CHAPTER 7
ENVIRONMENTAL MANAGEMENT PLAN
This chapter describes several environmental management measures to minimize the adverse impacts of the proposed lignite mining including pollution control measures during progressive phases of mining.

7.1 General status

Panandhro lignite mine produces around 4 to 5 million MT of lignite per annum by open cast mining operations. The control of the pollution due to mining and Kachchh lignite Thermal Project is of considerable importance. Appropriate techniques have been adopted for control of pollution during lignite mining and project execution phase as well as due to transportation in the lease area. The following factors are necessary for maintaining environmental aspects important to mining operations.

7.2 Site preparation - mining activity

The clearance of site for mining involves removal of a substantial quantity of soil and debris and produce large quantities of unstable material called overburden. The leveling operations also involve the stockpiling of back fill materials by Bucket wheel excavator and conveyor belt. (Plate - 7.1). All the disturbed slopes should be stabilised before the rainy seasons. During dry weather conditions it is necessary to control the dusting associated with the excavation, leveling and transportation activities. The lignite excavation is carried out both by conventional manually and through mechanized means as discussed in earlier chapters.

7.3 Air environment

The following precautions have to be considered to check air pollution in the lignite mine area:

- Special precautions have to be taken in the lignite and overburden handling system by providing dust extraction and suppression system (Plate - 7.2).
- Water sprinkling system has to be provided throughout the mine area especially on the mine haulage carrying the lignite loaders (Plate - 7.3).
- Installing dust collection systems at the lignite transfer points and stock pile areas.
- Prompt removal of the dust from different sources by frequent watering on the haul-roads has to be carried out to reduce the dust generation.
- The dust particles during the transportation by conveyer belt system generates a particle size of around 5 to 10 microns which remain suspended in mine atmosphere for a
considerable period, hence face mask should be provided to all the workers involved in the above operations.

- Pitch roads should be constructed at least up to mine office and other important units.
- For transporting lignite, means of belt conveyors should replace the dumpers, as these are the main cause of dust generation and also generate exhaust gases (Plate -7.1).
- Proper and regular maintenance of mining equipments has to be considered.
- Tankers having a total capacity over 40,000 litters need to put for continuous sprinkling of water in each shift to suppress the dust.
- High density green cover around overburden dumps has to be carried out to reduce the fugitive dust emissions to ensure the cut in the emission.
- Progressive land reclamation using over burden dump is to be headed for fast land reclamation and land use planning (Plate -7.5).

7.3.1 Fugitive dust management

Common sources of fugitive dust include unpaved roads, aggregate storage piles, heavy vehicular movement, lignite excavation and overburden removal changing the opening of face of the lignite bearing block. The dust is generated by two basic physical phenomena;

1. Pulverization and abrasion of surface materials by application of mechanical force due to the application of heavy machinery equipment and vehicles.
2. Generation of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by high wind speeds.

The dust generated can easily be suppressed by adopting the regular sprinkling of water; preferably waste water. The treated acid mine water should be utilized for dust suppression in and around mine areas (Plate -7.4).

7.3.2 Dumping Area

The overburden removed during lignite mining operations at Panandhro is dumped at the overburden dumping sites identified within the mine area. These overburden dumps are a major source for the fugitive dust rising into the atmosphere. These need to be protected by growing green cover using the native plant species. (Plate- 7.8 b & c)
7.4 Noise Environment

The observed noise levels due to mining operation in the surrounding villages are well within tolerance limit. In fact, the neighboring villages do not experience elevated noise due to mining activity, mainly because the mining itself is quite low noise generating most of the time. However, the mining area does have high noise levels for the personal working. For this purpose strict implementation of wearing the earplugs etc. should be observed so that the work force does not suffer hearing loss and raise noise related disorder.

7.5 Water Environment

- The acid mine drainage collected and impounded in the mine area pits has to be pumped out to a storage pond for treatment. Neutralization has to be carried out by using limestone before reusing the treated water for dust suppression (Plate -7.4).
- The treated and neutralized acid mine water has to be used for plantation on the overburden dumps lying around the mine site.
- Garland drains around the mine overburden have to be provided to prevent spilling surface water from overburden areas.
- The effluent generated from GMDC colony has to be properly treated to reuse the same for plantation throughout the colony.
- The Sewage Treatment Plant (STP) has to be properly maintained to meet the standards of the regulatory bodies for the effluents.
- About 70 m$^3$/day of treated effluent can be supplied for greenbelt development by pipeline network system.

7.5.1 Equipments maintenance to reduce contamination.

- It has to be ensured that diesel powered mining vehicles are properly maintained to minimize the exhaust. Vehicle maintenance area should be located in such a manner that contamination of ground water by accidental spillage of oil does not occur.
- Combustible waste should be burnt in a controlled manner. Other wastes should be disposed off in an approved dump. Particular care is taken to ensure that the liquid waste such as acid mine drainage arising from mining operations is after neutralizing.
7.6 Reclamation of the mined areas

After completion of the lignite extraction from the mined area, land reclamation should be done considering following precautions.

- Existing topography, drainage system, water bodies, land use and residential areas.
- Direction of ground water flow.
- Sources of contamination to the ground water.
- Wind direction and velocity.
- Distance of ash disposal and overburden sites from the reclamation area.

7.6.1 Preliminary requirements for reclamation plan

The reclamation of land should take into account, the perceived land use, geology of the area, soil types and landform in the surrounding areas. Hydro geological investigations to harness fresh water and aiding the natural recharge into the ground water. Heritage location/sites both natural and manmade need to be protected and aesthetic ambiance around them shall be improved.

7.6.2 Site reclamation—general procedure

- Preparation: The first step in reclamation is to ensure that the site is cleaned up and made safe for dumping waste generated during mining (Plate - 7.6).
- Landscaping: This shall be carried out by reshaping and grading to ensure that the final landform is stable and that drainage patterns have been re-introduced, to their natural course.
- Topsoil conservation: The top soil shall be repeatedly re-leveled after the other overburden material is filled back to the mined areas. This ensures reclaiming the natural vegetation and agriculture of the region (Plate - 7.7).

7.7 Biological environment

The total process of reclamation should be completed in two phases. First phase is technical reclamation which includes backfilling of the excavation and subsoil and grading. The second phase is biological reclamation which is most important and takes three to five years.

The major issue related to biological environment associated with mining activity is land degradation leading to destruction of flora and thereby loss of habitat of associated fauna. It therefore, becomes imperative that this damage must be checked and defined measures are taken to reclaim the abandoned mining areas. Environmental management plan is aimed at reclamation.
of land i.e. treatment of land creating conditions for pulling the land to productive use i.e. agriculture, forestry or recreation and to maintain the aesthetic beauty as well as to avoid an adverse visual impact.

7.7.1 Biological reclamation

Reclamation of the mined dumps is very intricate, complicated, site specific as well as mine specific process (Plate-7.8). Establishment of vegetation on these site is generally difficult due to altered pH, variable texture, lack of organic matter fragmented rocks and many other adverse biological & toxic chemical factors. Integrated biological and mechanical practices make successful reclamation possible.

Fertile topsoil is essential for improving the mined surfaces which are devoid of organic matter. Mulching with agricultural refuse, sugarcane refuse, pulp fiber, straw etc. will alter the characteristics of the surface and will help to conserve moisture during the establishment of seedlings. Following is to be achieved during biological reclamation.

a. To re-vegetate waste land with productive and economically viable species.
b. To reduce atmospheric pollution due to dust and fumes.
c. To reduce noise levels as trees acting as noise barrier.
d. To enhance aesthetic value.

7.7.2 Selection of species

Following criteria are important before selection of any species for introduction;

a. Species for plantation should be selected on the basis of agro-ecological conditions, soil type, supportive and nutritive capacities of soil i.e. dump material.
b. Species should be indigenous fast growing, hardy should have deep and large root system and resistant to grazing.
c. The species should also have economical & social value fodder, fruit, fiber etc.
d. The selected species should be able to grow quickly and improve the surrounding soil and environment.
e. In order to check erosion, grass species should be planted as it grows fast, spreads quickly over large area, and root stalks survive under adverse condition.
f. In order to improve quality of dump leguminous plant should be planted which are important colonizers and also enrich soil due to nitrogen fixing bacteria, in their root nodules.

g. The selected tree species should be coppicing, pollarding and encouraging the growth of grasses and weeds under their canopy, besides being economically useful.

7.7.3 Post introduction monitoring:

a. Need based fertilizers and nutrients should be applied to the soil before and after sapling plantation.

b. Planted species should be protected from grazing, illegal cutting and felling and should be provided tree guard or fencing.

c. Proper irrigation system should be developed on site so that required water supply can be maintained during initial stages.

d. In order to achieve proper growth regular de-weeding, hoeing operation should be carried out.

e. The growth should be monitored of increase in height, girth and root penetration.

f. Use of bio-fertilizers such as *rhizobium* and *azotobactor* cultures will be useful to establish soil-plant-microbial ecosystem which is self sustainable.

g. The use of algae, lichens and mosses in stabilization of tailings and other overburdens accelerates the establishment of higher order plant species.

Selection of species, preparation of dump, proper plantation, irrigation facility and proper caring and monitoring will be helpful for complete restoration of ecosystem as well as economic and aesthetic value of the region.

7.8 Plantation / greenbelt within GMDC

Plantation programme is planned on the overburden and other areas within the mine site. The decoaled area is filled back, overlaid by top soil cover of about 1.5 - 2m and plantation is selected having a survival rate of nearly 60%. Different varieties of plants are planted for ensuring biodiversity and some prominent local varieties planted are; Pillu, Neem, Kharek, Goras Imli, Ram Baval, Desi Baval, Pomegranate etc (Plate -7.8).

The total area covered under green cover is about 525 ha, 480000 plants planed the survival rate of plants is over 57%.
7.8.1 Special Plantation

As a part of plantation special emphasis is given on the *Jetropha* plantation aiming to its potential to provide bio-diesel. The plantation of this which is popular as bio-diesel plant is considered ideal for such reclamation to ensure economic usage.

7.9 Rainwater Harvesting

The region is arid and receive very less rainfall (350mm) occurs. As water is a scarce commodity for the region it is appropriate to use the mine pits for rainwater collection (Plate – 7.11 c). GMDC has created two such water bodies in the river bed area. This storage of water is also recharging aquifer and the details of these water bodies are as follows:

(i) **North Pit Water Body**

- Approx. area in sq.m. - 75000
- Approx. depth in m. - 20
- Quantity of stored water - 15 L m³
- Quality of water - potable nature with 1700 TDS

Uses:
- Agriculture - Fulra village for 800 acre of land farming
- KLTP - for power generation and cooling purpose.
- Mines Road - Plantation and dust suppression
- Mines and Surrounding areas - Ground water recharge

(ii) **C-Block Water Body**

- Approx. area in sq.m. - 45000
- Approx. depth in m. - 18
- Quantity of stored water - 8 L m³

7.10 Dew Harvesting Plant

As said in previous part very less rain fall occurs in the region so the atmospheric moisture settling as dew also need to be harvested. Galvanized Iron sheet roofs & thin plastic films are effective means for collection of the water by means of naturally cooled dew condensers.

Yield of trials at Kothara (Plate - 7.10)

9 liters / m² / Season Total area 5400 m²
Efficiency of collection 90% = 5400 X 0.9 X 9 = 44000 liter
Rain water collection on this surface area = 1,000,000 liter
The data is encouraging and need to adopt the dew harvesting on larges is obligatory.

7.11 GREY WOLF PROTECTION PLAN.

The Narayan Sarovar Sanctuary hosts the grey wolf which is an endangered species. The sanctuary is in close proximity to the mining lease areas. As part of EMP, in consultation with forest officials appropriate measures are taken to help the conservation of endangered species.

The plan includes sealing of core zone, plantation on 170 Hact. land along the periphery and inside the lease area, construction of check dams, construction of water storage tanks for lean season, construction of Van Talavadi, creation of water holes having depth of three meters and gradient < 30° , Two earthen dams of 1500m³ capacity, demarcation and fencing of sanctuary, nature education programme, literature and publicity material.

7.12 POST-PROJECT ENVIRONMENT MONITORING PROGRAM & ANAGEMENT PLAN

7.12.1 Environmental management

7.12.1.1 Generation of environmental data bank
Evolving micro-environmental management plan for the project in collaboration with other agencies and consultants.

Monitoring project implementation along with environmental control measures.
Co-ordination with Ministry of Environment & Forest (MoEF), central or state pollution control board for prevention and control of pollution.

7.12.1.2 Implementation organization

The responsibility for implementing environmental management plan rests as under:

A) Corporate Level
Gujarat Mineral Development Limited, the owner of this project has already set up an environmental cell headed by a Chief General Manager at its Head Quarter. The cell provides necessary support that is required for environmental management of various projects and mines under the jurisdiction of the company.
B) Project level

The environmental activities of the project are carried out by environmental cell at project level headed by a General Manager (Env.) assisted by environment engineer under the overall control of Chief General Manager at corporate office.

The objectives of this Organization are:
1. To implement environmental control and protection measures.
2. Subsequent environmental monitoring of the efficiency of various control measures.
3. Plantation/ green belt development.
4. Land restoration.

7.12.2 Environmental monitoring and control

For effective implementation and midterm corrective measures (if required) monitoring and control of programme implementation is essential. For this purpose a time bound action programme for environmental management has been prepared.

The scope of environmental management includes plantation, surface drainage, air water and noise pollution check etc. For the purpose of land reclamation and a forestation, the project has interaction with Gujarat state forest department.

7.12.2.1 A) Air, water & noise level monitoring schedule

To check the efficiency of air, water and noise pollution control measures, environmental monitoring is carried out by external environmental auditor as per statutory guidelines at strategic locations. The monitoring report is submitted to Gujarat Pollution Control Board. Annual environmental audit report is being prepared by external environmental auditor and submitted to GPCB for audit other working mine of corporation.

In case, it is found that the pollution levels exceed the tolerance limits as fixed by the state/ central pollution control board or any other statutory body, the corrective measures are immediately taken up for redressed.

7.12.2.2 B) Health monitoring

A periodic monitoring of health of the worker and staff associated with the mining operations and other connected industrial activities is conducted for identifying occupational diseases etc. in time and initiating remedial measures.
7.12.3 Post-Project environmental monitoring

7.12.3.1 Air environment

For the lignite mine, two types of monitoring systems are proposed i.e. emission monitoring and ambient air quality monitoring systems. The ambient air quality monitoring systems are recommended for monitoring variations in ground level concentrations of particulates and gaseous pollutants while emission monitoring covers fugitive emissions generated during mining activities and vehicular movement.

A micro-processor based weather monitoring station for measuring wind speed, wind direction, ambient temperature and rainfall is recommended to be installed within the project site within the mining area.

7.12.3.2 Noise environment

Monitoring of the noise levels and exposures during mining activity is essential to assess the implementation of environmental management plan to reduce noise levels. A good quality integrated sound level meter and noise exposure meter may be procured for the same. Audiometric tests should be conducted periodically for the employees working close to mining equipments generating higher noise levels.

7.12.3.3 Water environment

Mining activities generate acid mine drainage which should be collected and stored separately through pumping techniques. This water should be properly neutralised by addition of limestone and other suitable alkali so that this treated and neutralised acid mine waters can be utilised for dust suppression through sprinkling.

The domestic waste and oil & grease generated from mine site and workshop should be collected and stored separately. This water should be properly treated and treated water can be utilized for dust suppression and green belt development.

Wastewater should be analysed regularly for the relevant parameters presented under baseline information. Analysis of influent and effluent of wastewater treatment plant is recommended. Sampling analysis of wastewater from individual treatment units for relevant parameters depending on type of treatment facility provided may be carried out once in a week.
7.12.5 Risk Assessment And Disaster Management Plan

Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine should be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. This is possible only when there is adequate safety in opencast mines. Hence mine safety is one of the most essential aspects of any working mine. Indeed, safety of the mine and the employees will be taken care of by the Mines Act 1952, which is well defined and laid down procedure for safety and is constantly monitored and supervised by Director General of Mines Safety.

7.12.5.1 Identification of Hazards

There are various factors, which can lead to disaster in mine. These hazards are as follow:

a) Slope failure
b) Overburden dump
c) Heavy machinery
d) Heavy rains & cyclonic activity

The mining activity has several disaster prone areas. As checklist, depicting likely disaster events due to the mining activity is presented in Table 7.1.

7.12.5.1.a Slope failure

If the slope angle of the benches is more than the angle of repose or if there is any geological disturbance that leads to failure of benches, which ultimately, endanger the man and machinery.

7.12.5.2.b Overburden

The high overburden dumps may cause landslides. High overburden dumps created at the quarry edge may cause sliding of the overburden dump or may cause failure of the pit slope due to excessive loading, thereby causing loss of life and property. Siltation of surface water may also cause runoff from overburden dumps.

7.12.5.3.c Effect of Haulage Truck Operation on Dump Point Stability

Operating mine haulage trucks near the crest of stockpiles and waste dumps is a potentially hazardous practice often-resulting in slope failure and dump point accident. The dump
point accident involves the fall of a haulage truck over the edge and down the front slope of the stockpile or waste dump. The practice of end dumping over the crest of the pile places the haulage truck near the edge of a marginally stable structure leaves little room for operator error.

It become evident that the complexity of the truck slope system could not adequately be represented through conventional slope stability analyses. Conventional two-dimensional methods are useful in determining the overall stability of a slope under its own weight or by an externally applied constant load. They are not, however, useful in modeling localized three-dimensional failures on what would otherwise be considered a stable slope. A technique was required that would model these local three-dimensional failures, and which would consider the dynamic forces generated by operating haulage trucks. Utilizing the kinetic method of limit analysis, interaction between haulage truck operation and slope stability are analyzed. The analysis is based on the following fundamental assumptions:

1. The slope is stable under its own weight.
2. The material by which the slope is built is homogeneous, isotropic and dry or only slightly wet.
3. The slope extends beyond the failure region induced by the haulage truck, with the upper surface being horizontal.
4. The slope failure is induced by weight of the truck transmitted through the rear axle.
5. The slope has consistent slope angle from the base of the dump of the crest.

The method determines an admissible track weight (upper bound value) for varying distances from the slope edge. Input parameters are the material strength, slope geometry and initial forces induced by vehicle tracking. This method can be utilized to assist in determination of safe operating distances for a haulage truck from slope edge, the development of vehicle operating procedures and the admissible weight for static concentrated loading near the crest of an otherwise stable slope.

7.12.5.4.d Measures to prevent the danger of overburden

1) A sturdy stonewall should be built around the toe of each active dump at a distance of about 50 m from the toe.
2) To prevent the failure of overburden slopes, especially during rainy season, following precautions need to be taken against this hazard:
i) Proper terracing of the dump slope, with maximum bench height of 30 meters.

ii) In flat areas where the dumping operations have come to an end, the slope angle should be flattened by about $5^\circ$ lower than the angle of repose, which varies from site to site, but it is generally expected to be around $25^\circ$.

3) Planting vegetation as early as possible over the overburden dump slopes.

4) The drainage channels along the overburden dump to provide additional protection.

5) While doing this, a distance of over 15 m should be left between the overburden dump and the bench.

6) When two or more trucks are being delivered at the same time, they should mention at least two trucks.

7.12.5.5.e Measures to prevent truck/dumper accidents

1) All transportation within the main working should be carried out directly under the supervision and control of the management.

2) The vehicles must be maintained in good repairs and checked thoroughly at least once a week by the competent person authorized for the purpose by the Management.

3) Road signs should be provided at each and every turning point especially for the guidance of the drivers at night.

4) To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of lorries should as far as possible be made man free, and.

5) A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.

6) Haul trucks should be oriented essentially perpendicular to the bream, while unloading.

7) Generally, oversize rocks should be dealt with in the pit by secondary blasting. However, for haul trucks at the dump with such oversize materials, the following recommendations are given. Load consisting of large rocks must not be over the edge. This is unsafe and may damage equipment. Such load must be inside and perched over the edge.
8) Dumping of overburden or waste material by dumpers and dozers should follow certain general precautions.

7.12.5.6.f Dozer procedure on dump

1. Dozers are used on the dump to maintain the dump surface and the safety berm and to push material over the edge as required. As and when required one or more load may be depend short of the crest to provide materials for building and maintenance of the berm or the dump surface and grade.

2. Dump material may vary considerably in its durability and strength. Material with a high constant of waste particle or material, which deteriorates over time, may contribute to a variety of problems such as permeability due to breakdown in gain size with resultant buildup at pure water and lower shear strength. These could result in reduced stability.

Overburden soil should be excluded from main rock dumps, as it will hinder drainage and introduce zones of lower shear strength. Overburden should be placed in specifically designated and designed dumps or stockpile sites. If it is not possible to place overburden soil in specifically designed dumps, it may be mixed into rock dumps. The intent is to mix it, is appropriate properties such that the fine-grained material can be accommodated in the voids between coarser rock particles without significant effect on the dump shear strength parameters. The soil material must be mixed with the rock to one part of soil in a ratio of not less than ten parts of rock to one parts of soil.

7.12.5.7.g Cyclonic activity

The area is not regularly visited by cyclonic activity, however, it occur with a periodicity of five to six years. The low pressure generally remains in Arabic Sea but there are commas under its influence and because of that medium to heavy rains do occur.

To mitigate these, close liaison with district administration would be kept for the movement of cyclone and as soon as it approaches danger zone the men and machineries should be withdrawn.

Since a natural drain named Moti passes through lease and is proposed to be diverted. Therefore during the course of planning and implementation of diversion this aspect would be kept in the mined, so that no major disaster occurs. Importantly there is no habitat down the line of river in lease area and place adjacent to it. Also major disaster on any habitat is visualized.
7.12.5.8.h Fire During mining of lignite, in the above lignite there is carbonaceous shale, which contains sulphur, contact with air it gets fire, carbonaceous shale dumped in over burden dump.

Above carbonaceous shale, waste material dump. But still in some portion carbonaceous shale contact with air gets fire, (Plate -7.9 a) which are controlled by water sprinkling on working phase & over burden dump, in the mine to reduce spontaneous ignition fires, (Plate -7.9 b)

The mining activity consumes a large quantity of diesel and oil. The risk of fire may always be there in stores.

To prevent this, fire extinguishers and other fire fighting equipments would always be available at nearest place and persons working in the area would be trained to handle them properly

Table- 7.1 Check List for Likely Disaster in Open – Cast Mines.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activities</th>
<th>Human Risk</th>
<th>Ecological Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Severe</td>
<td>Non – severe</td>
</tr>
<tr>
<td>1</td>
<td>Extraction of Ore</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Removal of Overburden and Storage</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Transportation of Ore on Haul Road</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Use of Machinery</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

7.13 Socio economic management

Environment is a whole complex of physical, social, economic, cultural and aesthetic dimensions which affects individuals, communities and ultimately determines their forms, characters, relationships and survivals. As such it becomes imperative to integrate the components of socio-economic environment in impact assessment study related to environmental conservation, protection and management.

The social environment refers to demographic structure of the area incorporating population dynamics, infrastructure resource base and health status of the community, while economic environment refers to land utilization pattern, land values, employment generation, industrial development and sustainability of the project in financial terms. Aesthetic environment refers to scenic value of the area, tourist attraction, forest, wildlife, historic and cultural
monuments.

Panandhro mine lease area is 1719 hectares with total lignite bearing area 850 hectares. Average annual lignite production is 4 to 5 million MT. The villages surrounding the mine lease area are Fulra, Khanot, Panandhro, Baiyava, Umarsar, Mindhiari, Subhaspar, Dhareshi.

Infrastructure resource base in villages under the study area is very poor. Approach road in most of the villages are by katchha road. Infrastructural facilities are well developed in Panandhro such as, Dayapar, Subhashpar Panandhro road, as well as abridge across the Kali River. Infrastructure facilities were developed by G.M.D.C and they play a very significant role in the socio-economic status of the Kachchh district.

Mining is a labour intensive industry and involve a large number of people in various activities like mining, loading, unloading, transportation, construction etc. Mining is a major sector providing employment opportunities to the local population. At present mining is being done in three shifts. It is revealed that about 28.9 % of the total population are found to be engaged in mining activity. At present about 1000 families are dependant for their existence on the mining activities. About 500 local people are also working with contractors of G.M.D.C.

Transportation, trade and commerce industries are important sector associated with mining. About 35 million tonnes of the lignite is transported and 1200 to 1500 trucks are being loaded every day. Presently 1514 mazdoor i.e. labourers are engaged in this activity. Other activities related to transportation are hotelling, truck workshop, tyre repairing, petrol pumps etc. It is estimated that 7000 families are dependant on above mentioned activities. About 3.6 & 5.4% population of the study area are engaged in transportation, trade and commerce.

Based on the discussion held with number of respondents from each village it is concluded that, there is no adverse impact on people due to the project. Overall positive impacts are due to increased infrastructure facilities, education, employment, health & medical facilities. The standard of living has increased due to above mentioned improvements. The quality of life has improved and satisfactory through out the villages surveyed. Overall opinion of people about the project is favorable.
Plate 7.1: utilization of bucket wheel excavator and conveyor belt for reclamation of mine pit.

Plate 7.2: water sprinkling on roads in the mine area for suppressing the dust.

Plate 7.3: Closeup of water sprinkling on roads in the mine area.

Plate 7.4: Use of treated acid mine for water sprinkling on roads & plantation area.

Plate 7.5: Panoramic view of the plantation area on the backfilled mines.
Plate 7.6: Preparation for plantation in the back filling area of the mines.

Plate 7.7: Top soil collected for plantation.

Plate 7.8: Well spaced Plantation over the dumps & reclaimed area. (b& c) close up of Native dates plants, Tamarind plantation

Plate 7.9: Overburden dump with sulfur content and (b) spontaneous fire being extinguished during mining.
Plate 7.10: Dew water harvesting at kothara by GMDC.

Plate 7.11: (a) Happy villagers at GMDC constructed pond at Fulra (b) a pump house (c) Water harvesting pond in mines (d) Modern Higher education building.