CHAPTER 4.

BASELINE ENVIRONMENT

4. BASELINE ENVIRONMENT STATUS

4.1 STUDY AREA

The proposed mine block is situated at Singrauli district of Madhya Pradesh covering about 20.37 sq km of area in core zone. The study area has been divided into two zones viz.

- The core zone is the proposed mining site covering 20.37 sq km including quarry area, project office, workshop, external dump, safety zone, etc.
- The buffer zone consists of the area within 10km radius from the centre of the core zone. There are 66 villages and parts of Singrauli Municipal Corporation areas. The Jayant, Gorbi, Amlohri and Nigahi Mines are located in the buffer zone. **Figure 4.1** shows the map of the study area with all features.

4.2 STUDY PERIOD & METHODOLOGY

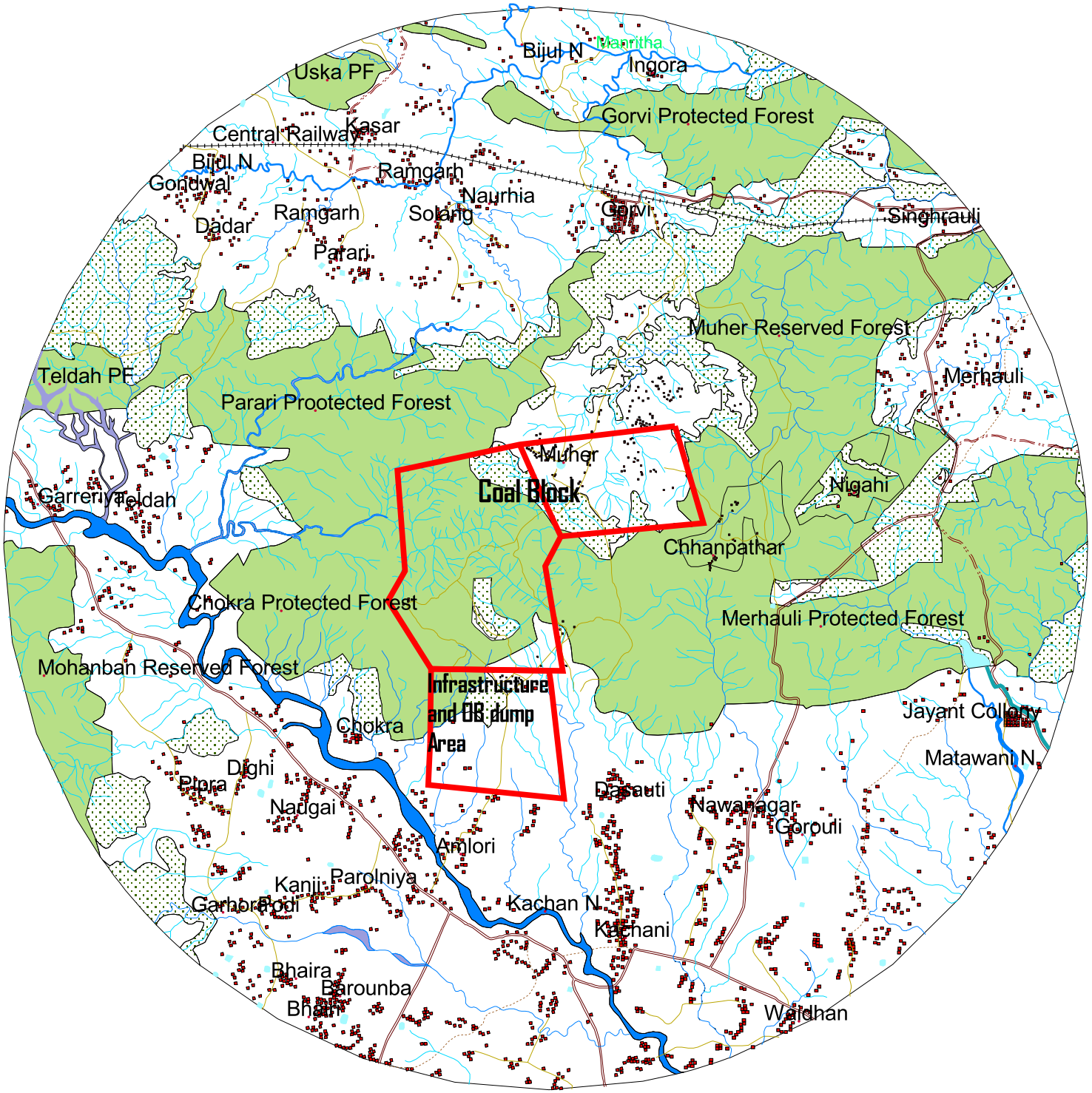
The baseline study for the project was conducted during winter season consisting period of December 2007 to February 2008. For collecting the base line data, a temporary field office was established at Waidhan town. The team consisted of technical personal viz. environmental scientists and engineers along with the field staff. Sampling of soil and water, monitoring of air quality and noise level and other field data collection were carried out by the team operating from this field station.

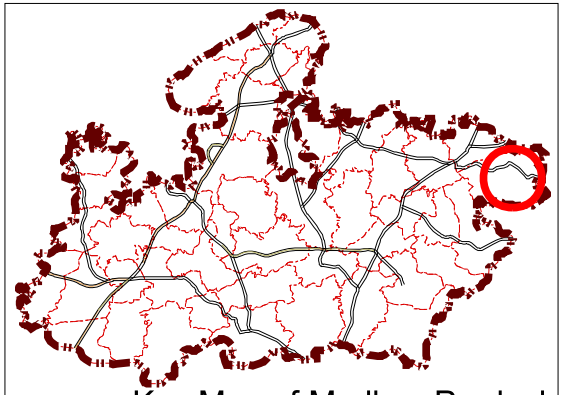
A meteorological station was setup in Gorbi town. Wind speed, wind direction, dry and wet bulb temperature, relative humidity and general weather conditions were recorded throughout the study period in an automated data logger.

In order to assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler at 11 different locations in study area and analyzed for primary air pollutants to work out the existing status of air quality.

Ground water samples were collected from the existing open wells, while surface water was collected from rivers and ponds in the core and buffer zone. The samples were analyzed for parameters necessary to determine water quality (based on IS: 10500 criteria) and those which are relevant from the point of view of environmental impact of the proposed OCP.

Socio-economic data was collected from field studies and secondary sources like Census of India 2001, Revenue Department data, etc. Primary socio-economic survey of the project site has also been conducted to find-out the demographic and social characteristics of the project affected persons.





Legend:

- Site boundary
- Natural Drainage
  - Canal
  - Streams
  - Nala
  - River
- Transportation
  - Motorable Road in Dry Seasons
  - Mud Roads
  - Other Road
  - Pacca Road
  - Rails
- Land use pattern
  - water body
  - River
  - Revenue Land
  - Open Forest
  - Nala
  - Forest boundary
  - Settlement

Study Area Map

N W E S

Figure No: 4.1

0.4 0 0.4 0.8 1.2 Km

Client:

Sasan Power Limited

(An Associate of Reliance Power Limited)

Consultant:

Envirotech East Pvt. Ltd. Kolkata.

Secondary data for various Govt. Institutions like District Informatics Centre, Forest Department, Central Ground Water Board and Irrigation Department have also been collected.

4.3 PHYSICAL ENVIRONMENT

4.3.1 Meteorological Condition

The meteorological conditions at the project site will regulate the transport and diffusion of air pollutants released into the atmosphere. Therefore, meteorology is considered as an important tool for air pollution assessment.

This section makes a comparative analysis of the meteorological condition of the study area. The data used for the purpose are the last 20 years average IMD data, the recent IMD data of nearest meteorological observatory at Sidhi, and the on-site data recorded during the study period.

4.3.2 Climate

4.3.2.1 *Long-term Meteorological Scenario*

Meteorological aspects consist of the climatic factors, which are prevailing in the area, including temperature, humidity, rainfall, wind speed, etc. The detail of IMD data of 20 years at Sidhi station, which is about 75 km away from the site, was procured. The analysis of the data is given in the following section.

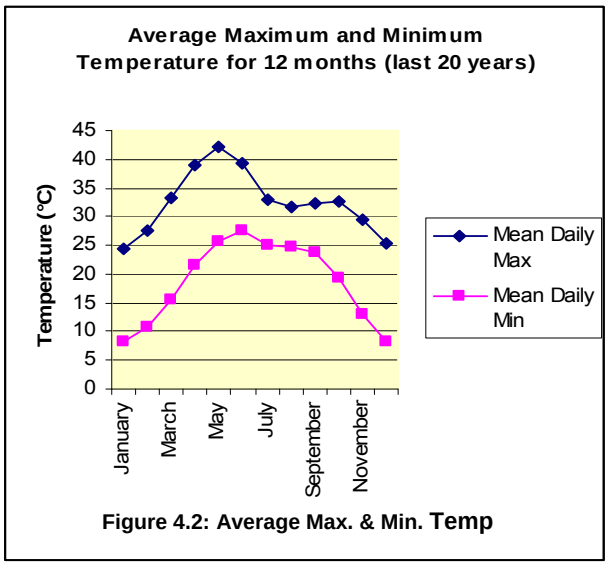


Figure 4.2: Average Max. & Min. Temp

Temperature

The annual mean maximum and minimum temperature recorded at IMD station Sidhi based on the data of last 20 years have been furnished in **Table 4.1**. The area has quite high temperatures during summers and moderate cold in winters. The highest average monthly maximum temperature recorded is about 42°C in the month of May while the lowest average monthly temperature recorded is 8.1°C in the month of January. The monthly average maximum and minimum temperature is furnished in **Figure 4.2.**

Table 4-1: Average Monthly Temperature, Sidhi (20 Years)

Months	Temperature °C	
	Mean Daily Max	Mean Daily Min
January	24.3	8.1
February	27.6	10.8
March	33.4	15.5

Months	Temperature °C	
	Mean Daily Max	Mean Daily Min
April	39.1	21.5
May	42.0	25.8
June	39.2	27.5
July	32.9	25.1
August	31.7	24.6
September	32.3	23.8
October	32.6	19.4
November	29.5	13.0
December	25.3	8.3
Mean	32.5	18.6

Source: Climatological Tables, IMD, Government of India

Rainfall

The southwest monsoon arrives around the third week of June. The region experiences a total rainfall of about 1132.7mm with 55 numbers of total rainy days. The average monthly rainfall data and number of rainy days in a month are furnished in **Table 4.2** and **Figure 4.3.**

Table 4-2: Average Monthly Rainfall, Sidhi (20 Years)

Month	Rainfall (mm)	No of rainy days
January	27.0	2.0
February	18.4	1.7
March	13.2	1.0
April	3.4	0.5
May	8.8	0.8
June	133.5	6.3
July	338.2	15.0
August	325.2	14.9
September	211.8	9.2
October	33.4	2.2
November	12.1	0.7
December	7.7	0.7
TOTAL	1132.7	55.0

Source: Climatological Tables, IMD, Government of India

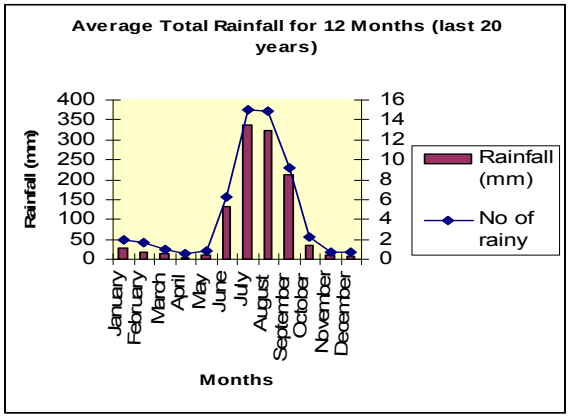


Figure 4.3: Average Total Rainfall

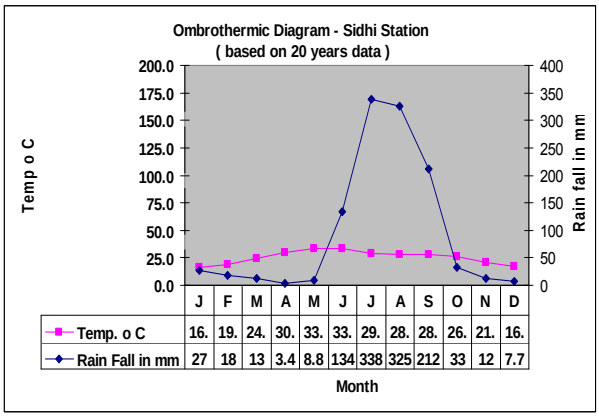


Figure 4.4: Ombrothermic Diagram

A perusal of the ombrothermic (temperature vs. rainfall) diagram **(Figure 4.4)** would indicate that the site experiences a long dry xeric period starting from October to May, where the rainfall is not sufficient enough in relation to temperature. From June to September, there is considerable rainfall, which is noted as wet period, where sufficient rainfall is available.

Relative Humidity

The area has dry climate except the monsoon period when the humidity is high in the air. The summer season is the driest part of the year when relative humidity goes down to 23% or less in the afternoons especially during April or May months. July and August being the rainiest months has highest humidity of 83% and 85% respectively in the morning, while the lowest humidity is found to be 23% during night time in the month of May. The annual mean relative humidity of last 20 years is furnished in **Table 4.3** and **Figure 4.5.**

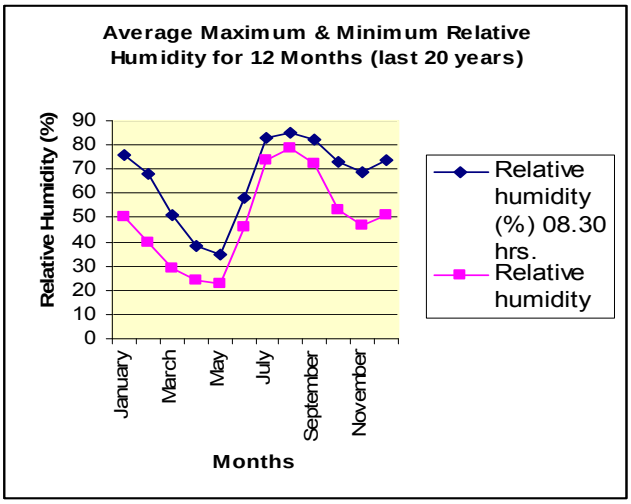


Figure 4.5: Average Max. & Min. Relative Humidity

Table 4-3: Average Monthly Relative Humidity Sidhi (20 Years)

Months	Relative humidity (%)	
	08.30 hrs.	17.30 hrs.
January	76	50
February	68	40
March	51	29
April	38	24
May	35	23
June	58	46
July	83	74
August	85	79
September	82	72
October	73	53
November	69	47
December	74	51
Average	66	49

Source: Climatological Tables, IMD, Government of India

Wind

As observed from **Table 4.4**, the average wind speed in Sidhi District was found to be 3.6 km/hr. During the winter season, the wind generally blows from North-west, West and North-northwest whereas during the summer season the wind direction is predominantly west, West-Southwest and West- North West.

Table 4-4: Avg. Monthly Wind Speed (Last 20 Yrs)

Months	Mean Wind Speed (kmph)
January	2.1
February	2.7
March	3.3
April	4.5
May	5.1
June	6.5
July	5.3
August	4.5
September	3.9
October	2.4
November	1.8
December	1.6
Average	3.6 km /hr.

Source: Climatological Tables, IMD, GOI

4.3.2.2 *Meteorological Data from IMD, Sidhi*

Detailed IMD micro-meteorological data of Sidhi station has been collected for the period from December 2007 to February 2008. The summary of the data is reproduced in **Table 4.5.**

Table 4-5: Summary of IMD Data of Sidhi (December 2007 to February 2008)

Month	Temperature (C)			Relative Humidity (%)		Total Rainfall (mm)	No. of Rainy Days	Avg. Wind Speed(km/hr)	
	Avg Max	Avg Min	Avg	Avg Max	Avg Min			8.30	17.30
December	26.0	9.4	17.7	54.6	47.6	3.6	1.0	0.6	0.6
January	25.3	8.6	29.7	56.4	43.3	6.0	3.0	0.9	0.9
February	27.6	8.9	31.5	51.4	41.7	1.4	1.0	0.9	0.9

Source: Sidhi Observatory, IMD

4.3.2.3 *Meteorological data recorded at site.*

The data on surface meteorological parameters (wind speed and direction) in the study area were monitored for the periods of December 2007 to February 2008. The data was monitored from the weather-monitoring station placed near the proposed plant-site. The instruments were located to allow free exposure to the atmosphere all through the study period.

Table 4-6: Summary of the Site Specific Meteorological Data

Months	Temperature (°C)			Relative Humidity (%)			Avg. Wind Speed (m/s)	Total rainfall (mm)	No of rainy days
	Avg	Max	Min	Avg	Max	Min			
December	22.5	28.2	9.0	63.0	77.1	46.3	1.12	8.4	2
January	23.2	31.0	13.0	61.9	76.4	46.2	1.08	10.8	2

Months	Temperature (°C)			Relative Humidity (%)			Avg. Wind Speed (m/s)	Total rainfall (mm)	No of rainy days
	Avg	Max	Min	Avg	Max	Min			
February	24.4	33.0	16.0	63.5	74.0	46.7	1.11	13.3	3
Average	23.3	30.7	12.7	62.8	-	-	1.10	10.8	-

Source: Field monitoring, GREENC

Data on temperature as well as relative humidity were manually recorded on hourly basis for 24 hrs throughout the study period. The cloud cover observations were visually recorded at the site. The data collected winter periods are reproduced and furnished in **Table 4.6.**

Wind rose diagram **(Figure 4.6)** from the monitored data for the winter seasons (December '07 to February '08) shows that the predominant wind direction during the study period was mainly WNW, NW, N and W.

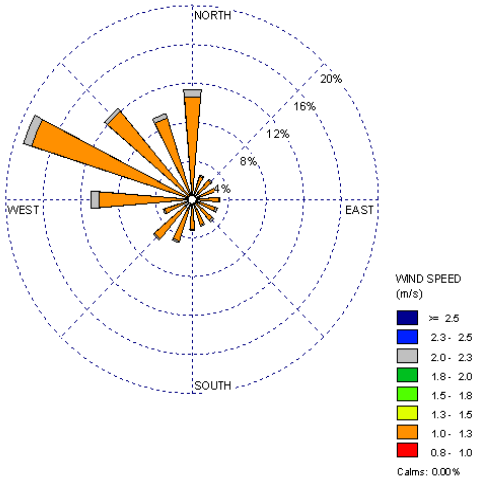


Figure 4.6: Wind rose diagram for the Winter Seasons

4.3.3 Ambient Air Quality

Air quality of the proposed study area has been monitored and analysis has been done of the existing Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur Dioxide (SO_2), and Nitrogen Oxide (NO_X) in the air.

Methodology of air sampling consists of collection of air samples at selected locations using Respirable Dust Samplers (RDS) for determining SPM, RPM, SO_2 and NO_X. RDS were placed at a height of 3.0 m above ground level, free from obstructions and considering the wind direction. The methodologies for sampling and analysis of air pollutants are given in **Table 4.7.**

Table 4-7: Techniques used for Air Quality Monitoring

Parameter	Techniques	Technical Protocol
Suspended Particulate Matter	High Volume Sampler (Gravimetric Method)	IS:5182 (Part-IV)
Respirable Particulate Matter	Respirable Dust Sampler (Gravimetric Method)	IS:5182 (Part-IV)
Sulphur Dioxide	Modified West & Gaeke	IS:5182 (Part-II)
Oxides of Nitrogen	Jacob & Hochheiser	IS:5182 (Part-VI)

4.3.3.1 *AAQ Stations Location*

AAQ monitoring has been carried in 11 selective locations whose selection was principally governed by the wind rose pattern for the winter season and also the accessibility of the

selected sites. The selection of AAQ stations was done on the basis of meteorology in the upwind and downwind direction. Attempts were made to locate the AAQ stations (which are free from local effects) at a reasonably right place to get a representative picture of the prevailing baseline air quality in the study area. Some of the monitoring stations are also distant to have clear ambient quality of the buffer zone where mines are already in operation. The names of the sampling stations for AAQ analysis and their respective direction and distances from the site are mentioned in **Table 4.8** and **Figure 4.7**. As most of the areas in the block are forest area, it was not possible to install machines in the forest.

Table 4-8: Sampling location for Ambient Air Quality Analysis

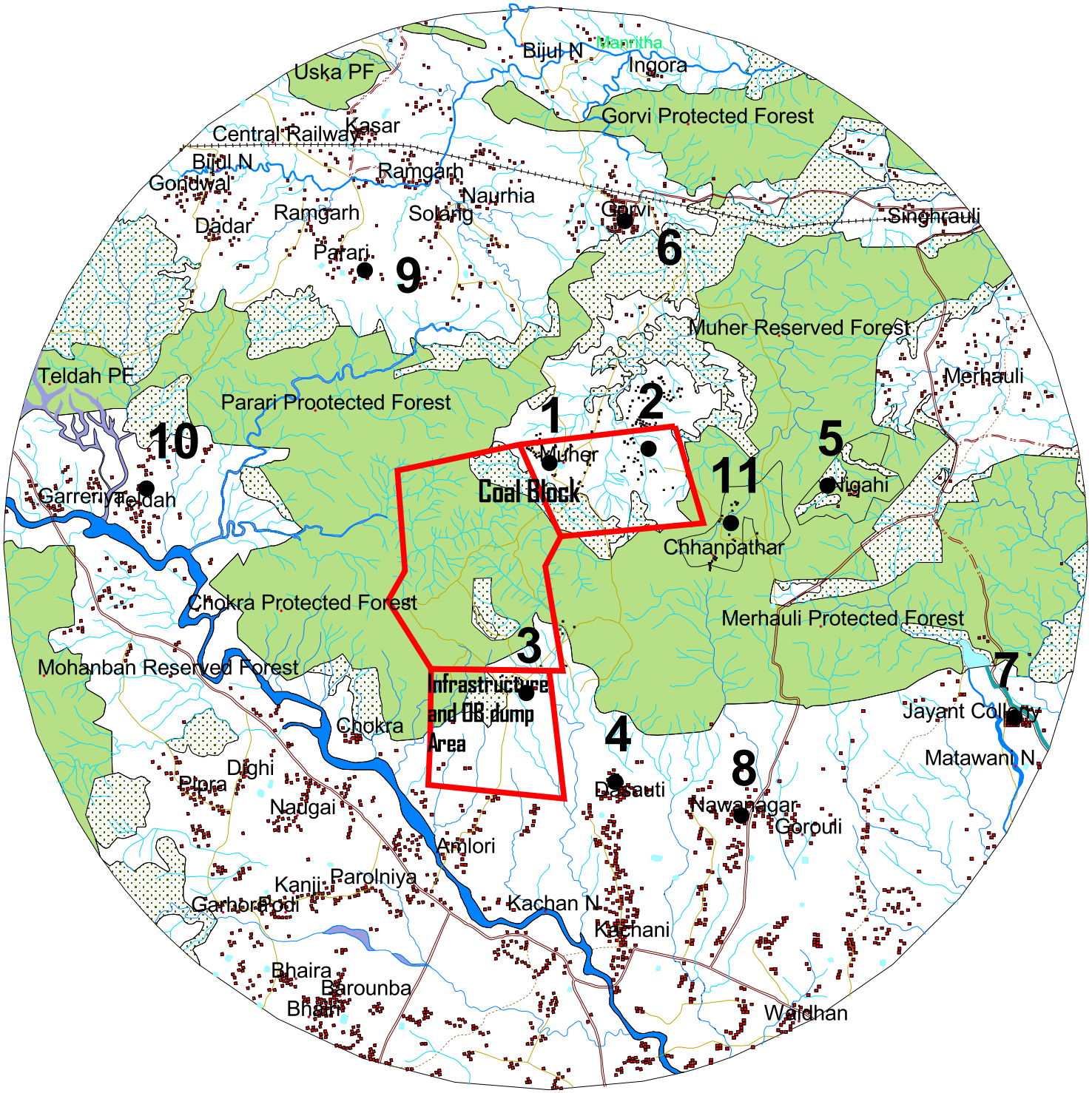
Sampling Stations	Code	Direction	Distance (km) from core zone
Pokhra tola	A1	Onsite	Within
Nigahi Tola	A2	Onsite	Within
Amlohri	A3	S	Within
Dasuati	A4	SSE	0.5
Nigahi	A5	E	2.0
Gorbi	A6	N	3.0
Jayant Colony	A7	ESE	5.5
Nawanagar	A8	SSE	2.5
Parari	A9	N	3.0
Teldah	A10	W	4.0
Chanpathar	A11	E	0.5

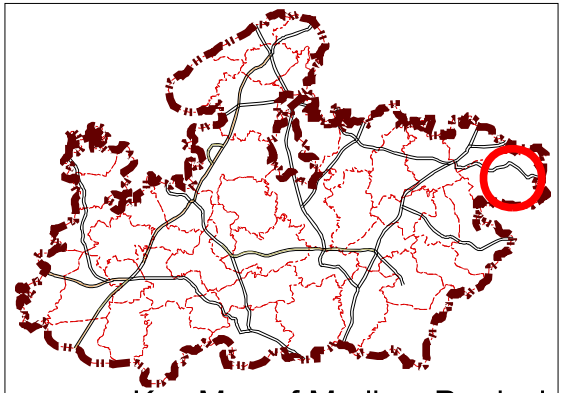
4.3.3.2 *Quality of Ambient Air*

Specific station-wise recorded Ambient Air Quality (AAQ) data of 11 stations are reported in **Table 4.9 to Table 4.12**. It is observed from the tables that the P_{98} values of SPM ranges from 145µg/m^3 to 191µg/m^3 and P98 values of Respirable Particulate Matter (RPM) was recorded between 60µg/m^3 to 81µg/m^3. The P_{98} value of SO_2 and NO_X varied from 13 to 22µg/m^3 and 14 to 29µg/m^3 respectively. Thus all the values of SPM, RSPM, SO_2 and NO_X are well within the stipulated levels of NAAQS and within CPCB norms for the same categories of area.

Table 4-9: Ambient Air Quality (SPM) in µg/m³

Location Code	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQ9	AQ10	AQ11
Min	80	87	80	96	110	95	90	110	78	78	106
Max	146	160	150	170	172	192	176	172	146	146	176
P98	145	154	148	169	170	191	175	172	146	146	174
Mean	117	122	121	138	143	158	143	142	125	125	142
24 Hrs Avg. Standard	200	200	200	200	200	200	200	200	200	200	200





Legend:

- Air Quality Monitoring Station
- Site boundary

Natural Drainage
- Canal
- Streams
- Nala
- River

Transportation
- Motorable Road in Dry Seasons
- Mud Roads
- Other Road
- Pacca Road
- Rails

Land use pattern
- water body
- River
- Revenue Land
- Open Forest
- Nala
- Forest boundary
- Settlement

Air Quality Monitoring Location Map

N
W E
S

Figure No. 4.7

0.4 0 0.4 0.8 1.2 Km

Client:

Sasan Power Limited

(An Associate of Reliance Power Limited)

Consultant:

Envirotech East Pvt. Ltd. Kolkata.

Table 4-10: Ambient Air Quality (RSPM) in µg/m³

Location Code	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQ9	AQ10	AQ11
Min	34	30	32	40	42	51	44	40	40	30	31
Max	63	74	72	76	76	81	75	70	71	57	67
P98	60	68	68	72	72	81	73	69	71	57	66
Mean	45	49	49	55	56	66	59	53	59	50	55
24 Hrs Avg. Standard	100	100	100	100	100	100	100	100	100	100	100

Table 4-11: Ambient Air Quality (SO_2) in µg/m³

Location Code	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQ9	AQ10	AQ11
Min	8	11	13	14	13	10	9	8	7	8	10
Max	13	18	21	22	21	15	21	20	18	13	18
P98	13	18	21	22	21	15	19	20	18	13	17
Mean	10.2	14	15.5	16.1	15.7	11.5	13.5	12.2	11.9	11	12.5
24 Hrs Avg. standard	80	80	80	80	80	80	80	80	80	80	80

Table 4-12: Ambient Air Quality (NO_X) in µg/m³

Location Code	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQ9	AQ10	AQ11
Min	12	15	15	15	14	15	12	11	10	8	12
Max	20	26	29	28	29	30	29	28	20	14	29
P98	19	26	29	26	27	28	27	27	20	14	27
Mean	14.4	19.6	19	18.9	20.1	19.6	18.7	16.9	15	10.8	17.4
24 Hrs Avg. Standard	80	80	80	80	80	80	80	80	80	80	80

The SPM, RSPM, SO_2 and NO_x concentrations were observed to be below the stipulated standards of CPCB for industrial/ residential / rural region at all of the air quality monitoring locations during the study period.

4.3.4 Topography

Moher block has uneven topography. The block stands as high plateau in north and east over the plains in the south and west. The plateau is characterized by steep escarpment extending along the southern and western block boundary. The maximum elevation in the study area is about 530 m (contour value) above in the northern portion over the plateau; whereas the minimum elevation is around 320m along the southern and 360m in the western portion. There is an 'eight' shaped flat low land in the central to southern portion of this block.

Whereas Moher–Amlohri Extension coal block exhibits undulating terrain with general slope towards north, northeast and some extent to southwest. The surface elevation varies from 515 m on the southeastern part of the plateau, 465 m on the northeast and 435m in the southwest.

4.3.5 Soil

The study area is covered with light to dark brown sandy clay loamy soils in general. The soil is almost neutral in nature. The study area is covered with a thin to moderately deep soil cover ranging in thickness of 0 to 0.60 m as per Geological Report, which is underlain with coarse grained sandstone as revealed from the soil section observed in open dug wells that exist within study area.

Table 4-13: Selection of Soil Sampling Stations

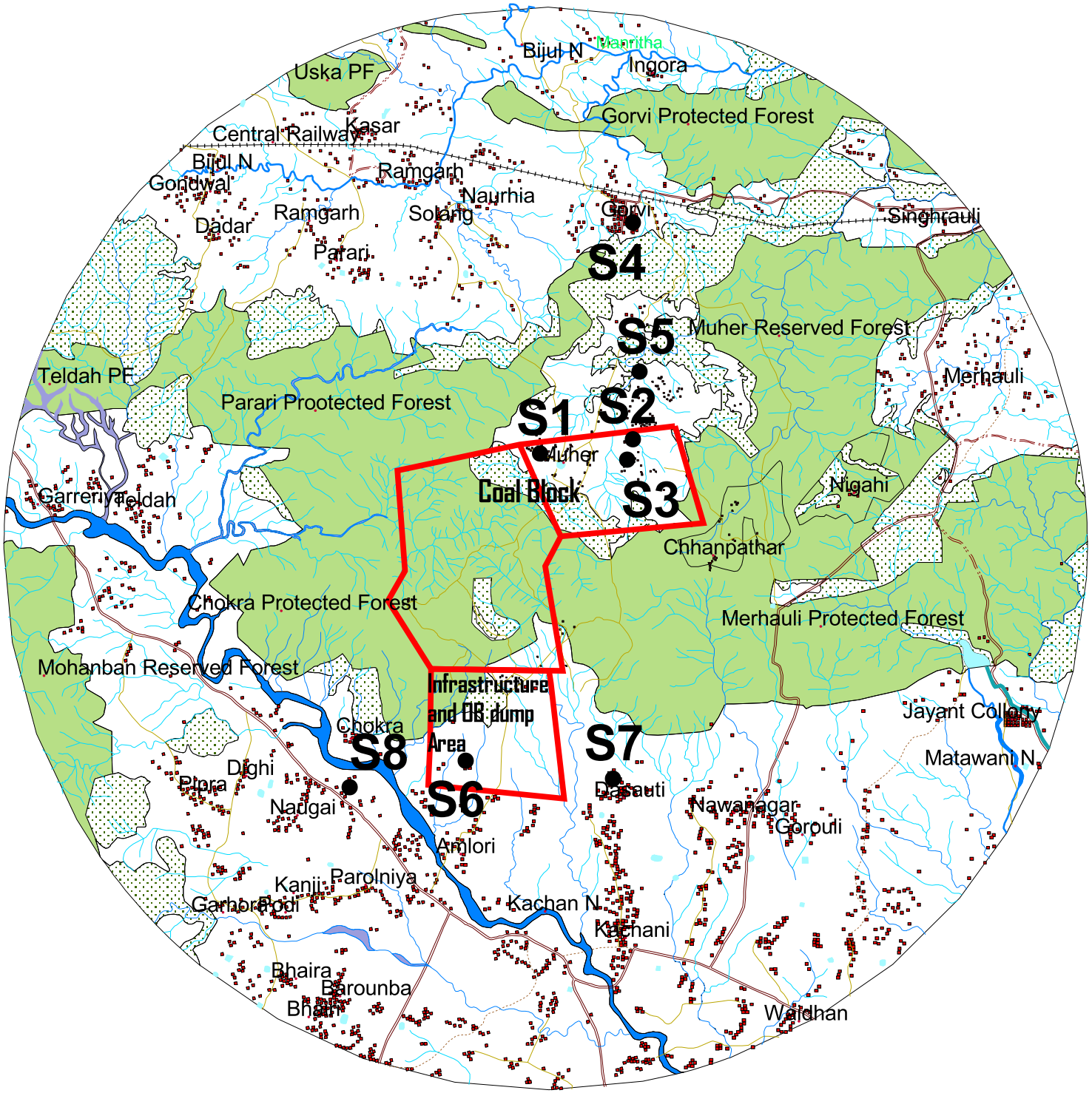
Name of the stations	Code	Direction	Distance (km) from core zone
Pokhra Tola	S1	Onsite	in core zone
Khariya tola	S2	Onsite	in core zone
Tendu Tola	S3	NE	0.5
Gorbi	S4	N	3
Near Marghatia nala	S5	N	1
Amlohri	S6	Onsite	in core zone
Dasauti	S7	SSE	3
Garhara	S8	SW	5

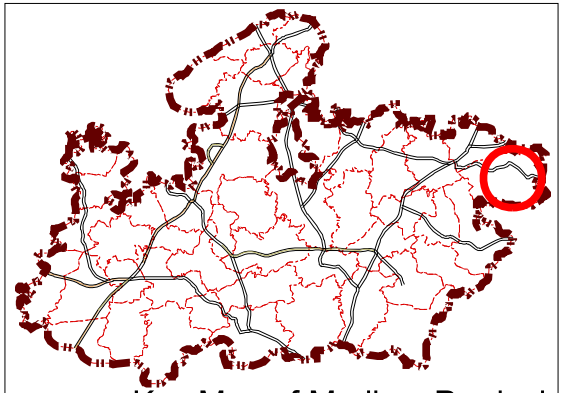
However, in the core zone, where ground flora is not there, the top soil layers are washed away by surface runoff leading to soil erosion and further degradation of the land which caused the formation of rills and gullies in places. The soil is predominantly sandy in this area. The area is being utilized for agricultural use and only rain fed crops such as Rice; Maize etc. are grown in the study area.

Soil samples were collected from eight locations. Out of eight locations two of them are located in the core zone at Pokhra Tola and Khariya Tola. Other six locations are in buffer zone at various directions and distances (**Table 4.13** and **Figure 4.8**). Soil samples were collected at 30cm depth and analyzed as per the standard methods. The analysis of the soil is presented in **Table 4.14.**

Table 4-14: Soil Characteristics

S. No.	Parameters	Unit	S1	S2	S3	S4	S5	S6	S7	S8
1.	pH		6.7	6.6	6.8	6.6	6.3	6.7	7.1	6.9
2.	Electrical Conductivity	µs/cm	540	480	520	510	420	630	410	720
3.	Salinity	PPT	0.32	0.03	0.30	0.32	0.28	0.45	0.28	0.54
4.	Texture		SCL	SCL	SCL	SCL	SCL	CL	SCL	CL
	Clay	%	27	28	30	23	20	37	26	35
	Silt	%	21	14	19	20	15	23	20	23
	Sand	%	52	58	51	57	65	40	54	42
5.	Moisture Content	%	1.70	1.61	1.50	2.10	2.80	3.80	1.45	3.60
6.	Water Holding Capacity	%	28.5	30.0	32.5	24.0	21.5	48.5	27.0	49.0
7.	Porosity	%	20.9	24.9	25.6	21.0	29.5	19.3	23.6	21.0





Legend:

- Soil Sampling Locations
- Site boundary

Natural Drainage
- Canal
- Streams
- Nala
- River

Transportation
- Motorable Road in Dry Seasons
- Mud Roads
- Other Road
- Pacca Road
- Rails

Land use pattern
- water body
- River
- Revenue Land
- Open Forest
- Nala
- Forest boundary
- Settlement

Soil Sampling Location Map

N, W, E, S

Figure No. 4.8

0.4 0 0.4 0.8 1.2 Km

Client:
Sasan Power Limited
(An Associate of Reliance Power Limited)

Consultant:
Envirotech East Pvt. Ltd. Kolkata.

S. No.	Parameters	Unit	S1	S2	S3	S4	S5	S6	S7	S8
8.	Organic Carbon	%	0.53	0.55	0.52	0.40	0.31	0.66	0.50	0.64
9.	Organic matter	%	0.91	0.95	0.90	0.68	0.54	1.14	0.86	1.10
10.	Bulk Density	gm/cm^3	1.39	1.36	1.37	1.42	1.46	1.32	1.4	1.33
11.	Nitrogen	%	0.048	0.043	0.04	0.034	0.027	0.058	0.042	0.050
12.	Phosphorus as P	mg/kg	3.00	3.30	3.10	4.20	6.00	5.10	5.50	4.40

SCL: Sandy Clayey Loam; CL Clayey Loam

The summary of the findings are given as below:

- Salinity is found to be low between 0.03-0.54 PPT, which indicates that water soluble salts are low in the soil
- Organic carbon content of the soil samples was found to be in the range of 0.31-0.66 %, which indicates that fertility status is low.
- The texture of the soil is found to be predominantly sandy clay loam and clayey loam with sand percentage in the range of 40 to 65%, silt between 15 to 23% and clay within 20 to 37%
- Organic matter content of the soil were found low in the range of 0.54-1.14 % indicating that fertility status is low
- Nitrogen content was found between 0.027 to 0.058 %. Whereas phosphorous content in the range 3 to 6 mg/kg
- Water holding capacity of the soil ranges between 21.5-49.0% and moisture content in the range of 1.45-3.60 %

In general the soil quality reveals that the soil is predominately sandy clay loam with high percentage of sand portion. The fertility of the soil for crops is found to be low as derived from the lower contents of organic matter, nitrogen, phosphorus, water holding capacity etc. However, it would support trees and shrubs to be planted as air pollution control measures.

4.3.6 Land use

The term land use used in the report highlights both land use and land cover. The land use of the study area was ascertained by utilizing three principal resources, namely, (i) SOI Toposheet no 63L/8 and 63L/12 of 1;50,000 scale (ii) Satellites imageries without any cloud supplied by National Remote Sensing Agency (NRSA), Hyderabad from IRS

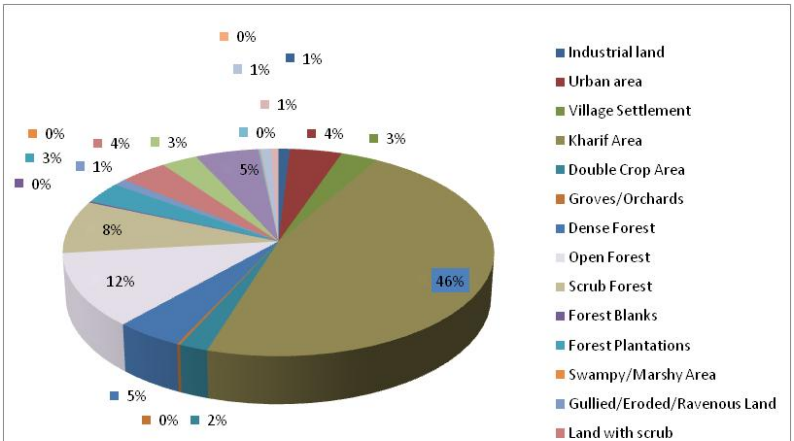


Figure 4.9: Distribution of Land use/Land cover pattern within Buffer Zone

P6-LISS IV and (iii) ground validation for the interpretation of the FCC imagery.

4.3.6.1 *Land Use: Buffer Zone*

The description of distribution of land use for the whole 10 km radius study area (core and buffer zone) is represented in **Table 4.15** and **Figure 4.9**. Major part of the landscape within 10km radius is undulating and rocky. The part of the land used for agricultural purpose is about 46.5%. The agricultural land is totally dependent on rain and is mostly single cropped. Only 1.9% of land area is under double cropping. As the land area is mostly undulating terrain with steep gradients, most of the land is not suitable for agricultural purpose.

The urban area covers 4.3% of the total study area and village settlement comprises of 3.05%. The towns of Singrauli and part of Waidhan fall in the study area. Land used for industrial purpose is 0.9%. Thermal Power Plants like Vindhyachal Super Thermal Power Plant falls in the periphery of the buffer zone.

The existing coal mining area adjacent to Moher in the east, south and southeast part, among which some are active and some are exhausted mines, occupy about 5.2% of the total land use. Dense forest covers about 4.6% of the study area and open forest cover is 11.5%, whereas scrub forest cover is 8.24%. Forest Plantations cover about 3.36% of the total study area. Rest out of the land cover comprises of swampy or marshy lands, gullied or eroded lands, land with scrub and without scrub. The Kachan Nadi covers 0.62% and other water bodies comprise of 0.811% of the whole study area.

Table 4-15: Land Use of Study Area

Category	Area in km^2	Area in Percentage
Industrial land	2.96	0.94
Urban area	13.60	4.33
Village Settlement	9.60	3.05
Kharif Area	146.00	46.49
Double Crop Area	6.18	1.85
Groves/Orchards	0.66	0.21
Dense Forest	14.48	4.61
Open Forest	36.40	11.59
Scrub Forest	25.88	8.24
Forest Blanks	0.59	0.19
Forest Plantations	10.57	3.37
Swampy/Marshy Area	0.01	0.10
Gullied/Eroded/Ravenous Land	3.30	1.1
Land with scrub	12.59	4.00
Land without scrub	9.44	3.01
Mines	16.44	5.24
Rocky / Stony waste	0.47	0.15

Category	Area in km^2	Area in Percentage
Open barren land	0.29	0.09
Water bodies	2.55	0.81
River	1.97	0.63
Total	314.00	100.00

4.3.6.2 *Land Use: Core Zone*

Table 4.16 and **Figure 4.10** describe the land use and land cover pattern of the Core zone. As per the land schedule, the applied mining lease (ML) area to be covered under the project activities is about 20.37 sq km on surface.

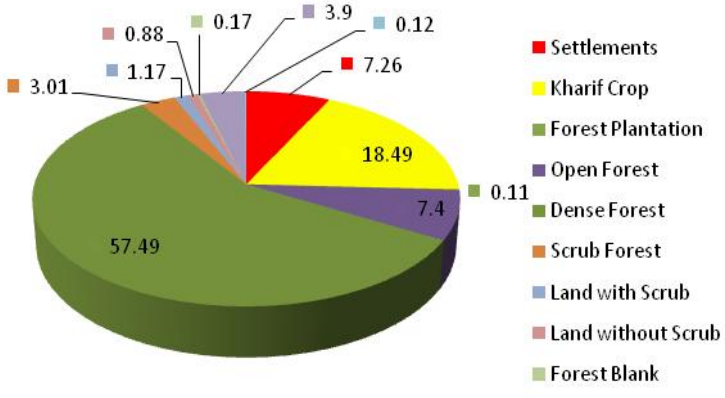


Figure 4.10: Distribution of Land use/Land cover pattern within Core Zone

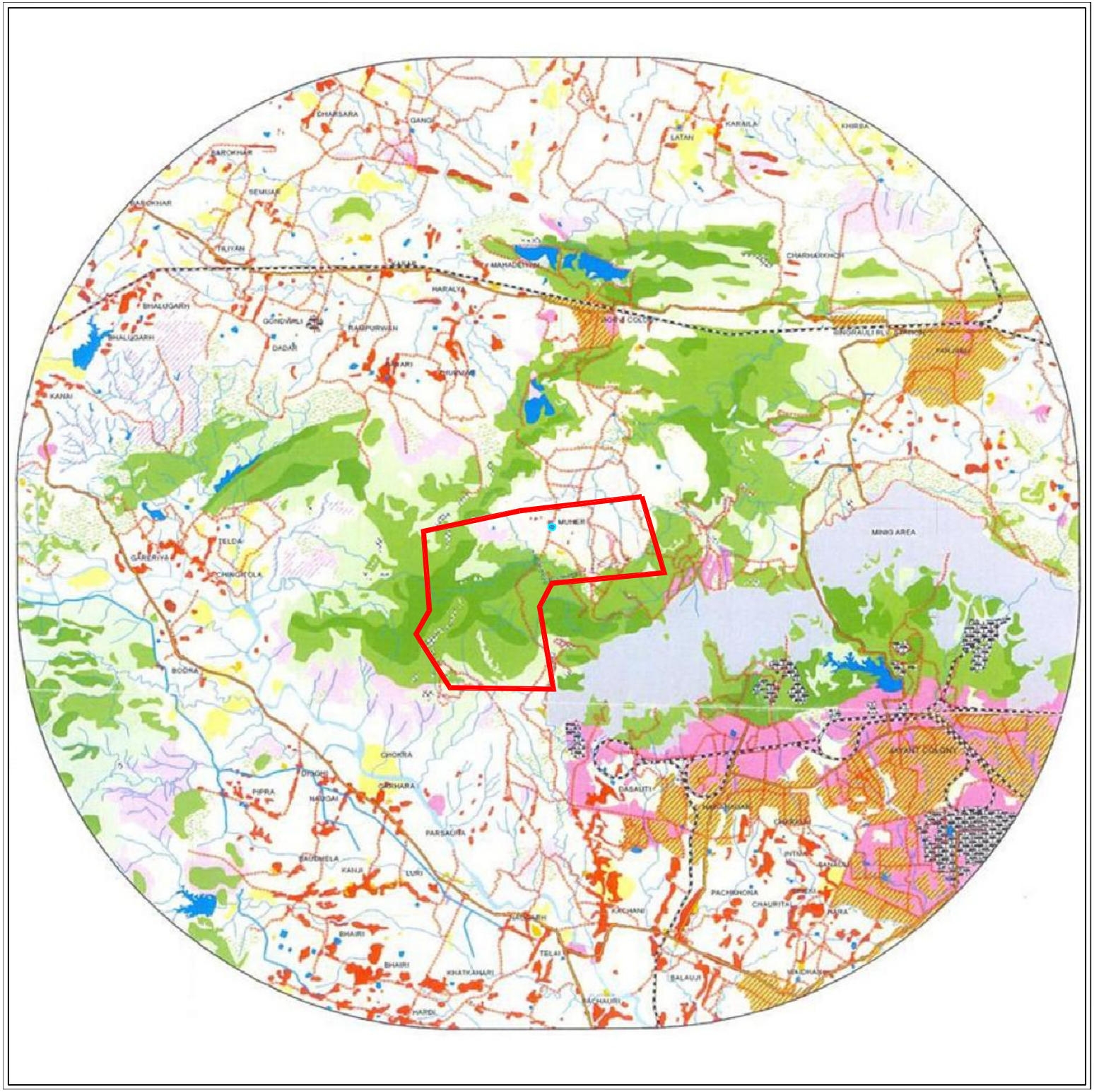
Table 4-16: Land Use of Core Zone

S. No.	Use	Area in km^2	Area in %
1	Settlements	1.48	7.26
2	Kharif Crop	3.75	18.49
3	Forest Plantation	0.02	0.11
4	Open Forest	1.57	7.40
5	Dense Forest	11.71	57.49
6	Scrub Forest	0.57	3.01
7	Land with Scrub	0.24	1.17
8	Land without Scrub	0.18	0.88
9	Forest Blank	0.03	0.17
10	Rock out-crops	0.80	3.90
11	Water Body	0.02	0.12
	Total	20.37	100.00

Within the Core Zone the agricultural land with single crop covers about 18.49% of the total area. About 57.49% of the land is under forest and 7.4% is open forest. Scrub Forest consists of only 3% of total land cover. The settlements consist of some hamlets of Moher, Naugarh and Amlohri villages and covers only 7.26% of the total land area. Some small water bodies occupy about 0.12% of the core zone area. The rest of the land consists of land with scrub, land without scrub, forest blanks and rock outcrops. The detailed land use map is exhibited in **Figure 4.11.**

4.3.7 Surface Drainage and Hydrology

The study area is traversed by small streams and nalas. For convenience of the study, the surface water hydrology is described separately for Core Zone and Buffer Zone (**Figure 4.12).**



STUDIES FOR MOHER & MOHER-AMLOHRI EXTENSION CAPTIVE COAL BLOCK OF SINGRAULI COAL FIELDS FOR 4000MW SASAN ULTRA MEGA POWER PROJECT

Land Use / Land Cover Map

Figure: 4.11

LEGEND:

- MAJOR ROADS
- OTHER ROADS
- RAILWAY
- DRAINAGE
- CANAL
- TOWN
- VILLAGE SETTLEMENT
- KHARIF CROP
- DUBBLE CROP
- GROOVES/ORCHARDS
- DENSE FOREST
- TOWN
- SCRUB FOREST
- FOREST BLANK
- FOREST PLANTATION
- MARSHY/SWAMPY
- GULLIED/RAVENIOUS/ROUNDED LAND
- LAND WITH SCRUB
- LAND WITH OUT SCRUB
- MINES
- STONY WASTE/ROCKY AREA
- TOWN
- INDUSTRY
- VACANT LAND
- RIVER

NORTH

Enclosure 1

In cm 1 0 1 2 3 4 Km

In Assosiation With:

SASAN POWER LIMITED

(A Subsidiary of Reliance Energy Limited)

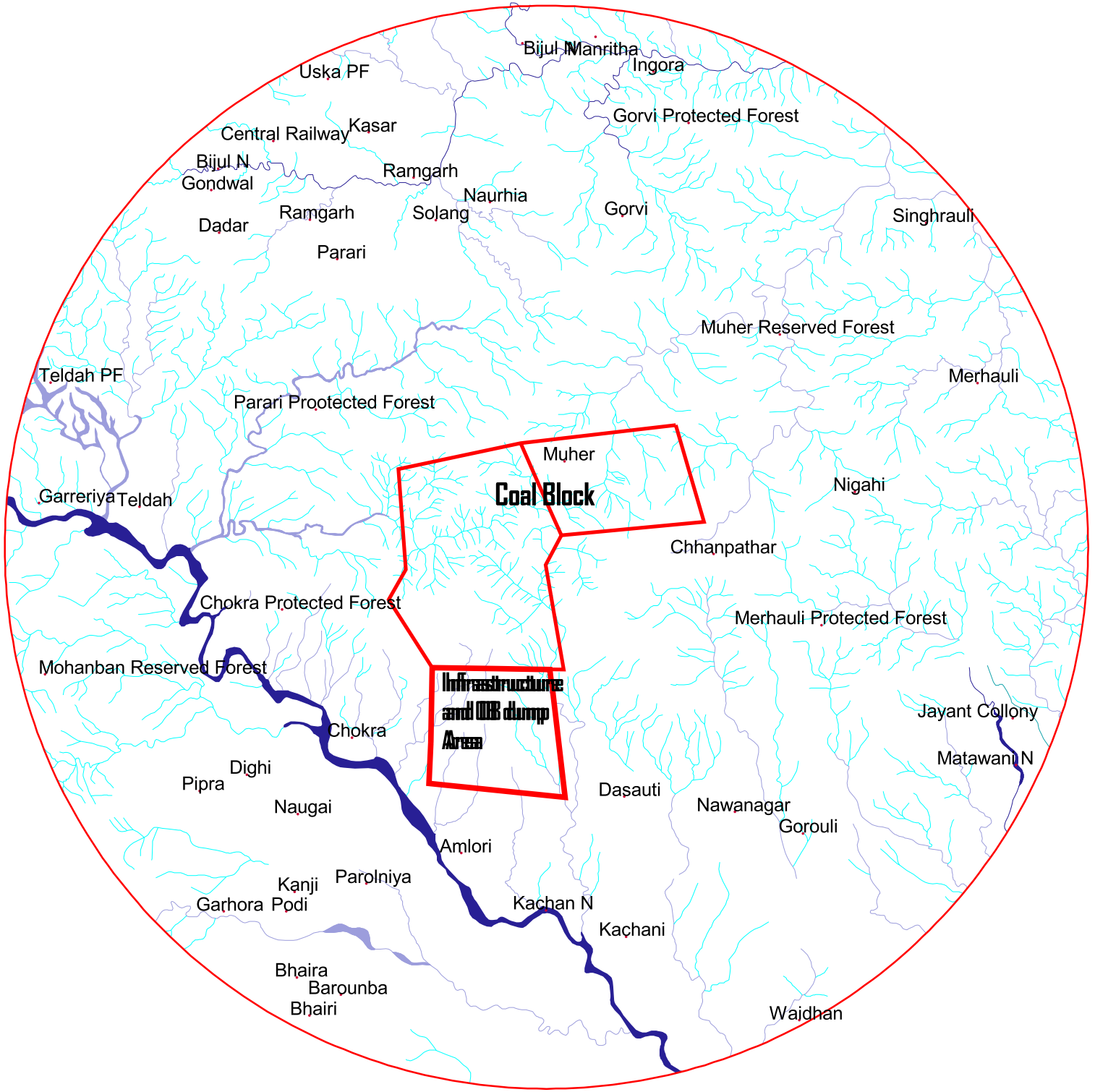
Consultant:

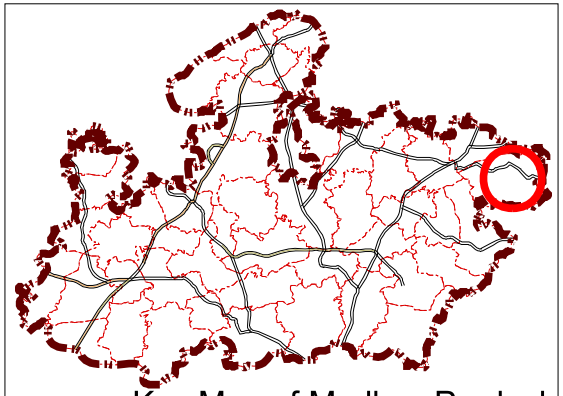
Envirotech East Pvt. Ltd.

Kolkata, West Bengal

In Assosiation With:

GIS Enabled Environment & Neo-Graphic Centre





Legend:

- Site boundary
- 10 km radious

Natural drainage

- Canal
- Streams
- Nala
- River

River & Nala

- Nala
- River

Drainage Map of the Study Area

N
W
E
S

Figure No: 4.12

0.4 0 0.4 0.8 1.2 Km

Client:

Sasan Power Limited

(An Associate of Reliance Power Limited)

Consultant:

Envirotech East Pvt. Ltd. Kolkata.

4.3.7.1 *Core Zone*

The Core Zone is drained by many small seasonal streams which remain dry for most of the year. These streams are mostly 1st and 2nd order streams originating from the Moher plateau. Some 3rd order and above streams observed in the 10km radius map are outside the core zone. These small streams discharge into three prominent nalas, one flowing roughly towards south from north near the eastern block boundary, second flows towards west near western block boundary and third nala in Moher-Amlohri extension flows from south to north. The core zone display radial drainage pattern, which is a characteristic feature of hilly regions.

In the eastern and south-eastern parts of the Moher Block, small streams converge into a depression and form a centripetal drainage pattern. These streams join in Trellis and Rectangular pattern to form a single stream. This stream flows further south and eventually joins the Hadahadwa Nala by maintaining a dendritic pattern. The Hadahadwa Nala subsequently joins Kachan Nadi in the southeast about 11-12 km away from the Project site. In the central part of the Moher block, a separate drainage basin is observed. Some small streams exhibiting Centripetal-Trellis pattern join another main stream which flows towards west to join Kachan Nadi in the southwest. The sharp escarpment of Moher plateau act as a water divide between these two nalas. The two main non perennial streams of Moher blocks are 2nd order streams and the small streams are 1st order streams.

The Moher-Amlohri Extension block exhibits dendritic drainage pattern. In the central and western parts small secondary streams join to form a main stream flowing towards northeast to join Bijul Nala in the North. Whereas in the southwest the streams are the part of the main drainage of Moher block maintaining rectangular drainage pattern flow towards west. In this block also the secondary streams are 1st order streams and the main stream is 2nd order stream.

The south flowing nala receives the southern and eastern discharge and the westerly flowing nala gets the northern and western runoff of the block. The far eastern nalla feeds itself from catchments area in the Amlohri extension side.

4.3.7.2 *Buffer Zone*

In the Buffer Zone, about 2 km west of the project site, Kachan Nadi drains through the study area flowing from North west to South east to meet at Govind Ballabh Pant Sagar Lake or reservoir which is about 15-16km South-east from the Project site. Kachan Nadi is the only perennial source of surface water. The tributaries from left and right banks of the nala reflect dendritic drainage pattern. Kachan Nadi is the 4th order stream in the study area.

In the South east of the study area many non perennial nalas like Nalwa Nala, Matwani Nala etc join together to end up in the reservoir. The streams and nalas are mostly 2nd and 3rd order streams and follow dendritic drainage pattern. The hilly tracts follow centripetal drainage pattern surrounding the project site. Bijul Nala, located about 5 km away from the Project in the north, is another non-perennial nala having East-West orientation. From east many small nalas join Bijul Nala and form its tributaries. These also maintain dendritic drainage pattern.

4.3.8 Groundwater Drainage and Hydrogeology

4.3.8.1 *Groundwater Resource and Water Table*

The groundwater occurs in water table and in sub-confined conditions in the Barakars where water in sandstones is under sub-confined conditions due to confining beds of carbonaceous shales as described in the geology section. The depth of water level ranges within 2 to 18 mbgl. The fluctuation of water table ranges from 2m to 6m from pre to post monsoon period.

4.3.8.2 *Aquifer Condition*

The study area lies at the northern extremity of the Son-Mahanadi coal bearing Gondwana basin. This is a typical Sedimentary basin. Ground water primarily occurs in the pore spaces of the superficial unconsolidated alluvial mass and weathered hard rock material. The top unconfined aquifer system, being a fairly potential entity, supports dug wells and other shallow ground water structures. The constituent rocks have a gentle slope (2^0 - 3^0) northerly dip, in the southern part 3^0 to 6^0 except in the north-eastern corner of Moher-Amlohri Extension block where dips are around 5^0. Three types of rocks are mainly found in this area, sandstone, shale and coal. The shale varies from sandy shale to carbonaceous shale and pure shale. Likewise sandstone also varies from pure sand stone of fine-grained, medium grained and coarse sandstone to shaly sandstone and coal varies from pure coal to shaly coal.

As per Mukherjee and Pandey, 2001 and CMPDIL Geological Report, 2007 the area contains both unconfined as well as semi-confined to confined aquifers. CMPDIL Geological Report, 2007 based on exploration boreholes lithologs delineates three favorable formations. These are

- Ranging from 100-120 m (CMSM-1).Grain size of this formation varies from medium to coarse grain and is friable at top and well cemented at bottom;
- From 55-65m (CMSM-1) on the north eastern side of the Moher block; and
- From 20 to 25 m. Water table under perched conditions above Khadia clay formation has also been observed near Moher village in north eastern side of the block

The four to five tolas of Moher village use dug wells as seasonal drinking water source. The pre-monsoon water level varies in depth from 10m to as much as 26m bgl (based on the

primary data collected from the field). Few dug wells have been reported to go dry during summer, whereas those along lower elevation and more depths have been reported to retain just 1m to 1.5m water column.

In the eastern part of the study area, i.e. in Pokhratola Dakhin there is a ground water mound and from this mound ground water is flowing in radial pattern, DWL (Depth to water level) of this area will fall more in the pre-monsoon time and rise less in the post monsoon time. Same situation is observed in Harraiya, Garhara tolas. Whereas Khadiatola, Amlohri, Garhariya, Gonwali, are the areas in better condition because there are ground water trough in those area, so these areas get more water than those previous tolas. The potentiality of the aquifer is very poor, and permeability also is poor.

Rainfall is the main source of ground water recharge of the study area. The ground water development factor in the area comes about 75.11 % [(Annual groundwater draft/Net Annual groundwater availability) x 100]. The stage of ground water development in the project area and its buffer zone is classified as "**Safe**" category.

4.3.8.3 *Occurrence of Groundwater*

Both the coal block is made up of medium to coarse-grained Barakar sandstone, which persists up to substantial depth (at least 90m bgl.) In case of Moher block major portion (nearly 75%) of the study area shows high variation of slope (moderately to steeply sloping) and hence create favourable condition for runoff, whereas the remaining (almost 25%) area forms the recharge zone. In contrary Moher-Amlohri Coal block shows less slope variation thus favourable for more recharge from rainfall infiltration (about 80% of the area).

This area being made up of coarse grained, weathered and jointed sandstone, results in percolation of rainwater to deeper zones.

The tolas of Moher village use dug wells (20 – 36 m bgl in depth) as seasonal drinking water source. They are located particularly in relatively low lying portions of this area. The post monsoon water level varies in depth from 8m to as much as 23m bgl. Few dug wells have been reported to go dry during summer, whereas those along lower elevation and more depths have been reported to retain just 1m to 1.5m water column. The depth of the water table was collected for pre-monsoon and secondary data for post-monsoon.

Ground Water Draft

Ground water withdrawal is generally for domestic, industrial and irrigation requirement. The net irrigation draft of the buffer zone of this block is 2981 ha (as per 2001 census record) which has been considered and is estimated as 0.34 Mm^3. Population in the core and buffer zone around the study area is about 273091 (as per 2001 census record).

The groundwater recharge and draft for the buffer zone were estimated at 45.51 Mm^3 and 19.52 Mm^3 respectively. Thus the balance annual ground water resource is available is projected at 25.99 Mm^3.

Groundwater Development

The ground water development factor in the area comes about 75.11% [(Annual groundwater draft / Net Annual groundwater availability) x 100]. The stage of ground water development in the project area and its buffer zone is classified as "Safe" category.

Radius of Influence

About 1440ha of core zone will get excavated due to open cast mining. Hence underground infiltration will stop in the area. However, ground water table will get affected only up to radius of influence 237.17m, from the quarry edge. Beyond this area, there will be infiltration to ground water resource.

4.3.9 Water Quality

4.3.9.1 *Surface water*

Four sampling locations were chosen for analyzing the quality of surface water in the study area. Among these two locations are in the Core Zone and other two sampling locations samples from Kachan Nadi and Marghatia Nala have been selected from the 5km Buffer Zone. The names of the sampling locations and their distances according to the directions are mentioned in **Table 4.17** and **Figure 4.13**. The quality of surface water as monitored during study period is presented in **Table 4.18.**

Table 4-17: Sampling location for Surface Water Quality

Sampling Location	Station Code	Direction	Distance from Core Zone
Kachan Nadi	SW1	SW	5
Pokhra Tola pond	SW2	Core Zone	0
Marghatia Nala	SW3	N	1
Nigahi Tola Pond	SW4	Core Zone	0

Table 4-18: Surface Water Quality

S. No.	Parameter	Standard	Unit	SW1	SW2	SW3	SW4
1	Colour	5	-	CL	CL	CL	CL
2	Turbidity		NTU	15	8	10	12
3	Odour	Unobj	-	unobj	unobj	unobj	unobj
4	pH	6.5 -8.5	-	7.7	6.7	6.9	7.2
5	Conductivity	--	µS/cm	350	390	430	470
6	Total Dissolved Solids	500	mg/L	255	280	340	370
7	Alkalinity	200	mg/l	120	130	110	150
8	Total Hardness (as $CaCO_3$)	300	mg/l	104	113	91	123

S. No.	Parameter	Standard	Unit	SW1	SW2	SW3	SW4
9	Calcium as Ca++	75	mg/l	30	32	25	36
10	Magnesium as Mg++	30	mg/l	7	8	7	8
11	Sodium	-	mg/l	35	39	60	55
12	Potassium	-	mg/l	5	5	3	4
13	Bicarbonates	-	mg/l	146	159	134	183
14	Chloride	250	mg/l	20	16	37	46
15	Fluoride	1.0	mg/l	0.82	1.00	0.75	1.00
16	Sulphate	200	mg/l	10	12	35	54
17	Nitrate	45	mg/l	2.6	3	2.6	2
18	Phenol Compounds (as C_6H_5OH)	0.001	mg/l	BDL	BDL	BDL	BDL
19	Cyanide	0.05	mg/l	BDL	BDL	BDL	BDL
20	DO	-	mg/l	4.6	5	5.2	4.2
21	Chemical Oxygen Demand	-	mg/l	20	40	24	41
22	BOD (3 days at 27°C)	-	mg/l	5	5	4	6
23	Arsenic	00.5	mg/l	BDL	BDL	BDL	BDL
24	Boron	1.0	mg/l	0.02	0.02	0.04	0.1
25	Cadmium	0.01	mg/l	BDL	BDL	BDL	BDL
26	Chromium	0.05	mg/l	BDL	BDL	BDL	BDL
27	Copper	0.3	mg/l	0.04	0.03	0.02	0.03
28	Iron	0.05	mg/l	0.15	0.2	0.14	0.22
29	Lead	0.001	mg/l	BDL	BDL	BDL	BDL
30	Mercury	0.05	mg/l	BDL	BDL	BDL	BDL
31	Zinc	5.0	mg/l	0.05	0.04	0.03	0.008
32	Total Coliforms	nil	No/100 ml	1600	1800	900	2000

CL: Colourless; BDL: Below Detection Level; unobj: Unobjectionable

The pH of surface water varies from 6.7 to 7.7 and the Total Dissolved Solids vary within the range of 255 to 370 mg/l. The Hardness values are in the range of 91 to 123 mg/l and obviously the calcium and magnesium are also found well within the limits of drinking water standard prescribed by BIS (IS 10,500: 1991). Other parameters like chloride, Fluoride, sulphate, Nitrate are also found within well within the limits of drinking water standards. The heavy metals such as Arsenic, Boron, Cadmium, Chromium, Copper, Iron, Lead, Mercury, and Zinc are all found within drinking water standards (Table 4.19).

The BOD values found in range of 4 to 6 mg/l indicates that these surface water bodies are slightly polluted in nature. However, the total coliform contents of the four surface water bodies were found at higher level in the range of 900 to 2000 MPN/ 100 ml, which are exceeding the limit of drinking water standard. In general, the surface water quality indicates that the water bodies are not polluted much and can be used for drinking purpose after necessary disinfection.

Table 4-19: Ionic Balance for Surface Water Samples

S. No.	Parameters	Unit	SW1	SW2	SW3	SW4
1	Na	mg/l	35	39	60	55
2	K	mg/l	5	5	3	4
3	Ca	mg/l	30	32	25	36
4	Mg	mg/l	7	8	7	8
5	Chloride	mg/l	20	16	37	46
6	NO_3	mg/l	2.6	3	2.6	2
7	SO_4	mg/l	10	12	35	54
8	HCO_3	mg/l	146	159	134	183
9	NA	meq/l	1.522	1.696	2.609	2.391
10	K	meq/l	0.128	0.128	0.077	0.102
11	Ca	meq/l	1.50	1.60	1.25	1.80
12	Mg	meq/l	0.57	0.66	0.57	0.66
13	Cl	meq/l	0.56	0.45	1.04	1.30
14	SO_4	meq/l	0.21	0.25	0.73	1.13
15	HCO_3	meq/l	2.39	2.61	2.20	3.00
16	NO_3	meq/l	0.04	0.05	0.04	0.03
17	Total Cations	meq/l	3.723	4.079	4.509	4.949
18	Total anions	meq/l	3.207	3.356	4.010	5.453
19	Cations /Anions ratio	_	1.16	1.22	1.12	0.91
20	% deviation of Cation vs Anion	%	7.45	9.73	5.86	-4.84

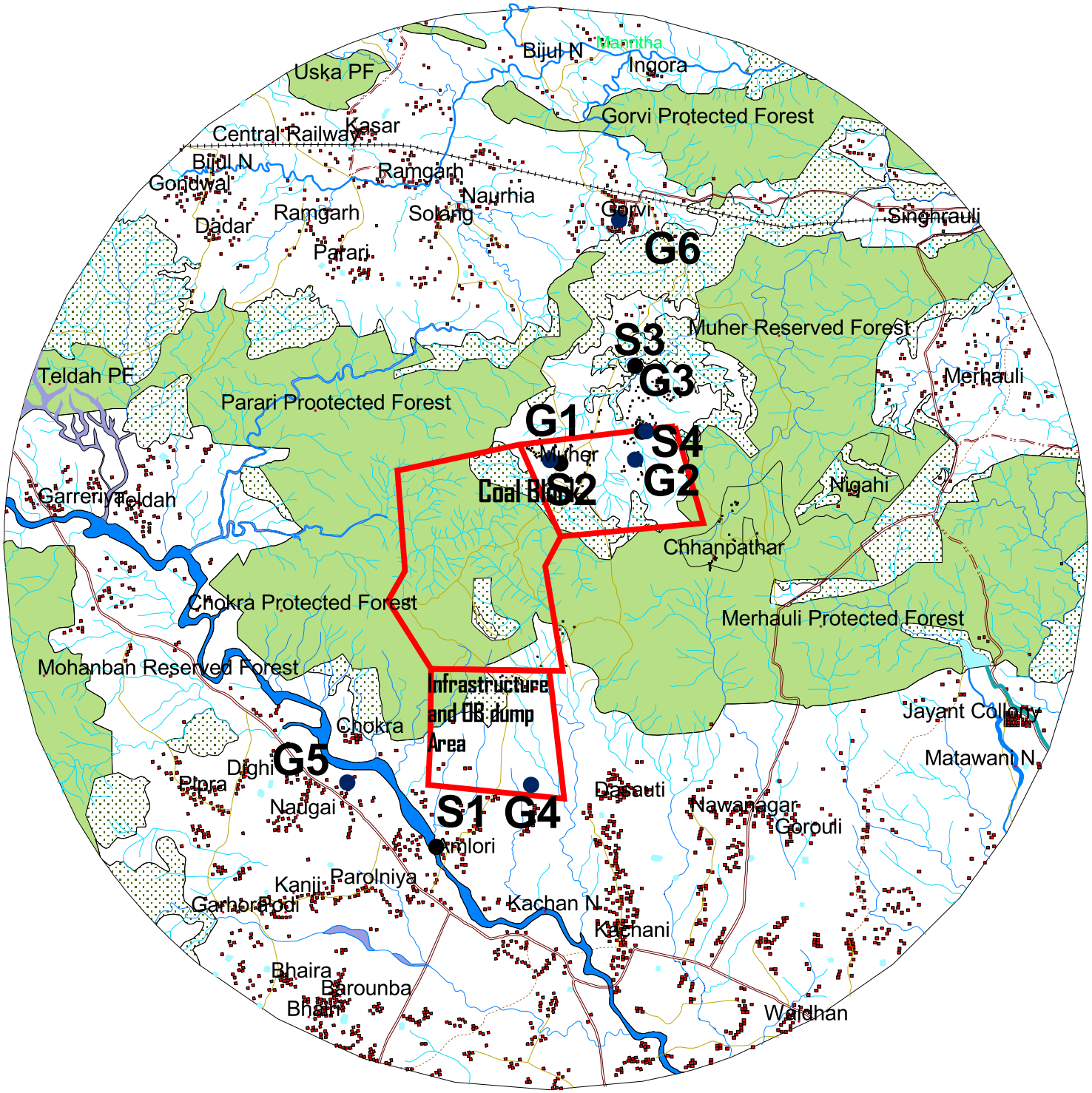
4.3.9.2 *Ground Water*

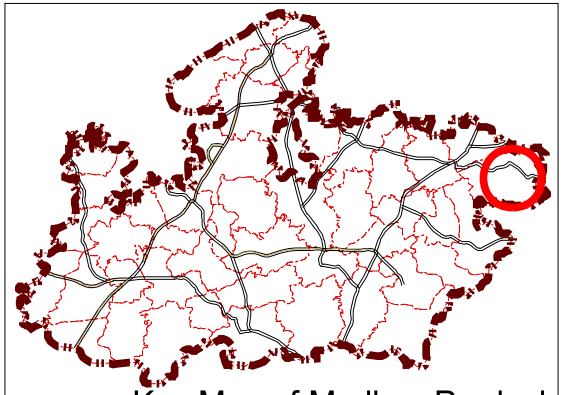
Ground water samples have been collected from six locations for analysis. The name and distance of the locations are mentioned in **Table 4.20** and **Figure 4.13.**

Table 4-20: Groundwater Sampling Location

Sampling stations	Code	Direction from site	Distance from core zone
Pokhra Tola	GW1	Core Zone	0
Khariya Tola	GW2	Core Zone	0
Nigahi Tola	GW3	Core Zone	0
Amlohri	GW4	Core Zone	0
Garhara	GW5	SW	5
Gorbi	GW6	N	3

The groundwater quality data is depicted in **Table 4.21**. From the observation it was found out that the pH of the groundwater was ranging from 6.8 to 7.8. Total Dissolved Solids were within the range of 172 to 600 mg/l. The hardness values were in the range of 140 to 277 mg/l and the calcium and magnesium were in the range of 38 to 58 mg/l and 11 to 26 mg/l respectively. The pH, TDS, hardness, calcium, magnesium alkalinity, chloride, and nitrate





Legend:

- Surface Water Sampling Station
- Ground Water Sampling Station
- Site boundary

Natural Drainage

- Canal
- Streams
- Nala
- River

Transportation

- Motorable Road in Dry Seasons
- Mud Roads
- Other Road
- Pacca Road
- Rails

Land use pattern

- water body
- River
- Revenue Land
- Open Forest
- Nala
- Forest boundary
- Settlement

Water Sampling Locations

N W E S

Figure No. 4.13

0.4 0 0.4 0.8 1.2 Km

Client:

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Consultant:

Envirotech East Pvt. Ltd. Kolkata.

are all found well within the limits of drinking water standard prescribed by BIS (IS 10,500: 1991). Fluoride values were also found within limits of desirable limit of 1,0 mg/l except one sample (1.3 mg/l) , which also meets the maximum permissible limit of 1.5 mg/l.

The heavy metals such as Arsenic, Boron, Lead and Mercury are all found within drinking water standards. In general, the groundwater quality indicates that the groundwater bodies are slightly polluted and can be used for drinking purpose after necessary treatment. The ionic balance of ground water are presented in Table 4.22.

Table 4-21: Ground Water Quality

S.No	Parameter	Unit	BIS Standard	GW1	GW2	GW3	GW4	GW 5	GW 6
1	Colour	-		CL	CL	CL	CL	CL	CL
2	Turbidity	NTU	5	1	2	1	2	1	3
3	Odour		unobj	unobj	unobj	unobj	unobj	unobj	unobj
4	pH		6.5 -8.5	6.8	7.2	7.4	7.8	7.5	6.7
5	Conductivity	µS/cm	--	560	610	580	630	310	720
6	TDS	mg/l	500	364	410	345	470	210	480
7	Alkalinity	mg/l	200	135	120	130	175	105	180
8	Total Hardness (as $CaCO_3$)	mg/l	300	178	210.8	169.3	257.3	140.2	276.9
9	Calcium as Ca++	mg/l	75	48	58	48	54	38	58
10	Magnesium as Mg++	mg/l	30	14	16	12	20	11	26
11	Sodium	mg/l	-	54	50	42	56	26	66
12	Potassium	mg/l	-	8	10	8	16	11	15
13	Bicarbonates	mg/l	-	164.7	146.4	158.6	213.5	128.1	219.6
14	Chloride	mg/l	250	50	55	61	66	35	75
15	Fluoride	mg/l	1.0	0.72	0.85	0.96	1.2	0.64	1.3
16	Sulphate	mg/l	200	40	60	58	62	28	80
17	Nitrate	mg/l	45	8	12	9	13	12	23
18	Phenol Compounds (as C_6H_5OH)	mg/l	0.001	BDL	BDL	BDL	BDL	BDL	BDL
19	Cyanide	mg/l	0.05	BDL	BDL	BDL	BDL	BDL	BDL
23	Arsenic	mg/L	00.5	BDL	BDL	BDL	BDL	BDL	BDL
24	Boron (as B)	mg/l	1.0	BDL	BDL	BDL	BDL	BDL	BDL
25	Cadmium	mg/l	0.01	BDL	BDL	BDL	BDL	0.02	0.08
26	Copper	mg/l	0.05	0.04	0.03	0.04	0.06	0.3	0.95
27	Iron	mg/l	0.3	0.4	0.5	0.7	0.56	BDL	BDL
28	Lead	mg/l	0.05	BDL	BDL	BDL	BDL	BDL	BDL
29	Mercury	mg/l	0.001	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Chromium	mg/l	0.05	BDL	BDL	BDL	BDL	0.06	0.1
31	Zinc	mg/l	5.0	0.07	0.06	0.03	0.07	8	16

CL: Colourless; BDL: Below Detection Level; unobj: Unobjectionable

Table 4-22: Ionic Balance for Ground Water Samples

S. No.	Parameters	Unit	GW1	GW2	GW3	GW4	GW5	GW6
1	Na	mg/l	54	50	42	56	26	66

S. No.	Parameters	Unit	GW1	GW2	GW3	GW4	GW5	GW6
2	K	mg/l	8	10	8	16	11	15
3	Ca	mg/l	48	58	48	54	38	58
4	Mg	mg/l	14	16	12	20	11	26
5	Chloride	mg/l	50	55	61	66	35	75
6	NO_3	mg/l	8	12	9	13	12	23
7	SO_4	mg/l	40	60	58	62	28	80
8	HCO_3	mg/l	165	146	159	214	128	220
9	NA	mq/l	2.348	2.174	1.826	2.435	1.130	2.870
10	K	mq/l	0.205	0.256	0.205	0.409	0.281	0.384
11	Ca	mq/l	2.40	2.90	2.40	2.70	1.90	2.90
12	Mg	mq/l	1.15	1.31	0.98	1.64	0.90	2.13
13	Cl	mq/l	1.41	1.55	1.72	1.86	0.99	2.11
14	SO_4	mq/l	0.83	1.25	1.21	1.29	0.58	1.67
15	HCO_3	mq/l	2.70	2.39	2.61	3.51	2.10	3.61
16	NO_3	mq/l	0.13	0.19	0.15	0.21	0.19	0.37
17	Sum of Cations	mq/l	6.100	6.641	5.414	7.183	4.213	8.284
18	Sum of anions	mq/l	5.076	5.386	5.678	6.869	3.861	7.757
19	Cations /Anions ratio	_	**1.20**	**1.23**	**0.95**	**1.05**	**1.09**	**1.07**
20	% difference of Cation vs Anion	%	**9.16**	**10.43**	**-2.38**	**2.24**	**4.36**	**3.29**

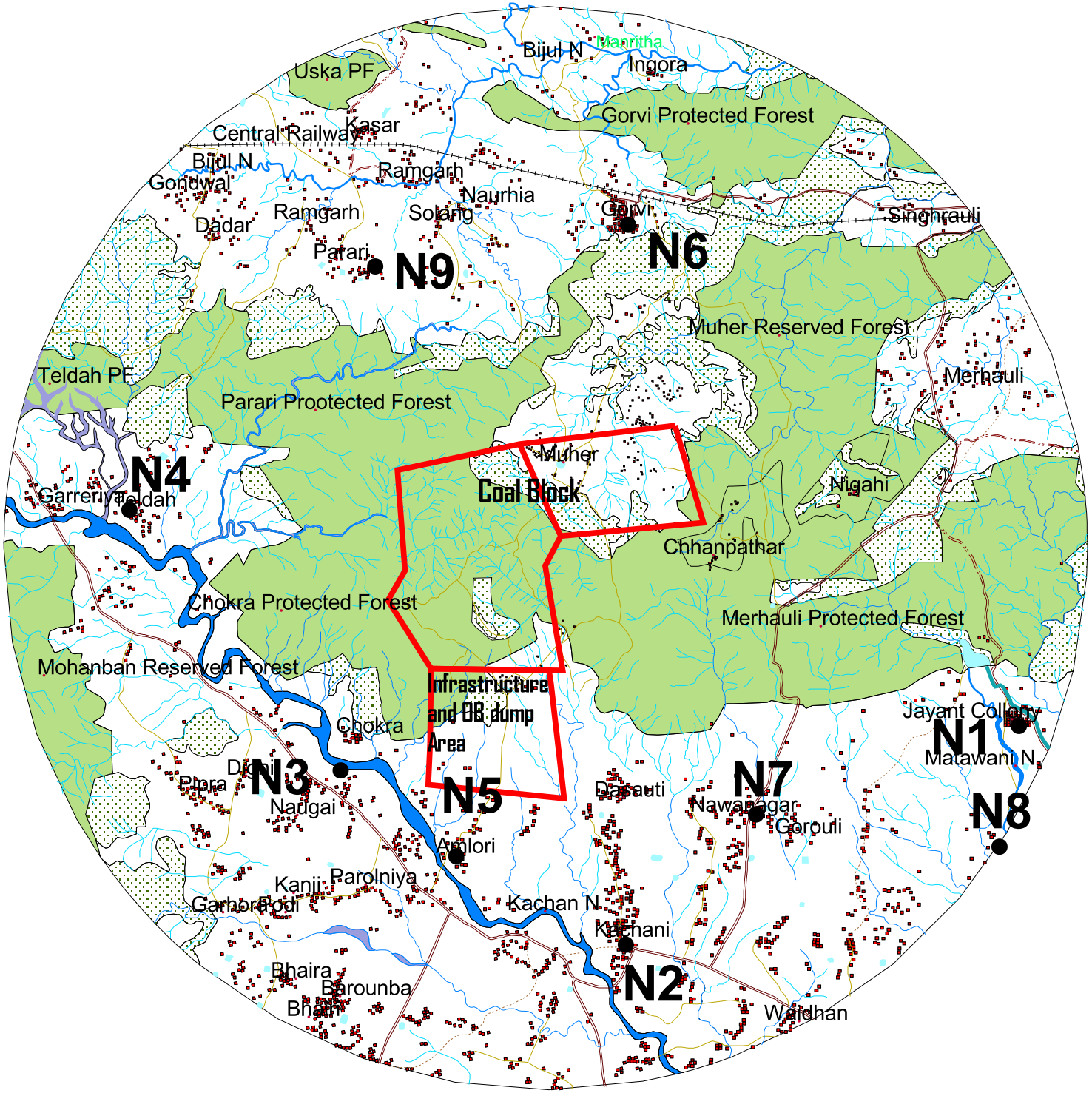
4.3.10 Noise Quality

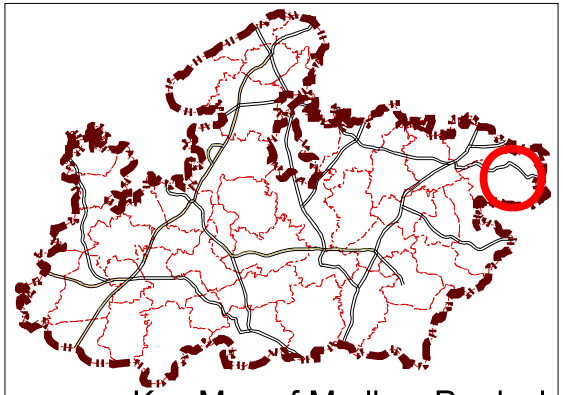
The noise quality of the region describes the extent of existing noise level in the area due to vehicular movement or any other activities. Eight noise monitoring stations were identified to assess the noise quality and analyzing the traffic movement in the area. The details of the monitoring stations are mentioned in **Table 4.23** and **Figure 4.14.**

Table 4-23: Sampling location for Noise quality analysis

Sampling Stations	Code	Direction	Distance in km
Pokhra tola	N1	Core Zone	0
Nigahi Tola	N2	Core Zone	0
Amlohri	N3	S	1.5
Dasuati	N4	SSE	2.5
Nigahi	N5	E	5
Gorbi	N6	N	3
Jayant colony	N7	ESE	8.5
Haraiya	N8	NW	3.75

Noise levels recorded in the surrounding villages during daytime were found to be within 42.35 - 52.20 dB (A) and during night time the Leq value ranges within 33.45-40.35 dB (A).





Legend:

- Noise Monitoring Stations
- Site boundary

Natural Drainage
- Canal
- Streams
- Nala
- River

Transportation
- Motorable Road in Dry Seasons
- Mud Roads
- Other Road
- Pacca Road
- Rails

Land use pattern
- water body
- River
- Revenue Land
- Open Forest
- Nala
- Forest boundary
- Settlement

Noise Monitoring Stations Map

N, W, E, S

Figure 4.14

0.4 0 0.4 0.8 1.2 Km

Client:
Sasan Power Limited
(An Associate of Reliance Power Limited)

Consultant:
Envirotech East Pvt. Ltd. Kolkata.

The monitoring station of Gorbi Colony is situated near the Railway line and main road. For this reason the noise of this location is higher than the other stations. However the noise level of all the stations was well within the prescribed norms.

Table 4-24: Equivalent Noise level

Stations	Equivalent Noise Level (leq) in db(a		Standard Limits in db (a) leq according to CPCB	
	Day	Night	Day	Night
Pokhra tola	42.35.	33.45	55	45
Nigahi Tola	43.20	34.51	55	45
Amlohri	47.52	35.12	55	45
Dasuati	46.51	34.25	55	45
Nigahi	49.75	35.42	55	45
Gorbi	52.20	40.35	55	45
Jayant colony	50.58	39.13	55	45
Haraiya	44.0	35.4	55	45

4.4 ECOLOGICAL ENVIRONMENT

The terms ecological environment would cover the part of environment consisting of all living forms such as plants and animals of the study area. The ecological aspects have been studied in two perspectives for this purpose.

- Terrestrial Ecological Status
- Aquatic Ecological Status

The species of the flora and fauna in the Study area has been collected from the Forest Range Office, Waidhan, Singrauli.

4.4.1 Terrestrial Ecological Status

Terrestrial Ecological Status implies to the status of plants and animals both exist on land. The land species of flora and fauna and their ecosystem are mentioned in the following section. A few Reserved and Protected Forest patches have been located both in Core and Buffer zone of the Study area.

4.4.2 Terrestrial Flora

The flora of the region can be divided into Natural vegetation/Forest vegetation, Shrubs, Herbs/grasses and Plantation vegetation raised by forest department in the degraded forest areas of Buffer Zone areas. Except for the Reserved and Protected Forests, the remaining areas lacked impressive forest cover.

No prominent grassland ecosystem has been found in the Core and Buffer zone areas. However the grasslands are mixed with natural vegetation was observed at forest edges, adjacent to agriculture lands and on valley slopes

The forest is characterized by Tropical Mixed Deciduous Forest. The distance of these forests from the proposed mining site within the Study Area (within a radius of 10 km) is provided in **Table 4.25**

Table 4-25: Forest in the Study Area

Forest Names	Distance from site (km)	Direction
Protected Forest		
Gorbi PF	6.5	N & NNE
Uska PF	7.5	NW
Parari PF	2.5	WNW
Chokhra PF	4.5	SW
Merhauli PF	4.5	S & SSE
Teldah PF	5.5	WNW
Reserved Forest		
Moher Reserved Forest	Core Zone	S, SE, E

Areas under various vegetation classifications in study area and the site are given in **Table 4.26** & **Table 4.27** respectively.

Table 4-26: Classification of vegetation in Study Area

Forest Names	Area (ha.)	Area (%)
Dense Forest	14.5	4.61
Open Forest	36.4	11.59
Forest Blanks	0.6	0.19
Forest Plantations	10.6	3.37
Scrub Forest	25.9	8.24
Scrub	12.6	4.00

Table 4-27: Classification of vegetation in Project Site

Forest Names	Area (ha.)	Area (%)
Dense Forest	11.7	57.49
Open Forest	1.57	7.40
Forest Blanks	0.03	0.17
Forest Plantations	0.02	0.11
Scrub Forest	0.57	3.01
Scrub	0.24	1.17

4.4.3 Methodology for Ecological Survey

The structure and composition of vegetation and forest cover was studied by phyto-sociological methods of vegetation survey. To characterize the vegetation in the study area, the data was analyzed for describing the properties of vegetation with reference to species composition and structural attributes expressed.

The structure and composition of vegetation and forest cover was studied by quadrate method in the forest area and random observation in the village areas. The quadrate method includes laying down of a square sample plot of suitable size for detailed analysis of vegetation. It may be a single sample plot or may be divided in to several subplots. For studying forest community quadrate equivalent to one-tenth ha. (10m x 10m) were used, whereas for studying shrubs the quadrates of smaller sizes (5m x 5m) were used.

The species of the flora and fauna in the Study area was also collected from the Forest Range Office, Waidhan, District: Singrauli.

4.4.3.1 *Species of Terrestrial Flora*

The terrestrial floral species consist of Tropical deciduous tree species, shrubs and dry deciduous grasses. The main tree species in the area are *Terminalia tomentosa* (Saj), *Terminalia ahata* (Kahu), *Terminalia chebula* (Myrobalam), *Delbergia sisso* (Shisam), *Madhuca latifolia*(Mahua), *Aegle marmelos* (Bel), *Acacia catechu* (Cutch tree/Khair), *Lagerstomia parviflora* (Nandi), *Zizyphus Mauritian* (Jujube tree) and *Zizyphus oenopila* (Jackal jujube).

The composition of herbaceous species was Bahunia vahili (Potter leaves), Bamboosa aurundinaceae (Black bamboo), Gmelina arborea (Sky flower), Cocculus hirsutus (jamiti-ki-bel), Tinospora cordifolia (Gulancha) etc.

To conduct the primary survey of forest in the core zone area all the floral species have been divided in three categories namely Sal, Sajja and Satkatha. A total 938979 no. of trees is found in the core zone area. The details of vegetation found in the core zone area are given in **Table 4.28.**

Table 4-28: Vegetation in Core Zone

Forest Names	Unit	No.
Total Forest Area	ha.	1198.0
Forest Quality	Quality	IVB and VB
Forest Density		0.2 – 0.4
Estimated Number of Trees	No.	938979

The details of the floral species present in the core zone and buffer zone are mentioned in **Table 4.29** and **Table 4.30** respectively.

Table 4-29: List of Flora in Core Zone

Common Name	Botanical Name	Family
Large Trees		
Achar	*Buchanania lanzan*	Anacardiaceae
Arjun	*Terminalia arjuna*	Combretaceae
Aam	*Mangifera indica*	Anacardiaceae
Imali	*Tamrindus indica*	Caesalpiniaceae
Kathmoor	*Ficus hispida*	Moraceae
Kala Siras	*Albizia lebbek*	Mimosaeae
Kussum	*Schleichera oleosa*	Sapindaceae
Kekad	*Garuga pinnata*	Burseraceae
Kaith	*Limonia*	Rutaceae
Kem (Mundi)	*Mitragyna parvifolia*	Rubiaceae
Khair	*Acacia catechu*	Mimosaeae
Gular	*Ficus glomerata*	Moraceae
Chichwa	*Albizzia odoratissima*	Mimosaeae
Jamun	*Eugenia jambolana* or *Syzygium cumini L*	Myrtaceae
Tendu	*Diospyros melanoylon*	Ebenaceae
Dhahpalash	*Cordia macleodii*	Boraginaceae
Dhaman	*Grewia tiliaefolia*	Tiliaceae
Dhawara	*Anogeissus latifolia*	Combretaceae
Dhobil	*Dalbergia paniculata*	Papilionaceae
Neem	*Azadirachta indica*	Meliaceae
Pakar	*Ficus infectoria*	Moraceae
Peepal	*Ficus religiosa*	Moraceae
Bad	*Ficus bengalensis*	Moraceae
Bahera	*Terminalia bellerica*	Combretaceae
Beejasal	*Pterocarpus marsupiam*	Papilionaceae
Bel	*Aegle marmelos*	Rutaceae
Bhirra	*Chloroxylon swietenia*	Meliaceae
Bhorasal	*Hymenodictyon excelsum*	Rubiaceae
Mahua	*Madhuca indica*	Sapotaceae
Mokha	*Schrebera swietenioides*	Oleaceae
Shisham	*Dalbergia latifolia*	Papilionaceae
Safed Siras	*Albizzia procera*	Mimosaeae
Sagun	*Tectona grandis*	Verbenaceae
Saj	*Terminalia tomentosa*	Combretaceae
Sal	*Shorea robusta*	Depterocarpaceae
Salai	*Boswellia serrata*	Burseraceae
Seja	*Lagerstroemia parviflora*	Lythraceae
Semal	*Salmalia malbarica*	Malvaceae

Common Name	Botanical Name	Family
Sonpakad	*Ficus tomentosa*	Moraceae
Sonpader	*Radermachera xylocarpa*	Bignoniaceae
Haldu	*Adina cardifolia*	Rubiaceae
Small Trees		
Amaltash	*Cassia fistula*	Caesalpiniaceae
Amta	*Bauhinia malabarica*	Caesalpiniaceae
Kewlar	*Bauhinia purpuraca*	Caesalpiniaceae
Jamrasi	*Elaeadendron glaucum*	Celastraceae
Deekamali	*Gardenia resinifera*	Rubiaceae
Tilwan	*Wendiandia exserta*	Rubiaceae
Ber	*Zizyphous jujuba*	Rahmnaceae
Maidalkadhi	*Litsea gluinosa*	Lauraceae
Mainfal	*Randia dumetorum*	Rubiaceae
Lokhandi	*Laxora arborea*	Rubiaceae
Sehra	*Baqhinia retusa*	Caesalpiniaceae
Shrubs		
Akol	*Alangium salvifolium*	Cornaceae
Adusa	*Adhatoda vasica*	Acanthaceae
Apamarg	*Achyranthes aspera*	Amaranthaceae
Arandi	*Ricinus communis*	Euphiorbiaceae
Aak	*Calotropis gigantea*	Asclepiadaceae
Kurka	*Gardenir gummifera*	Rubiaiere
Jangali Mehandi	*Dodonea viscosa*	Saoindaceae
Gudsakari	*Grewia hirsuta*	Tiliaceae
Gokharu	*Tribulus terrestris*	Zygophyllaceae
Godharu	*Xanthlum strumarium*	Compositae
Chipati	*Besmodium pulchellum*	Papilionaceae
Chireta	*Andrographis paniculata*	Acanthaceae
Jondhratni	*Antideshma ghassembilla*	Euphorbiaceae
Tulsi	*Ocimum sanctum*	Labiateae
Marorfali	*Helieteres isora*	Sterculiaceae
Mohti	*Vernonia divergens*	Compositae
Raimunia	*Lantana camara*	Verbenaceae
Harsingar	*Nyctanthes arbortristis*	Oleaceae
Vantulshi	*Daedalacanthus purouraseens*	Abanthaceae
Makor	*Zizyphus oenoblla*	Rhamnaceae
Vines		
Kiwanch	*Mucuna pruita*	Papilionaceae
Kevati	*Ventilago alyculata*	Rhamnaceae
Dhimarbel	*Ichnocarpus frutescens*	Apocynaceae
Tupbell	*Derris scandens*	Leguminnosae
Doodhbel	*Vallaris solanaceae*	Apocynaceae
Nagbel	*Cryptolepis buchanani*	Combreteaecae

Common Name	Botanical Name	Family
Palashbel	*Butea superba*	Papilionaceae
Pasaran	*Clematis smilacifolia*	Ranunculaceae
Bechandi	*Dioscorea daanona*	Dioscoreaceae
Makor	*Zizyphus oenoplia*	Rhamnaceae
Malkangini	*Celastrus paniculata*	Celastraceae
Mahul	*Bauhinia vahlii*	Papilionaceae
Ramdataun	*Smilax zeylanica*	Liliaceae
Rauni	*Acacia pennata*	Mimoseae

Source: Forest Working Plan

Table 4-30: List of Flora in Buffer Zone

Common Name	Botanical Name	Family
Large Trees		
Achar	*Buchanania lanzan*	Anacardiaceae
Arjun	*Terminalia arjuna*	Combretaceae
Aam	*Mangifera indica*	Anacardiaceae
Aonla	*Embilica officinalis*	Euphorbiaceae
Imali	*Tamrindus indica*	Caesalpiniaceae
Kathmoor	*Ficus hispida*	Moraceae
Kalla	*Dillenia pentagyna*	Dilleniaceae
Kasaio	*Bridelia retusa*	Euphorbiaceae
Kari	*Milusa tomentosha*	Annonaceae
Kumbhi	*Carerya arborea*	Myrtaceae
Kullu	*Sterculia urnens*	Sterculiaceae
Kussum	*Schleichera oleosa*	Sapindaceae
Kekad	*Garuga pinnata*	Burseraceae
Kaith	*Limonia*	Rutaceae
Kem (Mundi)	*Mitragyna parvifolia*	Rubiaceae
Khair	*Acacia catechu*	Mimosaeae
Gamari	*Gmelina acborea*	Verbenaceae
Gular	*Ficus glomerata*	Moraceae
Chichwa	*Albizzia odoratissima*	Mimosaeae
Chirol	*Holoptelea integrifolia*	Mimosaeae
Jamun	*Syzygium cuimini*	Myrtaceae
Jaymangal	*Oroxylim indicum*	Bignoniaceae
Jhingan	*Lannea coromandalica*	Anacardiaceae
Tinsa	*Ougenia oojeinensis*	Papilionaceae
Toon	*Cedrela toona*	Meliaceae
Tendu	*Diospyros melanoylon*	Ebenaceae
Dhahpalash	*Cordia macleodii*	Boraginaceae
Dhaman	*Grewia tiliaefolia*	Tiliaceae
Dhawara	*Anogeissus latifolia*	Combretaceae
Dhobil	*Dalbergia paniculata*	Papilionaceae
Neelgiri	*Cucalyptus Spp*	Myrtaceae
Neem	*Azadirachta indica*	Meliaceae
Pakar	*Ficus infectoria*	Moraceae
Padar	*Stereospermum suaveolens*	Bignoniaceae
Pangra	*Erthrina suberosa*	Papilionaceae
Peepal	*Ficus religiosa*	Moraceae
Poola	*Kydia calycina*	Malvaceae
Bad	*Ficus bengalensis*	Moraceae
Bahera	*Terminalia bellerica*	Combretaceae
Beejasal	*Pterocarpus marsupiam*	Papilionaceae

Common Name	Botanical Name	Family
Bel	*Aegle marmelos*	Rutaceae
Bhirra	*Chloroxylon swietenia*	Meliaceae
Bhorasal	*Hymenodictyon excelsum*	Rubiaceae
Mahua	*Madhuca indica*	Sapotaceae
Mokha	*Schrebera swietenioides*	Oleaceae
Riunja	*Acacia leucophloca*	Mimosaeae
Rohan	*Soymida fabrifuga*	Meliaceae
Lasoda	*Cordia dichotoma*	Boraginaceae
Shisham	*Dalbergia latifolia*	Papilionaceae
Safed Siras	*Albizzia procera*	Mimosaeae
Sagun	*Tectona grandis*	Verbenaceae
Saj	*Terminalia tomentosa*	Combretaceae
Sal	*Shorea robusta*	Depterocarpaceae
Salai	*Boswellia serrata*	Burseraceae
Seja	*Lagerstroemia parviflora*	Lythraceae
Semal	*Salmalia malbarica*	Malvaceae
Sonpakad	*Ficus tomentosa*	Moraceae
Harra	*Terminalia chebula*	Combretaceae
Haldu	*Adina cardifolia*	Rubiaceae
Small Trees		
Amaltash	*Cassia fistula*	Caesalpiniaceae
Amta	*Bauhinia malabarica*	Caesalpiniaceae
Asta	*Bauhinia racemosa*	Caesalpiniaceae
Kakai	*Flacourtia indica*	Flaeourtiaceae
Kachnar	*Bauhinia veriegata*	Caesalpiniaceae
Kathjamun	*Syzygium heyneanum*	Mytraceae
Kewlar	*Bauhinia purpuraca*	Caesalpiniaceae
Gabandi	*Cochlospermum religiosum*	Bixaceae
Gilchi	*Casearia graveclens*	Samoyoaceae
Ghot	*Zizyphus xylopyra*	Rahmnaceae
Jamrasi	*Elaeadendron glaucum*	Celastraceae
Deekamali	*Gardenia resinifera*	Rubiaceae
Tilwan	*Wendiandia exserta*	Rubiaceae
Papda	*Gardenia latifolia*	Rubiaceae
Fetra	*Gardenia turgida*	Rubiaceae
Ber	*Zizyphous jujuba*	Rahmnaceae
Bilsena	*Limonia acidissima*	Rutaceae
Bhilama	*Scmecarpus anacardium*	Anacardiaceae
Maidalkadhi	*Litsea gluinosa*	Lauraceae
Mainfal	*Randia dumetorum*	Rubiaceae
Roli	*Mallotus philippinensis*	Euphorbiaceae
Lokhandi	*Laxora arborea*	Rubiaceae
Sehra	*Baqhinia retusa*	Caesalpiniaceae
Shrubs		
Akol	*Alangium salvifolium*	Cornaceae
Adusa	*Adhatoda vasica*	Acanthaceae
Apamarg	*Achyranthes aspera*	Amaranthaceae
Arandi	*Ricinus communis*	Euphiorbiaceae
Aak	*Calotropis gigantea*	Asclepiadaceae
Karonda	*Carissa opaca*	Apocynaceae
Kala basa	*Colebrookia oppositifolia*	Labiatae
Kurachi	*Holarrhena antidysentrica*	Apocynaceae
Kora	*Pogostemon benghalensis*	Labiatae
Kali musali	*Curoulige orihiodus*	Amoniyllidaceae
Kela Jangli	*Musa sapiertum*	Musaleae

Common Name	Botanical Name	Family
Kurka	*Gardenir gummifera*	Rubiaiere
Khatua	*Antidesma diandrum*	Euphorbiaceae
Khursi	*Grewia rothil*	Tilliaceae
Jangali Mehandi	*Dodonea viscosa*	Saoindaceae
Gudsakari	*Grewia hirsuta*	Tiliaceae
Gokharu	*Tribulus terrestris*	Zygophyllaceae
Godharu	*Xanthlum strumarium*	Compositae
Chipati	*Besmodium pulchellum*	Papilionaceae
Chireta	*Andrographis paniculata*	Acanthaceae
Jondhratni	*Antideshma ghassembilla*	Euphorbiaceae
Jharneri	*Zizyphus nummularia*	Rhamnaceae
Jhau	*Tamrix dioica*	Tamaricaceae
Tulsi	*Ocimum sanctum*	Labiateae
Thuar	*Euphorbia neriifolia*	Euphorbiaceae
Dhavai	*Woodfordia fructicosa*	Lythraceae
Neelguri	*Vitex nigundo*	Verbenaceae
Neel	*Indigofera pulchella*	Papilionaceae
Pawar	*Cassia tora*	Caesalpiniaceae
Bankapas	*Thespesia lampas*	Malvaceae
Banrahar	*Moghania semialata*	Papilionaceae
Bividhang	*Embelia robusta*	Myrsinaceae
Besram	*Ipomea pes-caparae*	Convolvulaceae
Bhatkataiya	*Solanum nigrum*	Solanaceae
Bhirangraj	*Eclipta prostrate*	Compositae
Marorfali	*Helieteres isora*	Sterculiaceae
Mohti	*Vernonia divergens*	Compositae
Raimunia	*Lantana camara*	Verbenaceae
Satawari	*Asparagus recemosus*	Liliaceae
Sitafal	*Anona squamosa*	Anonaceae
Harsingar	*Nyctanthes arbortristis*	Oleaceae
Vantulshi	*Daedalacanthus purouraseens*	Abanthaceae
Makor	*Zizyphus oenoblla*	Rhamnaceae
Ratanjot	*Jetropha curcus*	Euphorbiaceae
Raimuniya	*Latana acovieata*	Verbenaceae
Vines		
Kiwanch	*Mucuna pruita*	Papilionaceae
Kevati	*Ventilago alyculata*	Rhamnaceae
Gunga	*Abrus precatorious*	Papilionaceae
Gauj	*Milletia auriculata*	Papilionaceae
Dokarbel	*Ampelocissus latifolia*	Vitaceae
Dhimarbel	*Ichnocarpus frutescens*	Apocynaceae
Tupbell	*Derris scandens*	Leguminnosae
Doodhbel	*Vallaris solanaceae*	Apocynaceae
Nasarbal	*Butea parviflora*	Papilionaceae
Nagbel	*Cryptolepis buchanani*	Combreteaecae
Palashbel	*Butea superba*	Papilionaceae
Pasaran	*Clematis smilacifolia*	Ranunculaceae
Bechandi	*Dioscorea daanona*	Dioscoreaceae
Makor	*Zizyphus oenoplia*	Rhamnaceae
Malkangini	*Celastrus paniculata*	Celastraceae
Mahul	*Bauhinia vahlii*	Papilionaceae
Ramdataun	*Smilax zeylanica*	Liliaceae
Rauni	*Acacia pennata*	Mimoseae
Grasses		
Kansh	*Saceharum spontaneoum*	Gramineae

Common Name	Botanical Name	Family
Kush	*Desmostachya bipinnata*	Gramineae
Kushal	*Heteropogon contortus*	Gramineae
Khas	*Vetivania zizanioides*	Gramineae
Gunher	*Themeda guadrivalais*	Gramineae
Cheer	*Imperata cylindrical*	Gramineae
Jhani	*Aristida setaceae*	Gramineae
Doob	*Cynodom dactylon*	Gramineae
Foolbahari	*Thysanolaena maxima*	Gramineae
Fooli	*Apude mutica*	Gramineae
Bahyadanda	*Arundo donax*	Gramineae
Bhurbhusi	*Eragrostis tenella*	Gramineae
Choti bhurbhusi	*Eragrostis interrupta*	Gramineae
Bharvel	*Dichanthium annulatum*	Gramineae
Moonge	*Erianthus munja*	Gramineae
Moya	*Pennisetum hohenackeri*	Gramineae
Rusa	*Cymbopogan martini*	Gramineae
Sabai	*Eulaliopsis binata*	Gramineae
Other plants		
Amarbel	*Cuscuta Reflexa*	Convolvulaceae
Chhend	*Phenoix acaulis*	Palmae
Bandha	*Dendrophthoe falcata*	Loranthaceae
Bamboo	*Dendrocalmus strictus*	Gramineae
Vanda	*Vandal terrs*	Grchidaceae

Source: Forest Working Plan

4.4.3.2 *Faunal Environment*

Among the faunal groups birds are most conspicuous, which are commonly seen in all the habitat types of terrestrial origin. As already discussed, the project site is surrounded with Protected Forest and Reserved Forest. There is no wildlife sanctuary in the study area. A few wild mammalian species of scheduled wildlife category have been reported by Forest Department in the Protected Forest areas of the study area. General birds, amphibians, reptiles and some domesticated animals have also been reported in the study area.

Terrestrial species in the study area can be classified into mammals, reptiles, amphibians and birds. The wild species are mostly monkeys. As the project area is surrounded by active mines, the possibility of wild animals in the project compartments is remote.

The number of species of fauna in the core and buffer zone are mentioned in **Table 4.31, 4.32** and **Table 4.33** respectively.

Table 4-31: List of Fauna in the study area

Common Name	No. of found	Schedule
Panther	6	I
Wild Boar	28	III
Sloth Bear	20	I
Barking Deer	5	III
Peacock	16	I

Common Name	No. of found	Schedule
Blue Bull	3	III
Common Langur	282	II
Rhesus Macaque	196	II
Hyenas	17	III
Indian Hare	30	IV
Wolf	4	I
Jackal	25	II
Indian Gazella	7	I

Table 4-32: List of Fauna in Core Zone

Common Name	Schedule
Wild Boar	III
Blue Bull	III
Common Langur	II
Rhesus Macaque	II
Hyeana	III
Indian Hare	IV
Jackal	II

Table 4-33: List of Fauna in Buffer Zone

Common Name	Schedule
Panther	I
Wild Boar	III
Sloth Bear	I
Barking Deer	III
Peacock	I
Blue Bull	III
Common Langur	II
Rhesus Macaque	II
Hyeana	III
Indian Hare	IV
Wolf	I
Jackal	II
Indian Gazella	I

4.4.3.3 *Endangered Species*

Endangered species or faunal habitats according to the Schedule-I of Wildlife Protection Act, 1975 have been recorded within the Waidhan Forest Range. These are *Panthera tigris, Panthera pardus, Melursus ursinus*, Bos gaurus and *Tetracerus quadricomis*. But within 5km from core zone no endangered species were found.

4.4.3.4 *Flight paths and migratory corridors*

The study areas do not represent any migratory paths or corridors to the birds and mammalian fauna as per certificate issued by the forest Department.

4.5 DEMOGRAPHY & SOCIO-ECONOMIC ENVIRONMENT

The prevailing status of demography and Socio-economic environment includes the demographic characteristics and socio-economic condition of the people in the area and illustrated in **Table 4.34**. This comprises of demographic profile, infrastructure, socio-economic condition, literacy and lifestyle etc. The proposed project will have some impact on the socio-economic environment of the people of surrounding villages experiencing development in the study area.

Table 4-34: Socio Economic Condition(Core Zone)

S. No.	Characteristics		Values
1	Total Household		817
2	Total Population		4331
3	Population below 6 years		627
4	Social categories	Scheduled Caste	215
		Scheduled Tribe	183
5	Household size		5.3
6	Gender Ratio		821
7	Literacy rate		82.5
8	Work Participation Rate		27.7
9	Categories of Workers	Total Workers	1201
		Main workers	1187
		Marginal workers	14
		Non-Workers	3130

Source: Primary Census Abstract, Census of India 2001

4.5.1 Socio-economic Environment of Buffer Zone (Secondary Data)

The Buffer Zone includes 66 villages surrounding the Core Zone and some colonies of the Municipal Corporation areas of Singrauli. Jayant, Gorbi, Nawanagar, Amlohri, and Nigahi Mines lie in the buffer zone. The socio-economic condition of the Buffer Zone is explained in the following section.

4.5.1.1 *Demographic Profile*

According to the 2001 census the Buffer Zone area has a population of 2,48,778 with an annual growth rate of 3.9%. The density of the population is quite high of about 792. The average household size of the area is 4.8 persons. This indicates the family size is not very big in the area and there is a predominance of nuclear families.

The percentage of male population of the area is 53.4% and female population is 46.6%. The gender ratio of the area is very low at 871. The population under 6 years of age is 46681, which is 18.8% of the total population. However the gender ratio under 6 years is better at 947. The low gender ratio in this area may be attributed to high rate of immigration of labours to this area as unskilled and semi-skilled workers.

Table 4-35: Demographic Profile of Buffer Zone

Parameters	Values
Household	46897
Total population	248778
Male	132969
Female	115809
Population under 6yrs of age.	46681
Household size	5.3
Percentage of Male	53.4%
Percentage of Female	46.6%
Gender Ratio	871
Percentage of Population below 06 years	18.8%

Social Composition

In the area under study, the scheduled caste population is 14.8% while the Scheduled Tribe population is 11.1% of the total population. The area is dominated by OBCs and about 48% of the population belongs to the above category. The rest population belongs to higher castes.

4.5.1.2 *Literacy rate*

The Literacy rate of the region is moderate and as shown in **Table 4.36** it is 64.2 %. This figure is higher than the national average. The female literacy rate of the study area which is 48.0% is lower than the male literacy rate of 78.1%. The female Literacy rate is lower than National Average Literacy Rate. It was found that the girls were not allowed to go outside the villages for studies and thus their educational attainment was restricted to maximum primary level.

Table 4-36: Social Status

Parameters	Values
Scheduled Caste	36783
Scheduled Tribe	27515
No. of Literates	129723
Total Female Literates	37554
Proportion of Scheduled Caste	14.8%
Proportion of Scheduled Tribe	11.1%

Parameters	Values
Literacy Rate	64.2%
Female literacy rate	48.0%

4.5.1.3 *Economic and Occupational Structure*

The economic and occupational structure reflects the economic environment of the study area. The composition of the workers to total population and the composition of the workers groups in the study area has been studied and described in this section and their numbers are listed in **Table 4.37.**

Table 4-37: Occupational Structure

Parameters	Population
Total Workers	79331
Total Main Workers	66432
Total Marginal Workers	12899
Total Non-Workers	169447
Work Participation Rate	31.8%

The economic status of the people in the study area is highlighted by the Work Participation Rate of the area which is 31.8% among the total population of 2,48,778. The Work Participation Rate is moderate where total workers are 63,406. The occupational structure of the study area is studied with reference to Main Workers and Marginal Workers and the Non-workers. The percentage of main workers is 26.7%, marginal workers are 5.2% and non-workers are 68.1%. It was found that due to absence of irrigation facilities and poor soil fertility, people of the area were not fully dependent on agriculture and mainly worked as miners in neighbouring mines. Due to rapid industrialization of the area, employment in the secondary sector is much more in demand.

4.5.2 Infrastructure

The core zone of the study area consisting of Moher, Amlohri and Nuagarh village falls under Singrauli Municipal area. Most of the villages in the Buffer Zone are electrified. All required infrastructure are available in Singrauli Town. The **Table 4.38** shows the amenities available in the surrounding villages and the amenities available in the municipal corporation area of Singrauli which include the Core Zone mostly.

Table 4-38: Infrastructure Facilities

Facilities	Types of facilities	Buffer Zone villages	Singrauli Municipality
Education Facilities	Primary School	52	125
	Middle School	11	34
	Secondary School	5	17

Facilities	Types of facilities	Buffer Zone villages	Singrauli Municipality
	Senior Secondary School	2	10
	College (incld Polytechnic)	0	4
Medical Facilities	Primary Health Center	1	1
	Primary Health Sub Center	7	0
	Health Centre	1	00
	Hospitals	0	5
	Mother Child Welfare Centre	2	0
	Community Health Center	3	0
Drinking Water	Tap	NA	NA
	Well	Available	Available
	Tank	Available	Available
	Tube well	A	Available
	Hand pump	Available	Available
Post & Telegraph Facilities	Post Office	10	2
	Phone Connection	33	NA
	Post & Telegraph office	3	2
Banking Facilities	Commercial Bank	1	18
	Co-operative Bank	1	2
Credit Societies	Agricultural Credit Societies	1	1
	Non-Agricultural Credit Societies	1	18
Power Supply	Domestic	7 villages	Available
	Agriculture	3 villages	
	Others	2 villages	
	All Purpose	45 villages	

4.5.2.1 *Occupational Health*

The occupational health risks involved in coal mines mainly includes mechanical injuries, chemical hazards, inhalation of dusts and noise deafness. In the study area the general health status of the people were found to be normal. Only normal diseases such as diarrhea, malaria, skin and lungs infections and fever were reported.

Out of the above mentioned illnesses, only lungs infection can be classified as occupation related diseases and could be attributed to predominance of mining activities in the study area.

4.5.3 Socio-economic condition of Core Zone (Primary Survey)

Core Zone consists of some parts of Moher village. Administratively, Moher is not a village but is part of the Ward 3 of Singrauli Municipal Corporation. Some hamlets of Moher, Amlohri and Nuagarh villages come under direct impact of the project because these hamlets are located within the Core Zone area.

The total population of Ward 3 is 4331 with 817 households having 5.3 household sizes. The gender ratio is 810 with 82.5 literacy rate.

4.5.4 Census of PAFs

People affected by the project have been classified as per definitions in GoMP's Model R&R Policy, 2002, which are reproduced below:

A Displaced Person (DP)

Any person who is displaced because the land is required or is likely to be required for development of the project; and who is normally a resident of and carried out some trade, profession to earn his livelihood in the concerned area as notified in the concerned notification published under section 4 of the Land Acquisition Act at least for a period of one year preceding the date of publication of such notice OR is tilling land in the concerned area at least for a period of 3 years preceding the date of publication of such notice.

A Displaced Family (DF)

- A family consisting of a project displaced person and his spouse, along with minor children and other relations such as widowed mother, widowed or unmarried sister, unmarried daughter or old father.
- Every son/ daughter/ brother who has attained maturity (> 18 years old) on or before the date of publication of notice under section 4 of LA Act is considered as a separate family unit.

Landless person: Any single person or along with his family who does not hold any farm land and does not have any land in his name for agriculture. Also those persons who are tilling the land owned by someone else will be considered in this category.

Small Farmer: Any farmer who owns 2 hectare or less of non-irrigated land or owns 1 hectare or less of irrigated land

Marginal Farmer: Any farmer who owns 1 hectare or less of non- irrigated land or 1/2 hectare or less of irrigated land. Coverage of the survey is given in **Table 4.39**.

Table 4-39: Affected Households

S. No.	Village	No of affected households
1.	Moher	317
2.	Bengabasti	22
3.	Amlohri	204

S. No.	Village	No of affected households
4.	Naugarh	74
Total		**617**

As per definition of MP R&R Policy 2002, the 617 affected households comprises 898 families, with every adult son, daughter and brother who have attained 18 years age as on Section 4 notification date being treated as a separate family.

4.5.4.1 *Land Ownership Pattern*

The land ownership pattern has been studied based on the land owned by the landowners. The **Table 4.40** gives the status of land ownership

Table 4-40: Land Ownership Pattern

Village	Land holding (acres)	General	Scheduled Caste	Scheduled Tribe	OBC	All	%
Moher	<2.5	16	8	20	105	149	64.2
	2.5 to 7.5	6	8	28	32	74	31.9
	>7.5	3	0	3	3	9	3.9
	Total	25	16	51	140	232	100.0
Bengabasti	<2.5	0	0	5	0	5	71.4
	2.5 to 7.5	0	0	2	0	2	28.6
	>7.5	0	0	0	0	0	0.0
	Total	0	0	7	0	7	100.0
Amlohri	<2.5	2	23	3	44	72	55.4
	2.5 to 7.5	0	16	1	33	50	38.5
	>7.5	3	2	0	3	8	6.2
	Total	5	41	4	80	130	100.0
Naugarh	<2.5	15	2	0	5	22	56.4
	2.5 to 7.5	9	0	0	4	13	33.3
	>7.5	2	0	0	2	4	10.3
	Total	26	2	0	11	39	100.0
All	<2.5	33	33	28	154	248	60.8
	2.5 to 7.5	15	24	31	69	139	34.1
	>7.5	8	2	3	8	21	5.1
	Total	56	59	62	231	408	100.0

From the above table it can be seen that most of the respondent households (61%) fall under the category of marginal farmers and own one or less than one hectare (~2.5 acre) of land. The number of large farmers is very limited and the maximum number of large farmers is found in Amlohri.

4.5.4.2 *Occupational Status*

The study found that of the 617 families, 408 families own land and the **Table 4.41** shows that most are engaged in farming.

Table 4-41: Occupation Profile of the Affected People

Occupation / Village		Moher	Bengabasti	Amlohri	Naugarh	All
Unemployed	No.	348	57	274	90	769
	%	24.2	54.8	24.4	21.2	24.9
Farming on own land	No.	174	4	121	37	336
	%	12.1	3.8	10.8	8.7	10.9
Farming on other's land	No.	26	0	34	8	68
	%	1.8	0.0	3.0	1.9	2.2
Housewives	No.	323	27	268	102	720
	%	22.5	26.0	23.9	24.0	23.3
Students	No.	435	7	333	130	905
	%	30.3	6.7	29.7	30.6	29.3
Casual labor	No.	131	9	92	58	290
	%	9.1	8.7	8.2	13.6	9.4
Total		1437	104	1122	425	3088

4.5.4.3 *Income Level*

The households get their livelihood through various means. They mainly include cultivation and non-agricultural labourers followed by agricultural labourers. Agriculture is the main income generating activity in the project area which generates around 70% of the revenue. Income pattern is depicted in **Table 4.42**.

Table 4-42: Income level of Affected Households

Village / Monthly income		Moher	Bengabasti	Amlohri	Naugarh	All
< Rs.2000/-	N	161	12	121	38	332
	%	50.8	54.5	59.3	51.4	53.8
Rs.2000 to 5000/-	N	124	10	68	26	228
	%	39.1	45.5	33.3	35.1	37.0
> Rs.5000/-	N	32	0	15	10	57
	%	10.1	0.0	7.4	13.5	9.2
Total		**317**	**22**	**204**	**74**	**617**

As the above table shows, most of the target population is extremely poor and below the poverty line (Poverty Line is defined as the per capita expenditure level, adjusted for inflation, by which intake of 2400 kcal per capita per day in rural areas is met). About 54% of the respondents earn less than Rs 24,000 annually. This reflects that the scope of employment in this area is extremely low. Although people have landholdings, productivity is low due to bad soil conditions and poor water sources.

4.5.4.4 *House Layout Details*

Most of the houses found in the area were kutcha or semi-pucca with temporary asbestos/ tin roof. Cowsheds and place for other domestic animals were within the courtyard of the houses. Kitchens were usually found in the courtyard with a sheltered alcove. Only four houses had toilet facilities and people practiced open defecation. Houses having toilets were located at a distance from the main house.

4.5.4.5 *Caste Characteristics*

Multiple caste groups and sub-groups inhabit the project area. The different classes of caste are grouped as Scheduled Castes (SC), Scheduled Tribes (ST), Other Backward Classes (OBC) and other General or Forward Castes. The village wise caste distribution is given below.

Table 4-43: Village-wise distribution of Caste Categories of households

Caste / Villages	General	Schedule Caste	Scheduled Tribe	OBC	Total
Moher	32	24	73	188	317
Bengabasti	0	2	19	1	22
Amlohri	6	65	27	106	204
Naugarh	37	10	7	20	74
Total	75	101	126	315	617
Percentage	12.2	16.4	20.4	51.1	100.0

In the areas under study, it was found that majority of the households (51%) belonged to the OBC category, followed by Scheduled Tribes (20.4%) and Scheduled Castes (16.4%). The general (higher) castes form 12.2%.

4.5.4.6 *Immovable Property*

Private assets likely to be lost due to the project are given in table below. These assets are mainly located within the residential area of affected households

Table 4-44: Impacted Immovable Assets by Type

Assets \ Villages		Moher	Bengabasti	Amlohri	Naugarh	All
Trees	No.	219	8	164	54	445
	%	69.1	36.4	80.4	73.0	72.1
Well	No.	308	1	154	67	530
	%	97.2	4.5	75.5	90.5	85.9
Tube Well	No.	2	20	41	5	68
	%	0.6	90.9	20.1	6.8	11.0
Cattle shed	No.	180	3	132	49	364
	%	56.8	13.6	64.7	66.2	59.0

From the above table it can be observed that people are mostly loosing water sources and trees. During the rehabilitation, care has to be taken to develop water sources and plant trees in the area.

ESIA STUDY

MOHER & MOHER AMLOHRI EXTENSION COAL BLOCKS, M.P. (INDIA)

CHAPTER 5.

PUBLIC CONSULTATION & INFORMATION DISCLOSURE

5. PUBLIC CONSULTATION & INFORMATION DISCLOSURE

5.1 INTRODUCTION

The need for public consultation and disclosure arises from the universal belief that transparency and accountability are fundamental to fulfilling any development mandate and in strengthening public involvement in the decision making process.

For all 'Category A' projects the project proponent or third party experts must have consulted with project affected communities in a structured and culturally appropriate manner. In projects with significant impacts on affected communities, the process must ensure their free, prior and informed consultation (FPIC) and facilitate their informed participation.

5.2 OBJECTIVES OF COMMUNITY CONSULTATION

Community Consultation was carried out in this project in order to minimize probable adverse impact of the project. The Community Consultation process has been carried out with the following objectives:

- To inform potentially impacted communities / individuals about the
  - Probable time of initiation of project;
  - Time taken for disbursement of compensation; Nature of compensation;
  - Probable compensation amount for various categories of losses;
- To solicit the views of affected communities/ individuals on social, economic and environment components and the significance of impacts;
- To serve as an important tool for collecting information about the natural and the human environments, much of which would never be accessible through more traditional approaches of data collection;
- To ensure enhanced public cooperation by creating awareness about purpose and benefits of the project.

Project Understanding

Group Discussion

5.3 INVOLUNTARY RESETTLEMENT

This project will result in physical and economic displacement resulting from land rights for public sector project acquired through expropriation or the compulsory procedures through Land Acquisition Act of the host country.

5.3.1 Land Requirement

Private Land for the mine is being acquired by the State Government through the provisions of Land Acquisition Act, 1894 (amended in 1984) and forest land is diverted under provision Forest Conservation Act 1980. Total viilage wise land requirement mine lease area and OB dump is given in the Table 5.1.

Table 5-1: Total Land Requirement for Coal & OB Area

Purpose	Village	Private Land	Government Land	Forest Land	Total
Coal Block	Moher including Bengabasti	352.84	121.44	1064.72	1539.00
OB Area	Amlohri	325.53	39.19	133.28	498.00
	Naugarh				
Total Land Requirement		678.37	160.63	1198.00	2037.00

Source: Sasan Power Limited

5.3.1.1 *Impact on host community due to land acquisition*

The 617 houses i.e. 3088 persons will affected by the project. The socio-economic conditions of these households are given in Table 5.2.

Table 5-2: Total Land Requirement for Coal & OB Area

Village	No. of households	No. of persons	SC	ST	Others	Households with cattle	BPL households
Moher	317	1437	24	73	220	180	161
Amlohri	204	1122	65	27	112	132	121
Naugarh	74	425	10	7	57	49	38
Bengabasti	22	104	2	19	1	3	12
Total	617	3088	101	126	390	364	332

The income pattern of the affected population shows that only 63 families are large farmers with a considerable no of landless agricultural labourers i.e. 228 families. The details in this regard are given below in the Table 5.3.

Table 5-3: Income Pattern

Landless Agri Labourers				Rural Artisan/Small Trader/ Self Employed				Small & Marginal Farmers				Large Farmers			
SC	ST	Others	Total	SC	ST	Others	Total	SC	ST	Others	Total	SC	ST	Others	Total
38	47	145	228	13	16	49	76	88	109	336	531	11	13	39	63

As the host community is already exposed to the industrial activity in the surrounding area there is no distinct cultural identity was observed during the census survey including for ST

population. There is conscious effort not to disturb their cultural heritages and SPL will ensure replacement of similar structure in the rehabilitation colony if such structured being affected.

5.4 REHABILITATION & RESETTLEMENT ACTION PLAN

SPL approved R&R policy consist the provision of both NPRR, 2007 as well Govt. of Madhya Pradesh Model R&R Policy. The detailed comparison of SPL R&R policy with NPRR, 2007 and GoMP's Model Rehabilitation & Resettlement Policy, 2002 are given in **Table 5.4.**

Table 5-4: Comparative Analysis of R&R Policies

Particulars	SPL R&R Policy	MP Policy 2002	National Policy 2007
Land compensation	@ current market rate	@ rate as on Sec 4 date	@ rate as on Sec 4 date
Eligibility	Persons >=18 yr old considered as separate family	Persons >=18 yr old considered as separate family	Family (irrespective of persons above 18 yrs age)
R&R colony	With basic facilities viz., Health Centre School & playgrounds Marketplace Panchayat Bhawan Library Herd Land Religious place Roads & Electricity Drinking water & sanitation	With basic facilities viz., Health Centre School & playgrounds Marketplace Panchayat Bhawan Library Herd Land Religious place Roads & Electricity Drinking water & sanitation	With basic facilities viz., Health Centre School & playgrounds Marketplace Panchayat Bhawan Library Herd Land Religious place Roads & Electricity Drinking water & sanitation
Plot	5400 sq ft (501 sq m)	5400 sq ft (501 sq m)	2691 sq ft (250 sq m)
House	To all eligible families	No provision	Only to BPL families
House building Allowance	As per Indira Awas Yojana	As per Indira Awas Yojana	Only to BPL families as per GoI program, if house not provided
Transport Assistance	Will be arranged by company for shifting within 25 kms and additional Rs 1,000 per family	To be arranged by company / Rs 1,000 in lieu thereof	Rs 10,000 per family
R&R Allowances	Rehabilitation Allowance: To all families Sustenance Allowance: To landless families	Rehabilitation Allowance: To all families Sustenance Allowance: To landless agricultural labour & landless SC/ST families	Rehabilitation Allowance: To families not given jobs Sustenance Allowance: To all families Compensation to rural artisans & families with cattle

Particulars	SPL R&R Policy	MP Policy 2002	National Policy 2007
Education stipend	To all school going children Girl child to get more stipend	No provision	No provision
Scholarship	To meritorious students for higher education	No provision	No provision
Pension	Rs 1,000 per month for people >=60 yrs old	No provision	Rs 500 per month
Employment	Priority to affected families based on skills Training for skills up gradation	Priority to affected families based on skills Training for skills up gradation	Priority to affected families based on skills Training for skills up gradation

As per approved SPL R&R Policy, displaced families will be provided the following compensation (apart from compensation legally due under Land Acquisition Act depending on category of the family/ person) (Table 5.5).

Table 5-5: Rehabilitation Entitlements – one time payment

Category of Displaced Family	Rehabilitation Entitlements
Families whose land is acquired	• Families of small & marginal farmers to get Rs 15,000 for 1 year as rehabilitation allowance • Other land owner families to get Rs 7,500 for 1 year as rehabilitation allowance
Landless families, who do not own any farm land	• Rs 15,000 for 1 year as rehabilitation allowance to agricultural labour families. • Rs 7,500 to other landless families.
SC/ST displaced families	• Rs 15,000 for 1 year as rehabilitation allowance
Families whose house is being acquired	• Families have the options to take plot and/or house and/or cash compensation in lieu thereof • Free transportation facility for each displaced family within 25 km., Shifting Charges Rs. 1000 for each eligible displaced family. Dismantling Charge as applicable. • Residential plot of 60' x 90' is being provided together with a ready to use house.

The SPL will try to replicate socio-cultural and religious ties of the existing host community at the resettlement site with participation and consultation of such families. Any families need special attention to avail rehabilitation support will be provided. An action plan regarding schedule of process of consultation, disclosure, grievance readdressal, support at the site to the affected is already in place and monitoring cell of SPL is executing the same.

SPL will also provide land purchase assistance to those affected families who want to purchase. This will be done through local revenue personnel. Wherever preferred, SPL will include livelihood restoration programmes for rehabilitation of the land owner.

5.5 PUBLIC CONSULTATION

5.5.1 Public Involvement

To ascertain the specific views of the community and stakeholders about the project, the EIA has been undertaken in an environment of open consultation. The entire process has been through free, prior, and informed consultations with stakeholders, including local communities, NGOs, various levels of government, inter-ministerial committees, and outside stakeholders. These consultations have resulted in broad community support for the project.

Public Consultation remains a continuous process. Apart from face-to-face discussions with affected people on demographic and resettlement issues that fed information into the resettlement plan, specifically in the locality of the Project, public consultations were carried out at levels of village and local administration.

Two series of consultations with project affected household has been done by the consultant on behalf of the Sasan Power Limited in 2006 and 2008.

5.5.2 Project Information Centre

A Project Information Center of SPL was established in Waidhan in the year 2008. This information centre has made the following information available to its visitors:

- Written and audiovisual information about the Project and the methods of extraction to be used;

- Project information sheets in both Hindi and English providing a general background to the Project and also on specific subjects such as open cast coal mining, programmes to boost local agricultural production, water management, resettlement and entitlements options;
- Project news updates;

5.5.3 Consultations with Key Government and Union Stakeholders

Discussions about the project have been held with government representatives at the district and village levels. The purpose of these discussions was to:

- Determine government stakeholder reactions to the project;
- Obtain stakeholder views about potential project impacts on various economic, social, and environmental issues;
- Develop strategies to minimize potential social and environmental impacts in consultation with government stakeholders; and
- Ensure government participation in the design of impact mitigation measures.

5.5.4 Consultations with NGOs and CBOs

Meetings were held with local non-government organizations (NGOs) and community based organizations (CBOs) operating specifically within the study area as well as with those working on relevant studies, such as the health impact assessment, at the district level.

5.5.5 Village- and/or Ward-Level Consultations

Consultations were initiated at a village level with male and female representatives invited to discuss the proposed project. The goal of these consultations was to obtain their views on the positive and negative socio-economic impacts that may arise from the proposed project; and to obtain their suggestions on potential mitigation measures for these impacts. The consultations involved the distribution of project information sheets, oral presentations about the project, and detailed discussions on the stakeholders' opinions and queries in reference to the project.

5.5.6 Individual and Group Discussions

Focused group discussions and interviews were held with various categories of people. The aims of these discussions were:

- To obtain the views of various categories of vulnerable groups within the study area, to discuss the project's associated impacts and benefits on those groups, and to ascertain those groups' expectations regarding project benefits;
- To hear suggestions for mitigating any anticipated adverse impacts and increasing anticipated benefits of the project; and
- To obtain the opinion of these groups about potential socio-economic impacts of the proposed project.

5.5.7 Subject Specific Surveys

A number of surveys and studies have been undertaken, including:

- A household demographic and socio-economic survey;
- A resettlement survey to obtain the relocation preferences of persons facing displacement;
- Interviews and qualitative and quantitative surveys to provide baseline information for a health impact assessment; and
- Village checklist survey
- Monitoring of various environment components like air, noise etc.

Although these surveys and subject-specific studies have focused on accumulating specific information and socioeconomic data, they have also provided stakeholders an opportunity to ask questions and express opinions about the Project.

The Project, although opposed by some people, is supported by the majority of local community residents, even with the understanding that a considerable number of residents will have to be resettled. Future concerns from affected people will be addressed via procedures outlined in the Rehabilitation & Resettlement Plan, and also via the Project information centers.

5.6 MAJOR ISSUES FROM CONSULTATION

5.6.1 Livelihood Issues

- The titleholders were more or less willing to part with their property in lieu of proper compensation. The productivity of the area is low due to low soil quality and water scarcity. As a result of which people are just able to sustain themselves from their income.
- The agricultural laborers were apprehensive about the land acquisition and opined that they are dependent on the fields for their livelihood and they do not have the skills of working in Coal mine. They were scared that if the agricultural lands were acquired they

would suddenly face threat of livelihood. The owners will get compensation and go away and they will be left without jobs or money, as they won't be eligible for any compensation.

- During consultation major opinion was that the project should be provided alternate source of livelihood to minimize the impact of the rehabilitation.
- People were of the opinion that there won't be any employment opportunities and economic development in the area. They were of the opinion that the tertiary employment will also be taken over by the outsiders who will come in search of jobs.

5.6.2 Social and Cultural Issues

- The people were scared that once the project starts, they would have to compete with outsiders who would migrate to this area. They also were of the opinion that they will lose their cultural identity and that their children will get spoilt by getting exposure to the outside world.
- The people were apprehensive that if they are resettled to a new place, their social fabric will break and they will have to start their life afresh. They said that they would become servants in the hands of the rich people in their own birthplace. They wanted proper planning for resettlement so that people of each village were resettled in the same place and their social interaction continued in the same manner.

5.6.3 Issues specific to women

- To the women, one of the major issues was availability of drinking and domestic water. During summers, women had to travel outside to get water for domestic purpose.
- Women stressed on employment opportunities for them. The women wanted the proponents to provide them with financial assistance so that they can start petty business ventures.

5.6.4 Other Issues

- Some people were scared of drastic increase in the pollution level in the area and the incidence of health problems was on the increase. However they were assured that utmost care will be taken to maintain proper environment balance and all machines required to reduce pollution will be used in the mine.
- There was a general demand to improve the services and infrastructure of the area. People were of the opinion that education and training facilities, health facilities and road infrastructure in the area required improvement and proponent should take up the responsibilities for developing the same. People wanted the proponent to develop training institutes and support the existing schools of the area.
- Majority of the people were of the opinion that the compensations should be paid well in advance so that they can get settled before the start of the construction work.

- It was requested by the people that a redressal system should be developed by the proponent so that the problems of the PAPs are heard and proper mitigation measures adopted.

5.7 PUBLIC HEARING

As per EIA Notification No. 1533 dated 14th September 2006 of MoEF, Government of India, public hearing was conducted at Govt. Secondary School (Rural) Tehsil- Singrauli for the proposed Moher and Moher Amlohri Extension Coal Block on 27.07.2008 at 11 A.M.

As per provision of notification the date, time & place of public hearing was advertised in daily news paper Dainik Bhaskar, Navbharat, Dainik Jagran & local news paper Dainik Samay on June 28th, 2008. For propaganda about the date, venue and time of public hearing, advertisement was made by putting banners, loud speaker announcement & photography on 26th July, 2008 in neighboring villages.

The public hearing was conducted by a panel, comprising of District Collector Singrauli and Regional Officer, Rewa, MPPCB along with other authorities, as well as SPL officials and Environment Consultants on behalf of project proponent. The local residents of the proposed project area and residents from neighboring villages were also present along with media representative.

All the opinions, comments, suggestions made by the villagers are suitably complied and details of the same are given in **Table 5.5.**

Table 5-6: Opinions & Compliance

S. No.	Name & address	Comments, Objection & Suggestion expressed	Action Plan
1	Prayaglal Village Amlohri	We should be provided land in lieu of land acquired from us and our boys should get employment	Employment opportunities will be provided as per State Govt. rehabilitation policy
2	Sanjay Singh Village Bhakuwar	I want to know about the measures to be taken by Project management at the	Dust protector will be attached with drills. Plantation will be done to control

S. No.	Name & address	Comments, Objection & Suggestion expressed	Action Plan
		time of coal mining for the air pollution control	dust emission. Water will be regularly sprayed on all roads & haul roads in and around the project site. The canopy cover & dust collector will be used in C.H.P. areas. Suitable measures will be adopted for checking soil erosion 6. Dust protection mask will be provided to all workers
3	Mahendra Kumar Singh Village Amlohri	What will be the dumping management for overburden during coal mining?	For seven years the overburden will be kept in external dump area, then back filling will be start
4	Ramlal Sah Village Amlohri	We agree to the planning, but proper rehabilitation, compensation and employment should be provided.	All basic infrastructural facilities e.g. School, Panchayat Bhawan, hospital, religious place, market, road, water, proper drainage & sanitation will be provided in rehabilitated villages. Compensation & employment opportunities will be as per rehabilitation policy.
5	Lalan Kumar Panika Village Amlohri	Project management should give in writing about the compensation to be provided to landless people.	
6	Ramsubhag Sah Village Amlohri	The compensation should be provided to the affected villagers of neighboring villages due to coal mining as per Govt. of india rehabilitation policy. The people who are having house and are lease holders, should get compensation as per rules. Regular employment should be provided to them.	
7	Ramsukh vaishya Village Amlohri	How the people will be compensated? Employment & medical treatment facility should be provided to land less people and school should be constructed.	
8	Shyamlal Sah Village Amlohri	As per rehabilitation policy 2007 we want compensation, employment for leaseholders and employment for all the four sons.	In the rehabilitated villages, infrastructural facilities like School, Panchayat Bhawan, hospital, religious place, market, road, water, proper drainage & sanitation will be provided. Compensation & opportunities for employment will be given as per rehabilitation policy.
9	Mukesh Tiwari Village Amlohri	Please tell us, how much area & how many people will be	In the coal mine 678.36 hectare private land will be acquired &

S. No.	Name & address	Comments, Objection & Suggestion expressed	Action Plan
		affected due to the proposed project?	617 families will be affected.
10	Chhotelal Basor Village Amlohri	The project should come up only after providing compensation, employment & plots. Poor people will not leave their land unless they are also compensated for the food grains produced by them on this land.	All basic infrastructural facilities e.g. School, Panchayat Bhawan, hospital, religious place, market, road, water, proper drainage & sanitation will be provided in rehabilitated villages. Compensation & employment opportunities will be as per rehabilitation policy.
11	Udaybhan Vill. Amlohri	All infrastructural facilities to be provided should be written in detail	Agreed
12	Ramlal Vill. Amlohri	All old trees like mango, mahua etc which are cut should be replanted by same varieties	Agreed
13	Rammilan Bharti Vill. Moher	Coal should be treated as black gold and hence compensation should be given accordingly	Compensation will be paid as per rehabilitation policies of the Govt.
14	Yamuna Prasad Verma	Educated unemployed should be given employment as per their qualification	Employment opportunities will be provided as per rehabilitation policy of the Govt.
15	Ramakumari Vill. Amlohri	All lease holders should get employment, plot & compensation	The facilities will be provided as per the rehabilitation policies of the Govt.
16	Ghanshyam Das Vill. Amlohri	We should be informed whether the facilities provided by the project proponent shall be orally or in writing.	The public information centre shall be formed by project management, which will communicate to the people.

5.8 MONITORING AND REPORTING

Environmental and social key performance indicators will be developed in accordance to IFC guidelines and will be monitored at regular interval to identify changes in conditions, new issues, mitigation, successes and opportunities for improvement in consultation and disclosure. The monitoring results will be reported as required, and will be available to the public. Stakeholder perceptions will also be monitored by SPL Community Relations Team Representatives.

5.9 INSTITUTIONAL ARRANGEMENT

The Sasan Power Limited (SPL), is responsible for implementation of the complete resettlement and rehabilitation of all those affected by the project. For implementation of R&R Plan, the SPL should focus on three critical aspects.

- Appointment of NGOs to assist in implementation of R&R Plan;

- Establish a District Level Committee (DLC) in Singrauli District; and
- Establish a Grievance Redressal Committee (GRC) as per the provisions of the State Provision on Rehabilitation.

Implementation Staff	Roles and Responsibilities of SPL & NGO
Chief Executive, SPL	• Overall responsibilities for land acquisition and R&R activities in the field. • Make budgetary provisions for land acquisition and R&R activities. • Liaison with district administration for land acquisition and implementation of R&R. • Participate in the district level committee.
LAO/RRO at SPL Project Office	• Co-ordinate with district administration and NGOs responsible for land acquisition and R&R. • Ensure that the land acquisition plans as per the need of coal blocks are submitted to the district administration for acquisition. • Liaison with the District Administration for dovetailing Government's schemes for income generation and development programs for the PAPs. • Co-ordinate with the NGOs appointed for implementation of the R&R. • Monitor physical and financial progress on land acquisition and R&R implementation activities including shifting of people. • Participate in regular meetings. • Organise by-monthly meetings with the NGOs to review the progress of R&R.
Non Government Organization	• Co-ordinate with the RRO to implement R&R activities. • Verification of PAFs listed out in the RAP. • Issue Identity Card to the PAFs • Develop rapport with the PAPs. • Facilitate the RRO in organising the public information campaign at the commencement of the R&R activities. • Distribute the pamphlets of R&R Policy and also explain to them the meaning and measures of mitigation to eliminate the feeling of insecurity among the PAPs. • Assist the PAPs in receiving the payment of compensation, opening of the Bank accounts and facilitate the vulnerable PAPs in ensuring that they get their dues on time and are not left out to deteriorate to the stages of impoverishment. • Generate awareness about the alternate livelihood options and their viability, the resource base and other opportunities, to enable the PAPs to make informed choices and participate in their own development. • Prepare micro-plans with PAPs for R&R. • Ensure that the PAPs receive their entitlements on time.

Implementation Staff	Roles and Responsibilities of SPL & NGO
	• Ensure preparation of resettlement sites as per the guidelines laid in the policy, complete with the basic facilities. • Submit monthly progress report. • Identify training needs of the PAPs for income generating activities and ensure they are adequately supported during the post-training period on enterprise development and management, the backward and forward linkages, credit financing and marketing of the produce. • Participate in the disbursement of cheques at public meetings and Gram Sabhas.

5.9.1 Rehabilitation & Periphery Development Advisory Committee (RPDAC)/District Level Committee (DLC)

RAP implementation will be coordinated through RPDAC/DLC. The RPDAC/DLC is an *adhoc* committee and will be dissolved once the R&R is complete. The committee will comprise of the Deputy Commissioner and officially deputed Land Acquisition Officer (LAO), Tehsildars of affected tehsils, Pradhans of Block Development Offices of affected Block, Chief Executive, RRO from SPL, representative of the Non-Government Organization (NGO) and representatives of the PAFs. The RPDAC/DLC will play a coordinating role in land acquisition and compensation, assistance and so forth.

5.9.2 State Rehabilitation Commission

The State Rehabilitation Commission (SRC) to be set-up under the Chairmanship of Chief Secretary to look into and redress, grievances and give suitable directive to the government officials, requiring bodies as well as PAFs to facilitate holistic resettlement and rehabilitation of PAFs and areas in totality of socio-economic, cultural and environmental domain.

5.10 GRIEVANCE REDRESSAL COMMITTEE

Grievance Redressal Committee (GRCs) will be formed at Singrauli District. The GRCs are expected to resolve the grievances of the eligible persons, within a stipulated time. The decision of the GRCs is binding, unless vacated by a court of law, and people are not debarred from moving to the court for issues including those related to R&R. However, it is expected that the GRCs will play a very crucial role, and will help implement the project as scheduled. The GRC at Singrauli district will consist of the following members,

- The District Collector;
- The Chief Executive, SPL;
- A representative of the local self government bodies (Village/Block Panchayats or municipalities);
- A representative of the NGOs involved in implementing the R&R Plan; and
- A representative of the PAPs.

The GRC will continue to function, for the benefit of the PAPs, during the entire life of the project (including the defects liability period). The response time prescribed for the GRC is 15 days. Since the entire resettlement component of the project has to be completed before the actual construction starts, the GRC will meet at least once in 15 days, to resolve the pending grievances. The committees will meet more frequently, if the number of grievances is large enough to necessitate such meetings.

5.11 IMPLEMENTATION PROCEDURE

The effectiveness of the R&R program is directly related to the degree of continuing involvement of those affected by the project. During the preparation stage, consultations were held at local and district level. Rounds of consultations with PAPs have been planned through NGO involvement during R&R Plan implementation. Consultations during R&R Plan implementation will involve agreements on compensation and assistance options and entitlement package. The other round of consultation will occur when compensation and assistance are provided and actual resettlement begins. The following set of activities will be pursued for effective implementation of R&R Plan.

- For the benefit of the community in general and PAPs in particular, RP and R&R policy will be translated in Hindi and will be distributed to PAPs, Stake holders and local public offices for easy access to RP related information.
- Key features of the entitlements will be displayed in billboards on the project corridor.
- Together with the NGO, Project Implementation Unit (PIU) will conduct information dissemination sessions in major intersections and solicit the help of the local community encourage the participation of the PAPs in RP implementation.
- Attempt to ensure that vulnerable groups understand the process and their needs are specifically taken into consideration.
- The NGOs involved in the implementation of RP will organize Public meetings, and will appraise the communities about the progress in the implementation of project works.
- The PIU will organize public meetings to inform the community about the payment and assistance paid to the community. Regular update of the program of resettlement component of the project will be placed for public display at SPL Project offices.

Finally, participation of PAPs will also be ensured through their involvements in various local committees such as District Resettlement Committee, and Grievance Redressal Committee. PIU and R&R Officers will maintain an ongoing interaction with PAPs to identify problems and undertake remedial / correctional actions.

5.11.1 Institutional Arrangement

SPL is responsible for implementation of the complete resettlement and rehabilitation of all those affected by the project. For implementation of R&R Plan, the SPL will focus on following critical aspects.

- R&R Plan Implementation Field Office
- Panchayat Level Committee (PLC)
- State Level Committee (SLC)
- Appointment of NGOs to assist in implementation of R&R Plan;
- Establish a Grievance Redressal Committee (GRC) as per the provisions of the State R&R Policy

5.11.2 Roles and Responsibilities

The role and responsibilities of the various offices in R&R implementation is presented in this section. The Head of Mines will be in charge of the overall project activities and participate in the State level Committee to facilitate land acquisition, preconstruction activities and implementation of R&R activities. Head of Mines shall (i) co-ordinate the implementation of R&R activities with corporate staff; (ii) review the micro plans prepared by the NGO; (iii) review monthly progress report; (iv) monitor the progress on R&R and land acquisition; and (vi) plan and conduct training programs for staff capacity building as well as capacity of field level NGOs and partner agencies.

5.11.3 R&R Plan Implementation Filed Offices and Tasks

The PIU will be responsible to carry the following task concerning resettlement of the project:

- Overall responsibility of implementation of R&R activities of R&R Plan;
- Responsible for land acquisition and R&R activities in the field;
- Ensure availability of budget for R&R activities;
- Liaison with district administration for support for land acquisition and implementation of R&R and
- Participate in the district level committees.

The Rehabilitation Officer (RO) responsibilities include the following:

- Co-ordinate with district administration and NGO for land acquisition and R&R;
- Translation of R&R policy in local language;
- Prepare pamphlets of the policy;
- Printing of the policy and identity cards for the PAPs;
- Ensure the development of resettlement sites, wherever required;
- Participate in the allotment of residential, commercial and agricultural plots;
- Liaison with district administration for dovetailing government's income generating and developmental programs for the PAPs;
- Ensure the inclusion of those PAPs who may have not been covered during the survey; facilitate the opening of joint accounts in local banks to transfer assistance for R&R for PAPs, and organize the disbursement of cheque for assistance in the affected area in public;
- Monitor physical and financial progress on land acquisition and R&R activities; and
- Organize bi-monthly meetings with the NGO to review the progress on R&R;

The implementing NGO will be principally responsible for the day-to-day implementation work. The selected NGO shall

- Develop rapport with the PAPs;
- Survey and verification of the PAPs;
- Prepare micro-plan for RP implementation;
- Co-ordinate with the RO to implement R&R activities;
- Assist to issue identity cards to the PAPs;
- Participate with the RO to undertake public information campaign at the commencement of the projects;
- Distribute the pamphlets of R&R policy to the PAPs;
- Assist the PAPs in receiving the compensation;
- Facilitate the opening of joint accounts;
- Generate awareness about the alternate economic livelihood and enable the PAPs to make informed choice;
- Enable the PAPs to identify the alternate sites for agriculture, residential and commercial plots;
- Participate in the consultation on allotment of shops and residential plots;
- Ensure the PAPs have received their entitlements;
- Ensure the preparation of rehabilitation sites;
- Participate in the meetings organized by the PIU;
- Submit monthly progress reports;
- Identify training needs and institutions for the PAPs for income generating activities;
- Participate in the disbursement of cheque for the assistance at public places;
- Coordinate the training programs of the APs for income generating activities; and
- Coordinate the meeting of District Level Committee.

Panchayat Level Committee (PLC)

Panchayat being the first tier of governance will serve as the grassroots level primary institution to safeguard the interest of PAPs. A PLC will be constituted represented by Sarpanchs, Pradhans, women members form the general body or Gram Sabha of villages covered under the Panchayat and with the ward members. The major role and responsibility of PLC would be: (i) to meet regularly at pre-decided dates specifically for grievance redressing purpose; (ii) put people at peace with their queries and problems; (iii) help in amicable settlement of disputes at community level; and (iv) carry forward the ones which are not reconciled to the Grievance Redressal Committee.

Coordination with other Agencies and Organizations

R&R Cell will establish important networking relationships with many departments and organizations. The Revenue Department has an influencing role in Land Acquisition

proceedings, and initiation of resettlement process. Unless the compensation process is prompt and efficient, implementation process will get delayed. R&R Cell will coordinate with the Project Land Acquisition Officer to expedite the land acquisition process.

Income restoration will be sole responsibility of the project authority. NGO will facilitate linkages to be established with the government poverty alleviation programs to restore the income of PAPs.

Restoration of community assets such as hand pumps, bore wells, drainage facilities will require help from PHED. Where schools are affected, coordination will be required from the District Offices of Education Department.
Considering the above, SPL will extensively work on developing lateral linkages for mobilization of resources to benefit the PAPs and to achieve the desired results expected from implementation of RP.

5.11.4 Grievance Mechanism

5.11.4.1 *Corporate Level*

At the corporate level, there is a Social Development Cell (SDC) which will plays an active role in overseeing resettlement and community development activities, guide and monitor the activities of the Rehabilitation Cell (RC) formed at the project level. This SDC at the corporate level will coordinate closely with NGO which will play a lead role in implementing the Rehabilitation Action Plan (RAP), select the evaluation and monitoring agency and other experts as and when required.

5.11.4.2 *Project Level*

At the project level, SPL has a full-fledged team, which looks after land acquisition at the Project level. Members from this team as well as full time Rehabilitation Manager guided and assisted by other senior personnel of SPL Project set-up form the SDC at the corporate level. In order to successfully implement Rehabilitation Action Plan (RAP) and Community Development Plan (CDP) activities, it is essential to organize communities in the form of village level committees (VLCs). The role of VLC will be to oversee implementation of projects at respective village levels, monitor contractors and be in close touch with the Rehabilitation Cell on a weekly basis. Date and time for weekly meetings will be decided upon with the consensus of VLC. Rehabilitation Cell will collect information from the PAFs with the help of VLCs and NGO and assimilate in the form of monthly progress report to assess progress and impacts of CDP and RAP implementation and adjust work programme where necessary, in case of delays or problems. Monitoring reports will be submitted at regular intervals (monthly/quarterly). The main roles of Rehabilitation Cell will be to oversee, proper and timely implementation of all activities in RAP and CDP. Internal Monitoring will be a regular activity for Rehabilitation Cell (RC) and Rehabilitation Manager will oversee the

timely implementation of R&R activities. Internal Monitoring will be carried out by the RC and the NGO. They will prepare monthly/quarterly reports on the progress of implementation.

5.11.4.3 *Grievance Redressal Committee*

The objectives of the mechanism are to provide a platform to the affected people to address their grievance which are sought by meaningful solutions. Thus, reflecting continued participation and justification to design, economic returns and by the PAP's themselves. The grievances addressed in this manner have community approval and the redressal is appropriated through stakeholders' participation. The committee thus formed for this purpose will continue to function for the benefit of the PAPs during the entire life of the project so that the PAP's grievances are redressed at the right time. Grievance Redressal Committee

SPL will develop a Grievance Redressal Cell (GRC) within the company for the proposed project. The regular activities and plans and mode of operation will be organised and streamlined. In this direction, the Cell will develop a time table for visiting villages and let the community know the time table in advance so that grievances are brought to the GRC. It will also prepare a list of issues and identify among them, those that can be handled at various levels by the committee.

The GRC presently comprises SPL representatives only which could be augmented by bringing in representatives of VLCs and NGO.

- A place for the grievance related proceeding will be organized within the village in consultation with VLC, key opinion leaders and Panchayat.
- All minor issues will be sorted out on the spot or within a span of 2 to 3 days, and documented
- Issues that need further discussion with SPL Management and government authorities as well as the views of key opinion leaders among the community like Panchayat members will be sorted out in the subsequent visit. Such redressal is expected to take about a week's time or two weeks time in a few cases, and the feedback will be provided to the villagers.

Issues requiring legal advice will be sorted out in a few weeks time. Any issues beyond this may be handled legally by an appropriate authority in court of law.

It is expected that formation of grievance redressal system at the villager door steps would help in sorting out confusion, miscommunication early and pave the way to bridge gaps between SPL and the affected people. This process would develop better rapport and trust. A flow chart is presented below showing the grievance redressal process at SPL.

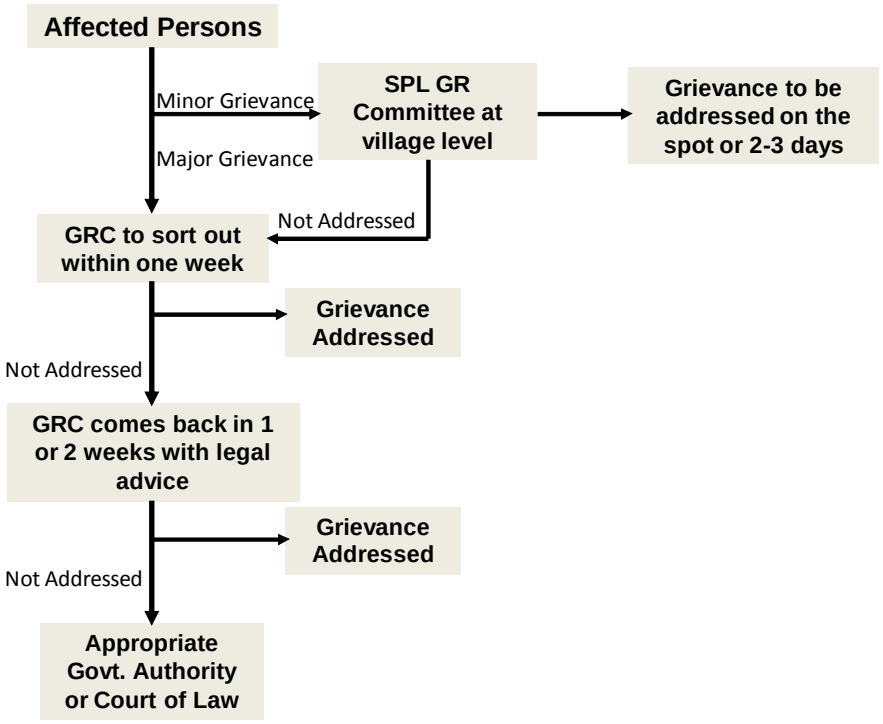


Figure 5.1: Grievance Redressal Process

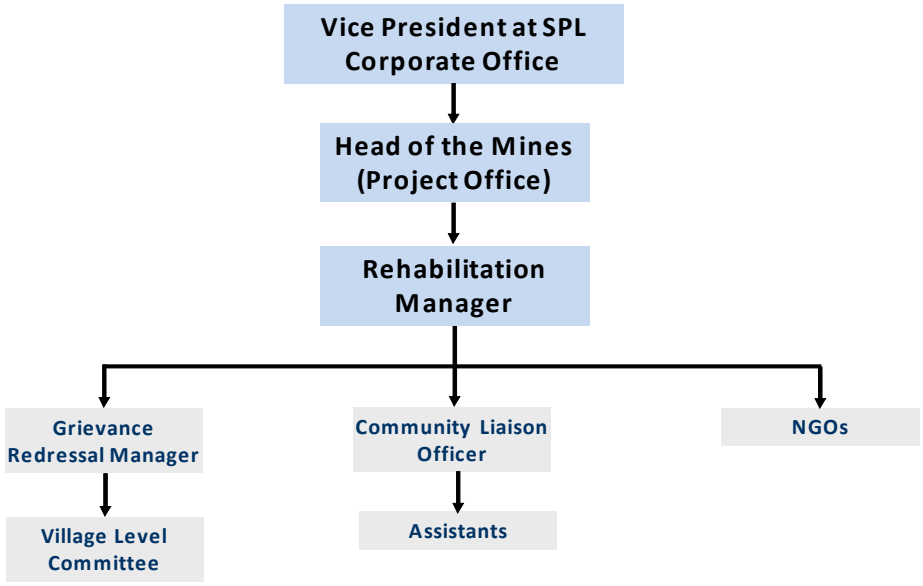


Fig 5.2: Organizational Chart for RAP and CDP

Regular and day to day monitoring of the progress of RAP and CDP activities will be done at the village levels by the individual VLCs with the help of the NGO. Monitoring indicators and activity schedules will be drawn up accordingly with the help of NGO. Release of funds will be based on phases, on completion of scheduled activities.

Internal Monitoring will be a regular activity for Rehabilitation Cell which will oversee the timely implementation of RAP and CDP activities. Internal Monitoring will be carried out by Rehabilitation Cell and the NGO who will prepare monthly/quarterly reports on the progress of CDP implementation.

However, at the village level, the periodicity of monitoring visits will be based on the size and time frame of the RAP and CDP for that village. Community Liaison Officer will collect information from the PAFs and assimilate in the form of monthly progress to assess the progress and results of RAP and CDP implementation and adjust work programme where necessary, in case of delays or problems. Both monitoring and evaluation will form part of regular activities and reporting on this will be given due importance in order to undertake mid-way corrective steps, if required.

5.11.5 Monitoring and Evaluation

An external agency independent of the projects or a local panel of experts will be engaged to carry out the evaluation and reporting of the implementation of the RAP and CDP. This external agency will conduct evaluation bi-annually during the life of the project. Any problems, encountered will be assessed and necessary changes will be recommended to the Social Development Cell at corporate level and CDP Cell at project level. The scope of Work of External Monitor will be as follows:

- Examine and verify internal monitoring systems and suggest changes
- Prepare independent reports based on monitoring visits
- Major recommendation for remedial actions
- Major recommendations for policy change
- Maintenance and updating database
- Evaluation of Delivery and Impacts of Entitlements
  - Identify the categories of impacts and evaluate the quality and timeliness of delivery of CDP
  - Determine how the CDP provisions/facilities were used and examine their impact and adequacy to meet the specified objectives of the CDP
  - Ensure the quality, sufficiency of funds and on-time delivery of provisions/facilities according to CDP
  - Establish by appropriate investigative and analytical techniques the pre-and post-project socio-economic conditions of the affected people.