CHAPTER 8

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS
The word lignite is derived from **self ignite**. Sulphur in lignite causes self-ignition of lignite when exposed to oxygen for longer time.

In an area of 8.3 sq. km nearly 94 million tonnes of lignite have been proved with lignite to overburden ratio ranging from 1:2 to 1:12. The average thickness of overburden is 30.77 m. Out of the total lignite, nearly 83 million tonnes of lignite constitute seams with thickness more than one meter and the lignite to overburden ratio ranges between 1:2 and 1:12. The average thickness of overburden is 29.45 m. The net calorific value is higher (averaging 3500 kCal/kg) and the moisture content is lower (39% as on received basis) than the other known lignite deposits in India.

The sulphur content, especially the organically combined sulphur and the inorganic constituents of lignite ash cause corrosion and fouling problems. The overburden consists of soft formations. Consequently heavy blasting in overburden, which normally poses a major problem and constitutes considerable expenditure in mining, can be avoided.

The overburden consists of soft formations. Consequently heavy blasting removal of overburden was not needed which normally poses a major problem and constitutes considerable expenditure in mining.

**8.1 ENVIRONMENTAL IMPACTS OF LIGNITE MINING**

In general any kind of opencast mining wreaks untold havoc on the area and its geography, disturbing rivers, canals and other water bodies. Mining also has a detrimental effect on local vegetation. The excavated material is dumped covering huge productive tracts. These overburden dumps then erode into fertile lands making them unproductive, silt-up live water bodies etc. The sulphur contained in the lignite is held responsible for sulphur dioxide emissions leading to acid rain. The influx of untreated acid mine drainage into streams can severely degrade both habitat and water quality often producing an environment devoid of most aquatic life and unfit for desired uses. The severity and extent of damage depends upon a variety of factors including the frequency, volume and chemistry of the drainage and the size and buffering capacity of the receiving stream.

Dust is generated due to open cast mining and movement of heavy vehicles and machinery. Operations of heavy earth moving machinery generate lot of low frequency noise pollution.
8.1.1 Leading producers of lignite

The mention of the following coal and lignite fields and the connected. Thermal power stations and plaus points. would not be out of place in the context of the development and utilisation of Panandhro lignite, as some of them have similar environments and problems.

(a) Wales point power station, New South Wales, Australia
(b) Morwell lignite field and Morwell and Hazdood power station, Victoria, Australia.
(c) Angle Soa lignite field and power station, Anglesea Victoria, Australia.
(d) Krabi lignite field and thermal power station krabi, Thailand.
(e) North Dakota lignite fields and thermal power station, North Dakota, U.S.A.

In Russia similar environments and conditions exist in far away lignite fields as in Kachchh,

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Considering the past damages and present changes the impact of lignite mining at Panandhro on the environment has been reviewed. Measures to minimize the ill effects of lignite mining like dust and noise emissions, water contamination and resettlements for future have been suggested. On the basis of past damages, two main areas of concern have been identified – i) to recultivate the old outside dumps which can be carried out with reasonable efforts and costs and ii) to extinguish the smoldering mine fires which cause environmental problems (air pollution), safety problems in the mines and an economic damage to the deposit.
8.2 Environmental issues
The major issues concerning the open cast lignite mines are Lignite fires, dumps, Recultivation, Water pollution, Noise, Dust, and Industrial fog.

8.3 Solid waste
The amount of waste material generated by open cast mining activities is far more than that of any other industrial sector. Waste constitutes about ~50-80 percent of the material extracted from the mine. Much of waste material is returned, and much of the disturbed land is restored through backfilling. The environmental impact of solid waste from mining is worse. GMDC has been mindful of potential liability from non-regulatory directions, including damage awards, citizen environmental lawsuits, unfavorable publicity, and the rest of the panoply of non-regulatory motivators. Therefore environmental norms are strictly abides by.

Major particulate pollution (fly ash and fugitive dust) problem in Panandhro area is due to lignite mining and lignite-based power KLTP station. Knowledge of source and distribution pattern of airborne particulate matter into size fractions is important for examining the effects of particulate pollution.

Data of airborne particle concentration measurements is useful to assess the air pollution levels based on national and international air quality standards. In this study an attempt has been made to investigate the particle size distribution of fly ash and fugitive dust in mining and power station operations area. Total Suspended Particulates (TSP) and particulate matter with an aerodynamic diameter l<10μm (PM10) were measured quantitatively. These measurements were gathered from ten monitoring stations located in the greater area of interest. Spatial, temporal variation and trend were analyzed for the last seven years. Furthermore, the geographical variation of PM10 -TSP correlation and PM10/TSP ratio are investigated and compared to those in the literature. The analysis has indicated that a complex system of sources and meteorological conditions modulate the particulate pollution of the Panandhro area.

8.4 Conclusions and Recommendations
A lignite deposit which occurs over an area of 8.2 km², certainly warrants exploitation by present day standards. A detailed mining report should be prepared and the unit cost of
mining lignite should be determined. Most people consider electricity a basic need, and would justify any scale of expansion. The real environmental and human health cost involved right from stage fuel is mined to the time electricity becomes available to us at the flick of a switch is never realized and hence should be worked out unbiased.

Before the commencement of mining, hydrological tests pertaining to the existing artisan conditions were carried and details evaluated.

Soil mechanics studies on overburden material were conducted for better planning for overburden dump and back filling.

As raw lignite can not be transported safely and economically over longer distances, consuming units may be located as near as possible to the lignite field. This would reduce the aerial extent of impact on air.

Two big rivers viz. Korawadi River and Kali River which drain storm water during monsoon period can be effectively used as surface and subsurface water in the area is either scarce or unsuitable.

There would be no problem connected with rehabilitation in the area as no village is affected and as there are no fertile lands in the area.

Korawadi River, which act only as flood channels and pass through the lignite field, which was diverted, is now redverted to its original position in consultation with the State Irrigation department.

A part of the initial excavated overburden has been effectively and purposefully utilized for damming of the rivers to form big surface reservoirs in up stream directions, at Sanandhro. During the diversion of Korawadi River, Fulra dam which is a dry reservoir at present has been considered in the larger interest. Small meteorological stations were erected and maintained at panandhro mine and KLTPS at Panandhro.

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8.5 AIR ENVIRONMENT

Keeping in view the nature and magnitude of pollution generated through mining operations, an area of 10 km radius from the exterior boundaries of lignite mine was covered
for the purpose of comprehensive environmental impact assessment. To establish the existing baseline air quality status of the air basin, Ambient Air Quality Monitoring (AAQM) nine locations were selected in different directions of the mine site. The meteorological data collected for November, December and January months shows a predominant wind flowing from ENE and NE to WSW and SW. The range of wind velocity is 3.6 to 72 km/h. Suspended Particular Matter (SPM), Respirable Particular Matter (RPM), Sulphur dioxide (SO2) and Oxides of Nitrogen (NOx) were identified as significant pollutants for air quality monitoring. Dust: Dust generation (SPM) due to mining operations and lignite transportation within the mine area are the major air pollution contributors. Around 1400 trucks (16 tonnes) loaded with lignite, transport the material from different mine pit locations. The speed of these vehicles is generally 20 kmph and the silt content of the haul roads is around 8%. Generally all the transportation trucks carrying the lignite are 6 wheeler trucks. The dust emission rate calculated for the vehicular movement (line sources) is in the range of 2.1 x 10gm/sec./m to 8.0 x 10gm/sec./m. The line source modeling results show that the maximum predicted fugitive dust concentration due to vehicular movement exists within the mine boundary only and not dispersed outside mining lease boundary. Narayan Sarovar Wildlife Sanctuary (NSWS) of Kachchh is located about 2.5 km south of the Panandhro lignite mine lease boundary and KLTP at Panandhro are also situated south of the mine lease boundary and adjacent to the mine lease. Panandhro village is located west of the mine and Khanot village is located to southeast at a distance of 1km from the mine boundary. Therefore NSWS, Panandhro, Khanot and other villages are located safely away from the potential air pollution area due to mining and KLTP at Panandhro. KLTP emissions, on account of their geographic position with respect to the prevalent wind direction.

8.6 NOISE ENVIRONMENT

The noise generated due to mining operations and movement of heavy equipments and vehicles, within the mining area and in the adjoining villages within the 10 km radius are in the range of 44.3 dB(A) to 53.7 dB(A) during winter season.

8.7 NOISE DUE TO VEHICULAR TRAFFIC

The traffic density in the adjoining villages surrounding the lignite mine site is low. The ambient noise levels in the surrounding villages of the mine site vary from 44.3 to 53.7
dB(A), highest being at Panandhro 53.7, followed by Umarsar 51.2, Fulra 49.3, Dhareshi and Koriani 48.3, Mindhiari 47.7, Akri Mines 46.6, Khanot 45.8, Baiyavo 44.6 and Subhashpar 44.3. Noise from Mining Machinery varies from 55 dB(A) to 80 dB(A). The CPCB standards for industrial and residential areas are 75 dB(A) and 55 dB(A) respectively during day time and 70 dB(A) and 45 dB(A) respectively during night time.

From the above, it is evident that noise levels in the residential areas are within limits but the noise from some of mining machinery is slightly above the prescribed upper limits.

8.8 Water environment

Acidification is the most common water quality problem in ponds/lakes created from open cast lignite mines. Aeration of aquifers and dump materials from mining activities lead to oxidation of pyrite. Pyrite oxidation products are stored in pore water, minerals and at the exchange complexes of the aquifers and dump sediments. Rainfall runoff transports sediments on the dump slope into the ponds. The acid mine drainage directly affects the ground water as well as surface water quality. Being highly acidic in nature, heavy metals get dissolved in it and are carried away to receiving water bodies. It is a unique problem as acid generation and discharge may continue to occur long after the mining activity has ceased.

Apart from this, the sulphur oxides released into air, during mining as well as from mine dumps, combine with water in the air and result in acid rain. However, it is not an acute problem due to scant and short spell of rains in Kachchh.

8.8.1 Ground water quality

Kali River flows in the west direction of the mine lease boundary. KLTP at Panandhro. ash pond is located adjacent to the southern boundary of the mine site. The overflow of the ash pond, flows towards the Kali River due to natural gradient. A number of surface drains are observed along the Dayapar – Panandhro road which is to the south of mine lease. Around seven surface water samples from Kali River and around five samples from natural drains flowing towards Kali River were collected and analysed for detailed physico-chemical parameters. Water samples from five natural ponds existing within the mine as well as surrounding areas of the site were also collected for characterization. In addition, five samples from different villages were collected for ground water quality.
Kali River is flowing from south to north along the western boundary of the mine site. The river water is contaminated due to the natural drains joining at various locations along the course of the river. The same river water enters the mine site near ‘C’ block area and flows towards north. The quality of Kali River water along the different stretches has been studied. There are few rain water storage ponds within the mine site and the water is mainly used for dust suppression as well as to supply the water for agricultural purposes to nearby villages.

Korawadi River flows from east to west along the middle part of the mine lease area and joins Kali River in the west central part of the mine lease. Downstream of the Sanandhro Dam before the release of discharge of KLTP ash dyke, the pH of water is 7.4. After the confluence of discharge from KLTP ash dyke pH is 7.7. pH is 7.8 before the confluence of Korawadi River and 6.4 in the immediate downstream side of the confluence. pH of pond-1 in the eastern part of Korawadi River and in pond-2 in the central part of Korawadi River are 7.3 and 6.3 respectively. TDS of Sanandhro Reservoir is only 210. Downstream of the Sanandhro Dam before the release of discharge of KLTP ash dyke, the TDS of water is 23400 After the confluence of discharge from KLTP ash dyke pH is 25000. TDS is 24900 before the confluence of Korawadi River and 14050 in the immediate downstream side of the confluence. TDS of pond-1 in the eastern part of Korawadi River and in pond-2 in the central part of Korawadi River are 1150 and 1178 respectively.

EC of Sanandhro Reservoir is only 0.44. Downstream of the Sanandhro Dam before the release of discharge of KLTP ash dyke, the EC of water is 38.3 After the confluence of discharge from KLTP ash dyke EC is 40.6. EC is 36.9 before the confluence of Korawadi River and 24.1 in the immediate downstream side of the confluence. EC of pond-1 in the eastern part of Korawadi River and in pond-2 in the central part of Korawadi River are 2.28 and 2.33 respectively.

Alkalinity of Sanandhro Reservoir is 110. Downstream of the Sanandhro Dam before the release of discharge of KLTP ash dyke, the alkalinity of water is 100 After the confluence of discharge from KLTP ash dyke Alkalinity is 140. Alkalinity is 35 before the confluence of Korawadi River and 0 in the immediate downstream side of the confluence. Alkalinity of pond-1 in the eastern part of Korawadi River and in pond-2 in the central part of Korawadi River are 30 each. The acid mine water generated during the lignite mine activity is stored as mine stored water within the mine site and is generally neutralized with the limestone (from

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overburden and interburden) before using for dust suppression and greenbelt development. The quality of natural effluent drains joining the Kali River was analysed for various physico-chemical parameters.

8.8.2 Natural drain effluent sample results

Natural drain samples were collected from five locations namely KLTP ash dyke, and to its south three more samples and one sample from Kali River. The pH at these locations is seen to diminish from 8.5 to 7.4 towards south and 6.8 in the Kali River.

8.8.3 Availability and wastewater

Source of water supply for general purpose for 4500 persons which include the families of all the employees residing in the township is through a dam which is situated at a distance of approximately 6 km from the colony. Water is continuously pumped from this dam for a period of 18 to 20 hours per day. Potable water is made available in the colony through ground water sources. There are 859 residential houses within the campus of the township. The total average quantity of water consumed in the colony is 420 m$^3$/day. 1500 workers are employed in the Panandhro lignite mine. The drinking water requirement in the mine is 50.0 m$^3$/day including all common facilities. This water requirement is met through groundwater which is brought from a near by place through tankers. Approximately 800 m$^3$/day of water is used for dust trapping operation in mining area. Source of water used for this purpose is through seepage water exposed during mining activities. Reverse Osmosis plant has been in operation for removal of salts to make it potable.

8.9 Soil analysis

Six soil samples were collected from different villages surrounding the mining site for physico-chemical characterisation. Two samples were collected near Khanot village - one (Khanot-1) from the agricultural fields and the other (Khanot-2) is from soil, behind the GEB power plant. The bulk density of these samples were in the range of 1.32 to 1.58 g/cc and these soils are moderately porous (34 to 41%). The chemical properties of 1:2 soil water extract results shows that pH is in the range of 7.2 to 8.2 and EC is in the range of 0.36 to 1.54 mS/cm. The Khanot 2 soil sample shows a EC of 70.1 mS/cm with high Ca$^{++}$, Mg$^{++}$ and Na$^+$.
concentrations. The chloride of this sample also shows a higher concentration of 1087 meq/100gm. The sample collected from Khanot-2 location shows an Exchangeable Sodium Percentage (ESP) of 66.7 which is very high as compared to the permissible limit of 15%. All other soil samples were in the range of 6.5 to 12.77 % which are within the permissible limit.

8.10 Environmental impacts and risks

In and around mine area, the ground water occurs under confined conditions about 15m to 60m below ground level (bgl) in Deccan Trap and Tertiary sediments. It occurs under water table conditions in Quaternary deposits and Deccan traps from 5.0 to 20 m bgl. The ground water levels are alarmingly reducing in and around mine area due to over-drafting of ground water for the mining and power house (17020 m$^3$/day) and also for agriculture in other parts of the area. The area receives scanty rainfall. The saline water intrusions also observed along the coastal areas. The groundwater samples have been collected from the mine and other parts of the area and analysed for its quality.

Results of the study and its trace element data were compared with standard quality for drinking water. The data shows high TDS 200 to 14122 ppm (1500 ppm), TH 90-580 ppm (100 ppm) and high Trace elements Pb 0.36 ppm, Ni 0.15 ppm and Co 0.11 ppm (0.1 ppm), Cd 0.02 ppm (0.01 ppm), Fe 860 ppm (1.0 ppm) and Mn 1.3 ppm (0.5 ppm).

The above data indicates that water quality has deteriorated considerably in the deeper aquifer wells as compared to shallow wells. This may be due to over-drafting and contamination of deeper brackish water influx into these areas in mine as well as other parts of the area. In general the quality of ground water in Tertiary and along the coastal areas is mostly brackish except along rivers fed by local dam waters. Whereas the waters in Deccan Traps are good but at places the deeper waters contain more TDS and iron, which makes this water unfit for domestic use.

8.11 Socio-economic environment

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 term. The aesthetic environment refers to scenic value of the area, tourist attraction, forest, wildlife, historic and cultural monuments.

8.11.1 Topography and demographic details

Topography of the region is gentle to undulating and the lignite field represents valley surrounded by semi circular hill ranges composed of traps. Korawadi & Kali rivers flowing through the field mostly remain dry throughout the year except during monsoon. Climate of the region is semi-arid type. Extreme climates are experienced in summer and winter. Rainfall is extremely scanty and is active from June to September with annual average rainfall of 335 mm.

There are total 18 villages under the study area, with 2372 households. Villages Akari and Malda registered lowest number of 9 households while Panandhro registered maximum number of 1259 households followed by Koriyani with 219. Population is thinly distributed in villages due to lack of facilities as well as communicational and topographical features. Population varies between a minimum of 39 persons at Akari and 57 persons at Malda (as per the census of 1991) to a maximum of 4925 persons at Panandhro. The predominant population of the study area consist of Hindus, followed by Muslims. Population of schedule caste and schedule tribe varied between 2.5 to 30.3% and 4.6 to 10.5% population of the total respectively. Sex ratio is nearly equal in all villages and literacy rate was very poor at the time of commencement of the mine. Demographic details have been studied.

8.11.2 Infrastructure resource base

Infrastructure resource base in villages under the study area was very poor before the lignite project. Now approach road in most of the villages are by kuchha road. Infrastructural facilities are well developed in Panandhro such as, Dayapar, Subhashpar Panandhro road, as well as bridge across the river Kali. Similarly resurfacing of the Dayapar Panandhro section, and Nakhatrana-Narayan Sarovar Road, widening of Bhuj-Dayapar-Subhaspar-Panandhro road etc. was carried out by GMDC It revealed that infrastructure facilities developed by GMDC played a very significant role in the socio-economic status of the Kachchh district.

Due to scarcity of drinking water in the area, water supply to most of the villages is through World Bank aided tanker Scheme (WBS). Tankers supply drinking water twice a
Other sources of drinking water are Korawadi River and Kali River as well as through construction of small reservoirs like Godhatad. GMDC supplies drinking water by tankers to Panandhro. Besides this GMDC has undertaken restoration, repairs, deepening and widening of local ponds in different villages. Electricity is utilized both for domestic and irrigation purposes. Though most of the villages are electrified power supply was not continuous except at Panandhro. Now with the introduction of State Government’s JyotiGram scheme it is uninterrupted power supply in the villages. Education facility up to primary level is available in most of the villages. Basic facilities are now available in all villages under the study area.

Medical facilities include Community Health Centre, Primary Health Centre, Maternity and Child Welfare Centre, etc. All these facilities are available at Panandhro. The major townships under the study area are Panandhro, Dayapar, Koriyani and Goduli.

8.11.3 Economy and employment pattern

Economy of the study area was found to be completely dependent on mining, agriculture and related activities. A total number of 985 persons from surrounding 12 villages of the mining site are employed by GMDC in various cadres other than labourers. It is estimated that Rs. 6423.5 Lakhs per month is incurred towards wages by GMDC.

Mining is a labour intensive industry and involves 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. 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 GMDC.

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 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.

Agriculture and related activities is another sector providing employment to local population. Groundnut, bajra, and jowar are the major crops and agriculture extends up to
November after monsoon season. About 24% of the total population is engaged in agriculture as cultivators, while 16.3% are agriculture labourers. Animal husbandry i.e. milk vending is a traditional occupation of the Rabari community. Cattle population of the region is estimated to be 31257. The Kakrag and Kundhi breed of cow and buffalo respectively are popular high milk yielding variety. About 5.6% of the total population is engaged in animal husbandry.

8.11.4 Socio-economic survey

A survey pertaining to the subjective analysis of the socio-economic indicators to assess the perception of the inhabitants in the study area as well as the project was undertaken. This in general also reflects the ‘Quality of Life’ in this region. The indicators refer to housing, occupation, education, health status, availability of fuel, water supply, sanitation and transportation. Besides this, expectations and aspirations of the people from the project were also studied.

The survey was conducted with the help of a pre-determined set of questionnaire involving a representative population of adult males and females within the study area.

8.11.5 Project awareness

Amongst the respondents awareness about the project is 100%. As good as 50-98% respondent opined that the project is the major source of employment in the region. 70% respondent feels that project is the major source of employment in the region. Employment opportunities further increased due to development in other sectors such as, transportation, automobile, trade and commerce associated with mining.

Improvement in health and medical facilities are envisaged by 58.6-80% of the respondent owing to the medical facilities provided by GMDC. This includes hospital at Panandhro and availability of Mobile Ambulance Dispensary. Besides this, special medical camps like Family Planning, Eye treatment, Malaria treatment, Blood Donation Camp etc. are organised by GMDC periodically.

About 73.5% respondent expressed their happiness over improvement in transportation facilities due to construction of roads such as, Dayapar-Subhashpar-Panandhro Road, Nakhatrana-Narayan Sarovar Road, and widening of Bhuj-Dayapar-Subhashpar-Panandhro Road, bridge across River Kali, and development of Koteshwar jetty

Overall opinion of people about the project is favourable. Quality of life : In the
present study an exercise has been carried out to assess the Quality of Life (QOL) in the villages surveyed. The concept and the particulars of the study are:

The Socio-economic indicators used for QOL assessment are i) Employment and working condition, Income; ii) Housing; iii) Food; iv) Clothing; v) Water supply and sanitation; vi) Health; vii) Energy; viii) Transportation and Communication; ix) Education; x) Environment and Pollution; xi) Recreation; xii) Social security and xiii) Human Rights.

On the basis of discussions 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 is found to be improved and satisfactory through out all the villages surveyed.

8.12 Welfare activities for employees by GMDC

Presently 985 persons from 12 villages surrounding Panandhro are employed by Gujarat Mineral Development Corporation and 1000 families are directly dependent on it for their survival. Welfare facilities for GMDC employees includes i) Free subsidized housing facilities by providing A, B, C and D type quarters to all employees of the corporation depending on gradation; ii) Water supply free of cost; iii) Electricity supplied at subsidised rate; iv) Free medical services available with X-ray facility and laboratory; v) Subsidised staff mess; vi) Free uniform, shoes, rain coat, soaps etc. are supplied periodically to all employees and labourers; vii) Cash awards to children of employees who secure more than 60% marks in their exams ranging from Rs. 30 for first standard to Rs. 150 for graduates; viii) Subsidised cooperative society on no loss-no profit basis; ix) Free milk and snacks to the children of miners; x) Subsidised canteen facilities on no loss-no profit basis; xi) Free school bus service for the children of the employees attending Dayapar High School; xii) Free Vocational training Centre operated for staff and labourers; xiii) Create education facility in the colony both in English & Gujarati medium; ixv) Creche & ret shelter facilities for mine workers; xv) Game facilities for Cricket, Volley Ball, Table Tennis, with all accessories xv) Cultural and
Sports activities organised every year xvi) Shopping complex with Post office and bank; xvii) Medical expenses reimbursement up to Rs 3300/-year; xviii) Education allowances to employees for their children studying in school and colleges and xiv) Group insurance scheme for all employees of the corporation.

8.12.1 Socio-economic assistance to Kachchh by GMDC: GMDC has been operating in Kachchh district for last two decades particularly in mining of lignite. It has emerged as a major center in this region. In addition to mining activity, steps are also taken for providing basic support to local community, development of region as well as protection of the environment.

8.12.2 Contribution to state & local economy: Corporation pays sales tax, royalty and turn over tax to the State Government. Royalty at the rate of Rs. 2.5 per ton of lignite and sales tax as 25% of the basic price of the lignite.

8.12.3 Annual wages payment: About Rs. 6,42,38,352 are being paid as wages to the employees of Lignite project, Panandhro. 50% of this amount remains in Kachchh district. Also about 500 local workmen are employed by the contractors to work with GMDC who is paying more than Rs. one crore per year to them as salary.

8.12.4 Benefits to social organisations of Kachchh district: Direct donations of rupees 3 Crores by GMDC has been given for various causes and requirement of local infrastructure needs

8.12.5 Community development programme

A mining project not only affects the people whose lands and houses have been taken over, but also people living in surrounding areas. The villagers are affected by the deterioration in environmental quality of the region through water, air and noise pollution and from ground vibration due to blasting and increased traffic on the roads. The mine becomes a competing user of the surface and ground water resources and may cause a reduction in water availability for the villagers. However, the impact on socio-economic environment is generally more severe than the other impacts. Panandhro lignite mine of Kachchh is located in remote sparsely populated undulatory terrane with a significant part of the inhabitants being gujjars (cowherds and shepherds) / sodha (immigrants from Sind Province of Pakistan) or
marginal farmers living on subsistence agriculture or animal farming. Panandhro lignite mining has generated lot of employment for the land oustees and other vast majority of villagers. The mining colony becomes an island of prosperity in the surrounding sea of poor villages. There are no other economically viable solid fossil fuel.

The community development work taken up by GMDC can be grouped under the broad heads of health, education, water supply, community facilities, sports and cultural events, skill upgradation and training, and tree plantation. GMDC arranged periodic medical camps, extended medical facilities, organized family welfare camps, provided schools; built a college at Nakhatrana; improved the village roads; repaired defunct water harvesting structures, promoted dew harvesting and roof rain water harvesting systems and built contour bunds for erosion control. Awareness programmes were carried out for sustainable land use practices afforestation programmes, arrange vocational guidance and training for youth, organized self help groups for village women, gave training on income generation activities in the villages.

It is concluded that any type of mining activity in an area inevitably affects local environment. However, the various environment problems in the mining activity of lignite mines of Panandhro and its surrounding area confined to mining areas and its downstream side of this project. It is also concluded that the present mining activity is confined to a very small area as compare to large geographical area of the Kachchh district. This lignite mining activity is providing the local population opportunity to improve their socio-economic condition and much needed lignite for pit head Power Station and various industries of (dyeing and refractory) hinterland of Gujarat and Rajasthan. However, proper environment management plan has to be chalked out to implement strictly the above remedies for various hazards in and around the mining areas by the GMDC, KLTP Panandhro, and other allied government agencies to minimize the damage to the local environment for long term sustainable development of the area and restoring the near original position of the land of mined out areas.

8.13 GEO-ENVIRONMENT HAZARDS IMPACTS AND REMEDIES

Geo-environment hazards noticed in the various structures carried out in lignite mine areas of Panandhro and its surrounding areas have been summarised in the following Table-10.
with its impacts and possible remedies of various hazards encountered in the mining zone and other study areas.

The overall benefits of the Panandhro lignite project and the lignite based Thermal Power Plant at Panandhro far outweigh the adverse environmental impacts due to lignite mining. The geo-environment has deteriorated to some extent but the remedial measures and environmental restoration efforts are highly commendable deposits by the state.

It is concluded that any type of mining activity in an area inevitably affects local environment. However, the various environment problems in the mining activity of lignite mines of Panandhro and its surrounding area confined to mining areas and its downstream side of this project. It is also concluded that the present mining activity is confined to a very small area as compare to large geographical area of the Kachchh district. This lignite mining activity is providing the local population opportunity to improve their socio-economic condition and much needed lignite for pit head Power Station and various industries of (dyeing and refractory) hinterland of Gujarat and Rajasthan. However, proper environment management plan has to be chalked out to implement strictly the above remedies for various hazards in and around the mining areas by the GMDC, KLTP Panandhro, and other allied government agencies to minimize the damage to the local environment for long term sustainable development of the area and restoring the near original position of the land of mined out areas.
### Table 8.1: Geo-environment hazards impacts and remedies.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Geo-environment hazards</th>
<th>Impact</th>
<th>Remedies suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Change in course of streams and their choking affecting morphology of land mine dumps.</td>
<td>Flooding of mines, upstream and downstream of the mine, acceleration erosion.</td>
<td>Proper dyking of mining zones and restoring of original stream course mining and land scaping dumps with low slopes.</td>
</tr>
<tr>
<td>2</td>
<td>Contamination of local stream water by acidic and blackish mine water effluents and power house effluents and desalination and demineralised plants' effluents.</td>
<td>Deterioration of surface water quality downstream side of mining zone affect of aquatic life.</td>
<td>Effluents to be properly treated before discharge into local streams.</td>
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<tr>
<td>3</td>
<td>Panandhro mine is highly acidic with brackish water. Its mine soil discharges into Kali and Korawadi nadi and into dams causing contamination and silting up of the dam.</td>
<td>Deformation of dam water quality and reducing water holding capacity of dam affecting aquatic life</td>
<td>Treating of effluents, stabalization of mine by terracing and plantation of variety of vegetation.</td>
</tr>
<tr>
<td>4</td>
<td>Soil erosion and gully formation on unstable steep (35°-40°) overburdened mine dumps of Panandhro.</td>
<td>Choking of natural streams and soil contamination by mine soils.</td>
<td>Stabilization of mine dumps by contour terracing. Dispersion terrace water and providing plantation of local variety on mine dumps.</td>
</tr>
<tr>
<td>5</td>
<td>Area is seismically active noticed in the form of earthquakes, presence of four terraces along the streams of the area and badland topography in unconsolidated Tertiary sediments by gully erosion caused in response to the seismicity of area.</td>
<td>Acceleration of soil erosion in the mining zones.</td>
<td>Proper terrace of mine affected areas and suitable plantation on vegetation in the affected zones to restore natural equilibrium on all streams increase the ground water recharge in and around lignite mine areas.</td>
</tr>
<tr>
<td>6</td>
<td>Atmospheric pollution due to burning carbonaceous shales with high sulphur content (3%) of lignite mine and in the overburdened dumps and dust pollution due to open cast mining.</td>
<td>Air quality deterioration.</td>
<td>Properly sealing of carbonaceous shale after its mining by suitable soil and dust suppression by periodic watering of dry working mine areas.</td>
</tr>
<tr>
<td>7</td>
<td>Deforestation in and around mine area by anthropogenic activity related to mining of lignite.</td>
<td>Ecological imbalance and soil erosion.</td>
<td>Suitable afforestation in and around mined out areas.</td>
</tr>
<tr>
<td>8</td>
<td>Destabilization of sand dunes as well as sands sheet along the coast due to over grazing and removal of green cover.</td>
<td>Accelerates erosion desertification of the coastal sand spreading into inland areas.</td>
<td>Providing green foliage to affected areas.</td>
</tr>
<tr>
<td>9</td>
<td>Breaching of check dams as well as percolation dams across the stream of the area due to non-provision of masonry spillways and shallow faulty foundation in Tertiary and Quaternary deposits.</td>
<td>Reduction of groundwater recharge.</td>
<td>Providing of lined spillways with good foundation for check dams.</td>
</tr>
<tr>
<td>10</td>
<td>Dipping of groundwater levels by over drawing for agricultural and mining activity.</td>
<td>Drying up of shallow aquifers and deterioration of water quality by sea water intrusion in land areas.</td>
<td>Recharging for scanty rainfall of the area by providing small check dams on all streams increase the ground water recharge in and around lignite mine areas.</td>
</tr>
</tbody>
</table>