3.0 BASELINE ENVIRONMENTAL STATUS

3.1 Introduction

This chapter illustrates the description of the existing environmental status of the study area with reference to the prominent environmental attributes. The study area covers 10 km radius from project boundary. The existing environmental setting is considered to adjudge the baseline environmental conditions, which are described with respect to climate, hydrogeological aspects, atmospheric conditions, water quality, soil quality, ecology, land use and socio-economic profiles of people. The baseline studies are carried out for three months, representing pre-monsoon season 2012 in the various domains of environment.

EIA notification requires that 10-km radius area surrounding the project site shall be covered under the study and the same is denoted as study area. As part of the study, description of biological environment and Human environment such as environmental settings, demography & socio-economics, land-use/ land cover, ecology & biodiversity have been carried out for entire 10-km radius. However, as a universally accepted methodology of EIA studies, physical environmental attributes such as Ambient Air Quality, Water Quality, Soil Quality, Noise Levels, Physiography, Hydrology, Odour, Solid Waste Generation have been studies at selective locations representing various land uses such as industrial, rural/ residential, commercial and sensitive locations including the densely populated areas, agricultural lands, forest lands and other ecologically sensitive areas, if any falling within 10-km radius study area.

This Report incorporates the baseline data monitored for three months (March – May 2012) representing pre monsoon season and secondary data collected from various Government and Semi-Government organizations. The methodology for sampling and analysis has been detailed in Annexure-IV.

3.2 Hydrology

3.2.1 Hydrogeology

According to the study conducted by the Central Ground Water Board, Ministry of Water Resources, Govt of India in Guntur district of Andhra Pradesh in the year 2007 the findings are given below. The Guntur district is underlain by various rock types of different age groups ranging from Archaean to Recent. The Archaean basement complex comprising the granite-gneisses, Schists, Khondalites, Charnockites and basic dykes of dolerites form the predominant rock types. It occupies around 1/3rd part of the district mainly in the central part of the district. These are the predominant water bearing formations in the district. These formations lack primary porosity. They developed secondary porosity through fracturing and subsequent weathering over ages and become water bearing, although very much limited. The movement of ground water is controlled by the degree of interconnections of the secondary pores and voids. The depth of weathered mantle ranges from about 8 to 15m bgl and below this zone fractured rocks are known to occur down to 40.0 m bgl. The depth to water level ranges from less than a meter to 12 m bgl. Dug wells generally yield 10 to 80 or even up to 200 m^3/day, depending on the location of the well. Bore wells drilled in these

formations are 30 to 40m deep and generally yield 1.5 to 5 lps and sometimes even more depending upon the fractured zone encountered in the bore well. The dug wells sustain four to six hours of pumping and capable of irrigating about 0.8 to 3.0 ha. A perennial spring, with a discharge of about 200 lpm is located along a fault, near Bugga Melleswara temple of Papayapalem in the Bellamkonda Mandal, and it is reported that this spring is being used to irrigate 10 ha.

The fringe of the Archaeans in the central part of the district is represented by the northeastern part of the Cuddapah basin, namely Nallamalai group of Upper Cuddapahs. In a sequential order, the younger Kurnools occurring in the Cuddapahs and those in the western parts of the district are thrust over by the Cuddapahs and these in turn by the Archaean granite-gneisses. The Upper Gondwana group of sandstones and shales out crop are seen at places between Guntur and Tenali. The youngest rock types of the district appear to be of Mio-Pliocene age followed by the Alluvial deposits of Recent to Sub-Recent age. In the Cuddapah and Karnool group of rock slaty phyllites, quartzites and lime stones the ground water occurs in the joints, bedding planes and the weathered portions. However, the quartzite do not form good aquifers in the area because of their compactness and occurrence at high relief. The ground water is developed in slaty phyllites by dug, dug-cum bore wells and few bore wells. The general depth of wells varies from 3 to 25 m bgl, with moderate to very poor yields ranging between 10 to 70 m^3/day. The depth to water levels range from 0.4 to over 7.0 m bgl, but in phyllites and slates it varies from 4 to 15 m bgl. The general yield of wells ranges from 20 to 80 m^3/day, with exceptions in the highly fractured locations.

The rocks of Upper Gondwanas occur as isolated out crops in the eastern part of the district, viz., around Mutkuru, Sangam, Jagarlamudi and Kolkalur areas. The Gondwana formations are of fluviatile or lacustrine origin and also contain intercalated marine sediments, suggesting the marine transgression. The upper Gondwanas in the district are divided into three divisions, viz., the basal Budavada sandstones, which are buff coloured and of marine origin; the middle thin bedded, buff coloured and fossiliferous (plant) Vemavaram shales and the upper brown to red coloured and un-fossiliferous Pavaluru sandstones. The ground water occurs under water table and confined conditions. The shales overlying the sandstone act as the confining medium. The ground water is tapped by means of dug wells, dug-cum-bore wells and bore wells. The depth to water ranges from 2.20 to 10.60 m bgl and the depth of dug wells varies between 5.50 and 18.50 m bgl. The tube wells in the area range in depth from 40.0 to 75.0 m bgl, with yield ranges from 28 to 1300 lpm for drawdowns of 8.0 to 15.0m. The quality of ground water in these formations at places is found to be brackish other wise in general it is good for potable purposes.

The alluvial formations which are of recent to sub-recent in age were formed from the weathering of the older rocks and also as fluvial/Marine alluvial materials and residual soils. The fluvial alluvial deposits in the district are mainly restricted to the Krishna River and its stream courses. Extensive tracts of alluvium can be observed in the east and southeastern parts of the district and comprises of intercalation of clay, silt, sand, gravel, pebbles and Kankar of variable thicknesses. The thickness of alluvium varies from a few metres to over 100m. These are of deltaic origin and marked at places by shallow to about 30m thick

sandy to gravelliferous palaeo/buried channels. The beach sands are combined to the areas along the sea coast with the occurrence of beach ridges and back swamps. Laterite, lateritic shingle and gravel occur in many parts of the district as superficial deposits. The thickness of the alluvium along the stream courses vary from 2 to over 10.0m bgl. Ground water is being developed in the flood plain areas of Krishna river course mostly through filter-point wells and shallow bore wells with yields ranging from 3 to over 15 lps as observed around Rayapudi and Borepalem areas of Amaravati and Thullur mandals. The depth to water level in the alluvium of fluviatile origin ranges from almost ground level to 5m bgl. The wells located in the river terraces and alluvial ridges register deep water level conditions of 7.0 to over 12.0 m bgl with poor to moderate discharges. The extensive deltaic alluvium occurring along the eastern and southeastern parts of the district comprises alluvium of over 100 m in thickness but due to their sandy clay nature are poorly permeable and the ground water movement is rather sluggish. As a result the ground water is highly mineralized and at places it is found to be brackish. The ground water utilization for irrigation in these areas is observed to be negligible due to poor quality. The palaeo-channels, buried channels and flood plains occurring in this region, especially, in the mandals of Dugirala, Tenali, Ponnur and Repalle, are found to be potential aquifers with good quality water. The palaeo/buried channels at places are thin to about 30m thick and consist of sandy, gravelliferous formations and yield fresh water. The extent of these formations vary from a few meters to as much as 2.5 km in width and hundreds of meters to several kilometers in length. Filter-point wells and shallow tube wells are the common ground water abstraction structures in these areas.

Ground water is brackish to saline at shallow depths especially in the areas bordering the coast. Only the beach ridges at shallow depths yield fresh water. In the deltaic and coastal alluvial areas, the depth to water level ranges from less than 1m to 5m bgl. The depth of open wells ranges from 2m to 12 m bgl and the depth of shallow tube wells and filter point wells range from 10m to 27m, with yields of 25 to over 75 cu.m/hr.

- **Ground Water Regime Studies**

In order to monitor the ground water regime in space and time, the Central Ground Water Board (CGWB) has been conducting Ground Water Regime Studies by the establishing and monitoring National Hydrograph Network Stations (NHNS) in the entire district. The Board so far had established 39 such hydrograph stations in various hydrogeological environments of the district which are being monitored four times in a year ie. in the months of January, May, August and November. These studies throw light on the pace of ground water development vis-a-vis recharge in different areas and the variation in the quality of ground water with time. The comparative study of the historical water levels highlight the areas extent of water logging, ground water behaviour and stage of development, over exploitation if any and fluctuations of water levels and quality changes with time and in space, effects of surface water on ground water, rainfall (Pre-and post-monsoon) recharge, chemical and other anthropogenic activities on the ground water regime. While analyzing the ground water regime in the district the data of 220 observation wells monitored by Andhra Pradesh State Ground water Department is also utilized. The State department collects water levels every month and water samples twice in a year to monitor the quality variations. The

study of hydrographs of National Hydrograph Network Stations indicate the changes in the ground water scenario of each station from time to time. The data of all the observation wells when correlated with rainfall as well as with the release and stoppage periods of canal water, there appears to be a clear relationship. There is a perceptible rise in the water levels from June/July onwards till December every year. Then the water levels fall from December onwards till May. Just after the onset of monsoon (say June) to March of the following year there is due to release of canal water in different irrigation commands in the district and between middle of March to May/June, the canal water is stopped.

This is reflected in the hydrographs with a steep rise and decline. The fall in the levels of hydrographs of the district may be attributed to the cessation of canal waters, apart from the lessening effects of rainfall. Based on the hydrograph data, hydrographs have been generated for the period since 1978 onwards. On perusal of the hydrographs it is observed that even though the annual rainfall received by the district for the last 4 years have been below normal it is observed that out of the 39 hydrographs 9 show raising trends during pre monsoon as well as during post monsoon periods. This may be attributed to the application of canal water in the area where these wells are located however the wells located near Guntur such as Prattipadu, Chebrolu, Sekuru and Guntur itself indicate that the ground water is no longer being extensively used. On analysis of the chemical data of water samples of these wells it is inferred that the ground water around these wells have become saline due to saline water ingress. The hydrographs of the wells at Repalle, Ponnuru, Chikaluripet, Medikondur show long term horizontal trends of the permonsoon as well as for post monsoon periods this may be attributed to the availability for surface water through canal and streams in the area and the less dependency on ground water resources due its slightly saline in nature with EC reaching to 1200 microseimens/cm. The hydrographs of the wells located at Rentachintala, Macheri, Sirigiripadu, Nekarikallu, Mangalagiri, Ipur, Vadlamudi, Pondugula show falling trends both for pre-monsoon as well as for post monsoon periods. This is because of the failure of rainfall over a period of time, more dependency on ground water in this area due to non availability of the surface water in the vicinity. Over all the picture of ground water indicates that the district average shows a ground water raising trends.

- **Depth to Water and its Behaviour in the District**

Taking the large extent of canal command areas as well as the resulting ground water build up in the district, the depth to water level zones were demarcated in the following order. The depth to water level distribution maps are prepared for May, 03 (Pre-monsoon), November, 03 (Post monsoon) and are shown in **Figure-3.2.1 and Figure-3.2.2** and in the prevailing conditions in the district.

Ground water depth levels of surrounding villages are as given in the **Table 3.2.1**

On perusal of the two maps indicates logging conditions during pre-monsoon period in a small area located in the south-central part of the district i.e. in the area located just north of Bapatla.

But during Post-monsoon period, water logging conditions were observed in areas around Atchempet, Nekarikallu, Pallapatla, Varagami, Chebrolu and Coastal areas. About 75% of the area in the district especially in the central and coastal areas show water logged (less than 2.0m bgl) to near water logged conditions (DTW 2.0 to 5.0 m bgl) during post-monsoon period. But most of these areas are occupied by areas prone to water logging (i.e. DTW 2 m to 5.0m bgl) during premonsoon time accompanied by the stoppage of canal water. The upland areas, pediment areas especially occupied by the quartzites, phyllites and slates and alluvial ridges, areas along the Krishna river, registered deep water levels of over 10 m bgl. An appraisal of the depth to water level maps reveals that water levels are shallow towards the branch canals and distributaries of NSRCCA.

TABLE 3.2.1
GROUND WATER DEPTH LEVELS

Sr. No.	Location/Village	Borewell/ Openwell	Depth of water from ground level (mtr)	Depth of water Level (mtr)
1	Shrinagar	Openwell	15	5.4
2	Ramapuram	Openwell	18.6	1
3	Gamalapadu	Openwell	3.2	3.2
4	Batrupalem	Borewell	16	--
5	Shankarapuram/ Kotayyanagaram	Borewell	16	--
6	Pondugula	Openwell	12	6.8

- **Study of Long Term Water Level Trends in the District**

To assess the long-term trends of water levels in the district, the National Hydrograph Network Stations data for 20 years (1984-2003) period were analyzed and the results show a declining trend from 0 to 1.0m during post-monsoon period and the rising trend from 0 to 2.0 m during pre-monsoon period in the larger parts of the canal command areas of the district. The trends are just opposite for the tail end areas during these periods.

3.2.2 Ground Water Resources

According to the study conducted by the Central Ground Water Board, Ministry of Water Resources, Govt of India in 2007 in Guntur district of Andhra Pradesh the findings are given below.

The ground water potential in the Guntur district, as on March, 2004 is estimated as per the GEC-1997 and the Report has been published by State Ground water board in consultation with Central Ground Water Board. The mandal wise ground water resources of Guntur district are given in **Table-3.2.1(A)**

- **Ground Water Recharge**

The sources of recharge to the ground water body in the district are rainfall, seepage from canals, return seepage from surface water irrigation, seepage from tanks/lakes/ponds. The trend of rainfall departure curve indicates the consistent nature of recharge in recent years.

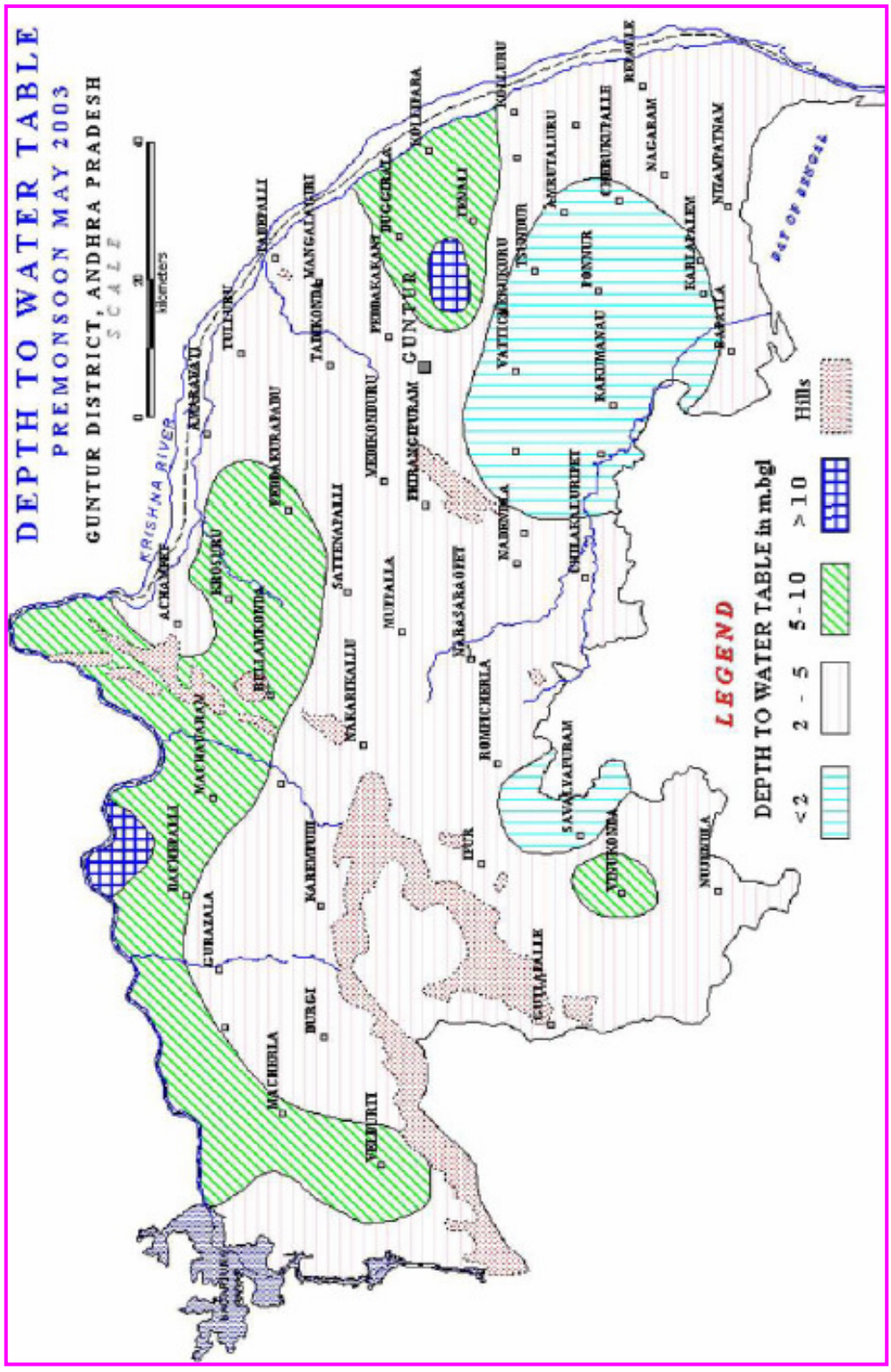


FIGURE-3.2.1
DEPTH TO WATER TABLE (PREMONSOON - MAY 2003)

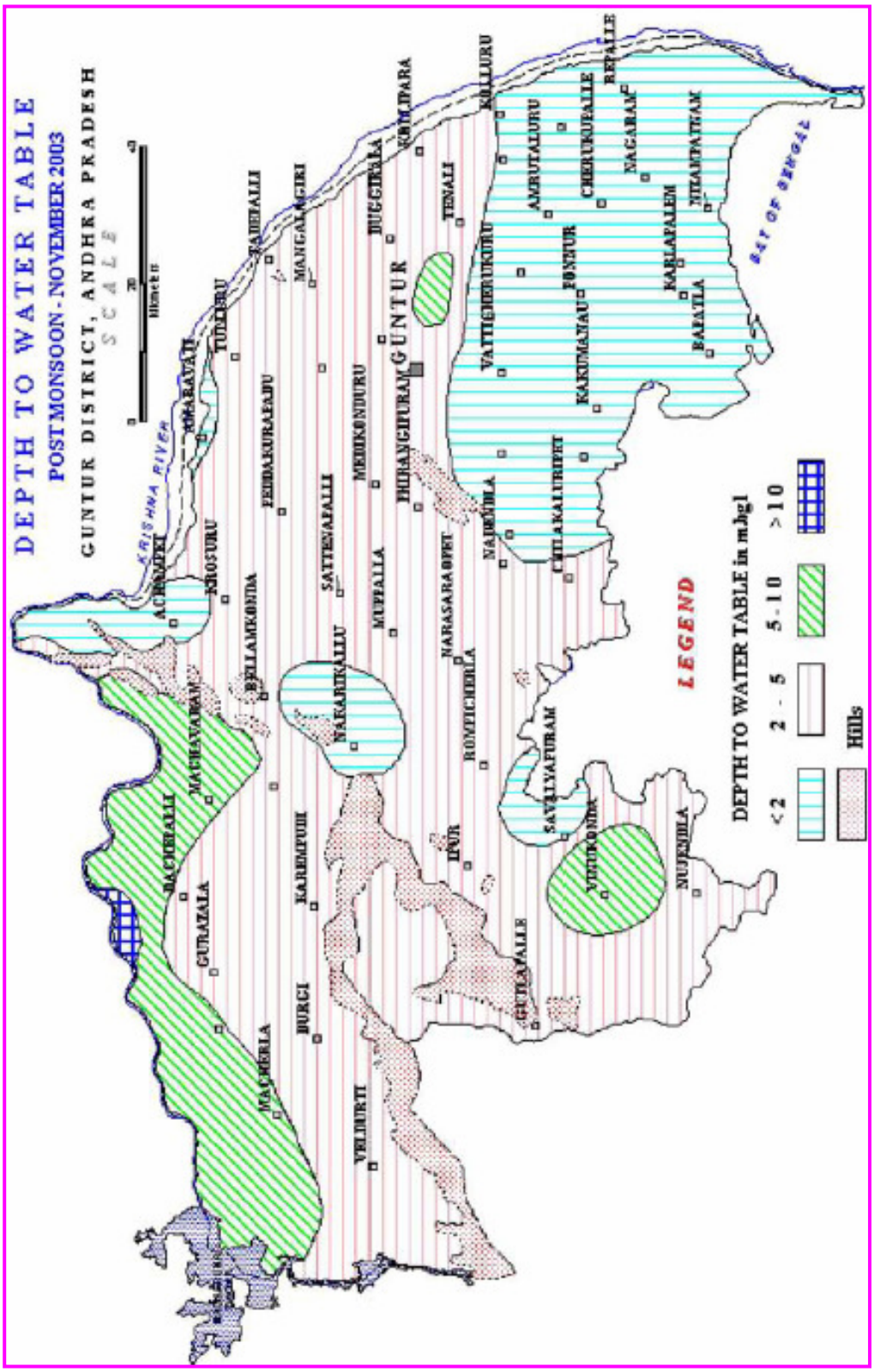


FIGURE-3.2.2
DEPTH TO WATER TABLE (POSTMONSOON – NOVEMBER 2003)

TABLE-3.2.1(A)
MANDAL WISE GROUNDWATER RESOURCE 2004, GUNTUR DISTRICT, A.P.

Sr. No	Mandal	Ground water availability ha.m			Ground water utilisation ha.m			Ground water balance ha.m			Stage of development %			Category		
		C	NC	T	C	NC	T	C	NC	T	C	NC	T	C	NC	T
1	2	3			4			5 = (3-4)			6=[(4/3)*100]			7		
1	Amaravathi	5113	0	5113	751	0	751	4362	0	4362	15	NA	15	Safe	NA	Safe
2	Amarthalur	5686	0	5686	506	0	506	5179	0	5179	9	NA	9	Safe	NA	Safe
3	Atchampet	5313	131	5445	674	50	724	4639	81	4721	13	38	13	Safe	Safe	Safe
4	Bapatla	9429	0	9429	1089	0	1089	8340	0	8340	12	NA	12	Safe	NA	Safe
5	Bellamkonda	3856	450	4306	208	87	295	3648	363	4011	5	19	7	Safe	Safe	Safe
6	Bhattiprolu	4954	0	4954	1304	0	1304	3650	0	3650	26	NA	26	Safe	NA	Safe
7	Bollapali	1336	2423	3759	80	3070	3150	1256	-648	609	6	127	84	Safe	OE	SC
8	Chebrolu	6686	0	6686	531	0	531	6155	0	6155	8	NA	8	Safe	NA	Safe
9	Cherukupally	4030	0	4030	1091	0	1091	2939	0	2939	27	NA	27	Safe	NA	Safe
10	Chilakaluripet	5760	0	5760	629	0	629	5131	0	5131	11	NA	11	Safe	NA	Safe
11	Dachapalli	10725	0	10725	1093	2	1096	9632	-2	9630	10	NA	10	Safe	NA	Safe
12	Duggirala	4743	0	4743	1178	0	1178	3565	0	3565	25	NA	25	Safe	NA	Safe
13	Durgi	1349	2452	3801	222	1070	1292	1126	1382	2509	16	44	34	Safe	Safe	Safe
14	Edlapadu	6007	0	6007	329	0	329	5678	0	5678	5	NA	5	Safe	NA	Safe
15	Guntur	6305	0	6305	230	0	230	6075	0	6075	4	NA	4	Safe	NA	Safe
16	Gurajala	12945	0	12945	627	0	628	12318	0	12318	5	NA	5	Safe	NA	Safe
17	Ipuru	4521	151	4672	569	59	628	3952	92	4044	13	39	13	Safe	Safe	Safe
18	Kakumanu	7087	0	7087	20	0	20	7067	0	7067	0	NA	0	Safe	NA	Safe
19	Karampudi	7748	644	8392	1307	270	1577	6441	373	6815	17	42	19	Safe	Safe	Safe
20	Karlapalem	3690	0	3690	162	0	162	3529	0	3529	4	NA	4	Safe	NA	Safe
21	Kollipara	4120	0	4120	1364	0	1364	2756	0	2756	33	NA	33	Safe	NA	Safe
22	Kollur	6156	0	6156	1685	0	1685	4471	0	4471	27	NA	27	Safe	NA	Safe
23	Krosuru	9689	0	9689	895	1	896	8795	-1	8793	9	NA	9	Safe	NA	Safe
24	Machavaram	3995	0	3995	720	0	720	3276	0	3276	18	NA	18	Safe	NA	Safe
25	Macheria	2870	1774	4644	242	320	562	2628	1454	4082	8	18	12	Safe	Safe	Safe
26	Mangalagiri	6869	0	6869	319	0	319	6550	0	6550	5	NA	5	Safe	NA	Safe
27	Medikonduru	3969	0	3969	151	0	151	3818	0	3818	4	NA	4	Safe	NA	Safe
28	Muppalla	6043	0	6043	174	0	174	5869	0	5869	3	NA	3	Safe	NA	Safe
29	Nadendla	7080	0	7080	181	0	181	6899	0	6899	3	NA	3	Safe	NA	Safe
30	Nagaram	8323	0	8323	519	0	519	7804	0	7804	6	NA	6	Safe	NA	Safe
31	Nakerikallu	6749	0	6749	977	0	977	5772	0	5772	14	NA	14	Safe	NA	Safe
32	Narasaraopet	8022	0	8022	429	0	429	7592	0	7592	5	NA	5	Safe	NA	Safe
33	Nizampatn	6955	0	6955	107	0	107	6848	0	6848	2	NA	2	Safe	NA	Safe
34	Nujendla	18455	0	18455	340	0	340	18116	0	18115	2	NA	2	Safe	NA	Safe
35	Pedakakani	7886	0	7886	33	0	33	7853	0	7853	0	NA	0	Safe	NA	Safe
36	Pedakurapadu	5600	0	5600	228	0	228	5372	0	5372	4	NA	4	Safe	NA	Safe
37	Pedanandipadu	6154	0	6154	46	0	46	6108	0	6108	1	NA	1	Safe	NA	Safe
38	Phyrangipuram	8661	1	8662	226	0	226	8435	1	8436	3	0	3	Safe	Safe	Safe
39	Piduguralla	5446	149	5595	763	0	763	4684	149	4832	14	14	14	Safe	Safe	Safe
40	Ponnur	11176	0	11176	1421	0	1421	9755	0	9755	13	13	13	Safe	NA	Safe
41	Prathipadu	3361	0	3361	143	0	143	3218	0	3218	4	NA	4	Safe	NA	Safe
42	PV palem	3052	0	3052	224	0	224	2828	0	2828	7	NA	7	Safe	NA	Safe
43	Rajupalem	4230	0	4230	826	1	827	3404	-1	3404	20	NA	20	Safe	NA	Safe
44	Rentachintala	6322	77	6399	146	100	246	6175	-23	6153	2	130	4	Safe	OE	Safe
45	Repalle	9546	0	9546	355	0	355	9192	0	9192	4	NA	4	Safe	NA	Safe
46	Rompicherla	6844	0	6844	305	0	305	6539	0	6539	4	NA	4	Safe	NA	Safe
47	Sattenapalli	10561	0	10561	242	0	242	10319	0	10319	2	NA	2	Safe	NA	Safe
48	Savalyapuram	4760	0	4760	171	0	171	4589	0	4589	4	NA	4	Safe	NA	Safe
49	Tadepalli	3714	0	3714	306	0	306	3408	0	3408	8	NA	8	Safe	NA	Safe
50	Tadikonda	3627	0	3627	411	0	411	3216	0	3216	11	NA	11	Safe	NA	Safe
51	Tenali	6731	0	6731	695	0	695	6036	0	6036	10	NA	10	Safe	NA	Safe
52	Thulluru	3129	0	3129	1065	0	1065	2064	0	2063	34	NA	34	Safe	NA	Safe
53	Tsundur	6583	0	6583	729	0	729	5854	0	5854	11	NA	11	Safe	NA	Safe
54	Vatticherukuru	4247	0	4247	20	0	20	4226	0	4227	0	NA	0	Safe	NA	Safe
55	Veldurthi	0	2425	2425	0	1079	1079	0	1346	1346	NA	44	44	NA	Safe	Safe
56	Vemur	5149	0	5049	674	0	674	4375	0	4375	13	NA	13	Safe	NA	Safe
57	Vinukonda	9402	52	9454	690	9	698	8713	43	8756	7	17	7	Safe	Safe	Safe
	Grand Total	352660	10729	363388	30421	6120	36542	322238	4609	326847	9	57	10	Safe	Safe	Safe

Note OE =Over exploited; SC = Semi critical ; C= critical ; C=Command ; NC = Non Command ; NA = Not applicable W

Leaving the flood plain and palaeo-channel areas, the ground water utilization in the large parts of the district is very limited because of the intensive canal irrigation, especially by the Nagarjunasagar Right Canal Command Area (NSRCCA), Krishna Western Delta (KWD) canal system and the Guntur Channel Scheme in these areas. In the tail end areas of the canal system, upland areas, flood plain, palaeo/buried channel areas, the ground water is being tapped both for domestic and irrigation purposes. These areas include Veldurti, Bollapalli, Chilakaluripeta, Krosur, Atchampet, Amaravati, Tadepalli, Mangalagiri, Thallur, Tadikonda, Dugirala, Kollipara, Kollur, Bhattiprolu, Tenali, Vemuru, Amarthalur, Tsundur and Ponnur mandals, where the ground water is developed through open wells, energized dug, dug-cum-bore wells, shallow tube wells and filter-point wells On the basis of the hydrogeological and other related information, the net annual recharge for the entire district is estimated as 3633.88 MCM/year and the net annual ground water draft in the district is worked to be as 365.42 MCM/year. Thus the ground water balance for future utilization is 3268.47 MCM/year based on the balance potential available for future development.

- **Stage of Development**

In order to check over-exploitation of ground water and to utilize the available resource in a planed way, the Ground Water Estimation Committee (GEC) 1997 has introduced certain norms so as to classify the areas as White, Grey and Dark categories. The blocks or mandals, where the stage of ground water development, in a period of five years, is below 65%, the area is categorized as 'White' or safe; those falling in the range of 65 to 85% as Semi critical and those 85%-100% 'Critical' and above 100% over exploited . The present stage of ground water development in the district is 10% with a net draft of 365.42 MCM out of the Ground water resource of 3633.88 MCM/year. Taking the annual growth rate as 2%, the stage of ground water development after five years is projected as 14% which comes under safe or 'White' category for further ground water development. Similar computations were made to assess the ground water potential and development prospects for each mandal and tabulated in Table and are shown in Plate. A perusal of the table highlights that Bollapalli mandal as Semi critical, with the present stage of development at 84%. It is seen from the Table that the stage of ground water development is around 10% as most of the mandals are covered under surface water irrigation. The water levels in most of these areas are shallow, i.e.., within 5.0 m bgl, with the prevalence of water logged and near water logged conditions. In such areas, ground water development through conjunctive use of surface and ground waters would mitigate not only water logging conditions but also improve the quality of ground water. However, when resource is calculated at the village level it seen that about 46 villages are falling under semi-critical/critical/over exploited category. These villages are listed in table- along with the level of development. It is seen that 13 villages are under semi-critical stage where as 8 villages are under critical stage and the rest 25 are under over exploited stage of development (**Table-3.2.2**).

It can be observed that Dachepalli and Machavaram mandals in which the mine lease is located does not come under the critical areas of exploitation and comes under safe category.

TABLE-3.2.2
MANDAL-WISE VILLAGES FALLING UNDER SEMI-CRITICAL/CRITICAL/OVER EXPLOITED CATEGORIES IN GUNTUR DISTRICT

Sr. No/ Category	Mandal	Village / Habitation	Level of Ground Water Development (%)	
			N	NC
Semi Critical				
1.	Amaravathi	Karlapudi / Amaravathi	75	0
2	Atchmpet	Madinpadu Agrap	0	67
3	Bellomkonda	Venkatayapallem	0	79
4	Ipuru	Angaluru	65	0
5	Kollipara	Bommuvaripalem	65	0
6	Kollipara	Thumuluru	67	0
7	Macherla	Macherla	0	66
8	Mangalagiri	Krishnyapalem	85	0
9	Thulluru	Ananthavaram	75	0
10	Thulluru	Nekkallu	71	0
11	Thulluru	Lingayapalem	77	0
12	Thulluru	Uddandarayunipadu	74	0
13	Veldurthi	Pathlaveedu	0	68
Critical				
1	Amaravathi	Amaravathi/Jupudi	94	0
2	Atchampet	Tallachervu	98	0
3	Atchampet	Challagaria	0	93
4	Durgi	Polepalli/Durgi	0	98
5	Tadikonda	Mothadaka/Tado	98	0
6	Tadikonda	Nidumukkala	98	0
7	Veldurthi	Veldurthi	0	88
8	Veldurthi	Veldurthi	0	99
Over Exploitation				
1	Bellamkonda	Kethavaram	0	218
2	Bhattriprolu	Peesaralanka	183	0
3	Bollapalli	Bollapalli / Ganding	0	381
4	Bollapalli	Ravulapalem	0	130
5	Bollapalli	Gutlapalli	0	306
6	Bollapalli	Bollapalli	0	313
7	Bollapalli	Ayyannapalem	0	150
8	Bollapalli	Mellavagu	0	618
9	Bollapalli	Gummanampadu	0	140
10	Bollapalli	Remidicher;a	0	163
11	Bollapalli	Garkapadu	0	243
12	Durgi	Darmavaram	0	283
13	Durgi	Poleypally	0	187
14	Ipuru	Agnigundala	0	182
15	Karampudi	Naramalapadu	0	342
16	Krosuru	Krosur / Peesapadu	158	0
17	Macherla	Koppunur	0	108
18	Nakerikallu	Chejerla / Nagank	123	0
19	Nakerikallu	Narsingapadu	135	0
20	Nakerikallu	Tripurapuram	107	0
21	Rajupalem	Kubadpuram	163	0
22	Rentachintala	Durgi / Darivemula	0	123
23	Tadepalli	Tadepalli	151	0
24	Thulluru	Vaddamenu / Thulluru	134	0
25	Veldurthi	Uppalapadu	0	199

➢ **Status of Ground Water Development**

An abstract of the ground water structures existing in the Guntur district is given in **Table-3.2.3.**

TABLE-3.2.3
FORMATION WISE DETAILS OF DIFFERENT GROUND WATER ABSTRACTION STRUCTURES AND THEIR YIELDS IN THE DISTRICT

Sr. No.	Formation	Rock /Aquifer	Type of well	Depth range	Yield ranga	Lifting device
1	Archaean Group of rocks	Granite Gneisses, Schists Charnokites	Dug wells	12-20 m	10-8- m^3 /day(200 m^3 / day)	Centrifugal pumps
			Borewlls	30-40 m	1.5 to 5 lps	Submersible Pump
2	Cuddapah Formation	Phyllites, Quartzites, limestone	Dug wells	3-25 m	20-80 m^3/ day	Centrifugal pumps
			Borewells	30-60 m	0.5-105 lps	Submersible Pump
3	Kurnjool Formation	Shales, Limestone Quartzites	Dug wells	4-15 m	10-70 m^3/ day	Centrifugal pumps
			Borewells	25-55 m	0.5-1.5 lps	Submersible Pump
4	Gondwana Group of Formation	Sandstones	Dug wells	5.5-18.5 m	12-90 m^3/ day	Centrifugal pumps
			Tube wells	40-75 m	28-1300 lpm	Submersible Pump
5	Alluvium	Sand, silt, Kankar, clay	Dug wells	2-12 m	200-320 m^3/ day	Centrifugal pumps
			Shallow Tube wells, filter points	25-75 m	25-75 m^3/ hr	Centrifugal pumps & submersible Pump

Most of the Guntur district is traversed by good network of irrigation canals of the Nagarjunasagar Right Bank Canal Command Area (NSRCCA), Krishna Western Delta (KWD) Canal System and Guntur Channels Scheme. Only the up land areas of the district are not covered in any of the irrigation scheme. About 77.61% of the total irrigated area in the district is through canal network and 2.94% through lift irrigation. 15.72% area is irrigated through Tubewells and filter points and the rest 3.72% area is irrigated through Tanks and other sources. The area irrigated under different sources in the district is given in **Table-3.2.4** and the Mandal wise and source wise details of irrigated area is given in **Table-3.2.5**. Wells and filter points irrigate 7.98% and the rest of the area accounts for 3.72 % are irrigated by tanks and other sources.

TABLE-3.2.4
AREA IRRIGATED BY DIFFERENT SOURCE DURING 2002-03

Sr. No.	Source of Irrigation	Kharif	Rabi	Total (Gross)
1	Canals	203466	1021	2,04,487
2	Tanks	2287	116	2,403
3	Bore Wells/Tube Wells Filter-Point wells	41339	8795	50,134
4	Dug Wells & Other sources	5808	1403	7,211

TABLE-3.2.5
MANDAL-WISE SOURCE-WISE AREA IRRIGATED 2002-03

Sr. No	Mandal	Net Area Irrigated By							Area Irrigated More than once
		Canals	Tanks	Tubewells and filter points	Other wells	Lift Irrigation	Other sources	Total	
1	Macherla	2437	45	3074	168	148	0	5872	522
2	Rentachintala	3898	0	251	2	0	0	4151	20
3	Gurazala	4637	0	0	0	0	0	4637	64
4	Dachepalli	2639	0	818	45	342	0	3844	73
5	Machavaram	137	85	189	0	6	219	636	17
6	Bellamkonda	258	0	326	147	138	40	909	32
7	Atchempet	303	84	0	128	58	0	573	0
8	Krosuru	120	246	0	44	184	0	594	0
9	Amaravathi	3	63	0	463	215	106	850	0
10	Thullur	40	55	3209	0	973	51	4328	293
11	Tadepalli	140	0	1468	141	944	0	2693	1292
12	Mangalagiri	2161	0	1962	187	1600	0	5910	1556
13	Tadikonda	118	0	182	0	0	0	300	144
14	Pedakurapadu	577	0	0	855	0	0	1432	0
15	Sattenapalli	3363	0	1	1004	200	0	4568	0
16	Rajupalem	1646	89	16	230	51	0	2032	36
17	Piduguralla	3987	50	0	0	0	0	4037	0
18	Karempudi	2983	0	701	0	0	0	3684	296
19	Durgi	333	20	6946	0	0	0	7299	1193
20	Veldurthy	0	0	4963	0	0	0	4963	73
21	Bollaplli	0	40	3549	211	0	60	3860	0
22	Nakarikallu	3888	220	505	279	0	0	4892	221
23	Muppalla	2075	32	0	96	27	0	2230	0
24	Phirangipuram	1919	0	72	11	0	0	2002	0
25	Medikondur	2685	0	2	89	0	17	2793	0
26	Guntur	459	0	103	43	0	0	605	0
27	Pedakakani	5633	37	121	51	168	8	6018	127
28	Duggirala	7713	0	2840	0	0	0	10553	834
29	Kollipara	6269	0	2531	0	0	0	8800	882
30	Kolluru	5034	0	2893	0	36	0	7963	656
31	Vemuru	8430	0	274	0	8	0	8712	417
32	Tenali	8634	0	972	0	0	0	9606	273
33	Tsundur	8270	0	779	0	0	0	9049	79
34	Chebrolu	6472	0	13	302	281	0	7068	340
35	Vatticherukur	6085	0	0	0	0	0	6085	0
36	Prathipadu	509	0	35	4	0	0	548	0
37	Edlapadu	45	0	0	3	0	0	48	0
38	Nadendla	293	0	0	309	251	0	853	0
39	Narasaraopet	2515	40	0	64	177	0	2796	65
40	Rompicherla	3435	102	0	149	0	295	3981	66
41	Ipur	412	428	89	231	10	145	1315	21
42	Savalyapuram	229	119	18	39	135	36	576	0
43	Vinukonda	0	408	25	182	422	0	1037	0
44	Nuzendla	0	171	33	163	184	0	551	0
45	Chilakaluripet	0	0	0	78	0	252	330	0
46	Pedanandipadu	98	0	0	0	20	0	118	0
47	Kakumanu	9915	0	0	0	0	0	9915	0
48	Ponnur	13143	0	885	0	85	0	14113	294
49	Amrthalur	10433	0	284	0	0	0	10717	22
50	Cherulupalli	6649	0	13	151	0	0	6813	123
51	Bhattiprolu	6224	0	1255	0	0	0	7479	116
52	Repalle	9734	0	26	0	0	0	9760	43
53	Nagaram	9926	0	74	0	308	0	10308	75
54	Nizampatnam	4028	0	1	0	555	0	4584	12
55	P.V.Palem	4641	0	0	32	0	0	4673	3
56	Karlapalem	5430	0	0	76	235	0	5741	93
57	Bapatla	13840	0	0	288	0	0	14128	152

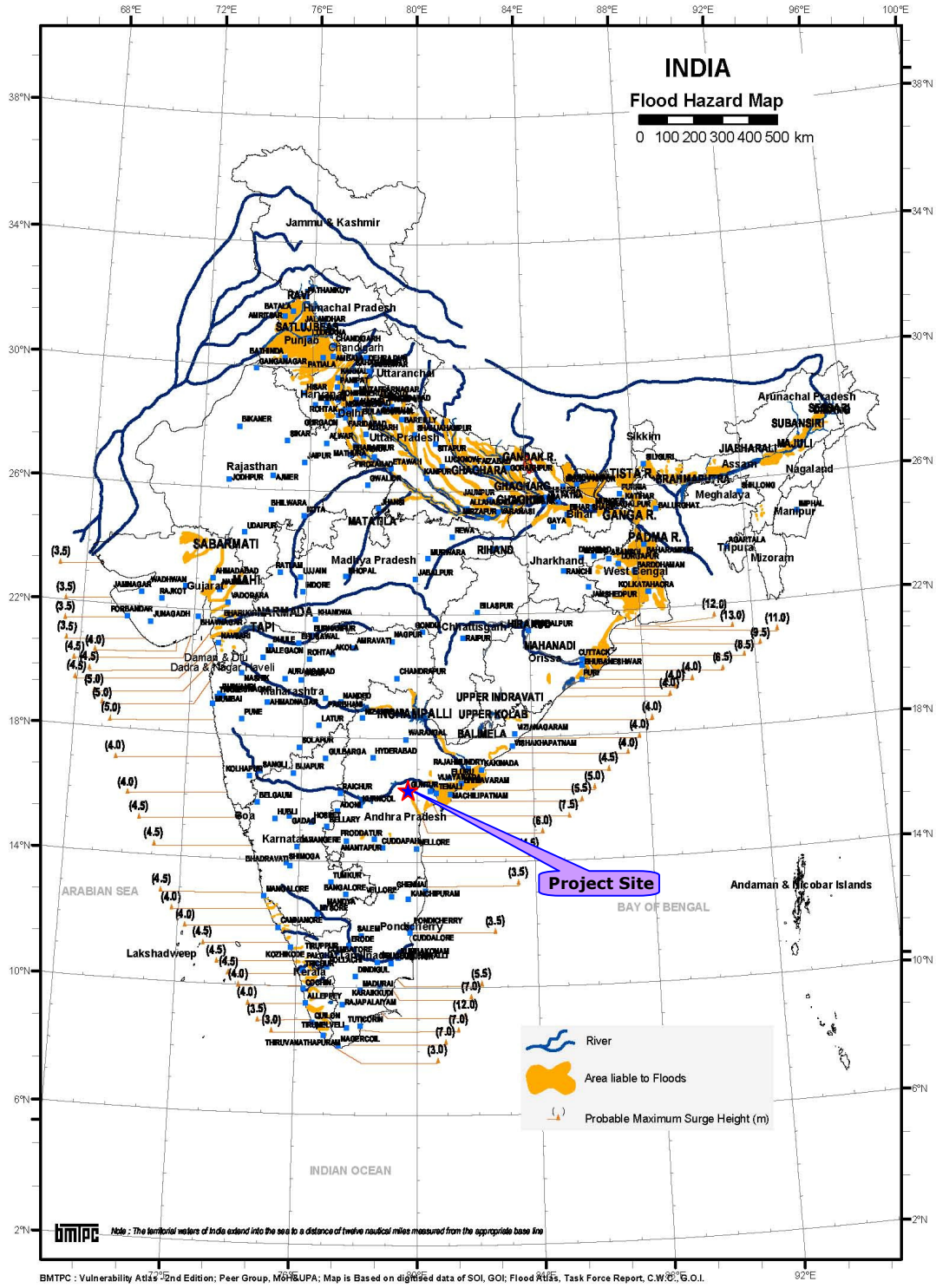


FIGURE-3.2.3
FLOOD ZONE MAPPING

3.3 Land Use Studies

Studies on land use aspects of eco-system play important roles for identifying sensitive issues, if any, and taking appropriate actions for maintaining the ecological balance in the development of the region.

3.3.1 Objectives

The objectives of land use studies are:

- To determine the present land use pattern;
- To analyze the impacts on land use due to plant activities in the study area; and
- To give recommendations for optimizing the future land use pattern vis-a-vis growth of plant activities in the study area and its associated impacts.

3.3.2 Methodology

For the study of land use, literature review of various secondary sources such as District Census Handbooks, regional maps regarding topography, zoning settlement, industry, forest etc., were taken. The data was collected from various sources like District Census Handbook, Revenue records, state and central government offices and Survey of India (SOI) Toposheets and also through primary field surveys.

3.3.3 Land use Based on Secondary Data

Based on the census report, 10-km radial distance around this Plant Centre has been considered in the study. These areas were studied in detail to get the idea of land use pattern in the study area. The land use pattern of the study area is given in **Table-3.3.1** and in detail presented in **Annexure-VI.**

TABLE-3.3.1
LAND USE PATTERN IN THE STUDY AREA

Sr.No	Particulars of Landuse	0-3 km	3-7 km	7-10 km	0-10 km	Area %
1	ForestLand (Ha)	146.23	4251.82	4135.02	35129.2	24.29
2	Land under Cultivation (Ha)					
	a) IrrigationLand (Ha)	1658.98	1358.19	2867.47	5884.64	16.75
	b) Un Irrigated Land (Ha)	255.55	3702.25	7214.39	11172.19	31.80
3	Cultivable WasteLand (Ha)	79.91	867.85	2102	3049.76	8.68
4	Area not Available for Cultivation (Ha)	1452.33	2006.57	3030.64	6489.54	18.47
	Total Area (Ha)	**3593.00**	**12186.68**	**19349.52**	**35129.2**	**100.00**

Source: District Census Hand Books – 2001

- ***Forest***

The revenue forestland under the study area consists 100 ha (24.29 %) of the total geographic area.

- ***Land under Cultivation***

The percentage of un-irrigated land is about31.80 % of the total land in the study area.

- ***Cultivable Waste***

This land includes that land, which was cultivated sometime back and left vacant during the past 5 years in succession. Such lands may either be fallows or covered with shrubs, which are not put to any use. Lands under thatching grass, bamboo bushes, other grooves useful for fuel etc., and all grazing lands and village common lands are also included in this category. The study area comprises about 8.68% cultivable wastelands.

- ***Land not available for Cultivation***

The land not available for cultivation is 18.47 % of the total study area.

3.3.4 Land Use Based on Satellite Imagery

Present land use based on remote sensing satellite imageries were collected and interpreted for the 10 km radius study area for analyzing the land use pattern of the study area. Based on the satellite data, land use/ land cover maps have been prepared.

- ***Land use/Land Cover Classification System***

The present land use / land cover maps were prepared based on the classification system of National standards. For explanation for each of the land use category the details as given in **Table-3.3.2** are considered.

TABLE-3.3.2
LAND USE/LAND COVER CLASSIFICATION SYSTEM

Sr. No.	Level-1	Level-2
1	Built-up Land	Town/cities
		Villages
		Institution/Industry/Godown etc
		Plotted Area/Layout
2	Agriculture Land	Crop Land
		Plantations
		Fallow
3	Forest	Evergreen/Semi evergreen
		Deciduous
		Forest Plantation
4	Wastelands	Rocky/Stony Waste
		Land with /without scrubs
		Saline/sandy & Marshy/swampy
5	Water Bodies	River/Stream
		Lake/Reservoir/Tanks
6	Others	Orchard/Other Plantation
		Shifting cultivation
		Salt Pans, Snow covered/Glacial
		Barren/Vacant Land

- ***Data Requirements***

IRS-P6 Geo-Coded FCC of LISS-III was acquired for 28th January, 2008 and was used for the mapping and interpretation. Besides, other collateral data as available in the form of maps, charts, census records, other reports and especially topographical survey of India maps are used. In addition to this, ground truth survey was also conducted to verify and confirm the ground features.

- ***Methodology***

The methodology adopted for preparation of landuse/ landcover thematic map is monoscopic visual interpretation of geocoded scenes of IRS-P6 satellite LISS-III and field observations are taken. The various steps involved in the study are preparatory field work, field survey and post field work.

- ***Pre-field Interpretation of Satellite Data***

The False Color Composite (FCC) of IRS-P6 satellite data are used for pre-field interpretation work. Taking the help of topo sheets, geology, geo-morphology and by using the image elements the features are identified and delineated the boundaries roughly. Each feature is identified on image by their image elements like tone, texture, colour, shape, size, pattern and association. A tentative legend in terms of land cover and land use, physiography and erosion was formulated. The sample areas for field check are selected covering all the physiography, land use / land cover feature cum image characteristics.

- **Software's used**

a) ERDAS Imagine for image processing/rectification/geocoding;
b) AutoCAD for data preparation after visual interpretation of the image; and
c) Arc View for Image/Landuse presentation.

- ***Ground Truth Collection***

Both toposheets and imagery were taken for field verification and a transverse plan using existing road network was made to cover as many representative sample areas as possible to observe the broad landuse features and to adjust the sample areas according to field conditions. Detailed field observations and investigations were carried out and noted the landuse features on the imagery.

- ***Post Field Work***

The base maps of the study area were prepared, with the help of Survey of India Toposheet. Preliminary interpreted land use and the land cover features boundaries from IRS-P6 False Colour Composite were modified in light of field information and the final thematic details were transferred onto the base maps. The final interpreted and classified thematic map was catrographed. The cartographic map was coloured with standard colour coding and detailed description of feature with standard symbols. All the classes noted and marked by the standard legend on the map.

➢ ***Final Output***

The final output would be the landuse/land cover map and numerals were given different colour code for each category as shown in map. Area estimation of all features of Land use/Land cover categories was noted. The thematic map and land use pattern is shown in **Figure-3.3.1.** The details of the land use in 10-km radial study area are given in **Table-3.3.3.**

TABLE 3.3.3
LAND USE BREAK UP OF THE STUDY AREA

Sr. No.	Land Use	Area (Hectares)	Percentage (%)
Built-up Land			
1	Settlements	609	1.60
2	Industry/Institutional Area	575	1.51
Forest			
3	Dry Deciduous Forest	2622	6.89
4	Degraded Scrub Land	3905	10.27
5	Forest Blank	548	1.44
Agricultural Land			
6	Plantation	11	0.03
7	Double Crop/Irrigated Land	7800	20.51
8	Other Agriculture Land	13201	34.71
9	Fallow Land	128	0.34
Waste Land			
10	Land with scrub	1865	4.90
11	Land without scrub	3277	8.62
12	Rocky / Stony/Barren land	1325	3.49
13	Quary/Mining land	587	1.54
Water Body			
14	Stream/River/Tank/Reservoir	1103	2.90
15	Dry River	474	1.25
Total		**38029**	**100**

➢ ***Observations***

The land use pattern of the study area indicates no forest land in the study area. The land under agriculture is about 55.59%.

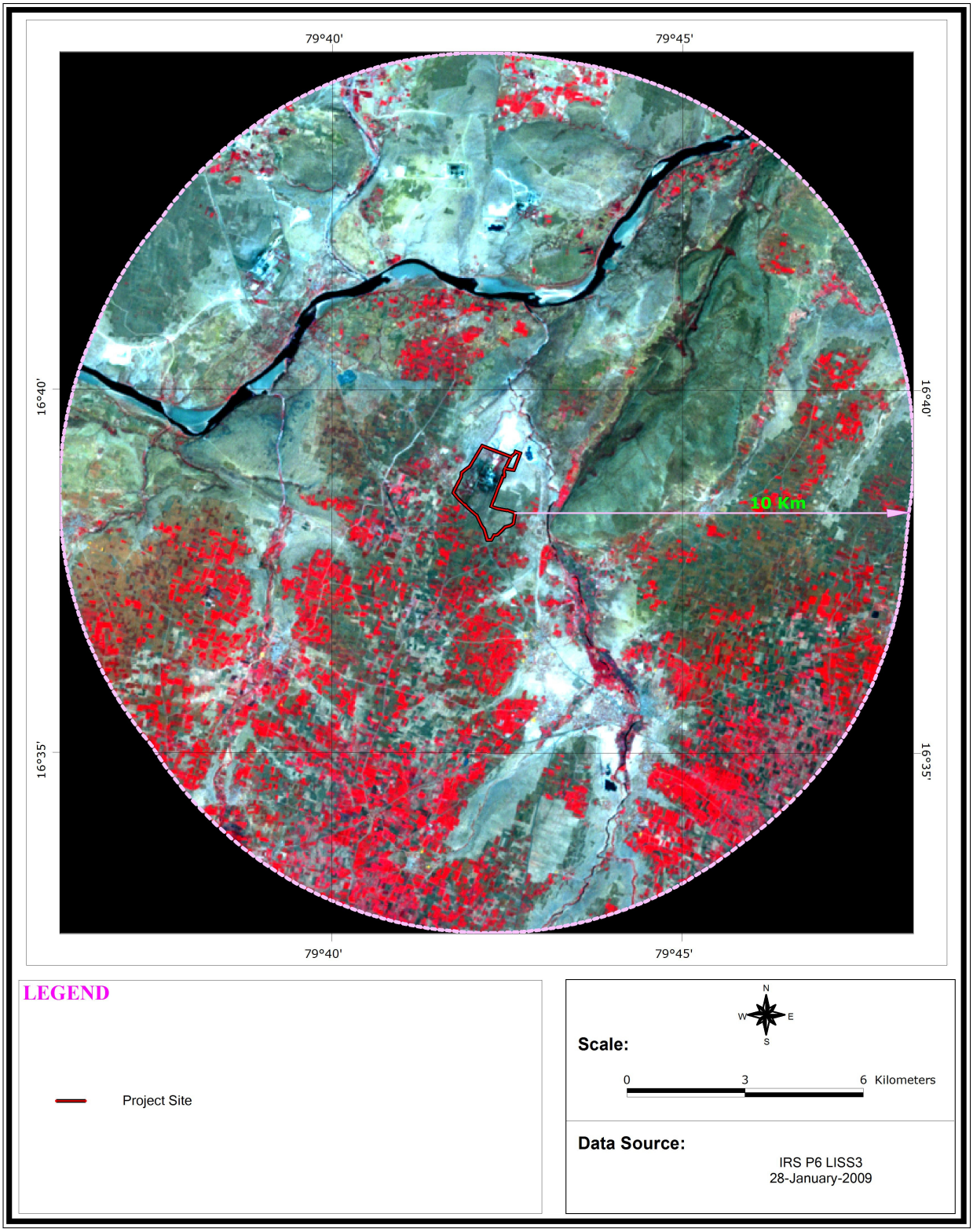


FIGURE-3.3.1
SATELLITE IMAGERY

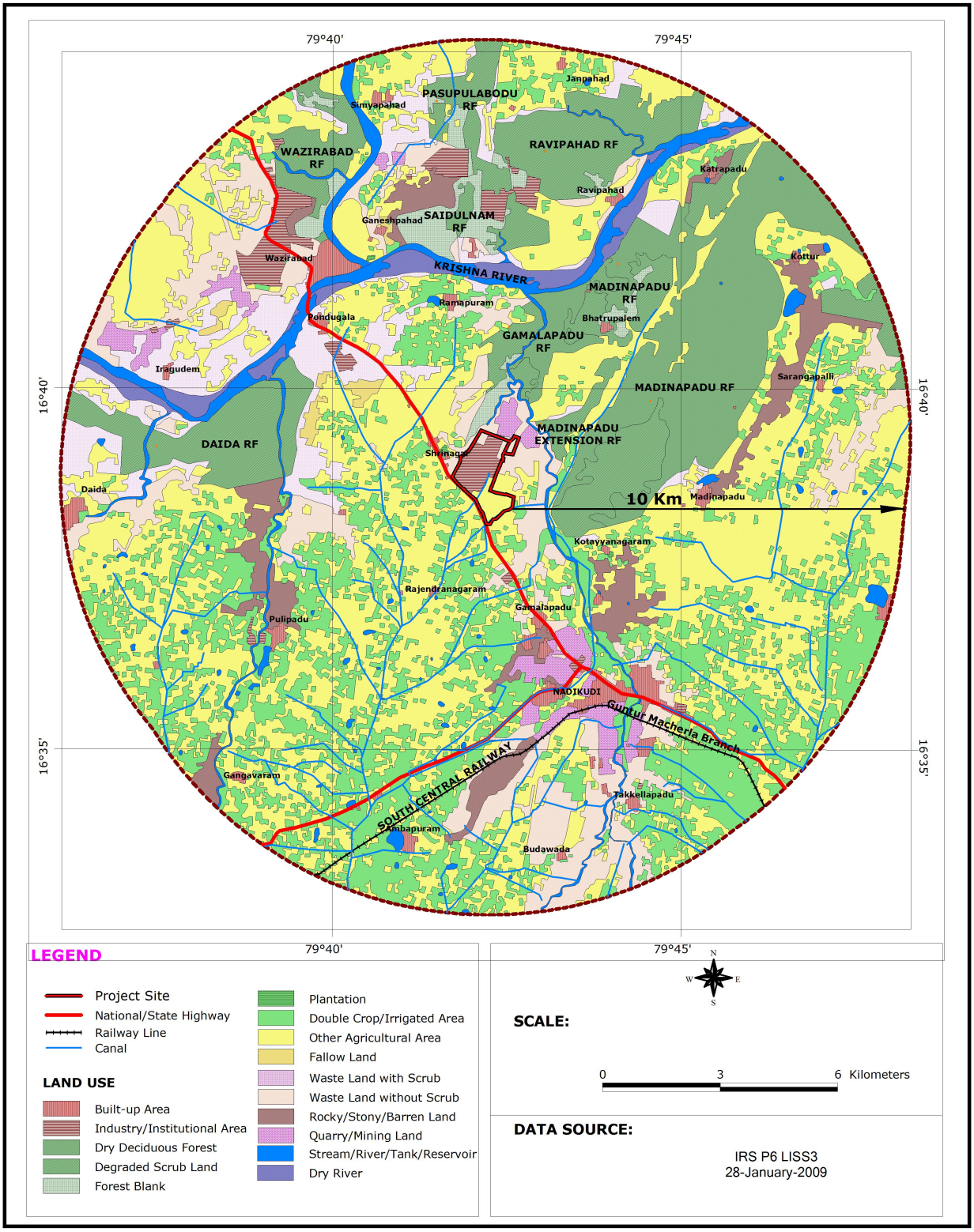


FIGURE-3.3.2
LAND USE MAP

3.4 Soil Characteristics

It is essential to determine the potential of soil in the area and identify the impacts of urbanization and industrialization on soil quality. Accordingly, a study of assessment of the soil quality has been carried out.

3.4.1 Data Generation

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the plant area representing various land use conditions. The physical, chemical and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil upto a depth of 90 cm. A total of eight samples within the study area were collected and analysed. The details of the soil sampling locations are given in **Table-3.4.1** and are shown in **Figure-3.4.1**. The sampling has been carried out once in the study period.

TABLE-3.4.1
DETAILS OF SOIL SAMPLING LOCATIONS

Code	Location	Arial Distance (km) with respect to plant Centre	Bearing w.r.t Plant
S1	Plant Site	--	--
S2	Kotayya Nagaram	2.5	SE
S3	Gamalapadu	2.7	SSE
S4	Madinapadu	4.9	E
S5	Shrinagar	0.8	NW
S6	Ramapuram	3.4	N
S7	Pondugala	4.9	NW
S8	Srinivasapuram	2.9	WSW

The soil quality at all the locations during the study period is given in **Table-3.4.2**. The results are compared with standard classification given in **Table-3.4.3**.

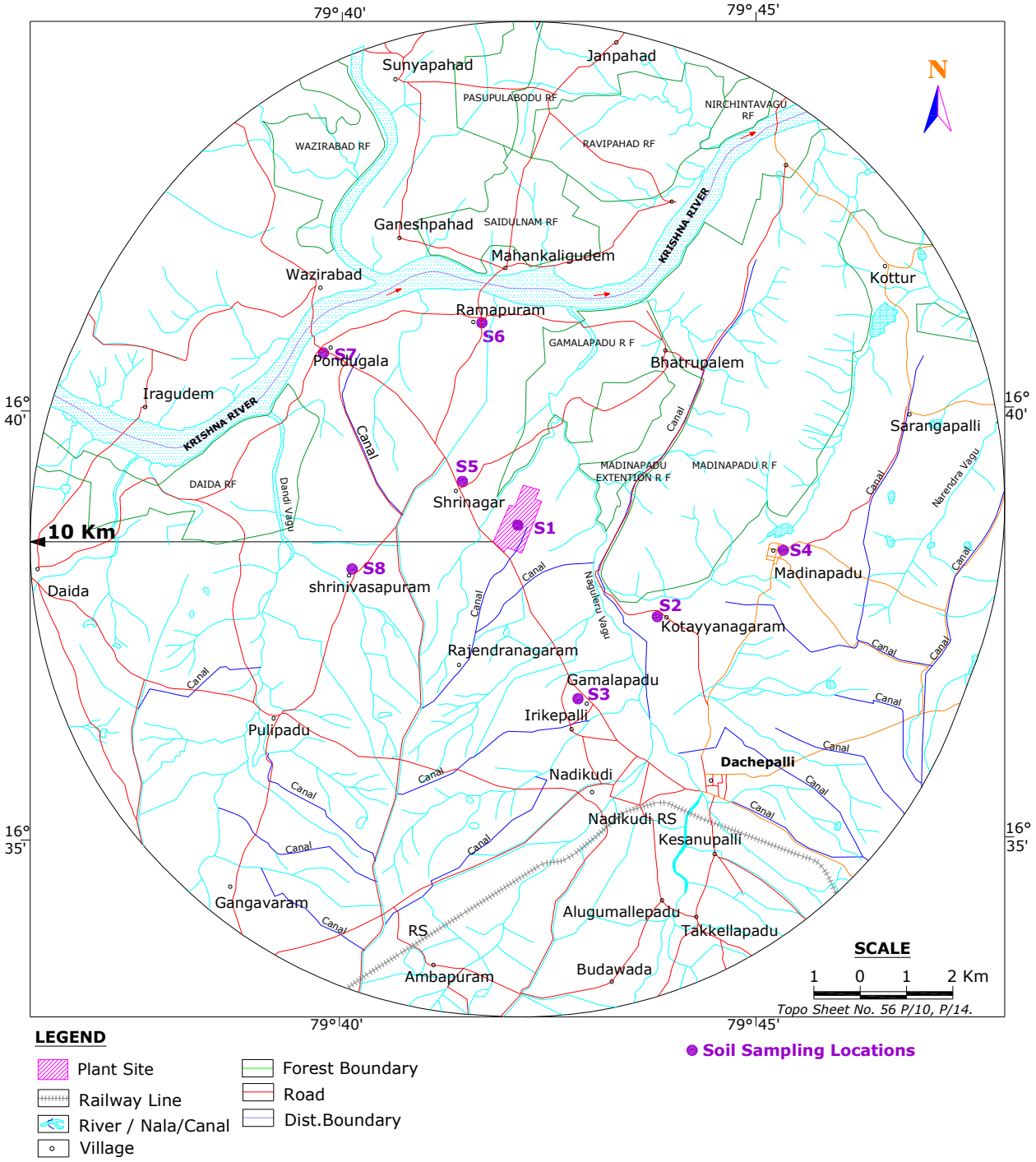


FIGURE-3.4.1
SOIL SAMPLING LOCATIONS

TABLE-3.4.2
SOIL ANALYSIS RESULTS

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
pH (1:2.5 soil water extract)	7.9	7.8	7.8	8.1	8.2	8.1	7.9	8.2
Conductivity (µs/cm) (1:5 soil water extract)	466	263	226	245	338	344	305	326
Texture	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Sandy clay
Sand (%)	50	52	48	50	50	45	48	44
Silt (%)	10	12	16	14	16	15	14	16
Clay (%)	40	36	36	36	37	40	38	40
Bulk Density (gm/cc)	1.1	1.2	1.2	1.1	1.2	1.2	1.2	1.1
Exchangeable Calcium as Ca (mg/kg)	17397	11764	16916	16892	16180	10089	14286	16414
Exchangeable Magnesium as Mg (mg/kg)	2463	399	1253	1420	1223	1379	1081	1544
Exchangeable Sodium as Na (mg/kg)	1520	154	342	562	1526	616	204	194
Available Potassium as K (kg/ha)	860	676	838	1196	1060	550	1258	472
Available Phosphorus (kg/ha)	82	48	56	68	52	56	62	48
Available Nitrogen as N (kg/ha)	112	74	92	102	94	71	82	80
Organic Matter (%)	1.06	0.7	0.95	0.88	0.97	0.74	0.77	0.69
Organic Carbon (%)	0.61	0.4	0.55	0.51	0.56	0.43	0.45	0.4
Water soluble Chlorides as Cl (mg/kg)	940	656	373	563	574	689	622	648
Water soluble Sulphates as SO_4 (mg/kg)	100	88	88	89	83	86	69	90
Sodium Absorption Ratio	1.07	0.12	0.26	0.42	1.4	0.58	0.17	0.15
Aluminium	5.24	1.48	3.6	3.8	4.76	2.41	4.08	5.05
Total Iron (mg/kg)	2.36	2.72	1.98	2.01	3.09	2.65	2.82	3.11
Manganese (mg/kg)	520	502	290	360	3359	435	420	606
Boron (mg/kg)	37	40	42	62	48	64	32	44
Zinc (mg/kg)	62	39	68	69	60	90	48	52

TABLE-3.4.3
STANDARD SOIL CLASSIFICATION

Sr. No.	Soil Test	Classification
1	pH	<4.5 Extremely acidic 4.51- 5.00 Very strongly acidic 5.00 - 5.50 slightly acidic 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 µmhos/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

Sr. No.	Soil Test	Classification
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 : Hand Book of Agriculture, ICAR

3.4.2 Baseline Soil Status

It has been observed that the texture of soil is mostly sandy clay in the study area. The common color of the soil ranged from light brown to black. It has been observed that the pH of the soil quality ranged from 7.8 – 8.2 indicating that the soil is usually moderately alkaline in nature. The pH values indicate that the soil is moderately alkaline in nature.

The Electrical Conductivity was observed to be in the range of 226 - 466 µS/cm, with the maximum (466 µS/cm) observed at S1 and with the minimum (226 µS/cm) observed at S3.

The Nitrogen values ranged between 71 – 112 Kg/ha. The maximum value (112 kg/ha) was found at S1 indicating that the soil is having good quantity of Nitrogen. The minimum value (71 kg/ha) was observed at S6 indicating that the soil has less quantity of Nitrogen.

The Phosphorus values range between 48 – 82 Kg/ha. The maximum value (82 kg/ha) was found at S1 indicating that the soil has more than sufficient quantity of Phosphorus. The minimum value (48 Kg/ha) was observed at S2 & S8 indicating that the soil has medium quantity of Phosphorus.

The Potassium values range between 472 – 1258 kg/ha. The maximum value (1258 kg/ha) was found at S4 indicating that the soil has more than sufficient quantity of Potassium. The minimum value (472 Kg/ha) was observed at S8 indicating that the soil has more than sufficient quantity of Potassium.

3.5 Meteorology

The meteorological data recorded during the monitoring 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.

The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-monsoon season : March to May
- Monsoon season : June to September
- Post-monsoon season : October to November

On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected at site every hour continuously from 1st March 2012 to 31st May 2012 and four locations during June and July. The generated data then compared with the meteorological data generated by nearest India Meteorological Department (IMD) station located at Rentachintala. The available meteorological data of IMD, Rentachintala station has been collected and analyzed.

3.5.1 Methodology

Site specific data covering micro-meteorological parameters were recorded on hourly basis during the study period and comprises of parameters like wind speed, wind direction (from 0 to 360 degrees), temperature, relative humidity, atmospheric pressure, rainfall and cloud cover. The minimum, maximum and average values for all the parameters except wind speed and direction are presented in **Table-3.5.1**.

TABLE-3.5.1
SUMMARY OF THE METEOROLOGICAL DATA GENERATED AT SITE

Month	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	Atmospheric Pressure (mb)	
	Min	Max	Min	Max		Min	Max
Pre Monsoon Season 2012							
March	21.5	36.1	41.8	58.3	0	996.3	1008.7
April	24.8	38.6	36.4	53.7	5.4	993.2	1006.3
May	29.1	42.5	39.7	57.6	12.3	991.5	1001.4
Range	***21.5-42.5***		***36.4-58.3***		***17.7***	***991.5-1008.7***	

- ***Wind Speed/ Directions***

The windrose for the study period representing Pre-Monsoon and a part of Pre-monsoon season is shown in **Figure-3.5.1** and presented in **Table-3.5.2**.

TABLE-3.5.2
SUMMARY OF WIND PATTERN AT THE STUDY AREA

Season	Pre-Monsoon season 2012
First Predominant Wind Direction	SE
Second Predominant Wind Direction	S
Predominant Wind Speeds (kmph)	1.3 to 5.0 5.1to 11.0 11.1 to 19.0
Calm conditions (%)	%

Note: Figures in parenthesis indicates percentage of time wind blows

- ***Pre-monsoon Season, 2012***

Predominant winds from SE direction were observed for 15.7% of the total time. In the S direction winds were observed for 9.9% of the total time. Whereas, in W direction the winds were observed for 8.9% of the total time. In other directions, the percentage frequencies observed were SSE (7.4%), E (6.8%), ESE (5.4%), NNE (4.4%), SW (4.2%), N (3.5%), NNW (2.5%), WSW (2.5%), SSW (2.0%), ve (2.0%), WNW (1.5%), NW (0.7%) and ENE (0.5%). Calm conditions prevailed for 22.1% of the time.

3.5.2 Secondary Data collected from IMD- Rentachintala

Secondary data from IMD-Rentachintala has been collected for pressure, temperature, relative humidity, rainfall, evaporation, wind speed and direction. The data at IMD is usually measured twice a day viz., at 0830 and 1730 hr.

3.5.2.1 Meteorological Data

The meteorological data is collected from the IMD-Rentachintala (about 30 km from the proposed project site), which is the nearest operating IMD station to the proposed project site. The data collected from IMD includes wind speed, wind direction (recorded in sixteen directions), temperature, relative humidity, atmospheric pressure and rainfall over a period of 10 years. The monthly maximum, minimum and average values are collected for all the parameters except wind speed and direction. The collected data is tabulated in **Table-3.5.3**.

3.5.2.2 Wind Speed/Direction

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours. While during the afternoon hours the winds were stronger. The wind roses for the study period representing pre-monsoon, monsoon, post-monsoon and winter seasons along with annual windroses are shown in **Figure-3.5.2** to **Figure-3.5.6** and presented in **Table-3.5.4**.

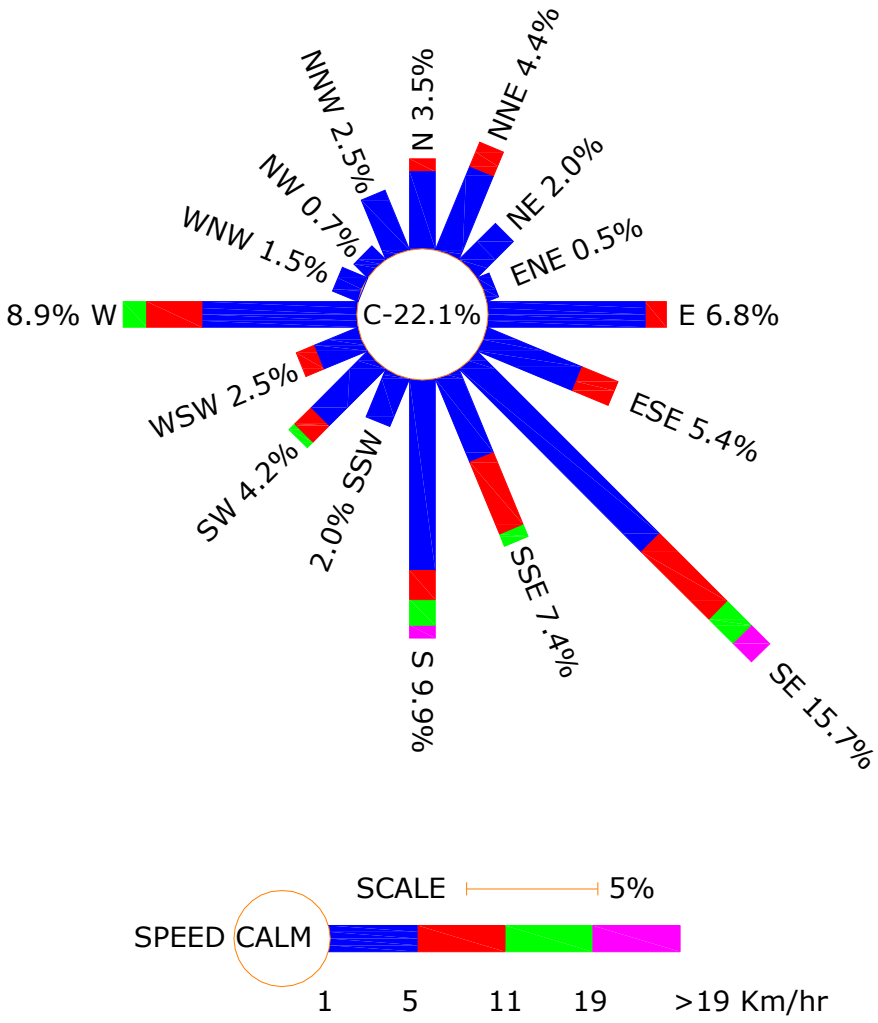
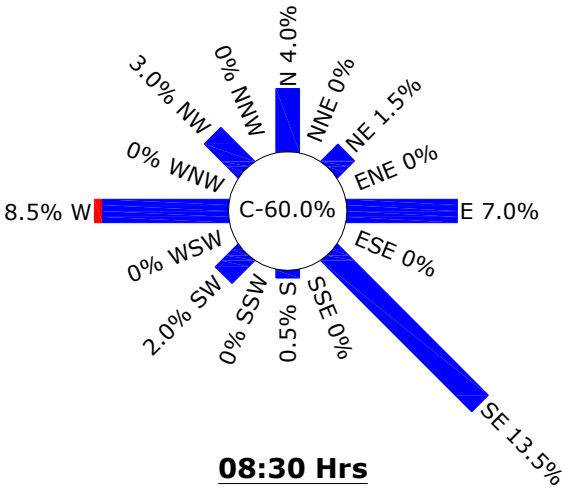
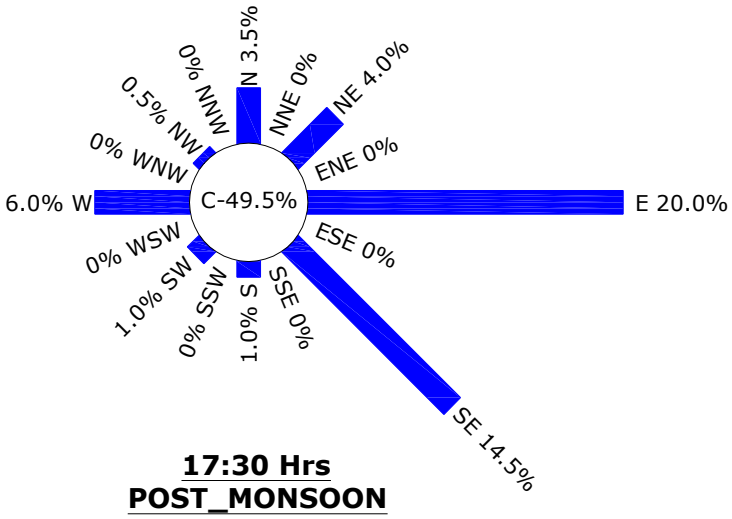


FIGURE-3.5.1
SITE SPECIFIC WINDROSE- PREMONSOON SEASON



08:30 Hrs
POST_MONSOON



17:30 Hrs
POST_MONSOON

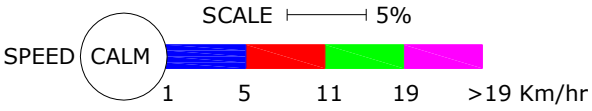


FIGURE-3.5.2
POST MONSOON WINDROSE - IMD RENTACHINTALA

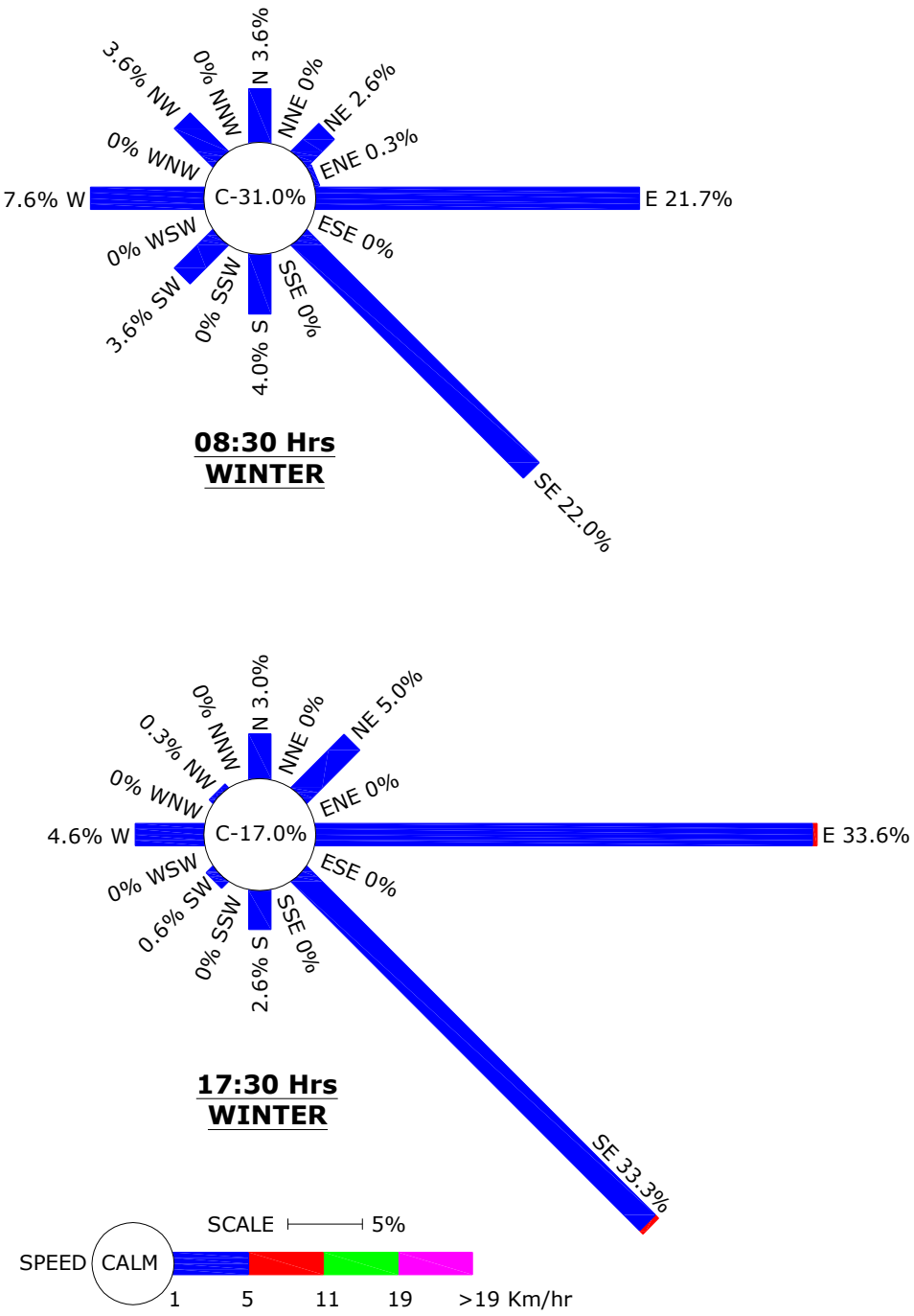


FIGURE-3.5.3
WINTER WINDROSES – IMD RENTACHINTALA

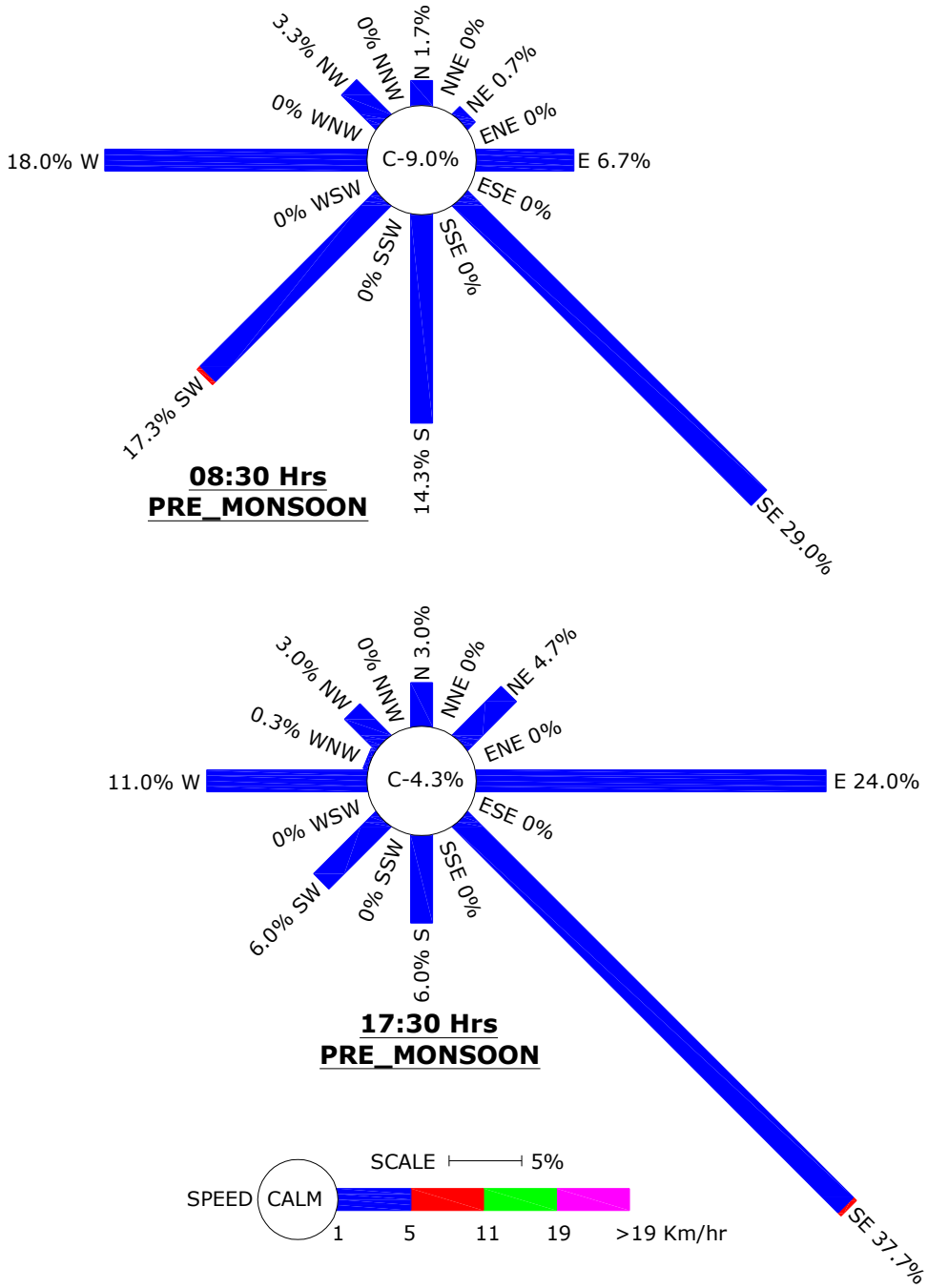


FIGURE-3.5.4
PRE-MONSOON WINDROSES – IMD RENTACHINTALA

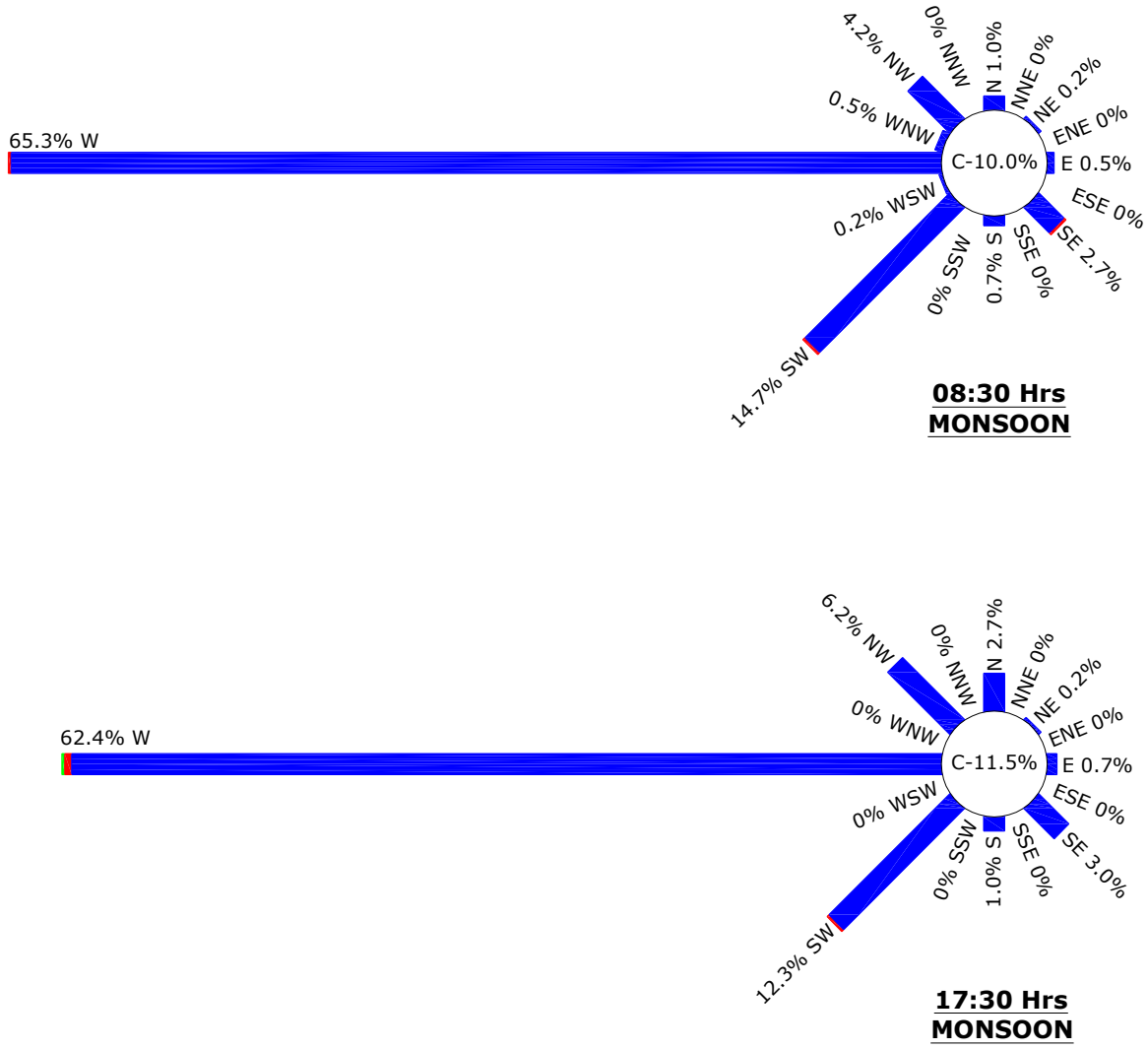


FIGURE-3.5.5
MONSOON WINDROSES – IMD RENTACHINTALA

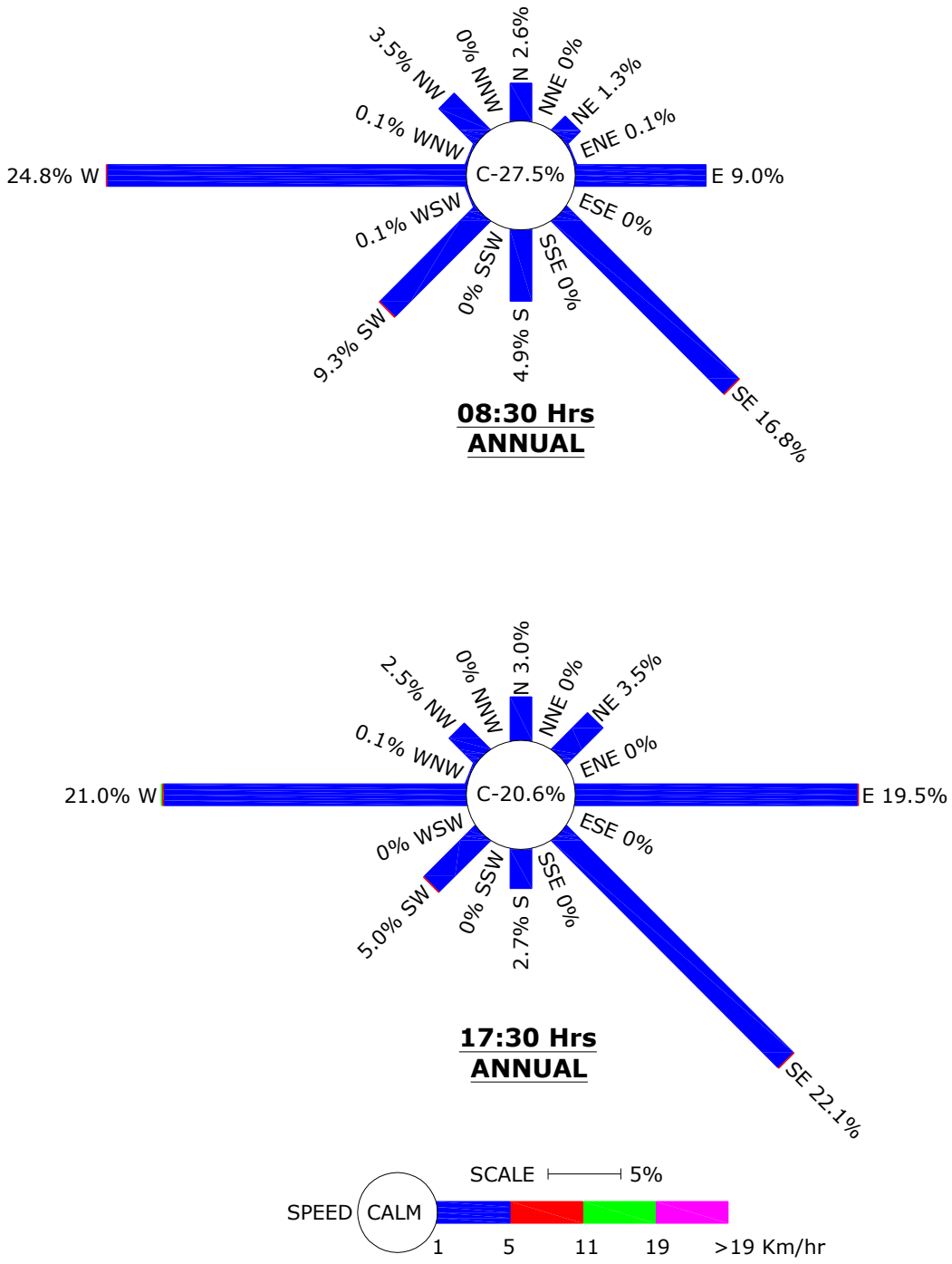


FIGURE-3.5.6
ANNUAL WIND ROSE (IMD- RENTACHINTALA)

TABLE-3.5.3
CLIMATOLOGICAL DATA-STATION: IMD, RENTACHINTALA

Month	Atmospheric Pressure (mb)	Temperature (^{0}C)		Relative Humidity (%)	Rainfall (mm)
		Max	Min		Monthly Total
January	1014.1	30.7	17.2	72.7	4.5
February	1011.7	33.4	19.7	67.7	4.1
March	1009.1	37.1	22.7	62.4	1.5
April	1007.0	39.5	25.7	59.2	13.9
May	1003.3	41.3	28.8	51.6	21.0
June	1002.3	37.6	28.0	59.1	83.2
July	1002.5	35.2	26.7	65.4	60.9
August	1003.9	33.3	25.8	73.1	111.4
September	1005.6	33.8	25.5	73.1	43.2
October	1008.5	32.6	24.0	79.9	71.3
November	1011.7	31.6	21.0	74.9	18.5
December	1014.0	30.3	17.2	71.7	6.4
	1002-1004.1	***17.2-41.3***		***51.6-79.9***	***439.9***

TABLE-3.5.4
SUMMARY OF WIND PATTERN-IMD RENTACHINTALA

Season	First Predominant Winds		Second Predominant Winds		Predominant Wind Speeds		% Calm Conditions	
	0830	1730	0830	1730	0830	1730	0830	1730
Post Monsoon	SE (13.5%)	E (20.0%)	W (8.5%)	SE (14.5%)	1.0 to 5.0, 11.0 to 19.0	1.0 to 5.0, 5.0 to 11.0	60.0	49.5
Winter	SE (22.0%)	E (33.6%)	E (21.7%)	SE (33.3%)	1.0 to 5.0, 5.0 to 11.0	1.0 to 5.0, 5.0 to 11.0	31.0	17.0
Pre-monsoon	SE (29.0%)	SE (37.7%)	W (18.0%)	E (24.0%)	1.0 to 5.0, 5.0 to 11.0	1.0 to 5.0, 5.0 to 11.0	9.0	4.3
Monsoon	W (65.3%)	W (62.4%)	SW (14.7%)	SW (12.3%)	1.0 to 5.0, 5.0 to 11.0	1.0 to 5.0, 5.0 to 11.0	10.0	11.5
Annual	W (24.8%)	SE (22.1%)	SE (16.8%)	W (21.0%)	1.0 to 5.0, 11.0 to 19.0	1.0 to 5.0, 5.0 to 11.0	27.5	20.6

Note: Figures in parenthesis indicates % of time wind blows

3.5.3 Comparison of Primary and Secondary Data

The India Meteorological Department (IMD) records the data twice a day viz. 0830 hr and 1730 hr while the site-specific data has been recorded at an hourly interval. On comparison of site specific data generated for study period vis-à-vis the IMD data, slight variations were observed. The following observations are brought out:

- The predominant wind direction observed at the proposed project site during the study period of Pre-Monsoon season were SE for 15.7 % of the total time and followed by S direction for 9.9 % of the total time, whereas the predominant wind direction and wind speed as recorded by IMD, Rentachintala during the Pre-Monsoon season are SE (33.3 %) and W (14.5 %) followed by SW (11.6 %);

- The temperature recorded on site when compared vis-à-vis the IMD data, slight variations was found. The mean maximum and mean minimum temperatures recorded at site during study period were 42.5^{o}C and 21.5 ^{o}C, whereas the maximum and minimum values recorded at IMD-Rentachintala during the same period are 41.3 ^{o}C and 22.7 ^{o}C respectively;

- The Relative Humidity was observed to range from 36.4-58.3 % during the study period at the site, whereas according to IMD-Rentachintala, the Relative Humidity was observed to be in the range of 51.6-62.4% during the same season.

The data generated at proposed project site when compared with the data recorded at IMD, it is observed that the data generated at the site is broadly in comparison with regional meteorology, except for minor variations as described above.

3.6 Air Quality

The ambient air quality with respect to the study zone of 10-km radius around the plant forms the baseline information. The prime objective of the baseline air quality study was to assess the existing air quality of the area. This will also be useful for assessing the conformity to standards of the ambient air quality during the operation of cement plant. The study area represents mostly rural/residential environment.

This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling. Ambient air quality monitoring has been carried out during March 2012 to May 2012 representing pre-monsoon season.

3.6.1 Methodology adopted for Air Quality Survey

Selection of Sampling Locations

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality-monitoring network. The design of monitoring network in the air quality surveillance program has been based on the following considerations:

- Meteorological conditions on synoptic scale;
- Topography of the study area;
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

Ambient Air Quality Monitoring (AAQM) stations were set up at eight locations with due consideration to the above mentioned points during March to May 2012 and June & July, 2012 **Table-3.6.1** and **Table 3.6.1(A)** gives the details of environmental setting around each monitoring station. The locations of the selected stations with reference to the plant are given in the same table and shown in **Figure-3.6.1.**

Frequency and Parameters for Sampling

Ambient air quality monitoring was carried out at a frequency of two days per week for three months at each location representing pre-monsoon and a part of winter season. Ambient air quality at 8 locations within the study area of 10-km radial distance from project site within two down wind directions is presented in **Table-3.5.1.** The baseline data of air environment was monitored for parameters mentioned below:

- Particulate Matter ($PM_{2.5}$);
- Particulate Matter (PM_{10});
- Sulphur dioxide (SO_2);
- Oxides of Nitrogen (NOx);
- Carbon monoxide (CO); and
- Hydrocarbons.

TABLE-3.6.1
DETAILS OF AMBIENT AIR QUALITY MONITORING – PRE MONSOON

Station Code	Name of the Station	Aerial Distance (km)	Direction	Environmental Setting
		w.r.t. Plant		
AAQ1	Plant Site	--	--	--
AAQ2	Kotayyanagaram	2.5	SE	Upwind
AAQ3	Gamalapadu	2.7	SSE	Crosswind
AAQ4	Madinapadu	4.9	E	Crosswind
AAQ5	Shrinagar	0.8	NW	Downwind
AAQ6	Ramapuram	3.4	N	Crosswind
AAQ7	Pondugala	4.9	NW	Downwind
AAQ8	Srinivasapuram	2.9	WSW	Crosswind

TABLE-3.6.1(A)
DETAILS OF AMBIENT AIR QUALITY MONITORING – MONSOON

Station Code	Name of the Station	Aerial Distance (km)	Direction
		w.r.t. Plant	
AAQ1	Shrinagar	0.8	NW
AAQ2	Ramapuram	3.4	N
AAQ3	Batrupalem	3.6	NE
AAQ4	Gamalapadu	2.7	SSE

➢ ***Duration of Sampling***

The sampling duration for $PM_{2.5}$, PM_{10}, SO_2 and NOx is twenty four hourly continuous samples per day and CO and HC are sampled for 8 hours continuously thrice a day. This is to allow a comparison with the present revised standards mentioned in the latest Gazette Notification of the Central Pollution Control Board (CPCB) (November 2009).

3.6.2 Presentation of Primary Data

Various statistical parameters like 98th percentile, average, minimum and maximum values have been computed from the observed raw data for all the AAQ monitoring stations. The results of monitoring carried out are presented in **Annexure-VII**. The summary of these results representing pre-monsoon season and partly monsoon seasons are given in **Table-3.6.2** and **Table 3.6.2(A)**. These are compared with the standards prescribed by Central Pollution Control Board (CPCB) for rural and residential zone and industrial zone.

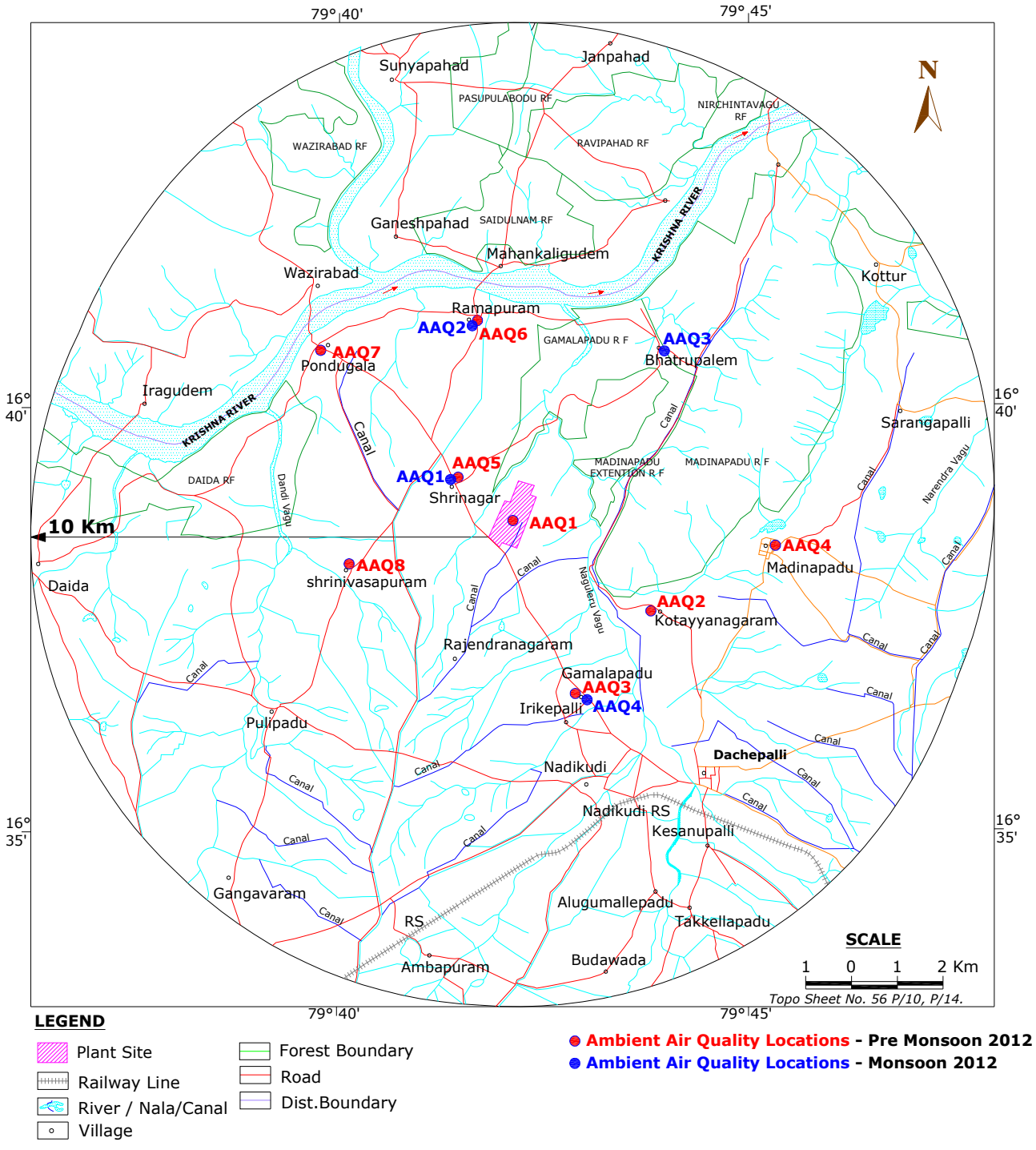


FIGURE-3.6.1
AIR QUALITY SAMPLING LOCATIONS

TABLE-3.6.2
SUMMARY OF AMBIENT AIR QUALITY RESULTS - PRE MONSOON 2012

Station Code	Location/ Village	PM2.5				PM10			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Plant Site	15.6	23.8	20.1	23.2	41.7	67.3	54.3	66.7
AAQ2	Kotayyanagaram	11.4	17.1	13.8	16.8	27.8	43.9	34.7	43.4
AAQ3	Gamalapadu	11.9	17.7	14.3	17.4	29.4	46.7	38.8	46.3
AAQ4	Madinapadu	12.3	18.4	15.3	17.8	33.1	50.8	42.9	49.6
AAQ5	Shrinagar	14.8	22.2	17.9	21.7	40.5	63.1	52.8	62.5
AAQ6	Ramapuram	13.4	20.3	16.7	19.8	36.6	56.2	46.9	55.6
AAQ7	Pondugala	14.1	21.6	17.4	21.1	39.4	58.5	48.7	57.8
AAQ8	Srinivasapuram	12.7	19.1	15.3	18.7	35.3	53.7	43.1	53.1
Range		***11.4 – 23.8***				***27.8 – 67.3***			

Station Code	Location/ Village	SO2				NOX			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Plant Site	10.7	13.9	11.8	13.4	11.6	14.9	13.1	14.6
AAQ2	Kotayyanagaram	7.9	10.2	8.8	9.9	<9.0	11.6	10.1	11.3
AAQ3	Gamalapadu	8.1	10.8	9.3	10.5	9.6	12.7	10.9	12.4
AAQ4	Madinapadu	8.9	11.5	9.9	11.2	10.3	12.9	11.4	12.6
AAQ5	Shrinagar	10.2	13.5	11.7	13.2	11.8	14.9	13.1	14.6
AAQ6	Ramapuram	9.3	12.4	10.5	12.1	10.8	13.7	12.1	13.3
AAQ7	Pondugala	9.7	12.8	10.8	12.4	10.4	14.3	12.1	13.9
AAQ8	Srinivasapuram	8.5	11.1	9.5	10.8	9.5	13.5	11.1	12.8
Range		***7.9 – 13.9***				***<9.0 – 14.9***			

Station Code	Location/ Village	CO				HC			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Plant Site	228	371	313	366	112.4	131.3	119.9	130.4
AAQ2	Kotayyanagaram	220	369	316	367	98.4	109.5	102.3	108.4
AAQ3	Gamalapadu	255	375	323	371	101.1	111.4	105.8	110.9
AAQ4	Madinapadu	238	371	322	368	103.8	118.7	110.5	117.8
AAQ5	Shrinagar	228	372	315	369	109.9	128.5	119.2	127.9
AAQ6	Ramapuram	273	362	318	361	102.3	121.8	112.7	121.1
AAQ7	Pondugala	245	362	313	356	108.4	124.3	116.3	123.5
AAQ8	Srinivasapuram	226	376	323	372	101.7	113.2	106.9	112.6
Range		***220-376***				***98.4 – 131.3***			

Except CO all values mentioned above are expressed in µg/m^3

TABLE-3.6.2(A)
SUMMARY OF AMBIENT AIR QUALITY RESULTS - MONSOON 2012

Station Code	Location/ Village	PM2.5				PM10			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Shrinagar	12.5	15.6	13.7	15.3	33.7	60.4	47.4	59.8
AAQ2	Ramapuram	10.1	12.9	11.3	12.6	28.5	53.2	40.5	52.6
AAQ3	Batrupalem	9.4	11.8	10.3	11.6	24.4	50.2	39.2	49.9
AAQ4	Gamalapadu	8.9	10.7	9.5	10.4	20.2	45.8	33.2	44.8
Range		***8.9 – 15.6***				***20.2 – 60.4***			

Station Code	Location/ Village	SO2				NOX			
		Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Shrinagar	8.1	11.9	9.6	11.6	9.6	14.2	11.5	13.9
AAQ2	Ramapuram	6.9	9.7	7.9	9.4	8.6	10.9	9.5	10.7
AAQ3	Batrupalem	6.5	8.9	7.6	8.7	8.1	10.4	9.2	10.2
AAQ4	Gamalapadu	7.2	10.5	8.8	10.2	9.1	12.5	10.7	12.3
Range		***6.5 – 11.9***				***8.1 – 14.2***			

Except CO all values mentioned above are expressed in µg/m^3

❖ **Pre monsoon season, 2012**

- ***Particulate Matter ($PM_{2.5}$)***

The minimum and maximum concentrations for $PM_{2.5}$ were recorded as 11.4 μg/m^3 and 23.8 μg/m^3 and respectively. The minimum concentration was recorded near AAQ2 maximum concentration was recorded at AAQ1 which falls in down wind direction.

- ***Particulate Matter (PM10)***

The minimum and maximum concentrations for PM_{10} were recorded as 27.8 μg/m^3 and 67.3 μg/m^3 and respectively. The minimum concentration and the maximum concentrations were recorded AAQ2 and AAQ1.

- ***Sulphur Dioxide***

The minimum and maximum SO_2 concentrations were recorded as 7.9 μg/m^3 and 13.9 μg/m^3. The minimum concentration was recorded at AAQ2 and the maximum concentration was recorded at AAQ1.

- ***Nitrogen Oxide***

The minimum of <9.0 μg/m^3 observed at AAQ2 and maximum concentration of 14.9 μg/m^3 for NOx was recorded at AAQ1.

- ***Carbon Monoxide***

The minimum and maximum carbon monoxide concentrations were recorded as 220 μg/m^3 and 376 μg/m^3.

- ***Hydrocarbons***

The values of hydrocarbons are in the range of 98.4 – 131.3 μg/m^3.

Air quality monitoring was carried out as per G.S.R no. 826 (E), dated 16th November 2009 and the observations at all the monitored locations are well within the limits as per prescribed standards.

3.7 Water Quality

Selected water quality parameters of ground water and surface water resources within 10-km radius of the study area has been studied for assessing the water environment and evaluate anticipated impact of the plant. Understanding the water quality is essential in preparation of Environmental Impact Assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters; and
- Predict the impact of water quality by these mining and related activities.

The information required has been collected through primary surveys and secondary sources.

Eight groundwater sources and five surface water sources covering 10-km radial distance were examined for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of existing industrial and other activities on water.

The samples were collected and analysed once during the study period. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA).

3.7.1 Water Sampling Locations

Water samples were collected from thirteen sampling locations. These samples were taken as grab samples and were analyzed for various parameters to compare with the standards for drinking water as per IS: 10500. The water sampling locations are listed below in **Table-3.7.1** and are shown in **Figure-3.7.1**. The results of monitoring carried out for the study are presented in **Table-3.7.2**.

TABLE-3.7.1
DETAILS OF WATER SAMPLING LOCATIONS

Code	Location	Arial Distance (km)	Direction
		wrt Plant	
Ground Water			
GW1	Plant site	--	--
GW2	Kattayanagaram	2.5	SE
GW3	Gamalapadu	2.7	SSE
GW4	Madinapadu	4.9	E
GW5	Shrinagar	0.8	NW
GW6	Ramapuram	3.4	N
GW7	Pondugala	4.9	NW
GW8	Srinivasapuram	2.9	WSW
Surface Water			
SW1	Dandi vagu	4.4	W
SW2	Nala near Shrinagar	0.1	NW
SW3	Naguleru vagu near Kotayanagaram	1.7	SE
SW4	Krisnha river near Ramapuram	4.0	N
SW5	Baturalem	4.8	NNE

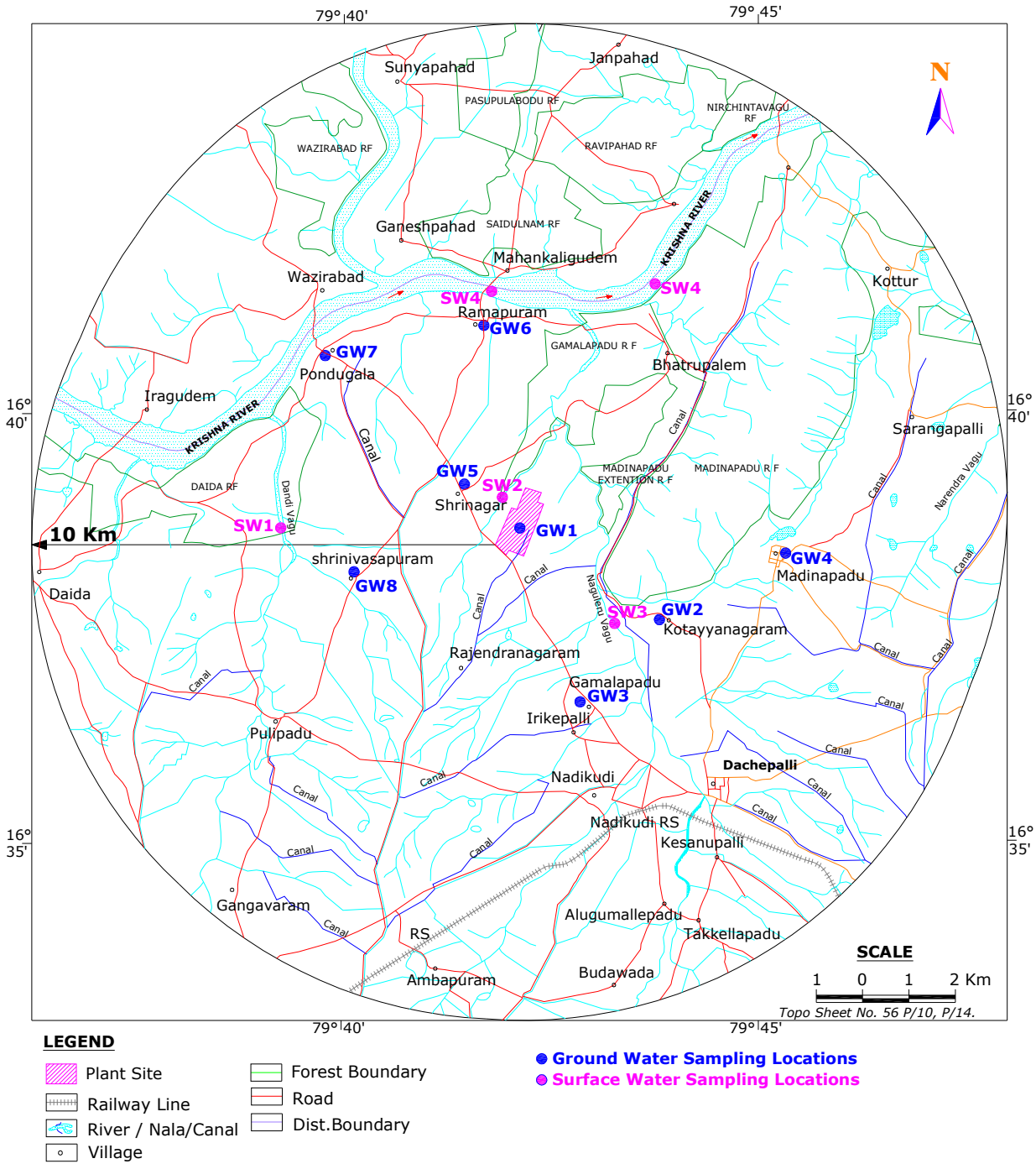


FIGURE-3.7.1
WATER SAMPLING LOCATIONS

TABLE-3.7.2(A)
GROUND WATER QUALITY

Sr. No.	Parameter	Unit	Limits as per IS10500	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
1	pH	-	6.5-8.5 (NR)	7.7	7.9	7.9	7.7	7.6	7.2	7.3	7.5
2	Colour	Hazen	5(25)	2	2	2	3	2	2	2	2
3	Taste	-	Agreeable	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag
4	Odour	-	UO	UO	UO	UO	UO	UO	UO	UO	UO
5	Conductivity	µS/cm	$	2940	989	2150	1051	2100	1776	1847	2250
6	Turbidity	NTU	5(10)	3	4	3	4	3	3	3	3
7	TDS	mg/l	500(2000)	1996	674	1458	710	1422	1202	1254	1528
8	Total Hardness as CaCO3	mg/l	300(600)	690	345	590	388	540	480	572	580
9	Total Alkalinity	mg/l	200(600)	305	200	195	210	315	315	335	345
10	Calcium as Ca	mg/l	75(200)	216	94	164	87.2	184.0	158.4	169.6	156.0
11	Magnesium as Mg	mg/l	30(100)	36.5	26.7	43.7	41.3	19.4	20.4	36.0	46.2
12	Residual Chlorine	mg/l	0.2 Min	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
13	Boron	mg/l	1	0.53	0.09	0.36	0.11	0.37	0.23	0.22	0.40
14	Chlorides as Cl	mg/l	250(1000)	389	111	333	108	330	240	264	375
15	Sulphates as SO_4	mg/l	200(400)	576.4	91.3	400.6	87.2	233.6	166.1	106.7	223.8
16	Fluorides as F	mg/l	1.0(1.5)	1.2	0.3	1.0	0.3	1.0	0.5	0.4	1.1
17	Nitrates as NO_3	mg/l	45(NR)	24.4	31.1	39.9	58.4	22.8	77.4	135.4	28.9
18	Sodium as Na	mg/l	$	360.2	56.7	239.9	51.6	233.9	183.6	132.8	256.9
19	Potassium as K	mg/l	$	2.1	1.9	22.1	2.7	1.8	1.8	50.7	1.8
20	Phenolic Compounds	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21	Cyanides	mg/l	0.05(NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
22	Anionic Detergents	mg/l	0.2(0.1)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
23	Mineral Oil	mg/l	0.01(0.03)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Arsenic as As	mg/l	0.01(NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
26	Copper as Cu	mg/l	0.05(1.5)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
27	Lead as Pb	mg/l	0.05(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Manganese as Mn	mg/l	0.1(0.3)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
29	Iron as Fe	mg/l	0.3(1.0)	0.05	0.05	0.08	0.03	0.07	0.03	0.05	0.05
30	Chromium as Cr+6	mg/l	0.05(NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01
31	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5(15)	1.43	0.01	0.02	0.05	4.80	0.05	0.03	0.56
33	Aluminium as Al	mg/l	0.03(0.2)	0.04	0.04	0.08	0.06	0.05	0.06	<0.01	<0.01
34	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	Pesticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
36	E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
37	Total Coliforms	MPN/100 ml	10	<2	<2	<2	<2	<2	<2	<2	<2

 # Values in parenthesis are maximum permissible limits in absence of alternate source.$: Limits not specified, NR: No Relaxation, UO: Un-Objectionable, Ag: Taste agreeable, Abs: Absent

TABLE-3.7.2(B)
SURFACE WATER QUALITY

Sr. No.	Parameter	Unit	Limits as per IS10500	SW1	SW2	SW3	SW4	SW5
1	pH	-	6.5-8.5 (NR)	8.0	7.9	7.7	8.1	7.9
2	Colour	Hazen	5(25)	3	4	3	3	4
3	Taste	-	Agreeable	Ag	Ag	Ag	Ag	Ag
4	Odour	-	UO	UO	UO	UO	UO	UO
5	Conductivity	µS/cm	$	1125	702	1805	693	709
6	TDS	mg/l	500(2000)	5	5	4	4	5
7	Turbidity	NTU	5(10)	768	482	1230	468	478
8	Total Hardness as CaCO3	mg/l	300(600)	280	174	370	170	185
9	Total Alkalinity	mg/l	200(600)	210	215	330	165	165
10	Calcium as Ca	mg/l	75(200)	44.0	41.6	96.8	33.6	30.0
11	Magnesium as Mg	mg/l	30(100)	41.3	17.0	31.1	20.9	26.7
12	Residual Chlorine	mg/l	0.2 Min	<0.2	<0.2	<0.2	<0.2	<0.2
13	Boron	mg/l	1	0.10	<0.01	0.27	0.08	0.08
14	Chlorides as Cl	mg/l	250(1000)	208	60	340	92	94
15	Sulphates as SO_4	mg/l	200(400)	44.7	50.9	85.3	44.0	49.3
16	Fluorides as F	mg/l	1.0(1.5)	1.2	0.4	0.8	0.5	0.5
17	Nitrates as NO_3	mg/l	45(NR)	0.3	<0.1	0.3	0.4	0.7
18	Sodium as Na	mg/l	$	123.6	73.4	239.9	78.9	75.1
19	Potassium as K	mg/l	$	5.1	15.6	10.6	0.8	3.0
20	Phenolic Compounds	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001
21	Cyanides	mg/l	0.05(NR)	<0.02	<0.02	<0.02	<0.02	<0.02
22	Anionic Detergents	mg/l	0.2(0.1)	<0.1	<0.1	<0.1	<0.1	<0.1
23	Mineral Oil	mg/l	0.01(0.03)	<0.01	<0.01	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01
25	Arsenic as As	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01
26	Copper as Cu	mg/l	0.05(1.5)	<0.01	<0.01	<0.01	<0.01	<0.01
27	Lead as Pb	mg/l	0.05(NR)	<0.01	<0.01	<0.01	<0.01	<0.01
28	Manganese as Mn	mg/l	0.1(0.3)	<0.01	0.21	0.02	<0.01	<0.01
29	Iron as Fe	mg/l	0.3(1.0)	0.02	0.12	0.07	0.03	0.02
30	Chromium as Cr+6	mg/l	0.05(NR)	<0.05	<0.05	<0.05	<0.05	<0.05
31	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5(15)	0.01	0.13	0.02	0.014	0.02
33	Aluminium as Al	mg/l	0.03(0.2)	0.05	0.03	0.04	0.03	0.02
34	Mercury as Hg	Mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001
35	Pesticides	Mg/l	Absent	Absent	Absent	Absent	Absent	Absent
36	E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent
37	Total Coliforms	MPN/100 ml	10	<2	<2	<2	<2	<2

 # Values in parenthesis are maximum permissible limits in absence of alternate source.$: Limits not specified, NR: No Relaxation, UO: Un-Objectionable, Ag: Taste agreeable, Abs: Absent

3.7.2 Presentation of Results

- ***Ground Water***

The results for the parameters analyzed for ground water samples are presented in **Table-3.7.2(A)** and are compared with standards for drinking water as per IS: 10500-1991 "Specifications for Drinking Water".

The residents of the villages make use of these water for drinking and other domestic uses. In total 8 water samples were collected from different sources around the project site within the periphery of 10 km.

The pH of the water samples collected ranges in between 7.2 to 7.9. The conductivity recorded in between 989 to 2940 µmhos/cm in the sample.

Sodium and potassium concentrations varied in between 51.6 to 360.2 mg/l and 1.8 to 50.7 mg/l respectively. The higher concentration of Sodium is observed at GW7 bore well.

Total hardness expressed as $CaCO_3$ ranges between 345 to 690 mg/l. The concentration of Nitrate fluctuates between 22.8 to 135.4 mg/l with higher concentration of nitrate observed in GW7 sample.

The chemical analysis of ground water samples revealed that these water samples are slightly alkaline in nature. This may be attributed to the local geologic conditions.

- ***Surface Water***

Five surface water samples have been collected from near by river (60 m upstream and downstream) and other surface drains. The physical, chemical and biological characterization is given in **Table-3.7.2(B)**. The results for the parameters analyzed for ground water samples are presented in Table-3.6.2(B) and are compared with standards for drinking water as per IS: 10500-1991 "Specifications for Drinking Water".

The pH of the surface water samples collected ranges in between 7.7 to 8.1. The conductivity recorded in between 693 to 1805 µs/cm in the sample. The sodium and potassium concentrations varied between 73.4 to 239.9 mg/l and 0.8 to 15.6 mg/l respectively.

Total hardness expressed as $CaCO_3$ ranges between 170 to 370 mg/l. The concentration of nitrate fluctuates between <0.1 to 0.7 mg/l.

3.8 Noise Level Survey

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound which is composed of many frequency components of various types of loudness distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the A

weighted Scale which is measured as dB (A). This is more suitable for audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of a human ear.

The impact of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent or continuous in nature). It can be observed that steady noise is not as annoying as one which is continuously varying in loudness;
- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance; and
- The location of the noise source, with respect to noise sensitive landuse, which determines the loudness and period of exposure.

The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise. The environmental impact assessment of noise from the existing plant, construction activity, and vehicular traffic can be undertaken by taking into consideration various factors like potential damage to hearing, physiological responses, and annoyance and general community responses.

The main objective of noise monitoring in the study area is to establish the baseline noise levels, and assess the impact of the total noise generated by the cement plant operations around it.

3.8.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise at different noise generating sources has been identified based on the activities in the village area, ambient noise due to industries and traffic and the noise at sensitive areas like hospitals and schools.

The noise monitoring has been conducted for determination of noise levels at eight locations in the study area. The noise levels at each location were recorded for 24 hours. The environment setting of each noise monitoring location is given in **Table-3.8.1** and shown in **Figure-3.8.1**.

TABLE-3.8.1
DETAILS OF NOISE MONITORING LOCATIONS

Location Code	Location	Arial Distance (km) w.r.t. Plant Area	Direction	Zone
N1	Plant Site	--	--	Industrial
N2	Kotayyanagaram	2.5	SE	Rural / Residential
N3	Gamalapadu	2.7	SSE	Rural / Residential
N4	Madinapadu	4.9	E	Rural / Residential
N5	Shrinagar	0.8	NW	Rural / Residential
N6	Ramapuram	3.4	N	Rural / Residential
N7	Pondugala	4.9	NW	Rural / Residential
N8	Srinivasapuram	2.9	WSW	Rural / Residential

3.8.2 Method of Monitoring

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations covered in 10 km radius of the study area.

3.8.3 Presentation of Results

The statistical analysis is done for measured noise levels at **eight** locations during pre monsoon season. The parameters are analyzed for L_{day}, L_{night}, and L_{dn}. These results are tabulated in **Table-3.8.2.**

TABLE-3.8.2
NOISE LEVELS IN THE STUDY AREA

Code	Location	L_{10}	L_{50}	L_{90}	L_{eq}	L_{day}	L_{night}	L_{dn}
N1	Plant Site	49.8	46.3	42.5	47.2	48.0	44.3	51.5
N2	Kotayyanagaram	44.6	40.1	36.7	41.1	43.1	38.2	45.7
N3	Gamalapadu	43.9	40.0	36.3	41.0	41.8	38.2	45.3
N4	Madinapadu	41.3	37.5	33.7	38.5	39.7	35.8	43.0
N5	Shrinagar	45.7	41.5	37.6	42.6	43.6	39.2	46.6
N6	Ramapuram	43.5	39.7	35.9	40.7	42.3	38.0	45.3
N7	Pondugala	46.4	41.6	38.0	42.8	44.9	39.1	47.0
N8	Srinivasapuram	44.4	40.5	36.6	41.5	42.4	37.8	45.2

a) Daytime Noise Levels (L_{day})

The daytime noise levels at all the locations are observed to be within the range of 39.7 to 48.0 dB (A). The minimum noise level was observed to be 39.7 dB (A) at Madinapadu (N4) and maximum noise level was observed to be 48.0 dB (A) at Plant site (N1).

b) Night time Noise Levels (L_{night})

The night time noise levels at all the locations were found to be in the range of 35.8 to 44.3 dB (A). The minimum night time noise level was observed to be 35.8 dB (A) at Madinapur (N4) and maximum night time noise level was observed to be 44.3 dB (A) at Plant site (N1).

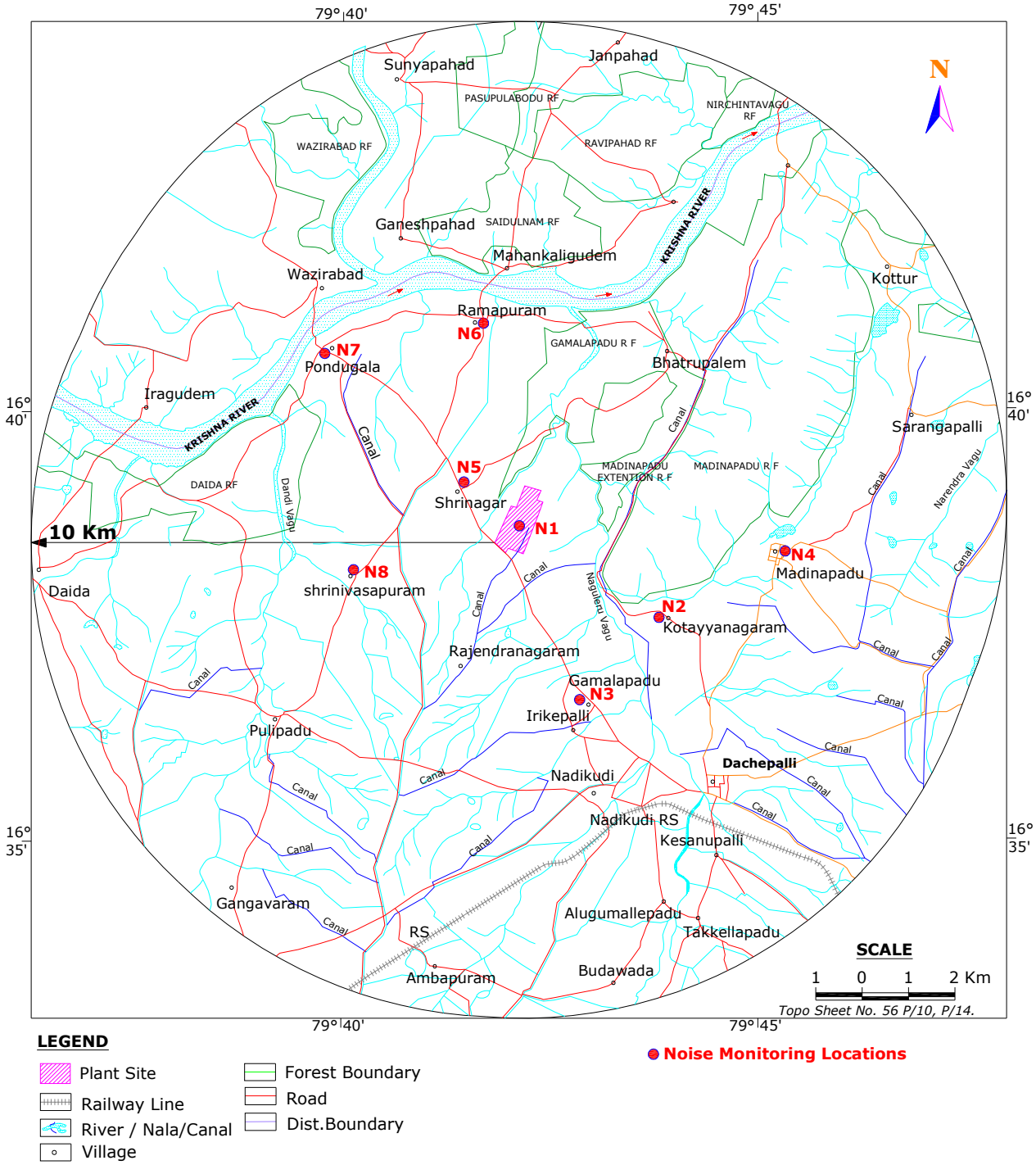


FIGURE-3.8.1
NOISE MONITORING LOCATIONS

3.9 Flora and Fauna Studies

An ecological survey of the study area was conducted during Pre monsoon season 2012 period to assess the existing floristic structure and record the biological resources.

3.9.1 Terrestrial Ecological Studies

3.9.1.1Objectives of Ecological Study

The objectives of the present study are intended to:

- Generate baseline data from field observations from various terrestrial ecosystems; and
- Compare the data so generated with authentic past records to understand changes.

3.9.1.2 Methods Adopted for the Study

To accomplish the above objectives, a general ecological survey covering an area of 10 km radius from the proposed project as centre.

- Reconnaissance survey for selection of sampling sites;
- Generation of primary data to understand baseline ecological status, important floristic elements;
- Generation of primary data to understand baseline fauna structure; and
- Collection of secondary data from Forest Working Plan and Gazetteers.

3.9.1.3 Criteria adopted for Selection of Sampling Locations

Reconnaissance survey was conducted to list of plant species on the basis of following criteria:

- In project area;
- Downwind direction of the proposed project area; and
- Upwind direction of the proposed project lease area.

A preliminary survey was made and six locations for detailed study within 10 km radius were selected. The selected locations are given in **Table-3.9.1** and shown in **Figure-3.9.1.**

The primary data was generated through:

- Preparing a general checklist of all plants encountered in the study area. This would indicate the biodiversity for wild and cultivated plants. The plants so encountered were classified into life form spectrum according to the classification of Raunkiaer's (Braun Blanquet) classification of life form spectrum.
- Phytosociological studies by using list count quadrate method. Sufficient number of quadrates of 100 m^2 size was employed for this. The number of quadrates depended on actual field requirements.

- Estimating basal areas of trees and shrubs at breast height [132 cm from ground or above buttresses].
- Herbaceous flora was studied by taking 10 quadrates in each location, each quadrate having 10 m^2.
- Determining frequency, abundance, relative frequency, relative density, relative dominance and importance value indices using Mueller-Dombois-Ellenberge [1974] Method.
- Determining the bird population of migratory and local birds by taking 10 random readings at every location.
- Observing mammals, amphibians and reptiles, noting their calls, droppings, burrows, pugmarks and other signs.
- Local inhabitants were interviewed for uses of plants and animals and to get ethnobiological data.

TABLE-3.9.1
SAMPLING LOCATIONS FOR ECOLOGICAL STUDIES

Location Code	Name of Village	Plant	
		Distance (km)	Direction
TE-1	Kotayyanagaram	2.5	SE
TE-2	Gamalapadu	2.7	SSE
TE-3	Madinapadu	4.9	E
TE-4	Shrinagar	0.8	NW
TE-5	Ramapuram	3.4	N
TE-6	Pondugala	4.9	WSW

3.9.2 Floristic Composition- Primary Survey

➢ **Floristic Richness**

Field survey conducted in pre monsoon season revealed a total of 251 species of plants of which 112 were phanerophytes, 108 were therophytes, 22 hemicryptophytes, and 9 geophytes. Among angiosperms 112 were woody members and rest belongs to herbaceous plants.

➢ **Flora recorded from core zone area**

The recorded list of plant species in core zone are presented in **Table-3.9.2.**

TABLE-3.9.2
FLORISTIC COMPOSITION IN CORE ZONE

Sr. No.	Technical Name	Family	Life Form
I. Agricultural Crops			
1	*Sorghum vulgare*	Poaceae	Hemicryptophyte
2	*Triticum vulgare*	Poaceae	Hemicryptophyte
3	*Zea mays*	Poaceae	Hemicryptophyte
4	*Oryza sativa*	Poaceae	Hemicryptophyte
5	*Pennisetum typhoideum*	Poaceae	Hemicryptophyte
II. Commercial Crops (including Vegetables)			
6	*Abelomoschus indicus*	Malvaceae	Therophyte
7	*Allium cepa*	Liliaceae	Geophyte
8	*Arachis hypogia*	Fabaceae	Geophyte
9	*Cajanus cajan*	Fabaceae	Therophyte
10	*Carica papaya*	Caricaceae	Therophyte
11	*Catharanthes pusillus*	Compositae	Therophyte
12	*Cicer arietinum*	Fabaceae	Hemicryptophyte

Sr. No.	Technical Name	Family	Life Form
13	*Citrus lemon*	Ruataceae	Therophyte
14	*Colacasia esculenta*	Areaceae	Geophyte
15	*Mangifera indica*	Anacardiaceae	Phanerophyte
16	*Memordia charantia*	Cucurbitaceae	Therophyte
17	*Psidium guava*	Myrtaceae	Phanerophyte
III. Plantations			
18	*Acacia nilotica*	Mimosaceae	Phanerophyte
19	*Azadirachta indica*	Meliaceae	Phanerophyte
20	*Bambusa arundanacea*	Poaceae	Phanerophyte
21	*Butea superba*	Caesalpinaceae	Phanerophyte
22	*Leucena leucophloe*	Caesalpinaceae	Phanerophyte
IV. Natural Vegetation/Forest Type			
23	*Abrus precatorius*	Fabaceae	Therophyte
24	*Abutilon indicum*	Malvaceae	Phanerophyte
25	*Acacia nilotica*	Mimosaceae	Phanerophyte
26	*Acacia leucophloe*	Mimosaceae	Phanerophyte
27	*Argemone mexicana*	Papevaraceae	Phanerophyte
28	*Blepharis madaraspatens*	Acanthaceae	Therophyte
29	*Boerheavia diffusa*	Nyctaginaceae	Therophyte
30	*Caesalpina pulcherima*	Caesalpinaceae	Phanerophyte
31	*Calotropis procera*	Asclipiadaceae	Phanerophyte
32	*Canna indicda*	Cannaceae	Therophyte
33	*Capparis aphylla*	Capparidaceae	Therophyte
34	*Carissa carandus*	Apocyanaceae	Phanerophyte
35	*Cassia auriculata*	Caesalpinaceae	Therophyte
36	*Cassia occidentalis*	Caesalpinaceae	Therophyte
37	*Cleome gynandra*	Capparidaceae	Therophyte
38	*Cleome viscose*	Capparidaceae	Therophyte
39	*Commelina benghalensis*	Commelinaceae	Therophyte
40	*Crotalaria medicagenia*	Fabaceae	Therophyte
41	*Croton bonplandinum*	Amaryllidaceae	Therophyte
42	*Cuscuta reflexa*	Cuscutaceae	Epiphyte
43	*Datura metal*	Solanaceae	Therophyte
44	*Desmodium triflorum*	Asclepiadaceae	Therophyte
45	*Eclipta alba*	Compositae	Heliophyte
46	*Eclipta prostrate*	Compositae	Hemicryptophyte
47	*Emblica officinale*	Euphorbiaceae	Phanerophyte
48	*Euphorbia antiquorum*	Euphorbiaceae	Phanerophyte
49	*Euphorbia hirta*	Euphorbiaceae	Therophyte
50	*Euphorbia neruri*	Euphorbiaceae	Therophyte
51	*Euphorbia nivula*	Euphorbiaceae	Therophyte
52	*Euphorbia tricauli*	Euphorbiaceae	Hemicryptophyte
53	*Evolvulus alsinoides*	Convolvulaceae	Therophyte
54	*Ficus benghalensis*	Moraceae	Phanerophyte
55	*Ficus hispida*	Moraceae	Phanerophyte
56	*Gossypium herbaceum*	Malvaceae	Therophyte
57	*Grewia abutifolia*	Tiliaceae	Phanerophyte
58	*Hibiscus micronthus*	Malvaceae	Therophyte
59	*Jatropha gossypifolia*	Euphorbiaceae	Therophyte
60	*Justia diffusa*	Acanthaceae	Therophyte
61	*Lantana camara*	Verbinacaee	Phanerophyte
62	*Leucas aspera*	Labiatae	Therophyte
63	*Loranthus sp*	Loranthaceae	Epiphyte
64	*Ocimum canum*	Labiatae	Therophyte
65	*Ocimum sanctum*	Labiatae	Therophyte
66	*Oldenlandia corymbosa*	Rubiaceae	Therophyte
67	*Opuntia elator*	Cacataceae	Therophyteq
68	*Oxalis corniculata*	Oxalidaceae	Therophyte
69	*Parkinsonia aculata*	Mimosaceae	Phanerophyte
70	*Parthenium hysterophorus*	Compositae	Therophyte

Sr. No.	Technical Name	Family	Life Form
71	*Phoenix aculis*	Palmae	Phanerophyte
72	*Pithocolobium dulce*	Mimosaceae	Phanerophyte
73	*Portulaca oleracea*	Portulaccaceae	Therophyte
74	*Prosopis spicegera*	Mimosaceae	Phanerophyte
75	*Sida cordifolia*	Malvaceae	Phanerophyte
76	*Solanum nigrum*	Solanaceae	Therophyte
77	*Solanum xanthocarpum*	Solanaceae	Therophyte
78	*Tamarindus indica*	Caesalpinaceae	Phanerophyte
79	*Triumferta pilosa*	Tiliaceae	Therophyte
80	*Vernonia cinera*	Compositae	Therophyte
81	*Vitex negungo*	Verbinaceae	Therophyte
82	*Xanthium strumariumk*	Compositae	Therophyte
83	*Zizyphus jujube*	Rhamnaceae	Phanerophyte
84	*Zizyphus nummalaris*	Rhamnaceae	Phanerophyte
V. Grasslands			
85	*Apluda mutica*	Poaceae	Hemicryptophyte
86	*Aristida adscensionsis*	Poaceae	Hemicryptophyte
87	*Cenchrus ciliaris*	Poaceae	Therophyte
88	*Cyperus triceps*	Cyperaceae	Therophyte
89	*Eragrostis biferia*	Poaceae	Therophyte
	Endemic species	**No endemic species recorded/reported as per BSI records**	

During the present study, all the plants observed in the field are recorded but there could be many other plants which have remained unrecorded due to limitation of time. Detail list of plant species recorded during study period are presented in **Table 1** of **Annexure-VIII**.

- ***Cryptogamic Vegetation***

The area shows many algae, fungi, bryophytes and ferns. Algae are present in aquatic bodies or in marshy places. Fungi, particularly from ascomycetes and basidiomycetes are located on ground or epiphytically. Lichens of crustose, foliose and fruticose types are present on different substrates (Lichens, Ascomycetes and Basidiomycetes could be observed near old house walls and agricultural waste dump areas. Bryophytes occur in wet areas and occasionally on barks of trees and old walls of houses. The commonly observed in this are *Funaria sp* and *Polypodium* sp.

- ***Life Form Spectrum***

Raunkiaer defined life forms as the sum of adaptations of plants to climate. Braun-Blanquet (1951), whose system is adapted in this study, modified the Raunkiaer's system. Following five of the ten classes created by Braun-Blanquet is present in the study area.

Phanerophytes : Shrubs and trees
Therophytes : Annuals including ferns
Hydrophytes : Water plants except plankton
Hemicryptophytes : Plants with perennial shoots and buds close to surface
Geophytes : Plants with parenting parts buried in substratum

251 plant species (except algae, fungi and bryophytes) were recorded from the study area. Their analysis is presented in **Table-3.9.3**.

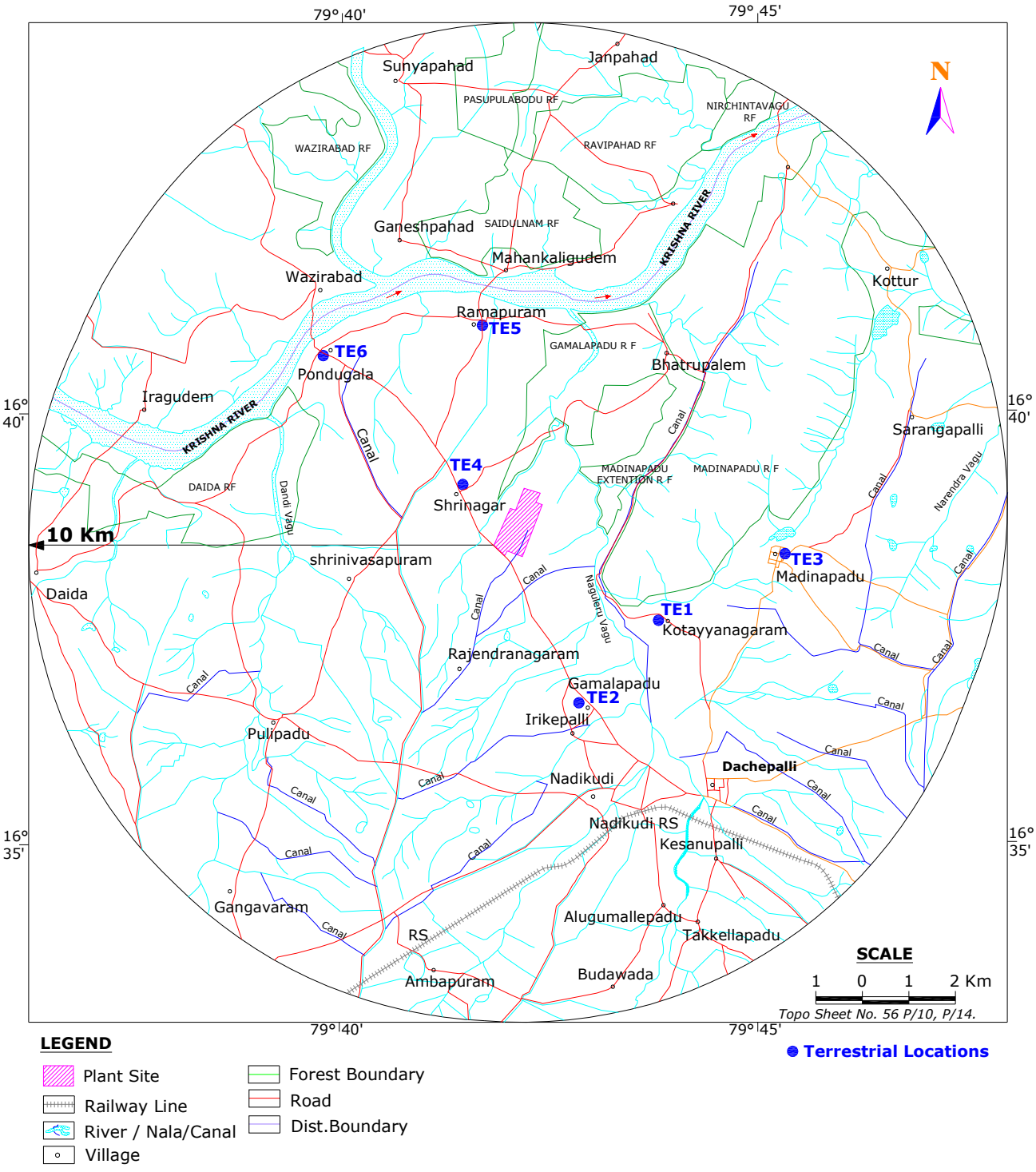


FIGURE-3.9.1
TERRESTRIAL ECOLOGICAL LOCATIONS

TABLE-3.9.3
CLASS WISE DISTRIBUTION OF PLANT SPECIES IN THE STUDY AREA

Type of Species	Number	% of Total
Phanerophytes (P)	112	44.62
Therophytes (T)	108	43.03
Hemicryptophytes (He)	22	8.77
Geophytes (G)	09	3.58
Total	**251**	**100.00**

- ***Comments on the Life Form Spectrum***

Life form spectrum is a reflection of plant community. A plant community is governed by several factors like climatic, edaphic, topographic and biotic. Even local variations in environment affect components of plant community. Among all these factors, life form spectrum of an area, which reflects climatic conditions prevailing.

In the study area, maximum number of species are phanerophytes (44.62%) followed by therophytes (43.03%). These classes are followed by hemicryptophytes (8.77%) and geophytes(3.58%).

Presence of large number of phanerophytes (shrubs and trees) and therophytes (Annuals or herbaceous vegetation) indicates tropical and mixed decidious vegetation structure. The area shows a rich gene pool of perennial shrubs and trees. This indicates a potentially good area for their growth.

Hemicryptophytes (predominantly grasses and sedges) were found to be significant in the area. These indicate fertile and wet soil in upper layer of soil profile. Hydrophytes were present in both the seasonal or perennial water bodies.

3.9.2.1Identification of Local Protected Species

A detailed enumeration of flora species from 10 km radius from buffer zone are presented in **Table-1 of Annexure-VIII.** As per Botanical Survey of India records and available published literature pertaining to the study area and current detailed study of project site, no threatened, endangered and rare plant species were observed from the study area.

3.9.2.2Details of Forest Areas

The details of forest blocks are presented in **Table-3.9.4.**

TABLE-3.9.4
DETAILS OF FORESTS IN STUDY AREA

Sr. No.	Details Forests	Distance from mine (km)	Direction Bearing w.r.t mine	Distance from cement plant (km)	Direction Bearing w.r.t cement plant
1	Tangeda RF	Adjacent	NNW	3.1	NW
2	Regulagadda RF	Adjacent	NE	1.0	NE
3	Vemavaram RF	1.1	S	2.1	S
4	Sultanpur RF	2.8	NNW	5.9	NNW
5	Govindapuram RF	3.0	ESE	2.8	ESE
6	Pittalsarikota RF	3.5	NE	5.0	NE

Sr. No.	Details Forests	Distance from mine (km)	Direction Bearing w.r.t mine	Distance from cement plant (km)	Direction Bearing w.r.t cement plant
7	Madinapadu RF	2.8	NW	4.6	NW
8	Chintalpalem RF	4.5	NE	6.0	NE
9	Uranam RF	4.5	E	4.9	E
10	Gurrambodu RF	6.8	NW	9.5	NW
11	Kamepalle RF	8.3	SE	8.1	ESE

3.9.2.3Wildlife Studies

- **Fauna recorded from core zone**

The recorded list of faunal species in core zone are presented in **Table-3.9.5.**

TABLE-3.9.5
FAUNA IN THE CORE ZONE

Technical Name	English Name/ Local Name	Conservation status as per Wild Life Protection Act 1972
Mammals		
Lapus nigricollis	Indian Hare	Sch-IV
Funumbuls palmarum	Squirrel	Sch-IV
Hystrix indica	Porcupine	Sch-IV
Birds		
Milyus migrans	Common Kite	Sch-IV
Corvus corvus	Jungle crow	Sch-IV
Corvus splendens	House crow	Sch-V
Aegithina tiphia	Iora	Sch-IV
Pycnonotus cafer	Red vented bulbul	Sch-IV
Columbus livibus	Rock Pigeon	Sch-IV
Lalage sykesi	Black headed cochoo Shrike	Sch-IV
Dicrurus macrocerus	Black Drongo	Sch-IV
Oriolus oriolus	Indian Oriole	Sch-IV
Acridotheres tristicus	Common myna	Sch-IV
Ploceus philippines	Weaver bird	Sch-IV
Uroloncha striata	Spotted munia	Sch-IV
Passer domisticus	House Sparrow	Sch-IV
Megalaima merulinus	Indian Cuckoo	Sch-IV
Eudynamis scolopaceus	Koel	Sch-V
Psittacula Krammeri	Rose ringed parakeet	Sch-IV
Alcedo atthis	Common Kingfisher	Sch-IV
Tylo alba	Barn Owl	Sch-IV
Astur badius	Shikra	Sch-IV
Lobvanella indicus	Redwattled Lapwing	Sch-IV
Bubulcus ibis	Cattle Egret	Sch-IV
Gallinula chlorpus	Moore hen	Sch-IV
Reptiles		
Chameleon zeylanicus	Lizard	Sch-IV
Ptyas mucosus	Rat snake	Sch-III
Naja naja	Cobra	Sch-IV
Bungarus candidus	Krait	Sch-IV
Vipera russeli	Viper	Part-II of Sch-II
Butterflies		Sch-IV
Euploca cora	-	Sch-IV
Euploca crassa	-	Sch-IV
0euploca dicciotianua	-	Sch-IV
Graphium agamemnos	Tailed jay	Sch-IV
Papilo polymnstor	Blue mormon	Sch-IV
Junonia atlites	Grey pansey	Sch-IV

Technical Name	English Name/ Local Name	Conservation status as per Wild Life Protection Act 1972
Juninia almana	Peacock pansey	Sch-IV
Pelopides assemensis	-	Sch-IV
Polytrema discreta	-	Sch-IV

Extensive field studies were conducted in Pre monsoon season to know the present status of fauna of the study area. Apart from that, secondary data was collected by mode of interaction of local elderly people and Forest Working Plans of Guntur district. The major wildlife present in buffer zone are presented in **Table-2** of **Annexure-VIII**.

3.10 Demography and Socio-Economics

In this section, the prevailing socio-economic aspects of people in the study area, which would form the basis for making planning efforts for the socio-economic development of people of the study area, have been described.

3.10.1 Methodology Adopted for the Study

The methodology adopted for the study mainly includes review of secondary data (District Census Statistical Handbooks-2001 and Primary Census Abstract of Census-2001) with respect to population, occupational structure and infrastructure facilities available for 10-km radius study area.

3.10.2 Review of Demographic and Socio-Economic Profile-2001

The village wise demographic data for the census year 2001 is given in **Annexure-IX**. The salient features of the demographic and socio-economic details are described in the following sections.

3.10.3 Demography

Almost all villages in the study area are experiencing a rapid growth of population, which may be due to the process of industrialization.

- ***Distribution of Population***

As per 2001 census the study area consisted of 102547 souls inhabited in study area. The distribution of population in the study area is shown in **Table-3.10.1**.

TABLE-3.10.1
DISTRIBUTION OF POPULATION

Particulars	0-3 km	3-7 km	7-10 km	0-10 km
No. of Households	1770	10603	4890	17263
Male Population	5175	32927	14182	52284
Female Population	5020	31465	13778	50263
Total Population	10195	64392	27960	102547
Male Population (0-6 years)	779	5371	2482	8632
Female Population (0-6 years)	761	4882	2303	7946
Total Population (0-6 years)	1540	10253	4785	16578
Average Household Size	5.8	6.1	5.7	5.9
% of males to the total population	50.8	51.1	50.7	51.0
% of females to the total population	49.2	48.9	49.3	49.0
Sex Ratio (no of females per 1000 males)	970.0	955.6	971.5	961.3

Source: District Census Hand Book –2001

The males and females constitute to about 51.0% and 49.0% of the study area population respectively during 2001.

- ***Average Household Size***

The study area has a family size of 5.9 as per 2001 census.

- ***Population Density***

The density of population reveals that the study area has an overall density of 309 persons per km^2 (PP km^2) as per 2001 census reports.

- ***Sex Ratio***

The configuration of male and female indicates that the males constitute to about 51.0 % and females to 49.0% of the total population as per 2001 census records. The sex ratio i.e. the number of females per 1000 males indirectly reveals certain sociological aspects in relation with female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 961.3 females per 1000 males as per 2001 census reports.

3.10.4 Social Structure

In the study area, as per 2001 census, 29.1 % of the population belongs to Scheduled Castes (SC) and 0.6% to Scheduled Tribes (ST). The distribution of population by social structure is shown in **Table-3.10.2.**

TABLE-3.10.2
DISTRIBUTION OF POPULATION BY SOCIAL STRUCTURE

Particulars	0-3 km	3-7 km	7-10 km	0-10 km
Schedule caste	2846	20288	7802	30936
% To the total population	27.9	31.5	27.9	29.1
Schedule Tribes	39	551	74	664
% To the total population	0.4	0.9	0.3	0.6
Total SC and ST population	2885	20839	7876	31600
% To total population	28.3	32.4	28.2	30.8
Total population	10195	64392	27960	102547

Source: District Census Hand Book –2001

3.10.5 Literacy Levels

The study area experiences a literacy rate of 47.7 % (2001). The distribution of literate and literacy rate in the study area is given in **Table-3.10.3.**

TABLE-3.10.3
DISTRIBUTION OF LITERATE AND LITERACY RATES

Particulars	0-3 km	3-7 km	7-10 km	0-10 km
Male Population	5175	32927	14182	52284
Female Population	5020	31465	13778	50263
Total Population	10195	64392	27960	102547
Male Population (0-6 years)	779	5371	2482	8632
Female Population (0-6 years)	761	4882	2303	7946
Total Population (0-6 years)	1540	10253	4785	16578

Particulars	0-3 km	3-7 km	7-10 km	0-10 km
Male literates	3166	20304	6425	29895
Female literates	2005	13450	3589	19044
Total literates	5171	33754	10014	48939
Male literacy rate (%)	61.2	60.2	64.2	61.1
Female literacy rate (%)	38.8	39.8	35.8	38.9
Average Male Literacy to the total population (%)	31.1	31.5	23.0	29.2
Average female Literacy to the total population (%)	19.7	20.9	12.8	18.6
Total Literacy rate (%)	50.7	52.4	35.8	47.7

Source: District Census Hand Book –2001

The male literacy i.e. the percentage of literate males to the total males of the study area works out to be 61.1%. The female literacy rate, which is an important indicator for social change, is observed to be 38.9 % in the study area as per 2001 census records.

3.10.6 Occupational Structure

The occupational structure of residents in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 10 categories of workers defined by the Census Department consisting of cultivators, agricultural laborers, those engaged in live-stock, forestry, fishing, mining and quarrying; manufacturing, processing and repairs in household industry; and other than household industry, construction, trade and commerce, transport and communication and other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As per 2001 census records altogether the main workers works out to be 26.0% of the total population. The marginal workers and non-workers constitute to 7.4% and 66.6 % of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The occupational structure of the study area is shown in **Table-3.10.4.**

TABLE-3.10.4
OCCUPATIONAL STRUCTURE

Particulars	0-3 km	3-7 km	7-10 km	0-10 km
Total Population	10195	64392	27960	102547
Total workers	2928	19056	12242	34226
Work participation rate (%)	28.7	29.6	43.8	33.4
Total main workers	2051	15819	8760	26630
% of main workers to total population	20.1	24.6	31.3	26.0
Marginal workers	877	3237	3482	7596
% of marginal workers to total population	8.6	5.0	12.5	7.4
Non-workers	7267	45336	15718	68321
% of non-workers to total population	71.3	70.4	56.2	66.6

Source: District Census Hand Book-2001