

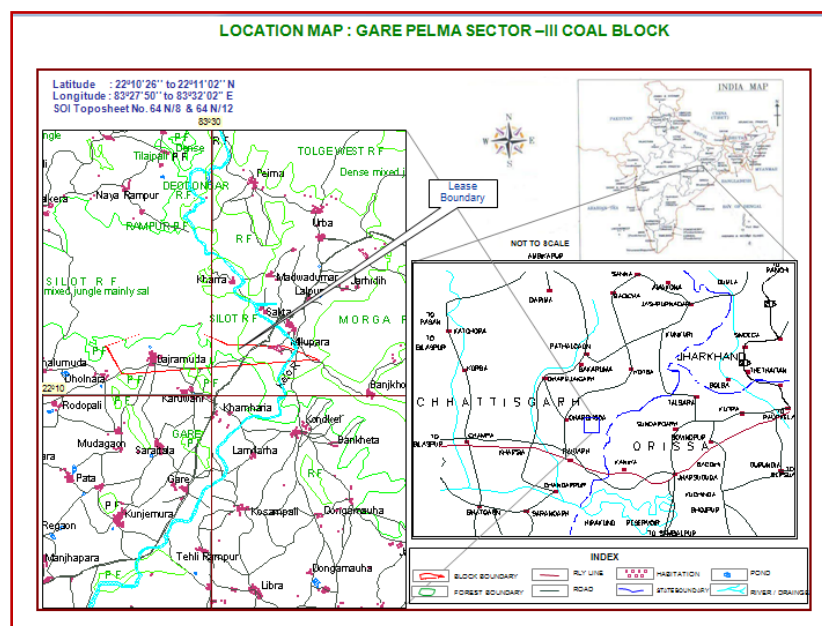
EXECUTIVE SUMMARY

1.0 INTRODUCTION : M/s Goa Industrial Development Corporation (GOA-IDC) is a Government of India undertaking. It has entered into MOU with M/s KSK Mahanadi Power Company Limited (formally known as Wardha Power Company Limited) for supply of coal from Gare-III coal block for use at its 1800 MW captive Thermal Power Plant being established at village Nariyara near Akaltara, District Champa-Jangjir Chhattisgarh. The Ministry of Coal, Govt. of India was requested by GOA-IDC to allocate Coal block for exclusive use in the aforesaid proposed power projects. Accordingly, The Ministry of Coal, vide its Letter No. 38039/14/2008-CA-I dated 12th Nov 2008., has allotted a coal block, identified as Garepelma Sector III, as captive source of coal for thermal power generation. The coal block is located at Dholnara, Bajramuda, Khamariya, Karwahi, Milupara, Tamnar tehsil, Raigarh district, Chhattisgarh State. GOA-IDC has applied for mining lease over an area of 639.1 ha and additional land required for the linked coal washery, R & R site adjacent to the mine lease area of 75.25 ha. It is proposed to develop this block by a combination of opencast and underground method with production capacity 6.5 MTPA peak and normative production capacity of 5 MTPA and to install a coal washery having a capacity of washing of coal @ 5 MTPA.

Figure 1A gives the location of proposed Gare Pelma Sector-III Coal Project along with state highways, roads, railways. The proposed mining block is a part of Mand Raigarh Coalfields. The area is located in Survey of India Toposheet No. 64 N/8 & 64 N/12 on 1 :50000 scale.

The Proposed Gare Pelma sector III coal Project & its pit head coal washery is spread over an area of 714.35 Ha. This consist of Privat land (460.99 Ha), Government Land (46.24 Ha), Reserved Forest

(165.10 Ha) and Chotte Bade Jhad ke Jungle (42.011 Ha). The proposed project



involves diversion of forest land, acquisition of private and government land, rehabilitation & resettlement of village Bajramuda, diversion of Road, and diversion of power transmission lines. As per the size and nature of the project, mandatory Environmental Clearance, Forest Clearance is essential, besides having consent to establish & operate from Chhattisgarh Environment Conservation Board.

The proposed project is a mechanised open-cast/underground coal mining project having pit head coal washery adjoining the mining lease and is classified as “**Category-A**” Mining Project by the Ministry of Environment & Forests, New Delhi as per the EIA Notification dated 14th September, 2006. An application for obtaining Environmental Clearance from Ministry of Environment & Forests (MoEF) has been made on 25th May 2009. Accordingly, the proposed project was considered by the Expert Appraisal Committee (EAC-Coal) on 21 July 2009. A detailed Terms of Reference (TOR) is prescribed by MoEF. The EIA report has been prepared following the existing guidelines of MoEF and CPCB and addresses all the TOR. The purpose of the report is to provide a complete information base of the study area in a document which is drafted in a standard format of EIA / EMP as required by the MoEF, Govt, of India. The objective of this investigation is to know the status of present environment in core as well as buffer zones of 10 km radius around the proposed Gare Pelma sector III Coal block & Pit Head Coal Washery. The scope of the study includes detailed characterization of existing status of environment in the study area with respect to various environmental components, viz. air, noise, water, land, biological and socio-economic components and other parameters of human interest.

2.0 PROJECT DETAILS : The proposed project is an integrated mechanised coal mine (Peak capacity @ 6.5 MTPA & rated capacity @ 5 MTPA) having a pit head washery of raw coal input of capacity 5 MTPA. The coal will be supplied by Goa - IDC to Thermal power plant of M/s KSK Mahanadi Power Company Limited (formally known as Wardha Power Company Limited), being set up at village Nariyara, near Akaltara, District Champa-Janjir, Chhattisgarh by rail which will be laid as per the area development plan. However, till rail transport is extended upto the area, coal shall be transported through road upto the nearest feasible rail head.

2.1.1 THE MINE: The Geological Report indicated 10 coal seams viz., seam I to X in ascending order occurring in proposed Gare Pelma Sector III. The coal seams VI to X are in-cropping and suitable for opencast mining. The coal seams I to IV at depth, will be worked by underground method. The maximum depth of seam I is 400m. The

annual rated capacity of opencast mine is presently planned for 4.0 MTPA with extractable reserve of 94.70 Mte and overall stripping ratio of 1:3.10. The underground mine target will be 1.0 MTPA. The total geological reserves are estimated as 210.20 Mte (Consisting of 141.50 Mte proved & 68.70 Mte Indicated Reserves). The corresponding Overburden has been estimated as 293.50 Mcum at an average stripping ratio of 3.10 cum/t. The grade of the coal as per the Geological Report is A to G. The weighted average quality of OCP is expected of Grade 'G' and that of UGP as 'D'.

MINING METHOD: Keeping in view of geological parameters, seam thickness & partings, it has been decided to do opencast mining from seam VI upwards. Seam V occurs in thin coal horizon within a stratigraphic height of 20-30 m, which are unworkable in most part of the block. Therefore, the seam V has not been considered for reserve estimation as well as working. The parting between seam VI and IV is 75-80 m. The average thickness of seam IV is 3.0. Therefore underground mining is envisaged from seam IV to seam I. Calendar programmes for opencast & underground are given under respective clauses above. The combined calendar programme is given here below:

TABLE-1
COMBINE PRODUCTION PROGRAMME

Year	OC Coal	UG Coal	Total (Mte)
1	0.5	-	0.5
2	1.5	-	1.5
3	3.0	-	3.0
4	4.0	0.2	4.2
5	4.0	0.5	4.5
6-10	20.0	5.0	25.0
11-15	20.0	5.0	25.0
16-20	20.0	5.0	25.0
21-25	19.0	5.0	24.0
26-30	2.7	5.0	7.7
31-40	-	10.0	10.0
41-45	-	3.7	3.7
Total	94.70	39.4	134.1

WASTE MANAGEMENT: The opencast mine is planned up to maximum 150 m depth with overall stripping ratio of 3.10 cum/t. The OB removed during initial years will be placed externally. The internal dumping will start when about 60 m space is available on quarry floor. By adopting the proposed sequence of mining, as the quarry advances, the amount of internal dump will increase as more space for the internal dumping is created. The part of waste generated from this mine i.e.

16.0Mcum) will be dumped externally over the revenue land partly inside and rest outside the block. The balance waste i.e. 277.5 Mcum OB will be dumped internally as concurrent backfilling. The concurrent back filling for opencast mine will start from 2nd year itself. Back filling will continue in quarry till end of mine-life. To arrest rain wash-off from the dumps, retaining wall would be erected around the periphery of the dumps, wherever required. The top of the dump will be terraced. The slope of the dump will be stabilized by seeding with grass.

The external dumps and back-filled quarry area shall be stabilized progressively by planting local tree-species so as to regenerate the flora & fauna in the area. Out of total quarry area of 442 Ha, 350 Ha will be utilised for back filling and the balance void in the quarry area (approx 92 ha) at the end will be converted into a water body, which will help to recharge and stabilize the water table in the neighbourhood and will benefit local population.

DRILLING AND BLASTING : Drilling & Blasting would be required only for overburden benches before excavation by shovel. Blasting pattern depends upon the nature and hardness of rock and varies from mine to mine. Blast holes will be suitably drilled to provide sufficient overburden to each shovel unit. There will not be any blasting for coal extraction as coal extraction has been proposed by surface miner. Following advantage will accrue by using surface miner and belt conveyor transportation:

- No drilling and blasting;
- Less fleet of dumper;
- Less air pollution; and
- Negligible noise pollution.

The handling capacity of the CHP has been decided to match with the production capacity of the mine. In order to meet the fluctuations of coal output from the mine due to irregularities of transport system and seasonal fluctuations, the design capacity of the CHP has been fixed at 1000TPH.

HAULAGE/TRANSPORT: Surface transport consists of transport of overburden and coal. Overburden will be transported by dumpers to respective OB dumps. Haul road has been provided for movement of dumpers. It has been planned to bring coal from coal face to surface by belt conveyor. Another set of conveyors are provided to transport coal into washing plant receiving stock yard. Belt conveyor has been envisaged for less fleet of dumper, negligible air pollution and negligible noise pollution. Loaded coal will move from washery head to Chhal road through Dholnara-Roopali-Kolam-Barkaspali-Gharghoda-Bhendra by pass to Khamaria.

2.1.2 THE COAL WASHERY: The dominant grade of coal from opencast working is G-F grade and the dominant grade of coal from underground working is D-E grade. Therefore, washery is required to upgrade the opencast coal to achieve the desired quality of coal required by power plant i.e., average 4200 K.Cal/kg GCV.

The coal washery shall be a two stage, three product Heavy Media Cyclone washery separating washed coal of Ash around 34% (GCV 4200 Kcal / kg.) The middlings of GCV around 3150 Kcal per Kg shall be used as fuels in FBC power plant. The rejects with no useful heat value shall be Backfilled in decoaled mine area or shall be disposed off as per the guidelines of MoEF.

The Coal Washery shall be environment friendly with close circuit water system comprising classifying cyclone, high frequency screen, thickener, multi roll belt press filter. The washery shall be State-Of-The-Art with modern instrumentation and PLC Controls.

2.1.3 Total cost of the proposed mine and coal washery is estimated to be about Rs.690 crores and Rs. 90 crores respectively.

The **total water requirement** for the proposed mine and coal washery will be approximately 2050 m³/day (915 m³/day for mining operation + 1000 m³/day for coal washery plus 135 m³/day for drinking purpose) and will be met from tube well and mine discharge. i.e., from worked out mine pits and rainwater collected in old mine pits at captive mines through the water supply system. The drinking water will be sourced from bore wells.

The Manpower required for operation of the opencast mine is 621 besides above about 61 persons will be deployed at Coal washery and about 1900 persons will be engaged for underground operations either directly or on contractual basis. The following activities are proposed to be outsourced:

- 1) Security: Entire security manpower is required to be arranged by outsourcing except skeleton manpower for supervision.
- 2) Welfare Facilities: like Canteen, Transport requirement, civil repair & maintenance are proposed to be outsourced. Hence only skeleton supervision manpower is provided for this purpose.
- 3) Light Vehicles: Only a few drivers are provided for Senior Executives.

Priority for employment opportunity for the local eligible person will be given during construction and operation stages of the above project.

3.0 BASELINE ENVIRONMENTAL STATUS : The total project area of the proposed Gare Pelma Sector III Coal Project & Coal Washery is considered as Core Zone while the 10 Km surrounding area of core zone is considered as Buffer Zone. Baseline environmental data was collected for all the components of environment like meteorology, air, water, noise, soil, geology, hydrogeology, flora-fauna, demographic and socio-economics, industries, places of archeological and historical importance etc. Standard guidelines prescribed by Ministry of Environment & Forests and Central Pollution Control Board. This report incorporates the baseline data generated through primary surveys for three months during March 2011 to June 2011 representing summer season.

Topography: Gare Pelma Sector III block exhibits a gently undulating topography with minor undulations. The elevation of the area varies from 377.747 m near the northern boundary in the central part, to 260 m in the eastern part near Kelo River. Gare sector III Block is generally characterized by a gently undulating topography with slope towards Kelo River in the east. However, in the area adjacent to Kelo River and in the eastern part the topography is relatively rugged. The northern, northwestern, central and east central parts of the block are covered by hills and Reserve Forests. The remaining part is mostly covered by paddy field.

Geology : The area is a part of Mand Raigarh Coalfields. The Mand-Raigarh Coalfield comprises the three fields earlier designated as Raigarh (North), Raigarh (South) and Mand River Coalfields. It is a part of the extensive spread of Lower Gondwana Formations, extending from Hasdo-Arand Coalfield through Raigarh basin to Ib River Coalfield in Sambalpur district, Orissa.

Drainage: The drainage of the area is controlled by Pajhar Nala on the west of the block and Kelo River in the east of the block which are the tributaries of River Mand. The drainage system in western part of the study area is controlled by Pajhar Nala which flows almost North to South.

Landuse of the Buffer Zone : As per census 2001 the total area estimated within 10 km radius of buffer zone (study area) around proposed coal block was 31273 Ha. (This area does not includes reserved & protected forest). The maximum area was under cultivation 67.69% (irrigated 2.08% and un-irrigated 65.61%). Followed by area under culturable waste land was 18.5%, area not available for cultivation was 8.41%. While area under forest was quite low 5.4%. The Geocoded Satellite Imagery for the study area covering 10 Km study area was procured from National Remote Sensing Agency (NRSA), Hyderabad.

Ground Water Level : Well inventory of 71 numbers of dug wells in 48 villages had been done in the core zone, buffer zone and outside buffer zone in Kelo River basin. The water level in core zone during pre-monsoon is 6.30 m to 14.10 m bgl, average being 9.00 m bgl, while during post monsoon it is 1.31 to 9.80 m bgl, average being 4.00 m bgl. In buffer zone the depth to water level in pre-monsoon varies between 5.15 to 12.10 m bgl, average being 9.00 m bgl while during post monsoon it is 0.80 to 8.00 m bgl average being 4.00 m bgl. The average water level fluctuating between two extreme seasons in core zone is 5.00 m. In buffer zone it is also 5.00 m, and 6.00 m in Barakars sandstone, and Metamorphics formations respectively.

Water Quality Monitoring: The water quality monitoring stations were selected with a view to represent the surface and ground water bodies in and around proposed lease area. There are number of seasonal nallahs and some perennial streams in the buffer zone. The stations were selected taking all these water courses into account, as per MoEF norms. A total of nine surface & eleven ground water sampling stations were monitored. The analysis of physico-chemical characteristics of the water samples one season are appended in Chapter 3 of EIA/EMP.

Ambient Air Quality Monitoring : The monitoring was carried out for 13 continuous weeks beginning from March 2011 to June 2011 as per norms stipulated by the Central Pollution Control Board Norms. To assess the base line ambient quality twelve air quality monitoring location were selected on the basis of wind direction and other meteorological parameters in core and buffer zone area.

Air Quality : The monitoring was carried out for 13 continuous weeks beginning from 4th March 2011 to 2nd June 2011 as per norms stipulated by the Central Pollution Control Board Norms. The PM₁₀ PM_{2.5} SO₂, NO_x values for all 12 stations were below the 24 hourly prescribed limit of 100 µg/m³ for Industrial, residential and other areas.

- **Particulate Matter₁₀ :** The 24 Hourly maximum concentration of PM₁₀ reported during the survey ranged from 37.2 to 50.7 µg/m³. This is lower than than the NAAQ permissible level of 100 µg/m³.
- **Particulate Matter_{2.5} :** The 24 Hourly maximum concentration of PM_{2.5} reported during the survey ranged from 13.2 to 17.6 µg/m³. This is lower than than the NAAQ permissible level of 60 µg/m³.
- **SO₂ :** The 24 Hourly maximum concentration of SO₂ reported during the survey ranged from 7.4 to 10.5 µg/m³. This is lower than than the NAAQ permissible level of 80 µg/m³.
- **NO_x :** The 24 Hourly maximum concentration of NO_x reported during the survey ranged from 8.2 to 11.8 µg/m³. This is lower than than the NAAQ permissible level of 80 µg/m³.

Noise Levels: A detailed noise survey was undertaken to study the baseline levels of noise, noise levels are in the range of 39.3-58.2 dBA at all twelve stations. These are low and well within limit prescribed for residential area.

Soil Quality : Soil samples were collected at 5 selected locations in the study area to assess the existing soil conditions around the proposed mine. Overall soils are moderately suitable for cultivation of arable crops and have moderate fertility.

Biological Environment : The core and buffer zones include the village settlements with their cultivated fields, forest areas as well as vast areas reduced to grasslands. Flora-Fauna: The detailed inventory of floral and faunal assemblage of the core and buffer zone has been prepared. The Wildlife Conservation Plan is systematically drafted and submitted to obtain approval from the Chief Wildlife Warden. Necessary allocation of funds for implantation of action plan will be made by M/s Goa IDC. The details of flora and fauna are provided in EIA/EMP. There is no ecologically sensitive areas such as Biosphere Reserves/National Parks/WL Sanctuaries/ Elephant Reserves, migratory corridors of fauna, and areas where endangered fauna and plants of medicinal and economic importance found in the 15 km area of the buffer zone.

Human Settlement and Demography : The area selected for the study constitutes 82 inhabited villages. The population is distributed among 12494 households in the study area. The 82 inhabited villages have a population of 54794 comprising of 27477 males and 27317 females. The number of females per 1000 males is 994. The overall literacy in the 82 villages of the study area was 71.17%.

Rehabilitation and Resettlement: The proposed land requirements including private and Government land is affecting 5 villages namely Dholnara, Bajarmuda, Milupara, Karwahi and Khamaria coming under Tehsil Tamnar of Raigarh District in Chhattisgarh. Of the five villages Bajarmuda is falling under core zone of the coal block and rest are in close vicinity of the coal block. Both Private and Government land will be acquired from 5 villages. The Government land belongs to Revenue Department. The details of total land under each village under both private land and government land and land under acquisition under the project is presented in Chapter 3.

Project Affected Family and Population : The definition of Project Affected Family (PAF) as per the Chhattisgarh Model R&R Policy, 2007 includes any affected person his wife/ husband minor children and aged parents, widow mother or sister and unmarried daughter / dependent on the affected person. Although some of the affected land owners may be living together in one household they will have to be

considered separate family for any entitlements. Hence the total number of titleholders and non-titleholders affected are considered as affected family. However few of them are non residents who are mainly daughters married and living in other places but having a share in their father's property and few who are settled at other places. Table 2 below gives details across the affected villages.

Table 2
Village wise number of project affected families

Sl. No.	Name of the Village	Resident Project Affected Family	Non residents Project Affected Family	Total Project Affected Family
1	Dholnara	59	23	82
2	Bajarmuda	273	16	289
3	Karwahi	49	22	71
4	Khamariya	30	10	40
5	Milupara	37	114	151
Total		448	185	633

Source : based on final R&R Report

M/s Goa IDC will provide all the benefits as per the Chhattisgarh Model R & R Policy 2007 (as amended). A detailed Rehabilitation and Resettlement Action Plan is drawn within the framework of the policy. The resettlement will be carried out as per the norms of the State Government at suitable alternate site, which will be identified in consultation with affected people and State administration.

Corporate Social Responsibility (CSR) : A detailed CSR plan is prepared by GOA-IDC which is included in Chapter 7 which provides details of CSR activities proposed. The proposed CSR activities are based on the felt needs of the area and the proponent shall implement the same in phased manner.

A systematic approach for the implementation of the peripheral area development in 5 selected villages in the buffer zone starting from the nearest village will be drawn up with the help of local community based organization & in consultation with the villagers. Assistance in the field of health and sanitation, environment conservation, water conservation, literacy, self help groups, development of infrastructure, sports and recreation will be provided in a phased manner. Company will spend on institution building in the village to be relocated, host village and 5 villages around the core zone viz. Dholnara, Bajramuda, Khamariya, Karwahi, Milupara. Institutions shall include women Self Help Group (SHG), Joint Forest Management (JFM), Cooperative for the non timber forest produce and promotion of dairies, pasture land development etc.

Risk Assessment & Disaster Management Plan : In any mining project, work safety is taken care of as per provisions in the Mines Act, the Coal Mines Regulation,

1957 and Rules framed there under. An assessment of risk at the proposed coal mine has been carried out. Inundation, fly rocks during blasting operations, risks associated with handling and use of explosives, failure of slope outside waste dump, surface fire, risks during operations of equipment and movement of vehicles has been dealt in details. The risk management plan as per the directives of competent authorities will be Implemented strictly.

4.0 ENVIRONMENT MANAGEMENT PLAN : The Environment Impact assessment for all the components of environment which are likely to be affected due to initiation of the mining activity has been carried out using standard methods and a comprehensive Environment Management Plan to mitigate the impacts are suggested. Impact assessment is carried out which is based on the proposed mining method / process technology and baseline data generated. During this process various studies were carried out through reputed & qualified scientific institutions as per the Terms of Reference and are as under;

- Report on the Flora and Fauna, Wildlife Conservation and Management Plan
- Dump Slope Stability Study
- Resettlement & Rehabilitation Action Plan
- Subsidence Prediction Report
- Study on Area Drainage, Hydrology and Hydrogeology
- Project Report on Coal Washery.

Based on the findings of these studies detailed Environment Management Plan (EMP) is given in EIA/EMP. A brief outline of EMP is given in following paragraphs;

Air Pollution Control: During the air quality monitoring and analysis, it was observed that Particulate Matter, SO₂, NO_x and CO are well within the permissible limits. The Air pollution control measures proposed to be adopted are:

- The transport of the coal from the mine to Proposed Thermal Power Plant is planned using railway network. Thus, the pollution through road transport is avoided. However, during initial phases till completion of the railway siding it is proposed to transport coal by existing road network. It is proposed to transport the excavated coal from mine pit to the Coal Handling Plant using covered belt conveyors having inbuilt water spraying arrangement. From CHP the coal will be transported to railway siding by the similar covered belt conveyors having inbuilt water spraying arrangement. The coal will be loaded in wagon by using silo with Rapid Loading System. Thus, the fugitive emissions during transport of the coal will be minimized. Coal transport roads should be metalled and black topped and regularly cleaned to prevent formation of dust from spillage coal. Wherever possible, green belt should be developed along the roadside to arrest airborne

dust movement. The wheels of the dumper shall be regularly washed. Road shall be cleaned at regular interval.

- Water spraying at regular intervals on haul roads
- Green belt will be developed along the roadside to arrest airborne dust movement.
- It is proposed to introduce wet drilling attachment in the drill machines that will considerably reduce the dust generation.
- Automatic water sprinkling system will be provided on the main haulage road and other places where dust likely to be high.
- Sprinkling of water in the loading and unloading areas.
- Biological reclamation of the inactive overburden dumps using local plant species, grasses, shrubs and legumes.

Water Pollution Control: As indicated above the mine water pumping is estimated to an average 4222 m³/ day. The industrial water requirement (2050 m³/ day) will be met from the pumped water and for drinking water requirement (135 M³/Day) bore wells will be made within the mining lease area. The balance quantity of water 2307 M³/Day will be discharged in nearby Nala after removal of suspended solids from the water. The treated water will meet the prescribed standards.

- * Settling tank of adequate capacity will be provided in series to collect the mine discharge water for settling the suspended solids.
- * The flow and the quality of pit water vary seasonally. Therefore settling tank should be able to absorb these fluctuations. Quality of the water will be monitored seasonally. The pit water must be neutral in nature and therefore necessary neutralizers may be provided to maintain the pH of the settling pond water.
- * Wash off from Mine Dumps will be controlled by constructing retaining walls of about 2 m thick and 3 m height at a distance of 100 m from the toe of the dumps. Water oozed out from the wall should be sent to setting tank before discharge into natural drains. Network of the garland drains and settling pits of sufficient width and depth to carry the storm rainwater to the setting tank will be constructed. Contour drain to arrest wash off from garland drain will be constricted at the toe of the overburden dump. The water from garland drain, contour drain will be allowed to settle in a settling pond. The setting tank should have at least 8 hr holding capacity and maximum depth of the tank could be 3m. Some precautionary measures are necessary to follow which include:
 - Series of check dams with gabion structures to be constructed at required places on overburden dump to intercept run off.
 - De-siltation of the constructed settling ponds/check dams should be done regularly to maintain its retaining capacity.
 - Drains should be constructed to channelise rainwater in loose surface area and preferably have some grass to arrest solid particles from runoff water.

Effluents generated by servicing of the vehicles mainly contain pollutants such as suspended solids (SS) and oil & grease. Provision of oil and grease trap will be made. An effective Effluent Treatment Plant for workshop effluent treatment is proposed. The oil and grease collected will be stored in leak proof containers and sold to authorized recyclers.

Noise Pollution Control: Noise should be best abated at source by choosing machinery and equipment suitably, by proper mounting of equipment & ventilation systems and by providing noise insulating enclosures or padding where practicable. A 50 m wide belt of trees of different heights should be useful to act as noise attenuator in the mining areas. Earmuffs and earplugs should be provided for those exposed to high noise levels as per statutory requirements.

Blasting Vibration Control: Coal will be excavated with the help of surface miner which avoid drilling, blasting and crushing. The coal cut by surface miner will be loaded in to tippers and will be transferred on to in pit belt conveyor. Blasting will be carried out in a periodical manner so as to minimize the impact. Drilling and Blasting in quarry should be done in accordance with the Mines Safety Act, Rules and Regulations. In order to check vibration and to keep them within set limit, delay blasting will be undertaken. Electric detonators [Short-Delay detonators] with 5 to 10 millisecond delay interval will be used.

Solid Waste Management: Rehabilitation of dump is an integral part of mining activity. Dumps are often unstable at an early stage and in the state of continuous deterioration. Therefore, effort shall be taken to minimize the soil runoff to the maximum extent of the fragile dump. The opencast mine is planned up to 150 m depth with overall average stripping ratio of 1: 3.10. Several alternatives are worked out to keep minimum external dump area. Finally after working out internal and external dumping arrangement a minimum of 45 ha land is required for external dump which will include 25 Ha inside the lease boundary and balance 20 Ha outside the mining lease. Measures to be adopted to minimize land degradation include:

- a) Backfilling of worked out pits to the original topography as far as possible followed by a biological reclamation. This will help in greening the area and increasing its aesthetic value.
- b) Proper dump and water management will be taken to prevent degradation of surrounding land.

- (i) **External Dump:** The external dump area will be located on non-coal bearing formation. The height of external dump is envisaged as 60 m above the general surface level. The total dump will be formed in two decks of 30 m each. A corridor of 100 m will be left between the toes of the external dump. The topsoil shall be

dumped separately where mining at present is not possible for future reclamation over stabilized waste dumps. A garland drain is proposed at the periphery of the external dump to control water run-off from external dumps.

- (ii) **Internal Dump:** A distance of minimum 100 m has been left open between toe of the internal dump and final edge of the quarry floor in order to facilitate possibilities of future extension of the mine on the south, if adjacent block is acquired. Back filling will be done leaving adequate distance from the central haul road, which shall be not less than the height of the dump. The bottom-most RL of internal dump is at 360m at the pit floor at the final stage, with decks of successive 30 meters leaving a 30m berm for each successive deck. Positions of mining faces, haul roads and internal dump at different stages of mine operations are as per the approved mining plan.

The height of the dump and dump slopes have been planned keeping in view the geo-mechanical and geo-technical characteristics of dump material and the dump floor inclination during different stages of mine operation. Following safety measures shall also be observed to improve the stability of OB dumps:

- After mining of coal, a layer of crushed rock, left out crushed coal and water lies on the de-coaled quarry floor- this heterogeneous mixture is termed here as interface material. This interface material covering the inclined quarry floor may be one of the major causes of any internal dump failure. Before backfilling, this interface material shall be cleaned with a dozer.
- Garland drains will be provided around the pit and the external dumps to divert the flow of water. The water collected in the garland drains will be reused for plantation activity. The design of the garland drain will be made keeping 50% safety margin over the peak sudden rainfall and maximum discharge in the area adjoining the mine site.

Land Reclamation Measures: The opencast mine is planned up to 150-m depth with overall average stripping ratio of 3.10. The total volume of OB has been estimated as 293.5 M m³. Overburden will be dumped in external as well as internal dump. The total volume of external dump has been estimated as 16 M m³ solid. Rest of the OB will be placed in internal dumps. The total volume of internal OB, i.e. the volume which will be accommodated internally by backfilling has been estimated as 277.5 Mm³. It is proposed to reclaim quarry area and external dumps at the end of the mining operations. The internal dumps will cover an area of 350 Ha besides 45 Ha of the overburden dumps. Thus, 395 Ha of the land will be biologically reclaimed in systematic phased manner. It is proposed to develop a water reservoir in an area of 92 Ha having a maximum depth of 30 m. The water reservoir so created will not only conserve the surface rain water but will act as water recharging area. This water will be used for raising the plantation during reclamation process. The water reservoir

will be systematically fenced by barbed wire having safe access. The standard method of land reclamation will be implemented. Selection of local tree species, grass and shrubs will be made in consultation with the forest department.

Green Belt Development: Besides compensatory afforestation on the equivalent land being diverted for non forest use, it is proposed to carryout plantation in systematic and phased manner. The stabilized area demarcated for the plantation will be properly fenced and plantation of the selected tree species will be carried out so that 2000 trees/ha will be planted. Maintenance of the trees will be taken for 3 years. Extensive green belt development programme will be undertaken within the mining lease and also assistance for plantation will be made to the nearby villages. It is proposed to develop a full fledged nursery having necessary infrastructure and equipments for the generation of healthy saplings. It is proposed to plant 20000 trees/year of selected tree species.

Forestry Clearance: An application for the diversion of the forest land for its non forest purpose in compliance with the Forest Conservation Act, 1960 has been made to state Government. The prior approval (Stage-I clearance) from MoEF has been issued on 11.04.2011.

Wild Life Protection and Conservation: Wildlife Conservation Plan by wildlife expert is under preparation. Guidance and consultation from Forest Department will be sought before its implementation. Provision of adequate funds will be made.

- To protect the wildlife, the mining area will be fenced properly with the wire link mesh. This will prevent inadvertent entry of animals in mine areas.
- Fire lines will be made at the boundary of lease to prevent spread of fire in the forest area. The fire lines will be regularly cleaned,
- Slat licks and water holes will be provided for animals in the forest area in consultation with the Forest Department.
- Mine management has decided to depute 3 firewatchers and 3 forest watchers in order to manage the wildlife & forest in better manner.