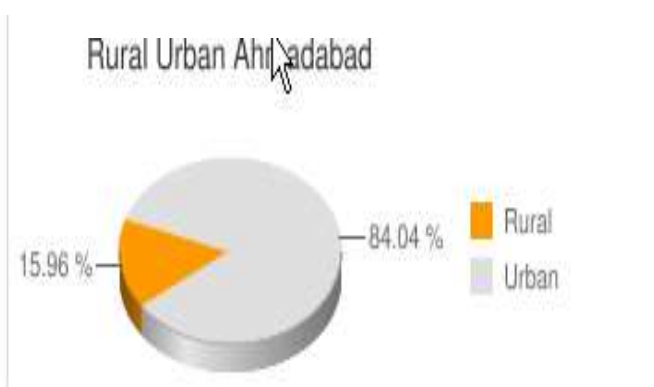
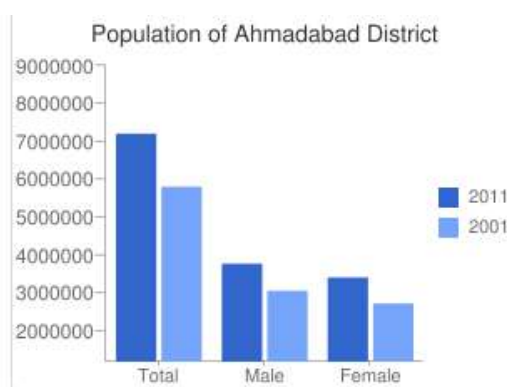
There was change of 24.03 percent in the population compared to population as per 2001. In the previous census of India 2001, Ahmadabad District recorded increase of 27.25 percent to its population compared to 1991

**Table 3-34: Demographic Profile of Ahmedabad District**

Description	2011	2001
Population	72.14 Lakhs	58.17 Lakhs
Actual Population	7,214,225	5,816,519
Male	3,788,051	3,074,556
Female	3,426,174	2,741,963
Population Growth	24.03%	27.25%
Area Sq. Km	8,107	8,107
Density/km2	890	719
Proportion to Gujarat Population	11.94%	11.48%
Sex Ratio (Per 1000)	904	892
Child Sex Ratio (0-6 Age)	857	836
Average Literacy	85.31	79.50
Male Literacy	90.74	87.31
Female Literacy	79.35	70.83

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Description	2011	2001
Total Child Population (0-6 Age)	842,518	769,666
Male Population (0-6 Age)	453,790	419,249
Female Population (0-6 Age)	388,728	350,417
Literates	5,435,760	4,012,140
Male Literates	3,025,463	2,318,295
Female Literates	2,410,297	1,693,845
Child Proportion (0-6 Age)	11.68%	13.23%
Boys Proportion (0-6 Age)	11.98%	13.64%
Girls Proportion (0-6 Age)	11.35%	12.78%



## Literacy

Average literacy rate of Ahmadabad in 2011 were 85.31 compared to 79.50 of 2001. If things are looked out at gender wise, male and female literacy were 90.74 and 79.35 respectively. For 2001 census, same figures stood at 87.31 and 70.83 in Ahmadabad District. Total literate in Ahmadabad District were 5,435,760 of which male and female were 3,025,463 and 2,410,297 respectively. In 2001, Ahmadabad District had 4,012,140 in its district.

## Sex – Ratio

With regards to Sex Ratio in Ahmadabad, it stood at 904 per 1000 male compared to 2001 census figure of 892. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 857 girls per 1000 boys compared to figure of 836 girls per 1000 boys of 2001 census data.

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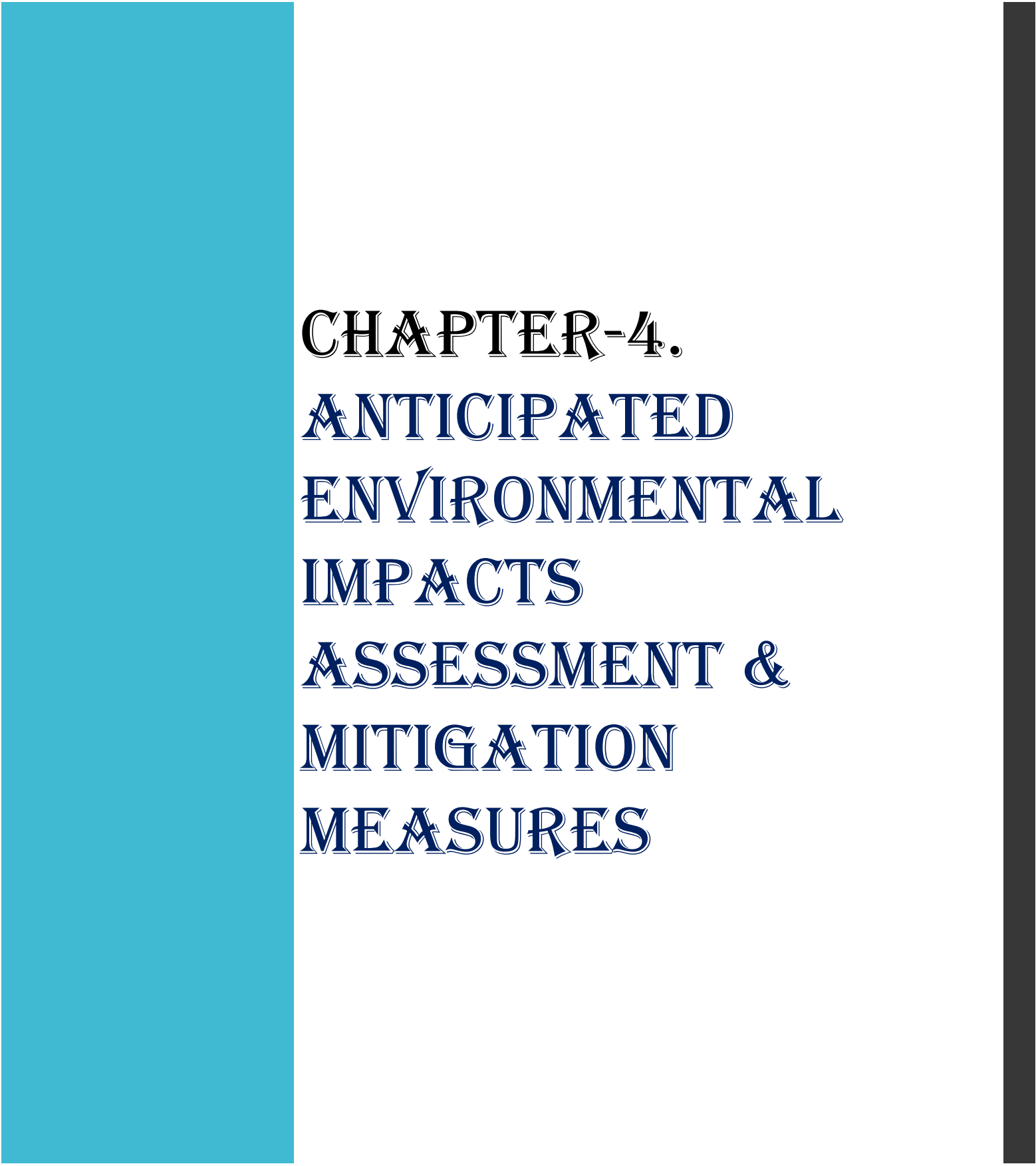
### Child Population

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Ahmadabad. There were total 842,518 children under age of 0-6 against 769,666 of 2001 census. Of total 842,518 male and female were 453,790 and 388,728 respectively. Child Sex Ratio as per census 2011 was 857 compared to 836 of census 2001. In 2011, Children under 0-6 formed 11.68 percent of Ahmadabad District compared to 13.23 percent of 2001. There was net change of -1.55 percent in this compared to previous census of India.

### Houseless

In 2011, total 3,902 families live on footpath or without any roof cover in Ahmadabad district of Gujarat. Total Population of all who lived without roof at the time of Census 2011 numbers to 13,869. This approx 0.19% of total population of Ahmadabad district.

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# CHAPTER-4.

## ANTICIPATED ENVIRONMENTAL IMPACTS ASSESSMENT & MITIGATION MEASURES



## 4. ANTICIPATED ENVIRONMENTAL IMPACTS ASSESSMENT AND MITIGATION MEASURES

### 4.1. INTRODUCTION

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural environmental components along the project corridor. For the assessment of impacts, the baseline information based on the field visits and the primary surveys of the various environmental components carried out. The description of the impacts on the individual components has been structured as per the discussion in **Chapter 3: Baseline Environmental Profile** of this report.

The impacts of the project are expected to be mostly direct and confined to the PROW. Only at critical locations where the engineering, environmental and social aspects have warranted a shift from the existing alignment, realignments have been proposed. The impacts on the various environmental attributes during construction as well as operation and mitigate measures have been discussed. Interaction of the project activities with environmental attributes is presented as activity-impact matrix is given in **Table 4.1**.

**Table 4.1: Activity-Impact Identification Matrix**

Sl. No.	Activities	Physical Environment			Biological Environment		Geology		Topography
		Air	Water	Noise	Flora	Fauna	Natural Drainage	Soil	
A. Construction Phase									
1	Labour Camp Activities		-ve/T						
2	Quarrying	-ve/T		-ve/T	-ve/T		-ve/T		-ve/P
3	Material Transport & Storage	-ve/T		-ve/T					
4	Earthwork						-ve/P	-ve/T	-ve/T
5	Pavement Works	-ve/T	-ve/T	-ve/T	-ve/T			-ve/T	-ve/P
6	Use of Construction Equipment	-ve/T	-ve/T	-ve/T		-ve/T			
7	Plantation	+ve/P		+ve/P	+ve/P				
8	Drainage Works						+ve/P		
9	Toll Plaza Construction	-ve/T		-ve/T					
10	Culvert & Bridge Construction		-ve/T	-ve/T			-ve/P		
11	Stripping of Topsoil							-ve/T	

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