PIBT
Pakistan International Bulk Terminal

Environmental & Social Impact Assessment (ESIA)

Proposed Coal Clinker and Cement Import/Export Terminal at Port Qasim Karachi

Final Report
July 2011



Environmental Management Consultants

بسم الله الرحمن الرحيم

In The Name of Allah, The Most Beneficent, The Most Merciful

PIBT

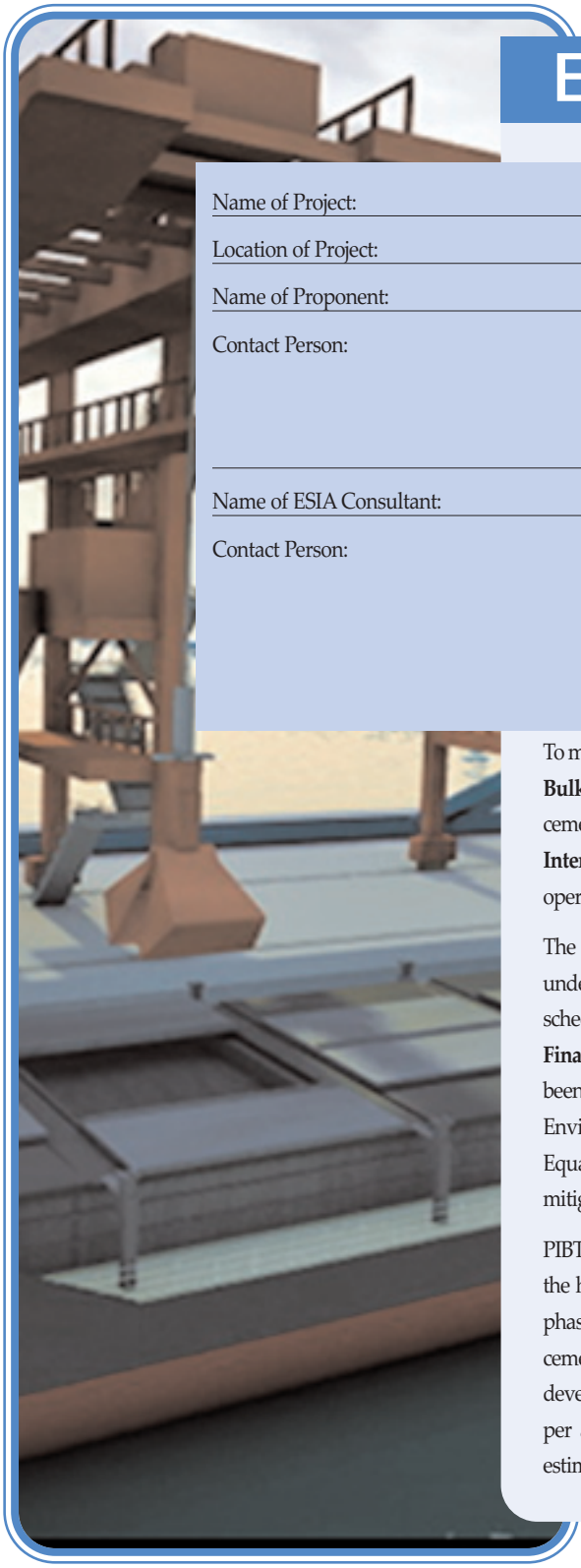
Pakistan International Bulk Terminal

ENVIRONMENT & SOCIAL IMPACT ASSESSMENT
PROPOSED
COAL, CLINKER & CEMENT TERMINAL AT PORT QASIM

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ENVIRONMENTAL MANAGEMENT CONSULTANTS

503, Anum Estate, Opp. Duty Free Shop, Main Shahrae Faisal, Karachi.
Phones: 9221-4311466, 4311467, Fax: 9221-4311467.
E-mail: mail@emc.com.pk, emc@cyber.net.pk
Website: www.emc.com.pk



Executive Summary

Name of Project:	Establishment of Coal, Clinker and Cement Import/Export terminal
Location of Project:	Port Qasim, Karachi
Name of Proponent:	Pakistan International Bulk Terminal (PIBT) Limited
Contact Person:	Mr. Sharique A. Siddiqui, Chief Executive Officer (CEO) 2nd Floor, Business Plaza, Mumtaz Hassan Road, Karachi. Tel: (92-21) 32400450 Fax: (92-21) 32400281 E-mail: sharique@mrgc.com.pk
Name of ESIA Consultant:	Environmental Management Consultants (EMC) Pakistan
Contact Person:	Mr. Syed Nadeem Arif, Managing Director Office # 503, Anum Estate Building, Main Shahrae Faisal, Karachi. Tel: 021-34311466, Fax: 021-34311467 E-mail: nadeem@emc.com.pk, mail@emc.com.pk

To meet the industry's demand for mechanized handling of dirty bulk cargo, **Pakistan International Bulk Terminal Limited** plans to setup the Country's first terminal to handle coal, clinker and cement. The coal, clinker and cement terminal will be established by the name of **Pakistan International Bulk Terminal (PIBT)** located at **Port Qasim** and setup on a 30 year built, own, operate and transfer concession from the Port Qasim Authority (PQA).

The Environmental & Social Impact Assessment (ESIA) responds to the statutory requirement under section 12 of **Pakistan Environmental Protection Act, 1997** and IEE/EIA Regulations 2000 for scheduled development projects. The ESIA also gratifies the evaluation criteria of the **International Finance Corporation (IFC)**. Applicable National & International Guidelines and regulations have been used as a reference in preparing this ESIA. The project falls in Schedule-II of Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 and Category-A of Equator Principles which means it could have significant environmental impacts if appropriate mitigating measures are not implemented.

PIBT will be located at a distance of 15 km from the National Highway, thus having direct access to the hinterland. It will also be connected to the National Railway network at Port Qasim. In a two phase development, PIBT will build capacity for handling up to 4 million tons per annum of coal, cement and clinker in Phase-I development. Handling capacity at additional 4 million tons will be developed in Phase-II. At the end of Phase-II, the terminal handling capacity will be 8 million tons per annum which can further be enhanced to 12 million tons per annum in future. The total estimated cost of development in phase-I and II is estimated to be 175 million USD.



Table 1: ESIA Study Team

Sr. No.	Name of Expert	Designation
1	Engr. Syed Nadeem Arif	Project Manager
2	Mr. Saquib Ejaz Hussain	Deputy Project Manager & EIA Specialist
3	Dr. Mirza Arshad Ali Beg	Team Leader & Senior EIA Specialist
4	Dr. Iqbal Ali	Senior Hydrologist
4	Dr. Shahid Amjad	Senior Oceanographic & Marine Biology Expert
5	Dr. Badar Munir Ghauri	Senior Expert on Air Quality Monitoring
6	Dr. Mansoor Imam	Senior Waste Management Expert
7	Dr. Viqar Husain	Senior Geologist
8	Ms. Zulekha Soorma	HSE Advisor
9	Ms. Kaneez Fatima Mamdani	Senior Sociologist

The storage area is on reclaimed land spread over 25 hectares or 62 acres. There will be 5 cement silos of 10,000 tons capacity each located at the western side of the storage area. Cement silos trucks will interface to discharge cement for onward pumping to cement conveyor and on to the vessels for export of cement.

The terminal development comprises of building a jetty of 439m in length for simultaneously operating two vessels of about 75,000 DWT. The jetty will have two coal ship unloading cranes and one clinker and ship loading crane. The jetty is connected to the storage area via trestle bridge spanning over 2.5 km in length. The trestle will have two covered conveyors, one for coal imports and the other for cement exports. The trestle will have the capacity to add one more conveyor for enhanced handling in future. The trestle will piles are designed to support Access Bridge for maintenance, fire fighting and other services. The storage area will have capacity to store about 900,000 tons of coal at any given time stacked in heap of about 15 meters height. Two stackers will run in between the coal piles to stack coal from being discharged from the ship and filled with the conveyor. Dust suppression water sprinklers will be located in the coal piles to contain coal dust. The terminal will also have the capacity to stack 350,000 tons of clinker at any given time.

The Pakistan International Bulk Terminal would also be the first and only dirt cargo terminal in Pakistan with state of the art mechanized handling of cargo conforming to international standards of efficiency. It will also be the first handling facility to comply with international standards of environmental pollution control and ensure a pollution free environment at PQ. Pakistan International Bulk Terminal is being financed by IFC. It is anticipated that the construction period for the jetty, trestle and storage yard will take approximately 30 months and the Project will become operational by the year 2015.

The '**No Action Alternative**' for siting the PIBT does not offer the much needed environmental advantages over the present system of having the imported coal handled at the open yard in Keamari area which is adjacent to the residential colonies that house the lower middle class populace of the port



area. Coal is currently being transported from the berths to the open yard in open top dumper trucks that spill coal on their way. It is being stacked in an open yard on large hillocks, which are sprayed with water from sprinklers. The water draining from the heaps of coal is allowed to drain untreated into the coastal water.

In view of the deficiency in not responding to the needs of environmental protection, the "No Action Alternative" does not need further consideration.

Selection of the preferred alternative system and site for establishment of Coal, Clinker & Cement Terminal at PIBT needs to be based on:

a) Substantial improvement in the current system of handling, storage and transportation of coal, clinker and cement.

b) Urgent need to provide better level of infrastructure service in handling coal, clinker and cement for storage, and shipping to meet the current and future demand for higher calorific value coal available for the cement industry, and to cater to the shipping requirements of clinker and cement export as bulk dry cargo.

Dredging to the required depth for berthing of vessels of 75,000 DWT as well as maintenance of the required dredged berth will be the responsibility of the PIBT. Dredging in front of the jetty to accommodate 55,000 DWT will be made before delivery of the crane and loader. Dredging for 75,000 DWT ships will only be made when the approach channel has been dredged to -15.5m depth to accommodate ships of the said size.

Alternatives available for **disposal of dredging spoil** include i) landfill of storage area, and ii) site identified by PQA. Alternative i) will require investigation on the suitability of reclaimed soil for reclamation of the back-up area that will be used as storage area. In both cases there will be problems of disposal of the dredged materials and material transfer through 2.5 km mangroves swamp. Geotechnical investigations at the site indicate that the top silty Clay/ Clayey silt is unsuitable for using in the reclaimed area, since use of such material in such areas will encounter undesirable large settlement of soil on long term basis. The material of Layer II and Layer III has been found usable for filling reclaimed area. The thickness of these layers is 3 to 6m and hence can be considered for the purpose of reclamation of the back-up area that will be used as storage area. The storage area comprises a large depression which will have to be filled in to level +5.50 m with some extra height to compensate for expected settlement.

International standards that are followed by PIBT relevant to c**ommunity engagement** include:

- International Finance Corporation, 'Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets' (IFC, 2007); and
- The Core Values of the International Association for Public Participation (IAP2).

The project has striven to rely on the following IFC principles:



- Early engagement: Commencing engagement early is critical in building trust, mutual respect and in establishing relationships with communities. PIBT will ensure that consultation activities are proactive, planned and delivered in a timely way.
- Long-term view: Establishing and maintaining relationships is a long-term investment. To enhance the value of community relationships, PIBT will take a long-term view to engagement.
- Tailored at each phase of project: The outreach and engagement program will be tailored to each phase of the project. In developing the project, activities, issues and stakeholders associated with the phase will be considered and built into the engagement activities for that phase.
- Proactive, not reactive: PIBT will set a proactive path for consultation and will consult in a strategic manner, as opposed to being reactive and responding to grievances as they arise. A proactive approach to consultation will build credibility and relationships with the community.
- Managed as a business priority: PIBT will ensure that engagement activities are planned and delivered through a systematic and consistent approach and that management responsibilities are assigned to each consultation activity.

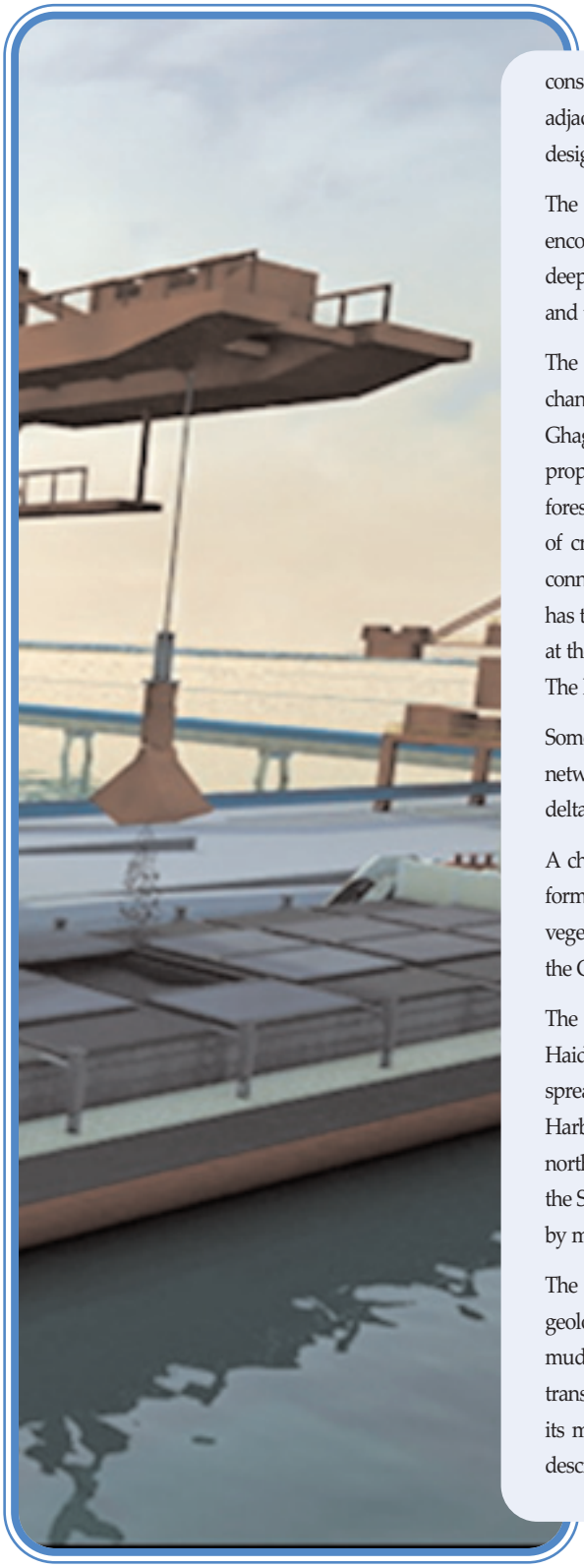
Initially public consultation in form of **group discussions** was carried out at different locations of the project area during the preparation of the Environmental and Social Impact Assessment (ESIA) with a view to minimize adverse impact of the project through creating awareness among the communities on potential benefits of the project. The meetings with communities were held during the months of Jan-Feb-March 2011. Moreover, **Scoping session** with major stakeholders was conducted on December 26 2010 at Hotel Regent Plaza, Karachi. The Scoping process identified data gaps relating to the quality of the marine environment baseline ambient air quality, baseline noise levels, Health & Safety issues, information about other planned developments in the area, Hazards and Risks associated with the constructed and operation activities of the Coal, Clinker and Cement Import/Export Terminal.





Environmental Baseline conditions were determined by surveys that were conducted following the ASTM Standard D6008-96: "Standard Practice for Conducting Environmental Baseline Surveys". The information for the baseline was collected through: i) Field surveys; ii) Consultation with stakeholders including the Project Proponent; iii) Desk-top surveys including review of published data and the archives of EMC and associates, and iv) Data purchase.

The **microenvironment** of the project site comprises i) the Kadiro Creek System, where the Project jetty will be located, ii) the 2.6 km strip of land/mudflat over which the 2.4 km trestle bridge will be



constructed to connect the Jetty with the on-shore storage area, and iii) the back-up area at a location adjacent to the western boundary of PQA on the north of Korangi Creek, south of the Oil/LPG area designated in the PQA Master Plan, and on the west of FOTCO facility.

The coastline of the microenvironment lies between Korangi creek inlet and Kadiro Creek and encompasses three islands: Bundal Island, Buddo Island and Khiprianwala Island and two large and deep openings towards the sea viz. Phitti Creek Mouth that forms the Approach channel of Port Qasim and the Kadiro Creek Mouth.

The **macroenvironment** of the Project extends over Port Mohammad Bin Qasim, the navigation channel and hinterland stretching from the Port area to the National Highway in the north, and from Ghaggar Phatak on the east to Mehran Highway on the west. The near shore macroenvironment of the proposed bulk terminal comprises a number of creeks, islands, wetlands, marshes and mangrove forests and forms the far west extension of the Indus Delta. Phitti creek is the largest among the group of creeks developed on the western parts of the former delta of the Indus River. Phitti Creek is connected to a system of creeks including Jhari, Kadiro, Korangi and Gharo Creeks. The eastern coast has tidal creeks with mangrove and mudflats which are linked with a network of creeks. The sea bed at the east and southeast coast is generally smooth and regular as is apparent from the bed contours. The land slope is gentle, generally ranging from 1/500 to 1/1000.

Some smaller creeks branch off these major creeks forming a big network of the Indus delta. This network of creeks is a very sensitive ecological area of the delta and has all the characteristics of the deltaic behavior.

A chain of small Islands such as Bundal, Buddo, and Khiprianwala are off shoots of Indus Delta formation system and are either sand banks or swamps partially submerged at high tide. Extensive vegetation of mangrove also exists. The islands are mostly flat and swampy. The Malir River drains into the Gizri Creek.

The **Geographical area** of the macroenvironment extends over the Union Councils (UC)s: Ibrahim Haidery, Rehri, Gulshan-i-Hadeed and Ghaggar of the administrative district #17 Bin Qasim. It is spread over Korangi Creek on the west and UC Ibrahim Haidery, Rehri, Chashma Goth, Korangi Fish Harbor, the deep sea fish harbor and salt works along the coast; Lath Basti, and Juma Goth in the northwest; the PROGAS jetty, FOTCO Jetty, IOCB, EVTL, and Port Qasim Industrial Area in the east; the Steel Mills in the far east, and the navigation channel of Port Qasim and the large mudflat covered by mangroves forest in the south.

The Kadiro Creek area, which forms the microenvironment of the Project, does not exhibit much geological and pedagogical diversity except that it is covered with mangrove supporting mudflats. The mudflats are recent deposits of the deltaic origin while their soil cover is the drift type that has been transferred with the flood flows. According to the Geological Survey of Pakistan the project area and its macroenvironment have only the middle and upper tertiary formations. The formations can be described as slightly weathered, recent and sub recent shore line deposits.



There is no inland surface water body in project area except the mudflat lying between the 9 meter contour and the coastline of Arabian Sea. There are quite a few springs including the Chashma at Chashma goth and some along the coastal road that runs along the base of the 5-9 meter contour that is conspicuous in the region.

EMC commissioned SUPARCO to undertake a baseline **air quality monitoring** survey at the proposed Coal, Clinker & Cement Terminal site. The survey has characterized the existing air quality in the vicinity of the Project site. The existing levels of primary pollutants were found well **within limits of NEQS** and the prescribed limits of International Standards for ambient air quality.

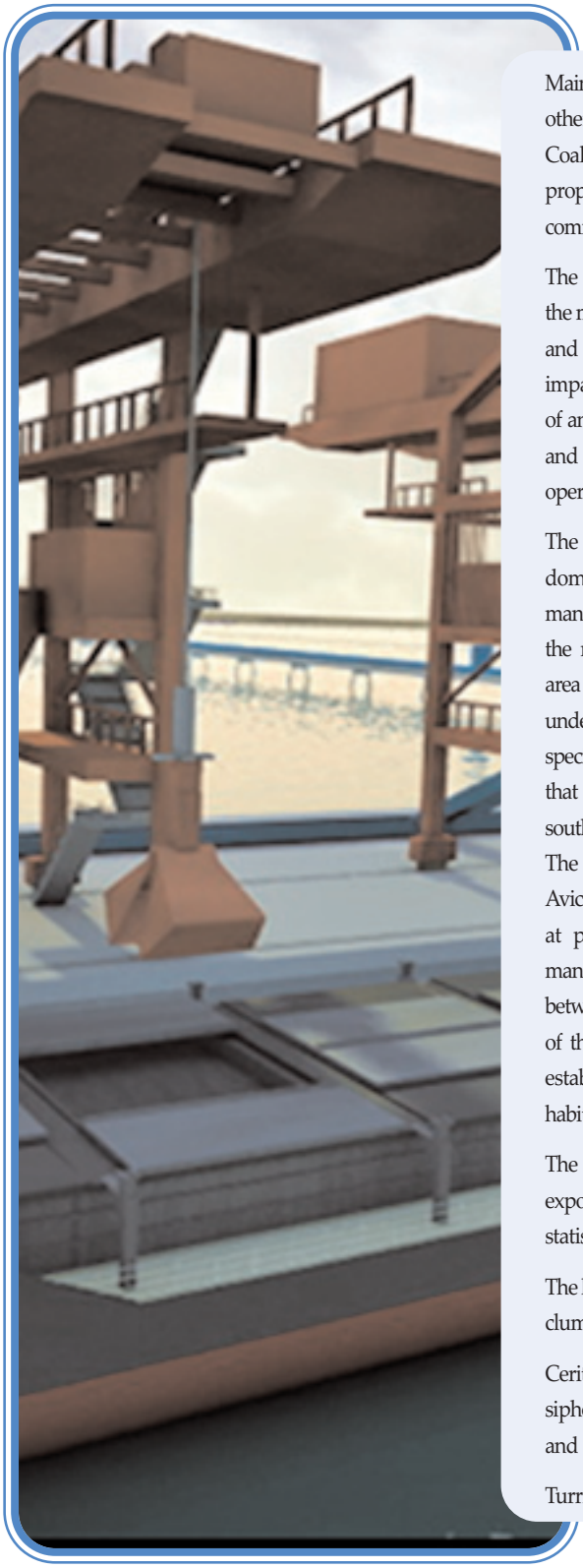
Terrestrial ecologies are, by definition, communities of species that interact in a land based habitat like a desert, a grassland, or a rainforest. The ecosystem of concern to the description of terrestrial ecology comprises the thin strip of land which is the Right of Way of the coastal road that separates the hill which forms the 9 meter contour line from the mudflat along the coastline of Arabian Sea. The coastal road starts from Ibrahim Hyderi and runs along the base of the 9 meter contour line to the FOTCO site where the PIBT would be located.

The terrestrial environment around the UCs consists of sparse scrub and a few trees of Acacia nilotica, with some grazing from domesticated animals including camels, goats and cattle. The land adjacent to the coastline has deposits of poorly sorted, unconsolidated loose gravel, sand and silt. It has sand bar deposits comprising medium to coarse sand, which is being exploited for cut-and-fill in the construction industry, and for land preparation for the industrial zone and for reclamation of land area on extensive areas in the south. This has disturbed the landform during the last three decades and has irreversibly changed the landscape of the near-shore area.

The built environment of the Project is served by the developed infrastructure of Port Qasim industrial area, Port Qasim International seaport, National highway and also the rail network which connect the macroenvironment with the city centre of Karachi and other cities of the country. The main access road from the National Highway, N-5 is a single 2-lane carriageway at present. However, it is planned to be dualized into a 4-lane divided road. The intersections are also proposed to be improved along with the various Port Development schemes being implemented at Port Qasim.

The composition of traffic is similar to other sections of National Highway passing through rural areas. Heavy traffic includes trailer, trucks and tankers that dominate the overall traffic stream. Road network within Port Qasim Industrial Zone is superior to other industrial estates in Karachi and roads are wide enough to support all types of vehicular traffic movement.

Beyond the PQA network, the project shall be connected with the various areas in Karachi and upcountry through the National Highway and the railway network. The PQA access road connects the proposed terminal to the National highway, N-5 which runs from Karachi to Peshawar and onwards to Afghanistan. From the National Highway, N-5 branch off different routes along National Highways leading to various other cities in the country. A link road starting near Steel Town connects the National Highway, N-5 with the Superhighway / Motorway, M-9 system near Kathore.



Main line of Pakistan Railways, running almost parallel to National Highway, N-5, links Port Qasim to other areas in the country especially to the Thar Parkar region providing opportunities for carriage of Coal and Clinker to the proposed terminal. However, development of a railway link between the proposed terminal and Pipri Marshalling Yard shall be required for making it a convenient and commercially attractive cargo movement facility.

The survey for description of **marine ecology** was aimed at identifying and if possible characterizing the mangrove ecosystem, marine organisms, their habitats, productivity, bird fauna of the creek system and the ecosystems in which they inhabit. The baseline surveys take into consideration the likely impact on the ecosystem by port development, and evaluate the ecosystems in terms of loss of habitat of any endangered organism that may be found in the mangrove ecosystem, among the marine flora and fauna of the mudflats, and may require special management during the development and operation phase of the Project.

The **Avicenna marina** is the dominant species of the mangroves in the Indus Delta. In the microenvironment of project area i.e. the Kadiro Creek system under study the most dominant species is also Avicenna marina that grew on the northern and southern banks of the Phitti Creek. The Mangrove population of Avicenna marina is highly dense at project site. The density of mangrove trees was estimated at between 50-60/100 m^2. The height of the individual tree within the established Avicenna marina habitat was greater than ~3 m.



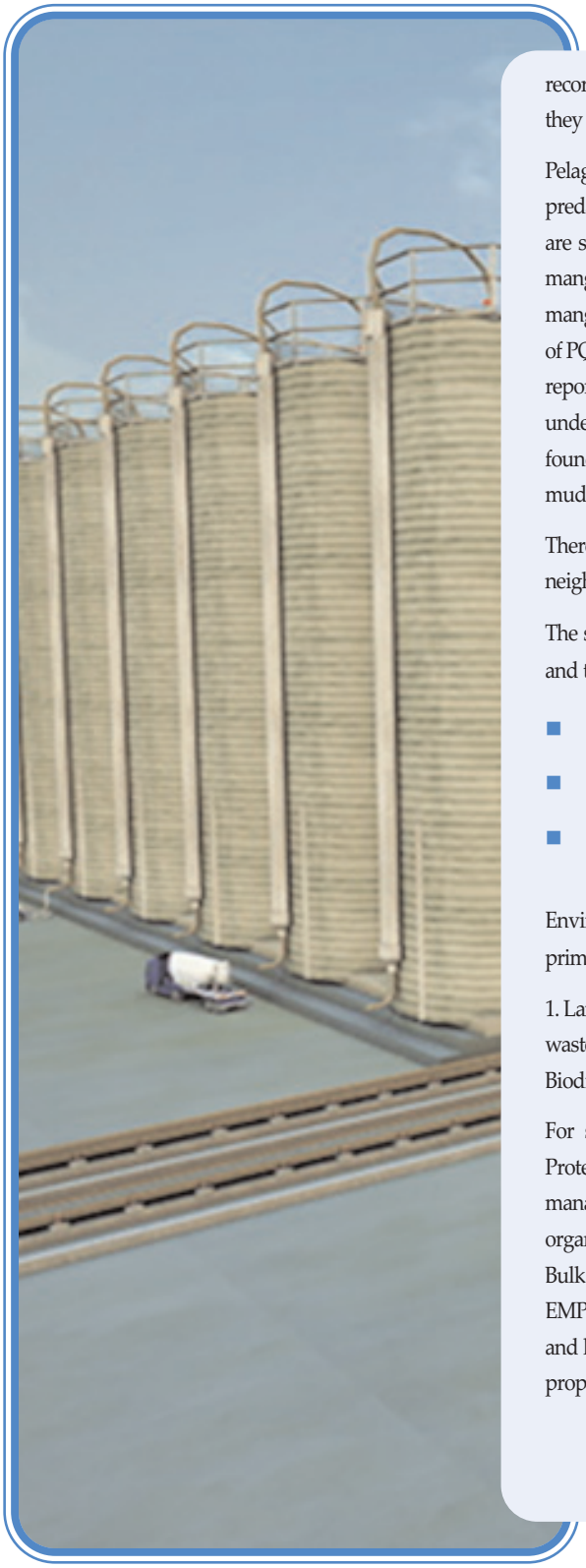
Figure: Mangroves Density at Project Site in Kadiro Creek

The **Habitat surveys** were undertaken during low tides at daylight hours. Low tides facilitated in exposing submerged mud flat community. Appropriate statistical analyses were performed using statistical packages for data crunching and interpretation of results.

The highly aggregate populations of Caridean Shrimp Species, Cerithium spp, Turritella spp have been clumped together.

Cerithium species are a large group characterized by an upturned canal in their shell that protects the siphon and allows them to live just beneath the substrate. Cerithium spp are algae and detritus feeders and are common prey for predatory mollusks.

Turritella are by far the largest family group and also one of the oldest, being represented in the fossil



record as long as 135 million years, during the Cretaceous Period. During their long presence on Earth, they have occupied every geographical locality and are ubiquitous.

Pelagic Fish community includes powerful swimmers, which are exclusively carnivore in nature like predaceous fishes, croakers, sharks, carangids breams, perches, and sea snakes. Dolphin and seagulls are some important forms, which readily pick up fishes, shrimps, and cephalopods for food. In the mangrove ecosystem the predaceous forms are often small in size and easily wander among the mangroves at high tide. A 15-20 minutes fish trawl was conducted at selected station in the major creeks of PQA viz -a- viz Phitti-Korangi-Kadiro creeks. The presence of Dolphins in the Phitti Creek has been reported by IUCN. The survey team did not see any dolphins in the area during the recent boat survey undertaken. Similarly, the team did not find any feeding turtles in the area nor any turtle tracks were found on the muddy shores. No turtle nest was observed. It is unlikely that the turtles would nest in muddy substrate, they prefer sandy substrates instead.

There are **no settlements** or sensitive areas including **archaeological sites or protected areas** in the neighborhood beyond 3.5 km radius.

The specific criteria used for determining the significance of impacts are identified for each resource, and the following assumptions are generally used when evaluating the potential project impacts:

- PIBT as project proponent will comply with all applicable laws and regulations;
- The construction phase of the project will proceed as described in Section 3; and
- PIBT as proponent will implement the mitigation measures and Environmental Management and Monitoring Plan in letter and Spirit.

Environmental issues in proposed Coal, Clinker and Cement Terminal construction and operation primarily include the following:

1. Land Use; 2. Dredged Materials Management; 3. Air Emissions & Dispersion; 4. Wastewater; 5. Solid waste management; 6. Hazardous Materials and Oil Spill Management; 7. Noise Emission; 8. Biodiversity; 9. Natural Events; 10. Traffic Management.

For successful environmental practices an essential requirement of the Pakistan Environmental Protection Act 1997 and the International Finance Corporation (IFC) is to develop an environmental management plan (EMP) to guide through the procedures to the management and employees of the organization for continual improvement. This EMP will be implemented by Pakistan International Bulk Terminal (PIBT), the proponents of Coal, Clinker & Cement Import/Export Terminal project. The EMP outline the objectives, define the responsibilities of the project sponsors/owners and contractor(s), and lay down the required communication, reporting procedures and mechanism through which the proposed measures will be monitored. Contingency Plan is part of the EMP.

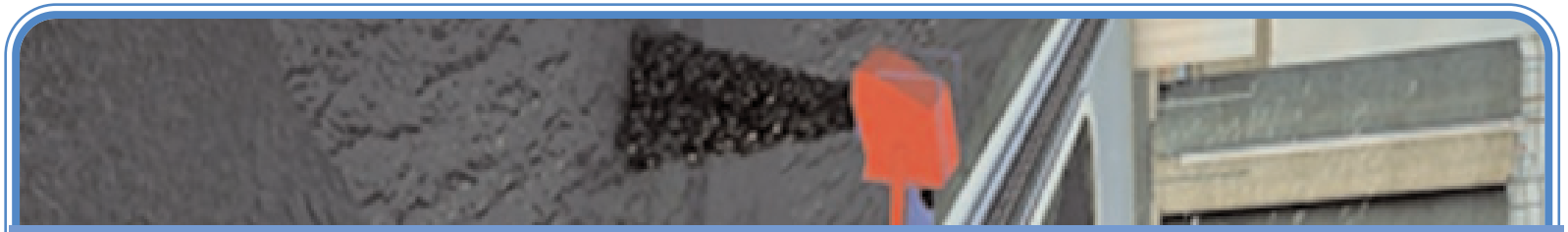


Table 2: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
1	Dredged Materials Management	1. Attempts will be made to save the trees by replanting them at another site, may be at the fenced boundary. In case they have to be removed, their removal will be compensated by planting four to six numbers for each mature or maturing tree removed. This would cause minimum disturbance to mangrove ecology during the construction and laying of the foundation piles for the trestle. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC.	Pakistan International Bulk Terminal
		2. Turbidity will be monitored during dredging event to ensure compliance with relevant international standards. If the turbidity standard is exceeded, dredging will be slowed down or shut down temporarily, until modifications can be made to the dredging technique to bring the operation back to compliance.	Pakistan International Bulk Terminal
		3. Prior to initiation of dredging activities, material/soil to be dredged will be evaluated for its chemical, biological, and engineering properties to ascertain if the dredged material can be used for reclamation or needs to be disposed of.	Pakistan International Bulk Terminal
		4. Excavation and dredging methods shall be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material, especially if the dredged material includes contaminated soil. There are several dredging methods as discussed in chapter 05; which are commonly used depending on the depth of the sediments and environmental concerns such as the need to minimize sediment suspension and increase dredging accuracy.	Pakistan International Bulk Terminal
		5. Use of techniques (e.g. silt curtains) to minimize adverse impacts on aquatic life from the re-suspension of sediments.	Pakistan International Bulk Terminal
		6. To prevent loss due to erosion, exposed soil materials will be protected by surface treatment such as armoring, pavement and vegetation. No mitigation measures other than those sited above are needed except that the entire operation will be keenly monitored by the proponent and IMC.	Pakistan International Bulk Terminal
		7. Dredged material will be analyzed in order to select appropriate disposal options (e.g. land reclamation, open water discharge, or contained disposal). Beneficial reuse of uncontaminated, dredged material such as that from the 2nd and 3rd layers at the dredging sites will be given priority.	Pakistan International Bulk Terminal
		8. The delivery of fill material to reclamation site at PIBT or site identified by PQA will be organized by spreading and compaction of fill layers to avoid spillage into the water.	Pakistan International Bulk Terminal
		9. Dredged material, in particular the 1st layer at dredging site, will be disposed of into Coffer Dam at the site designated by Port Qasim Authority if the dredge spoil is found contaminated. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) will also be required prior to discharge. Site-specific discharge quality standards will be established in consultation with EPA depending on the type and toxicity of the effluents and the discharge location.	Pakistan International Bulk Terminal
		10. The filling/reclamation material could be provided from offshore sources. These reclamation materials shall be placed by bottom dumping and thereafter by the rain bowing method. Side dams constructed in Christmas-tree fashion from quarried rock or large geo-bags will be used to manage the reclamation plan.	Pakistan International Bulk Terminal

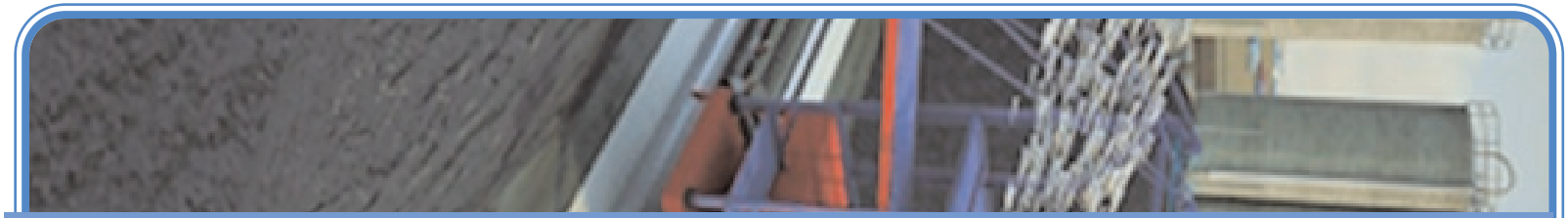


Table 2: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
		11. The compacting activity will need to be completed prior to the reestablishment of new near shore habitats around project area. When proposed works are complete, no anticipated adverse long-term operational impacts from site filling and soil settlement are expected.	Pakistan International Bulk Terminal
		12. The shore protection system will be designed to withstand wave and surge conditions associated with the nominal 100-year frequency hurricane event.	Pakistan International Bulk Terminal
		13. Shore protection along the reclaimed site will consist primarily of concrete caissons or equivalent systems. These shore protection systems will be installed in areas that have already been impacted by prior dredging activities. Therefore, no additional impacts are expected due to installation of the shore protection structures.	Pakistan International Bulk Terminal
		14. During operation of the proposed Terminal, periodic bathymetric surveys will be conducted by PQA and PIBT within the berthing and turning basin to estimate changes, if any, in bottom elevation and locate areas of sediment accumulation.	Pakistan International Bulk Terminal
		15. Inspection and monitoring of dredging activities will be conducted through an Independent Monitoring Consultant (IMC) to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.	Pakistan International Bulk Terminal
2	Air Emissions	1. Construction impacts on air quality will be mitigated through construction management practices, including the use of appropriate dust suppression measures. Air quality impacts from operation of the project's power production system will be minimized by appropriate technology to reduce the impact of emissions to confirm to World Bank standards. The power production system will be designed for high-efficiency with advanced combustion controls to minimize fuel consumption and pollutant emissions.	Pakistan International Bulk Terminal
		2. The construction contractor will be mandated to adopt SOPs to control dust emission by e.g. frequent sprinkling of water. Activities such as grading of aggregates which generate too much dust will not be allowed at Project site and will be carried out off site away from populated areas.	Pakistan International Bulk Terminal
		3. During periods when the prevailing wind direction is north-easterly and strong enough to generate airborne dust naturally, consideration would be given to either wetting or avoiding works that would worsen such conditions. It is not likely that dusty conditions would occur often enough to significantly disrupt the construction works.	Pakistan International Bulk Terminal
		4. Fugitive dust emissions will be minimized through the use of dredged fill material, which will be pumped in a slurry form through pipeline into dewatering basins located near the final reclamation areas. Construction equipment used for final grading will handle fill material with high moisture contents and minimal potential to generate fugitive dust. To further minimize emissions of airborne particulates, fugitive dust will be mitigated using the following measures, as necessary: ■ Use of water on areas of exposed soils, if necessary; and ■ Final grading and landscaping of exposed areas as soon as possible.	Pakistan International Bulk Terminal
		5. Emissions from vehicles and other engine-driven construction equipment will be temporary and cease once the project is completed. Nevertheless, mitigation measures including proper maintenance of construction equipment and controlling unnecessary idling of equipment will be implemented.	Pakistan International Bulk Terminal
		6. All emissions from construction and operation must be in compliance with air quality standards in vogue. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant but would continue for the life of the Project. Regular monitoring and evaluation is recommended.	Pakistan International Bulk Terminal



Table 2: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
		7. Traffic management plan will be followed to regulate the incoming and outgoing vehicles and also their operation and maintenance.	Pakistan International Bulk Terminal
		8. Pollution control will be achieved by a water sprinkling system that will be installed for dust suppression at PIBT.	Pakistan International Bulk Terminal
		9. Stockpile water spray systems that are designed to be effective in high wind conditions and more efficient where and when sprays are activated, may be adopted for PIBT.	Pakistan International Bulk Terminal
		10. The water sprinkling system will also be in place at transfer stations between conveyors, which form the other source of PM10 emission.	Pakistan International Bulk Terminal
		11. Planting of dense canopy trees	Pakistan International Bulk Terminal
		12. Mitigation measures including proper maintenance of construction equipment and controlling unnecessary idling of equipment will be implemented; contractors and operators will be mandated to use new generators and to regularly maintain them so that the emission levels remain within acceptable range.	Pakistan International Bulk Terminal
		13. Selective Catalytic Reduction or alternative systems would be installed on board the ships to reduce NOx emissions.	Pakistan International Bulk Terminal
3	Wastewater Discharges	1. Careful use of heavy machinery and equipment will minimize the impact due to release of contaminants during this short term activity. 2. Mitigation measures to minimize the impact of sewage effluent will be adopted by having a septic tank/soak pit system at campsite. 3. Disposal at designated site will be keenly monitored to ensure that the dredged spoil does not spill over back into the marine environment. 4. In order to minimize any impacts from losses or spillages of site materials and wastes during construction, the contractor undertaking the construction work will ensure that there are no losses of potentially polluting materials to the water and that any spillage on land is removed and cleaned up immediately. This measure will ensure that substances such as fuels and oils are not left to soak away. A clause to ensure this aspect of SOP will be included in the contract package of the construction works. In addition, before commencing any work that could involve spillages of polluting materials, the contractor will produce an effective plan of prevention and clean-up.	Pakistan International Bulk Terminal
		5. The resident engineer at site will be consulted and would approve such measures.	Pakistan International Bulk Terminal
		6. A further clause in the construction contract would ensure that the contractor keeps all working areas, storage areas, waterways and berths clear of any rubbish, debris and obstructions at all times. All debris and rubbish will be regularly removed from the site.	Pakistan International Bulk Terminal
		7. All possible precautions will be taken to provide for the safe storage and use of fuels, explosives, gas bottles and all other hazardous materials temporarily brought at site by contractor.	Pakistan International Bulk Terminal
		8. Protection bunds shall be constructed along vulnerable stretches to prevent movement of run-off as well as excavated material into adjoining mudflats.	Pakistan International Bulk Terminal



Table 2: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
		9. The wastewater and the run-off from coal yard will be stored separately, adequately treated and then discharged at the designated receptacle.	Pakistan International Bulk Terminal
		10. Safe handling and prevention of spills will be of prime concern at PIBT, which has a commitment to meet the emission guidelines for products handled at the facility. The transportation and storage system will be designed for zero leakage at the facility.	Pakistan International Bulk Terminal
		11. The storm runoff will be collected by open drains and discharged to the nearest storm water drain.	Pakistan International Bulk Terminal
		12. A monitoring program needs to be executed by the PQA to keep a close watch on the water and sediment quality and ensure enforcement of NEQS on port users. Monitoring would record any accumulation of contaminants and would be used as an indicator for targeting reduction of contaminating inputs.	Pakistan International Bulk Terminal
		13. Construction of the fuel tank will follow the provisions of the API in having a dyke constructed to contain the spilled contents of the tank.	Pakistan International Bulk Terminal
		14. Sewage effluent will be treated in septic tank before its discharge into PQA sewerage system or creek waters.	Pakistan International Bulk Terminal
		15. The ships calling on PIBT will be required to follow MARPOL 73/78.	Pakistan International Bulk Terminal
		16. PIBT will create facilities for reception of Bulk Cargo carriers and ships bilge water, ballast and solid waste and for their treatment at their onshore facility.	Pakistan International Bulk Terminal
4	Solid Waste Management	1. A record with respect to quantity, quality and treatment/management of solid/hazardous waste shall be maintained.	Pakistan International Bulk Terminal
		2. Centralized waste management facility will be provided to collect all wastes during construction phase.	Pakistan International Bulk Terminal
		3. The stockpiles, construction camps and other facilities will be located to the extent possible on land, which are devoid of vegetation.	Pakistan International Bulk Terminal
		4. Material resulting from clearing and grading will not be deposited on temporary or permanent basis in the approach roads, streams, ditches or on another position which may hinder the passage.	Pakistan International Bulk Terminal
		5. On completion of construction works all temporary structures, surplus materials, construction debris and wastes will be completely removed to avoid future land use incompatibility.	Pakistan International Bulk Terminal
		6. It will be ensured that all waste generated at the construction site and at the labor camps is collected and disposed of in an appropriate manner in a landfill site or recycled for reuse where feasible.	Pakistan International Bulk Terminal
		7. PIBT will dispose of the dredging spoil that comprises the un-useable material of the 1st layer at the proposed jetty site, along with plants and vegetation that will be removed for land clearance to a nearby site where the material will be placed in geo-bags to conserve the marine biota.	Pakistan International Bulk Terminal
		8. PIBT will also recycle the over burden at the proposed storage site and the material contained in the 2nd and 3rd layers at the proposed jetty site for filling the depression.	Pakistan International Bulk Terminal
		9. Standard construction procedure will be implemented to ensure that the impact on surface drainage pattern and soil erosion is kept to the minimum. This will necessarily include avoiding blockage of natural surface drainage and developing appropriate drainage system in areas where it is unavoidable.	Pakistan International Bulk Terminal

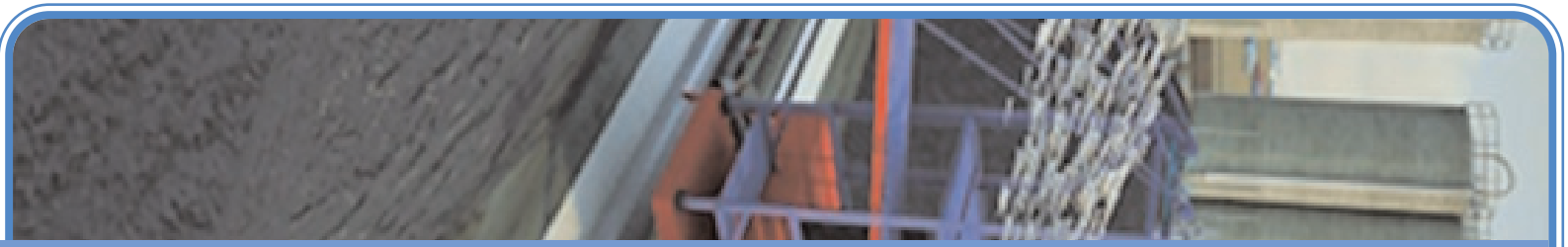


Table 2: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
5	Noise Emission	1. Noise generating units i.e. generators will be housed in individual enclosures specifically designed housings to reduce impact of noise emission.	Pakistan International Bulk Terminal
		2. As an occupational health and safety measure, the workers will, wherever necessary, be provided with ear protection equipment such as ear plugs and ear mufflers as per specifications to meet the World Bank guidelines.	Pakistan International Bulk Terminal
		3. Periodic maintenance of construction machinery and transportation vehicles should be undertaken to observe low noise level limits.	Pakistan International Bulk Terminal
		4. Transport of construction material to the site should be restricted to daytime operations.	Pakistan International Bulk Terminal
		5. Plantations of dense canopy trees such as the mangrove species that have been planted on the medians on Karachi City Roads, and also the trees that may be uprooted at the 2.5 km strip of mangrove area, can provide a good sound barrier.	Pakistan International Bulk Terminal
6	Ecology	1. The construction contract should include provisions to limit the removal of bushes and mangrove to the bare minimum and restricted to the land area identified by PQA. The bushes and mangrove seedlings may, as far as possible be saved and transferred to the adjacent area. Other plants in the vicinity will need to be protected against damage by construction operations. The areas beyond the limits of site shall not be disturbed or damaged otherwise. Trees and shrubs will be planted around the boundary of the storage area to compensate for the loss of shrubs and shield the development from visual intrusion.	Pakistan International Bulk Terminal
		2. Liquid effluent from offices and the facilities will be domestic sewage and will be treated using an appropriate system such as a septic tank to meet NEQS before discharge into the drainage system.	Pakistan International Bulk Terminal
		3. Coffer dam especially designed to strain water without releasing considerable sediment load back into the marine ecosystem may be built to retain the dredged material for subsequent use of the dredged spoil for reclamation.	Pakistan International Bulk Terminal
		4. Careful and regulated excavation, back filling and quality assured construction methods should be employed by the contractors. The foreign material for filling purposes should be contaminant free.	Pakistan International Bulk Terminal
		5. Loss of mangroves will be compensated by planting mangroves saplings in consultation with IUCN and IMC.	Pakistan International Bulk Terminal
		6. On completion of construction, the temporary canal will be back?filled and mangrove saplings planted to ensure re-colonization.	Pakistan International Bulk Terminal
7	Traffic Management	1. Advanced/automated systems for security checking to avoid unnecessary delays and queuing of vehicles,	Pakistan International Bulk Terminal
		2. Effective utilization of Road signs and markings for better guidance and control of traffic within the complex,	Pakistan International Bulk Terminal
		3. Segregation of vehicular and pedestrian movements, and provision of walkways/footpaths	Pakistan International Bulk Terminal
		4. Provision of designated parking and service areas for different types of vehicles and road connectivity of these areas.	Pakistan International Bulk Terminal
		5. Preparedness/arrangements for incident management, especially in the event of breakdown of vehicles along the circulation areas inside the terminal complex.	Pakistan International Bulk Terminal
		6. Well-designed road lighting system.	Pakistan International Bulk Terminal
		7. Provision of proper turning radii for trucks	Pakistan International Bulk Terminal
		8. Provision of sufficient lateral clearance and standard lane widths of 3.65m (12ft).	Pakistan International Bulk Terminal



Summary of Findings & Conclusion

Selection of the preferred alternative system and site for establishment of Coal, Clinker & Cement Terminal at PIBT needs to be based on:

a) Substantial improvement in the current system of handling, storage and transportation of coal, clinker and cement.

b) Urgent need to provide better level of infrastructure service in handling coal, clinker and cement for storage, and shipping to meet the current and future demand for higher calorific value coal available for the cement industry, and to cater to the shipping requirements of clinker and cement export as bulk dry cargo.

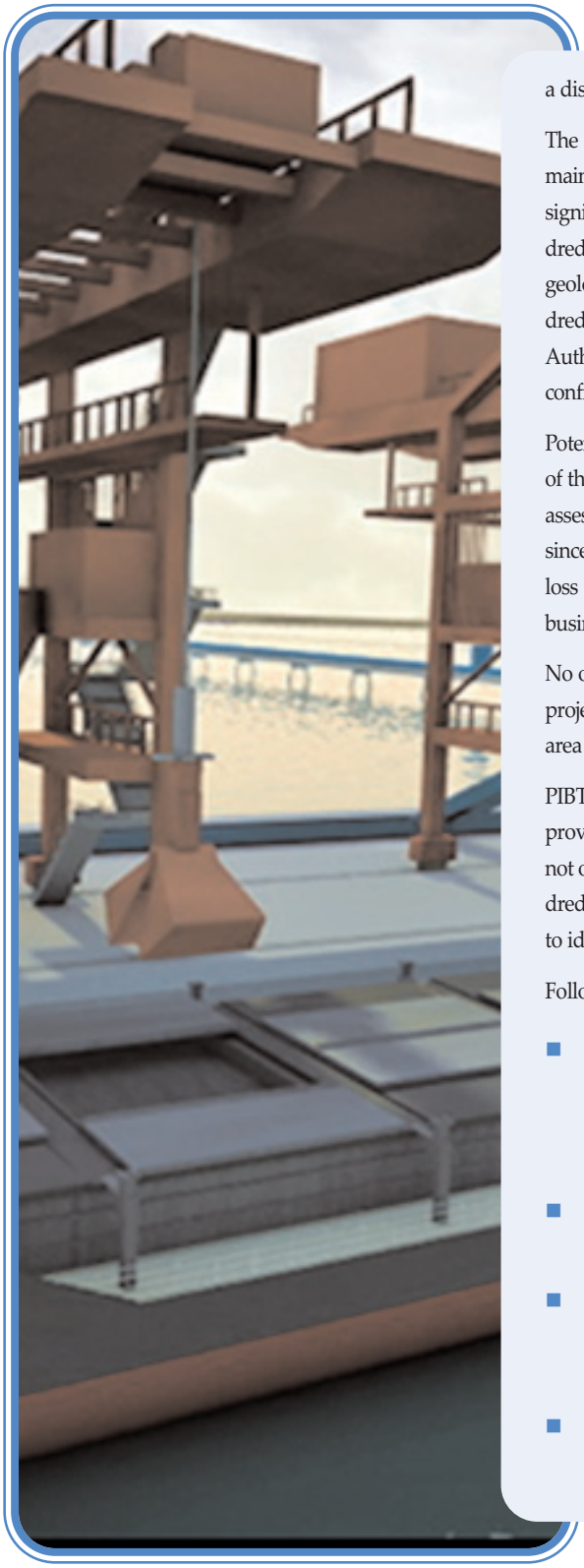
The demand for steam coal has grown manifold during the last one decade and is likely to continue for some time beyond the point when other fossil fuel resources will be exhausted. Moreover, the continuous rise in oil prices does not suggest that coal prices would also follow a similar trend. Coal prices, historically, have been more stable than oil prices. In the short term plan therefore steam coal will have to be imported in Pakistan to respond to the growing need for cement production whose export market is now well established.

The preferred site for locating the PIBT is in proximity the PROGAS Terminal and the FOTCO Oil terminal. Locating the PIBT in the proximity of these terminals/jetties would not affect the traffic flow and operational activities of the Port or the navigation channel or the adjacent Terminals.

The preferred site additionally offers the advantage that it will be sited at sufficient distance from the navigation channel but in the same channel that is dedicated to facilities handling LPG by PROGAS and fuel oil by FOTCO. This site duly addresses the security and safety concerns since it is sufficiently distanced from other port installations. It would also offer the following advantages:

- Site is less exposed to open sea;
- PIBT jetty will be at 0.7 km from PROGAS and 1.5 km from FOTCO jetty;
- PIBT trestle will run parallel to PROGAS and will over-pass the land mass between Kadiro Creek and Korangi Creek be separated by distance of about 1 km;
- Other jetties operational in the vicinity of the area are about 8 to 10 km from FOTCO Jetty. Hence locating the PIBT at the preferred site will not affect the traffic flow or the operational activities at the port.

The optimal mitigation measures have been taken into account while selecting the site, which will be offset by adequate distance from PROGAS Terminal and by the land mass that lies between Kadiro Creek and Korangi Creek. The trestle will follow a straight line between the storage area and the jetty, avoiding bends and transfer stations in the middle. The trestle will, while over-passing the said land mass, require removal of as many mangrove trees as the number of piles ~ 400 in number (2 piles at



a distance of 12 m over 2.4 km).

The dredging of a berthing pocket adjacent to the existing navigation channel, compared to the maintenance dredging of navigation channel being carried out regularly by port Qasim, will be significant. The hydraulic model studies for Port Qasim have extensively studied the impact of dredging of navigation channel and the spoil areas for over a decade. No significant impact on geology, geomorphology and hydrogeology has so far been identified. The comparatively moderate dredging for the berthing pocket and disposal of spoil in the areas designated by Port Qasim Authority may cause some negative impact on the geomorphology of the channel but this will be confined to the microenvironment and will not be significant.

Potential impacts of establishment of the PIBT facility during the construction and operation phases of the Project on the Physical, Biological and Socio-economic environment have been identified and assessed. Mitigation measures with respect to existing land use and land tenure will not be needed since the land area has been sub-leased officially by PQA to PIBT. Likewise there will be no issues on loss of land, or loss of business; no involuntary resettlement is consequently required and no business may be considered lost on the acquired land.

No obstruction to the main navigation channel will be caused by construction and operation of the project. The site is located in a seismically moderate to major hazard (seismic zone 2B of Pakistan) area and design of all facilities shall be based accordingly.

PIBT Management would try and use the soil obtained from excavation in the construction activities provided that the results of the soil investigation allow the soil to be used as such. However, if it is not of suitable material then it would be transferred to a site designated/identified by PQA. Similarly dredged material if not utilised, will be disposed at site designated by PQA. PQA has been requested to identify the dumping site.

Following measures will further reduce the expected potential impact:

- Dredged material will be disposed of into the terminal area development at the site by constructing protective bunds and at areas designated by Port Qasim Authority. Haulage as well as disposal of dredging spoil will be continuously monitored to ensure that dredge spoil does not spill over into the sea or to the seashore.
- No obstruction or filling up of any drainage or channel in the area is envisaged but close monitoring of the dredging operations will ensure safety of the channel.
- The structural design of facilities to take into account the seismic risk factor of 0.3 for Operational Basis Earthquakes (OBE) and a factor of 1/15 g for Maximum Credible Earthquake (MCE)
- The delivery of fill material to site will be equalized with spreading and compaction of fill layers to avoid spillage into the water



- Spoils from piling works will be disposed outside the channels and in areas designated by the Port Qasim Authority.
- Protection of fill slopes against erosion. During construction the slopes will be protected by sand bags until permanently protected by properly designated stone rip rap. Protective bunds for containment of the dredged material proposed above will be designed to retain the disposed material.
- Construction activities at the project site are not likely to interfere with the natural drainage of the area. The soil proposed to be used as fill will be granular in structure. The fill slopes on the creek side will be protected against erosion by stone pitching. However, spillage of fill material and waste on to the foreshore areas may occur during construction. Standard Operating Procedures will be adopted to limit the impact to level of non-significance.
- The ground water at Project site is highly saline, while the subsoil being fine grained and largely plastic, has very low permeability. Due to the proximity of seawater creeks, the subsoil drainage is towards the creeks. Construction of the PIBT facility, in particular the jetty and the piles, will result in short term increases in the suspended solid load of the creek system.
- The construction of the proposed project is not expected to interfere with the natural drainage of the creek system of the Project site. The construction of the PIBT Jetty and the trestle will result in short term increase in the suspended material in the water column of the creeks causing increased turbidity. Additionally release of contaminants / wastes, loss of benthic flora and fauna and mangroves may occur and may be cause of degradation of the quality of environment of the PIBT site.
- The re-suspended sediments may be transported and re-deposited elsewhere in the surrounding and this would have negative impact on benthic fauna and fishery resource.
- Direct impacts on water quality arise when the sediments are contaminated. The release of heavy metal, hydrocarbons, or other hazardous chemicals into the water column can induce toxic effects on marine biota. The release of organic wastes could cause localized oxygen depletion in the water column creating stress for aquatic biota.
- During the construction phase some sewage material would be generated at the camp site. The disposal of sewage into the marine environment will have adverse impact of low order on the water quality as well as marine biota.
- Careful use of heavy machinery and equipment will minimize the impact due to release of contaminants during this short term activity.
- Mitigation measures to minimize the impact of sewage effluent will be adopted by having a septic tank/soak pit system at campsite.

Based on the above observations and assessments it is envisaged that the PIBT will be constructed



and operated by adopting the mitigation measures for the likely adverse impact caused by different aspects. Environmental Management and Monitoring Plan as well as safety and security measures would ensure that the Project will not create adverse environmental impacts that have not been mitigated or leave the safety and security concerns of the stakeholders unmitigated.

Establishment of PIBT is compatible with the aims and objectives of (a) Sustainable Development in promoting improvement in quality of life through (a) Substantial improvement in the current system of handling, storage and transportation of coal, clinker and cement, (b) provision of better level of infrastructure service in handling coal, clinker and cement for storage, and shipping to meet the current and future demand for higher calorific value coal available for the cement industry, and to cater to the shipping requirements of clinker and cement export as bulk dry cargo, and (c) Infrastructure development for the Energy Sector in making available a sustainable energy source and thus contributing to sustainable economic development in Pakistan.

This ESIA Study finds that establishment of the PIBT at Port Qasim would fulfill the requirements of sustainable development by being socially equitable, and economically viable in improving the quality of life for all citizens of Pakistan, without altering the balance in the resources of the ecosystem of the region.

The Study therefore recommends that the ESIA should be approved with the condition that all mitigation measures recommended in ESIA report, suggestions of stakeholders and recommendations of experts committee will be adhered to by Pakistan International Bulk Terminal Limited and the legal requirements as well as the Environmental Management & Monitoring Plan shall be implemented in letter & Spirit. The monitoring shall be conducted by Independent Monitoring Consultant (IMC) in association with stakeholders including relevant active NGOs (like Shehri-CBE) and departments including IUCN & WWF. PIBT shall facilitate SEPA officers/officials as and when required for confirmation of compliance to approval conditions and commitments made by PIBT in ESIA. The monitoring reports shall be submitted to SEPA on monthly basis.

CONTENT

01	INTRODUCTION	01 of 12
1.1	Brief Description of Project	01 of 12
1.2	Profile of Project Proponent	04 of 12
1.3	Background and Objectivesof Project	04 of 12
1.3.1	World Coal Trade	04 of 12
1.3.2	Pakistan Coal Imports	07 of 12
1.3.3	Cement and Clinker Export inPakistan	08 of 12
1.3.4	Handling of Coal/Dirty Cargoat Karachi Port	08 of 12
1.3.5	objectives of project	09 of 12
1.4	Environmental & SocialImpact Assessment (ESIA)	10 of 12
1.4.1	Justification for ESIA Study	10 of 12
1.4.2	Categorization of the Project	10 of 12
1.4.3	Purpose of ESIA Study	10 of 12
1.4.4	Methodology Adopted for ESIA Study	10 of 12
1.5	Report Set-Up	12 of 12
1.6	ESIA Study Team	12 of 12
02	LEGAL AND ADMINISTRATIVE FRAMEWORK	01 of 18
2.1	Policy Framework	01 of 18
2.2	Statutory Framework	03 of 18
2.2.1	Pakistan Environmental Protection Act, 1997	03 of 18
2.2.2	Pak-EPA Review of IEE and EIA Regulations 2000	04 of 18
2.2.3	National Environmental Quality Standards (NEQS)	05 of 18
2..2.4	Self- monitoring and reporting rules 2001	05 of 18
2..2.5	The Biodiversity Action Plan	05 of 18
2..2.6	The Sindh FisheriesOrdinance, 1980	05 of 18
2..2.7	Antiquity Act 1975	06 of 18
2..2.8	Sindh Cultural Heritage (Preservation) Act, 1994	06 of 18
2..2.9	Forest Act 1927	06 of 18
2..2.10	Sindh Wildlife Protection(Second Amendment) Ordinance, 2001	06 of 18
2.3	Environmental and Social Guidelines	07 of 18
2.3.1	Environmental Protection Agency's Environmental and Social Guidelines	07 of 18
2.3.2	World Bank Guidelines on Environment	08 of 18

2.3.3	Equator Principle	08 of 18
2.3.4	IFC Performance Standards on Social and Environmental Sustainability	10 of 18
2.3.5	IFC-Environment, Health & Safety Guidelines for Ports, Harbors and Terminals	13 of 18
2.4	Acts, Regulations, Guidelines & Policies on PortActivities	13 of 18
2.4.1	Ports Act 1908 & Pakistan Territorial Waters & Maritime ZonesAct 1976	13 of 18
2.4.2	Port Qasim Authority Act,1973 (Modified in 2002)	13 of 18
2.4.3	Coastal Zone Regulation 1991	14 of 18
2.4.4	Maritime Policy of Pakistan	14 of 18
2.5	International Treaties and Conventions	14 of 18
2.5.1	International Convention on Biodiversity	15 of 18
2.5.2	Convention on Wetlands of International Importance,(RAMSAR) 1971	15 of 18
2.5.3	IUCN Red List	16 of 18
2.5.4	Kyoto Protocol	16 of 18
2.5.5	International Maritime Conventions	16 of 18
2.6	Administrative Framework	17 of 18
2.6.1	Institutional Setup for Environmental Management	17 of 18
03	**DESCRIPTION OF PROJECT**	**01 of 24**
3.1	Location of Proposed Terminal	01 of 24
3.1.1	Seaside Access	01 of 24
3.1.2	Hinterland connections	01 of 24
3.2	Civil Engineering and Construction Works	03 of 24
3.2.1	Jetty Design Criteria	03 of 24
3.2.2	Dredging and Reclamation	06 of 24
3.2.3	Approach Trestle & Causeway	06 of 24
3.2.4	Earth Works	07 of 24
3.2.5	Storage Yard Design Criteria	08 of 24
3.2.6	Storage Yard Design	08 of 24
3.3	Terminal Operations	09 of 24
3.3.1	Berth Capacity	09 of 24
3.3.2	Ship Loaders and Unloaders Capacity	12 of 24
3.3.3	Technical Performance of the Unloader	13 of 24
3.3.4	Technical Performance of the Loader	14 of 24
3.3.5	Conveyor belts capacity	14 of 24
3.3.6	Layout of the Jetty-Apron	14 of 24

3.3.7	Storage Yard	14 of 24
3.3.8	Handling Equipment in theStorage Yard	15 of 24
3.3.9	Wagon/TruckLoading/Unloading	16 of 24
3.3.10	Miscellaneous TerminalComponents	18 of 24
3.3.11	Manpower Requirements	18 of 24
3.3.12	Utilities	19 of 24
3.3.13	Buildings	22 of 24
3.3.14	Other major terminal facilities	22 of 24
3.3.15	Railway connection	23 of 24
3.4	Phasing Concept	24 of 24
04	**ENVIRONMENTAL AND SOCIAL BASELINE**	**01 of 47**
4.1	Methodology for baseline survey	01 of 47
4.2	Description of Microenvironment & Macroenvironment	01 of 47
4.2.1	The Port Qasim	02 of 47
4.2.2	Main Components and Facilities at PQA	04 of 47
4.3	Physical Environment	05 of 47
4.3.1	Topography	05 of 47
4.3.2	Geology, Geomorphology & Soil	05 of 47
4.3.3	Seismic Conditions	07 of 47
4.3.4	Tsunamis	09 of 47
4.3.5	Hydrology	11 of 47
4.4	Physical Oceanography	19 of 47
4.4.1	Bathymetry	19 of 47
4.4.2	Waves	19 of 47
4.4.3	Tides and Surges	19 of 47
4.4.4	Seawater Currents	20 of 47
4.4.5	Air & Seawater Temperature	21 of 47
4.4.6	Seawater Salinity	21 of 47
4.4.7	Suspended matter	22 of 47
4.4.8	Heavy Metals in Sea Water and Marine Sediments	24 of 47
4.4.9	Salinity & Recent Changes in Monsoon Current System	24 of 47
4.4.10	Cyclones & Storms	26 of 47
4.5	Meteorology and Climate	28 of 47
4.5.1	Climate	28 of 47

4.5.2	Temperature	29 of 47
4.5.3	Precipitation	30 of 47
4.5.4	Wind Speed and Direction	30 of 47
4.5.5	Humidity	32 of 47
4.5.6	Visibility	32 of 47
4.6	Ambient Air & Noise Quality	32 of 47
4.7	Terrestrial Ecology	33 of 47
4.8	Marine Ecology	33 of 47
4.8.1	Benthic Marine Habitats in PQA.	33 of 47
4.8.2	Marine Flora	33 of 47
4.8.3	Marine and Benthic Fauna	35 of 47
4.8.4	Birds Population	41 of 47
4.9	Socio-economic Considerations of the Microenvironment	42 of 47
4.9.1	Demography	43 of 47
4.9.2	Employment and Living Conditions	44 of 47
4.9.3	Dependence on Mangroves	45 of 47
4.9.4	Education	45 of 47
4.9.5	Health	45 of 47
4.9.6	Landscaping	46 of 47
4.9.7	Transportation Network	46 of 47
4.9.8	Archaeological and Historical Sites	46 of 47
05	**SCREENING OF ALTERNATIVES**	**01 of 07**
5.1	Screening of Alternatives	01 of 07
5.1.1	No Action, continuation with the existing condition	01 of 07
5.1.2	Screening of Alternative Sites & Selection of Preferred Alternative Site	01 of 07
5.1.3	Screening of Alternative Locations for Siting the PIBT Jetty, Trestle & Storage	03 of 07
5.1.4	Alternative DredgingTechniques	07 of 07
06	**STAKEHOLDER INTERACTION (CONSULTATION & DISCLOSURE PLAN)**	**01 of 15**
6.1	Public Consultation & Participation	01 of 15
6.2	PIBT's Policy of Public Consultation & Disclosure Plan	01 of 15
6.3	Identification of Stakeholders	03 of 15
6.4	Methods And Approach	03 of 15
6.5	Results of Consultation at The Planning Stage	06 of 15
6.6	Ongoing Community Engagement Plan for Construction & Operation Phases	09 of 15

6.7	Community Engagement Responsibilities	10 of 15
6.8	Training On Community Relations	11 of 15
6.9	Grievance Management	12 of 15
6.10	Performance Indicators	14 of 15
07	SCREENING OF POTENTIAL ENVIRONMENTAL & SOCIAL IMPACTS AND MITIGATION MEASURES	01of 43
7.1	Screening of Potential Environmental Impacts at Construction and Operations Stage	01of 43
7.1.1	Land Use	01of 43
7.1.2	Dredged Material Management	02 of 43
7.1.3	Air Quality, Gaseous Emissions & Dispersion	06 of 43
7.1.4	Waste Water Discharge	25 of 43
7.1.5	Noise Emission	28 of 43
7.1.6	Solid Waste	30 of 43
7.1.7	Impacts on maritime navigation	32 of 43
7.1.8	Impacts on Ecology	32 of 43
7.1.9	Natural Hazards	37 of 43
7.1.10	Protected Areas	38 of 43
7.1.11	Total Anticipated Traffic	39 of 43
7.1.12	Socioeconomic Impacts of Proposed Coal, Clinker and Cement Terminal in Port Qasim	42 of 43
08	ENVIRONMENTAL MANAGEMENT PLAN (EMP)	01 of 23
8.1	Objectives & Scope of EMP	01 of 23
8.2	EMP Process	02 of 23
8.3	Project Background	02 of 23
8.4	Management Approach	03 of 23
85.	Roles & Responsibilities	05 of 23
8.6	Implementation Stages of EMP	06 of 23
8.6.1	Planning and Design of Coal, Clinker and Cement Import/Export Terminal Project	06 of 23
8.6.2	Construction and Operation Phase	06 of 23
8.7	Communication & Documentation	18 of 23
8.7.1	Meetings	18 of 23
8.7.2	Minutes of Meeting	18 of 23
8.7.3	Monthly Reporting	18 of 23
8.8	Management, Co-ordination and Information	18 of 23
8.9	Environmentally Sound & Safe Working Procedures	20 of 23

8.9.1	Responsibility & Authority	20 of 23
8.9.2	Environmentally Safe Procedure Description	20 of 23
8.9.3	Emergency Response Plan	21 of 23
8.9.4	Training and Exercises	21 of 23
09	**SUMMARY OF FINDINGS AND CONCLUSION**	**01 of 03**
Appendix		
Appendix I	Environmental Management Plan	
Appendix II	Traffic Impact Assessment Report	
Appendix III	Environmental Protection Act 1997	
Appendix IV	Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000	

01 INTRODUCTION

Name of Project:	Establishment of Coal, Clinker and Cement Import/Export terminal
Location of Project:	Port Qasim, Karachi
Name of Proponent:	Pakistan International Bulk Terminal (PIBT)
Contact Person:	Mr. Sharique A. Siddiqui, Chief Executive Officer (CEO) 2nd Floor, Business Plaza, Mumtaz Hassan Road, Karachi. Tel: (92-21) 32400450 Fax: (92-21) 32400281 E-mail: sharique@mrgc.com.pk
Name of ESIA Consultant:	Environmental Management Consultants (EMC) Pakistan
Contact Person:	Mr. Syed Nadeem Arif, Managing Director Office # 503, Anum Estate Building, Main Shahrae Faisal, Karachi. Tel: 021-34311466, Fax: 021-34311467 E-mail: nadeem@emc.com.pk, mail@emc.com.pk

This Environmental & Social Impact Assessment (ESIA) study has been conducted by Environmental Management Consultants (EMC) Pakistan on request of Pakistan International Bulk Terminal (PIBT) for their proposed project of 'Handling Bulk Quantities of Coal, Clinker and Cement' at Port Qasim Karachi for Import/Export purposes. Submission of ESIA report is a statutory requirement under section 12 of Pakistan Environmental Protection Act, 1997 and IEE/EIA Regulations 2000 for scheduled development projects. This ESIA also gratifies the evaluation criteria of the International Finance Corporation (IFC). Applicable National & International Guidelines and regulations have been used as a reference in preparing this ESIA. The project falls in Schedule-II of Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 and Category-A of Equator Principles which means it could have significant environmental impacts if appropriate mitigating measures are not implemented.

Environmental Impact Assessment is a planning tool accepted as an integral component of sound decision making. The purpose of ESIA is to give environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activities before action is taken. Early identification and characterization of critical environmental impacts allows the public and the government to form a view about the environmental acceptability of the proposed developmental project and what conditions should apply to mitigate, reduce or compensate those risks and impacts.

1.1 Brief Description of Project

PQ is located 50 km from Karachi on the coastline of the Arabian Sea. The approach to port Qasim is along a 45 km long navigational channel from the Arabian Sea which provides safe and convenient navigation for vessels. It is country's second busiest port handling approximately 40% of the national cargo which was 25 million tons in the year 2010. The port encompasses a total area of 12000 acres where around 80% of Pakistan's automotive industry is located. The port also provides direct water front access to two major nearby industrial areas; export processing zone Landhi and Korangi Industrial area. Pakistan's growing industry requires viable and cost effective fuel sources for power generation. Demand for coal is steadily increasing due to the adoption of

coal fired system in a cement manufacturing process. Coal consumption and export of cement and clinker has been rising steadily in the last five years. In 2010, the country imported 4.565 million tons of coal and exported over 10.657 million tons of cement and clinker. In 2005, the cement and clinker exports were only 1.5 million tons. In spite of these cargo handling requirements, there is not dedicated bulk handling terminal in Pakistan to handle such cargos.

To meet the industry's demand for mechanized handling of dirty bulk cargo, Pakistan International Container Terminal (PICT) plans to setup the Country's first terminal to handle coal, clinker and cement. The coal, clinker and cement terminal will be established by the name of Pakistan International Bulk Terminal (PIBT) located at Port Qasim and setup on a 30 year built, own, operate and transfer concession from the Port Qasim Authority (PQA).

PIBT will be located at a distance of 15 km from the National Highway, thus having direct access to the hinterland. It will also be connected to the National Railway network at Port Qasim. In a two phase development, PIBT will build capacity for handling up to 4 million tons per annum of coal, cement and clinker in Phase-I development. Handling capacity at additional 4 million tons will be developed in Phase-II. At the end of Phase-II, the terminal handling capacity will be 8 million tons per annum which can further be enhanced to 12 million tons per annum in future. The total estimated cost of development in phase-I and II is estimated to be 175 million USD.















The storage area is on reclaimed land spread over 25 hectares or 62 acres. There will be 5 cement silos of 10,000 tons capacity each located at the western side of the storage area. Cement silos trucks will interface to discharge cement for onward pumping to cement conveyor and on to the vessels for export of cement.

The terminal development comprises of building a jetty of 460 m in length for simultaneously operating two vessels of about 75,000 DWT. The jetty will have two coal ship unloading cranes and one clinker and ship loading crane. The jetty is connected to the storage area via trestle bridge spanning over 2.5 km in length. The trestle will have two covered conveyors, one for coal imports and the other for cement exports. The trestle will have the capacity to add one more conveyor for enhanced handling in future. The trestle will piles are designed to support Access Bridge for maintenance, fire fighting and other services. The storage area will have capacity to store about 900,000 tons of coal at any given time stacked in heap of about 15 meters height. Two stackers will run in between the coal piles to stack coal from being discharged from the ship and filled with the conveyor. Dust suppression water sprinklers will be located in the coal piles to contain coal dust. The terminal will also have the capacity to stack 350,000 tons of clinker at any given time.

The Pakistan International Bulk Terminal would also be the first and only dirt cargo terminal in Pakistan with state of the art mechanized handling of cargo conforming to international standards of efficiency. It will also be the first handling facility to comply with international standards of environmental pollution control and ensure a pollution free environment at PQ. Pakistan International Bulk Terminal is being financed by IFC. It is anticipated that the construction period for the jetty, trestle and storage yard will take approximately 30 months and the Project will become operational by the year 2015.

1.2 Profile of Project Proponent

The Coal, Clinker and Cement Import/Export Terminal will be established as the Pakistan International Bulk Terminal (PIBT) Limited, at Port Qasim on a 30 year Build, Operate and Transfer concession from Port Qasim Authority. The sponsors of PIBT have been handling cargo at the Karachi Port since 1964. The sponsors have also set up a modern container terminal at Karachi Port by the name of Pakistan International Container Terminal (PICT) Limited. Pakistan International Container Terminal (PICT) is operating since the year 2002 as a modern container terminal at berths 6-9, East Wharf, Karachi Port, with all its equipment commissioned between 2004 and 2008.

PICT is the only Container Terminal in Pakistan Sponsored and owned by Pakistanis which is a public listed company and only port infrastructure project listed on the Karachi Stock Exchange. PICT is also the first port infrastructure project in Pakistan which is being financed by International Finance Corporation ("IFC") that is private sector arm of the World Bank. It is the first private sector project in which the OPEC Fund for International Development has participated as financiers.

1.3 Background and Objectives of Project

1.3.1 World Coal Trade

Coal is fast growing globally as the major fuel in use. Currently it provides 26 percent of primary energy and 40 percent of world electricity supply. In many respects it is prepared to address the growing concern for energy security that has been prompted by 1) abnormal surge in world oil prices to over $120 per barrel of crude, 2) mounting tensions of the western countries with Iran, 3) interruptions in the international supply network of gas from Iran and Russia, and 4) on-going stand-off in Egypt, Libya, Yemen and the Arabian Gulf.

Coal offers long term energy solution in being found in abundance locally in most parts of the world. World coal consumption was expected in the year 2004 to increase by 74 % in 25 years hence, and world trade of coal was expected to increase by about 40 % from 800 million tons in 2007 to 1122 million Tons in 2030 (IEA 2003, 2007). Share of coal in the global energy consumption scenario is expected to increase to 28 % by 2030, while the dwindling supplies of liquid fuel may increase the use of lignite (e.g. Thar & Lakhra coal in Pakistan) in power generation and thus increase the share of coal to more than 50%. Coal as an indigenously available resource has now gained strategic importance and is the fastest growing fuel globally.

Coal is traded internationally as steam coal and coking coal, however, most of the trade is in steam coal, which represents 70 percent of world coal trade as of 2008 when 58 percent of the exported steam coal was imported by Asian countries; their share in the total may increase to over 75 percent in the next 25 years.

- Seaborne trade in steam coal has increased on average by about 7% each year
- Seaborne coking coal trade has increased by 1.6% a year

Overall international trade in coal reached 941Mt in 2009; while this is a significant amount it is still only about 16% of total coal consumed. Most coal is used in the countries where it is produced.

Transportation costs account for a large share of the total delivered price of coal, therefore international trade in steam coal is effectively divided into two regional markets.

- Atlantic market, made up of importing countries in Western Europe, more specifically UK, Germany and Spain.
- Pacific market, which consists of developing and OECD Asian importers, more specifically Japan, Korea and Chinese Taipei. The Pacific market currently accounts for about 57% of world seaborne trade in steam coal.

Australia is the world's largest coal exporter. It exported over 259Mt of hard coal in 2009, out of its total production of 335Mt. International trade in coking coal is limited. Australia is the largest supplier of coking coal, accounting for 54% of world exports. The USA and Canada are significant exporters and Indonesia is emerging as an important supplier of coking coal.

Table 1.1 shows that Japan is the largest importer of steam as well as coking coal, followed by China, which is the world's largest producer as well as consumer of coal, accounting for 78% of its total energy requirement.

Importance of coal has been realized all over the world and that has prompted many countries to import coal to meet their energy and industrial needs. India, Indonesia, Germany, USA, Australia and UK are countries which have new coal based power plants. USA is world's second largest user of coal whose 60% energy requirement is met with coal. Table 1.1 also lists some of the importing countries and the gradual increase in the volume of import.

Table 1.1 Import of All Coal - MT

Location	2001	2002	2003	2004	2005	2006	2007
Africa and Middle East							
Egypt	1.17	1.625	1.66	1.58	1.8	2 (P)	
Israel	11.419	12.746	12.295	12.801	12.832	12.756	12.4(P)
Morocco	3.599	3.9	3.9	3.9	4	4.1	3.8 (P)
South Africa	2.162	1.751	1.814	1.8	1.844	1.965	
Europe							
Norway	0.791	0.655	0.669	0.765	0.674	0.427	0.4(P)
Hungary	1.464	0.816	1.007	1.036	1.339	1.765	1.79(P)
Ukraine						9.6	8.77(P)
Czech Republic	1.202	1.216	1.27	1.43	0.874	1.356	1.25(P)
Belgium	12.018	10.338	11.788	11.211	11.423	14.478	10.69(P)
Slovakia	4.271	3.474	4.945	5.07	5.324	4.459	2(P)
Lithuania						0.391	0.5(P)
Finland	6.089	5.678	10.145	8.287	8.11	6.84	7.34(P)
Turkey	8.389	13.516	15.555	16.346	16.507	20.287	21.32(P)
France	14.576	16.922	18.46	19.508	19.549	19.39	24.09(P)
Spain	18.912	24.521	21.551	24.469	24.76	25.04	26.04(P)
Latvia						0.1	0.1(P)
Austria	3.849	3.995	3.968	3.631	3.659	3.44	5.34(P)
Serbia						0.1	0.1(P)
Netherlands	26.967	25.78	29.707	32.338	30.223	20.2	16.15(P)
Switzerland	0.169	0.123	0.087	0.177	0.101	0.2	
Romania	2.784	3.672	3.269	3.614	3.553	3.469	4.11(P)
Russia	27.8	20.9	25.3	22.3	21.5	24	24(P)
Germany	28.244	27.009	28.883	32.467	34.431	40.17	44.1(P)
Slovenia	0.86	0.66	0.54	0.65	0.7	0.6	0.6(P)
Yugoslavia	0.4	0.4	0.4	0.4	0.4	0.4(P)	
Denmark	6.3	6.263	9.51	7.1	5.98	9.324	10.7(P)
Italy	20.224	19.876	21.274	25.722	25.086	22.57	22.6(P)
Ireland	1.966	1.589	2.1	2.02	2	1.8	2.9(P)
Malta	0.2	0.25	0.25	0.25	0.25	0.3	0.3(P)
Luxembourg						0.2	0.2(P)
Bulgaria	2.986	3.187	2.67	2.7	2.7	3.82	4.5(P)

Table 1.1 Import of All Coal - MT

Location	2001	2002	2003	2004	2005	2006	2007
Africa and Middle East							
Portugal	4.727	5.689	5.4	5.4	5.4	5.4	5 (P)
United Kingdom	35.542	28.909	31.896	36.154	43.969	49.705	42.23(P)
Sweden	2.748	2.597	3.028	2.996	3.197	3.033	3.53 (P)
Poland	0.817	1.053	2.071	1.415	2.31	3.43	2.5(P)
North America							
USA	17.871	15.188	22.613	24.635	27.506	30.63	26.33(P)
Canada	19.424	22.635	22.76	19.062	21.238	21.63	22.7(P)
Mexico	3.439	5.894	7.233	4.089	7.259	7.619	11.37(P)
North Asia							
Hong Kong	8.032	8.536	10.559	10.583	10.822	11.402	10.7(P)
Taiwan	48.799	51.215	54.957	61.112	63.225	60.762	65.42(P)
China	2.493	10.811	10.76	18.597	26.128	38.25	53.15(P)
Japan	155.784	158.534	167.019	179.984	180.808	179.35	180.21(P)
North Korea	0.451	0.64	1.045	1.871	3.104	3 (P)	1.8(P)
South Korea	66.59	70.118	71.699	78.965	76.759	84.814	86.24(P)
Oceania							
Australia						0.1	0.1(P)
New Zealand	0.092	0.076	0.352	0.76	1.05	1.2	1.5(P)
South America							
Chile	3.173	2.886	2.463	4.178	4.024	4.5	5.6(P)
Brazil	14.991	13.304	15.032	16.619	15.951	16.063	18.28(P)
Argentina	0.838	0.925	0.968	1.42	1.553	1.85	2.51(P)
South Asia							
India	20.404	24.504	28.169	32.456	34.566	42.79	49.85(P)
Bangladesh	0.25	0.25	0.25	0.25	0.25	0.3	0.4(P)
Pakistan	0.971	1.205	1.658	2.592	2.363	2.85	1.8(P)
South East Asia							
Indonesia	0.036						
Philippines	7.33	6.844	6.383	4.437	4.542	5.894	7.6(P)
Thailand	4.886	5.525	7.808	7.48	8.498	11.104	13.3(P)
Malaysia	4.5	4.97	5.34	6.15	7.75	11.103	12.6(P)
Total	644.14	665.31	727.54	777.64	807.19	880.69	922.84

Top Coal Exporters (2009)

Country	Total	Steam	Coking
Australia	259Mt	134Mt	125Mt
Indonesia	230Mt	200Mt	30Mt
Russia	116Mt	105Mt	11Mt
Colombia	69Mt	69Mt	-
South Africa	67Mt	66Mt	1Mt
USA	53Mt	20Mt	33Mt
Canada	28Mt	7Mt	21Mt

Table 1.1 Import of All Coal - MT

Top Coal Importers (2009)			
Japan	165Mt	113Mt	52Mt
PR China	137Mt	102Mt	35Mt
South Korea	103Mt	82Mt	21Mt
India	67Mt	44Mt	23Mt
Chinese Tapei	60Mt	57Mt	3Mt
Germany	38Mt	32Mt	6Mt
UK	38Mt	33Mt	5Mt

U.S. Energy Information Administration (IEA) World Energy Outlook Reference Scenario suggests that the global demand for coal would grow from 4,595 Mt in 2000 to 6,954 Mt in 2030. Supply of one unit of energy from coal is estimated at only about one-sixth as capital-intensive as producing and transporting the same unit from gas. Coal is thus the least capital-intensive of the fuels with a significant share in world energy supply. Investment in coal would rise to $1.9 trillion if coal-fired power stations are included.

Investment in the coal industry is split relatively evenly between developing countries and the rest of the world. Investment in the coal industry is in critical balance with sustained economic growth and poverty reduction measures all over the world but particularly in developing countries.

Gas-fired power plants are at present smaller in size and require short period to commission than coal-fired power plants. The longer term potential of advanced coal-fired power generation and carbon sequestration technologies is significant. Clean coal technologies in conjunction with carbon capture and sequestration would allow coal to continue to provide low cost electricity in the carbon sensitized environment.

A substantive barrier to investment in coal mining and coal-fired power plants is the concern that investments could be constrained by the impending carbon emissions penalties that may be unlikely because of uncertainties about future environmental policies. However, continued research into clean coal technologies and carbon sequestration promises the potential for further improvements in the environmental performance of coal-fired power and cement production systems. The barriers to investment in coal mining and coal fired power plants and cement industry may be removed in the not too distant future because 1) the depletion of hydrocarbon resources is imminent, and 2) research and development in carbon capture and sequestration is gaining ground. Energy Policy makers will need to prepare themselves to give coal the status that it deserves in providing the economic and social benefits of coal.

Total cumulative investment in the bulk-dry cargo fleet required for coal trade is expected to be around $34 billion. This will be driven by growth in the world's international sea-borne coal trade of 419 MT between 2000 and 2030 and by the internal shipping requirements of India, China and Indonesia of 105 MT. World sea-borne coal trade is projected to reach 977 MT in 2030. The combined internal trade of India, Indonesia and China will reach 246 MT in 2030. Global port investment needs are expected to be modest at around $13 billion over the IEA World Energy Outlook period.

1.3.2 Pakistan Coal Imports

Cement Industry is a major user of imported coal in Pakistan. With 29 cement plants and annual production capacity of over 44 million tones, it contributes significantly to the national gross domestic product (GDP).

Cement industry in Pakistan has experienced great many changes in fuel usage as well as process since its inception in the late 1930s. It started with coal as fuel and was continuing with this fuel type until early 1950s when it switched over to furnace oil and to natural gas in mid-1950s. It has similarly passed from vertical wet-process kilns to short dry-process rotary kilns with cyclone towers, high-efficiency coolers and tertiary air to pre-calciners. At present the improvement has been brought in by the high- efficiency clinker coolers, which

allow the recovery of a significant amount of thermal energy, through the pre-heating of secondary and tertiary air.

The cement industry is highly energy intensive. Each tonne of cement produced requires not only large amounts of fuels (coal, fuel oil, natural gas), but also a significant quantum of electric energy. To produce one tonne of clinker a cement plant uses 850,000 kcal, using any type of fuel. Since the heating value of furnace oil is almost twice that of local coal, a cement plant uses 88 kg of furnace oil as against 170 kg of coal. Depending on the raw materials and the process, the production of one tonne of cement consumes an average of 3400-5000 MJ fuel energy (primarily in clinker burning) and about 100-110 kWh electrical energy.

The thermal energy input of fuel distributed in the cement making process is as follows:

- About 50% in the clinker burning, 20% as sensible heat in the Pre-heater exhaust gas (which also includes the heat used for the evaporation of spraying water), 3% as heat taken away by the clinker, 14% as sensible heat of cooler exhaust gas, 11% loss as radiated heat and 1% others.
- About 35% electrical energy is used for raw material pre-treatment, about 22% for burning and cooling the clinker and about 38% for cement grinding.
- Size reduction processes (raw material crushing and grinding and finish milling, e.g. clinker and gypsum grinding) require between 78 and 86 kWh/tonne cement produced.

All fuels consumed by the Pakistan Cement Industry are imported and energy typically accounts for at least 40% of the production cost of cement. Coal takes away a major share of energy required for cement manufacturing. 90% of coal requirement of Pakistan cement industry is met by imported coal; in fact coal is imported in Pakistan mainly for the cement industry. Since, most of the cement plants are situated in northern zone therefore considerable cost is associated with transportation and handling of coal from unloading at Karachi Port to destinations of respective cement manufacturing units. On average 6500 tpd cement plant operating on coal requires 40,000 tonnes of coal monthly or 1100-1400 tpd. The cement industry was paying USD 90/t on CIF Karachi basis for 6000 Kcal/kg coal until recently. However, the Indonesian Coal Price Index (ICI), for Jan, 2011, stood at $112.4 per tonne, increasing to $122.43 per tonne in February, 2011 and to $127.05 per tonne in March. Transportation and handling, each tonne of coal adds approximately $35 to the cost incurred by cement plants in the northern zone.

Cement makers have to use expensive imported coal because the locally available coal does not meet their calorie requirement.

Pakistan imports coal mainly from Indonesia, South Africa and China, and itself produces 3.2 million tonnes every year. Being inferior in quality it is used in brick kilns. There are three countries in the world that have reserves sufficient for the next 250 years; they include Pakistan, India and China. The coal available in Pakistan has high sulphur and moisture content which makes it suitable for power generation, but not for cement production. China has almost banned coal exports ever since it started to set up coal-based power plants. India is converting many of its power plants to coal-based systems, while Pakistan is not even preparing to go back to cement and power production systems based on coal.

1.3.3 Cement and Clinker Export in Pakistan

Pakistan cement industry has a huge potential for export of cement to neighboring countries like India, U.A.E, Afghanistan, Iraq and Russian states. Cement industry has expanded from 23 cement plants with an installed capacity of 16.5 million tonnes per annum in the mid 1990s to 29 cement plants with capacity to produce over 44 million tonnes. It started exporting the excess production of clinker and cement by the sea route since the year 2002. The industry has achieved the capacity to export over eight million tonnes cement and clinker per annum.

1.3.4 Handling of Coal/Dirty Cargo at Karachi Port

Pakistan imported a total of 4.565 million tons of coal during year 2010, while the total demand for coal for the year 2011

Table 1.2: Export of Clinker and Cement (Qty/Tons)

`	|----------Cement----------|			|---Clinker---|			Export Breakup	
Years	Afghanistan	India	Other Countries	Other Countries	Total	%age Incr/(Decr)		North Zone	South Zone
	Via Land	Via Sea & Land	Via Sea	Via Sea					
2001-2002	106,620	-	-	-	106,620	100.00%		106,060	560
2002-2003	430,322	-	-	41,500	471,822	342.53%		428,602	1,720
2003-2004	1,118,293	-	-	-	1,118,293	137.02%		1,088,218	30,075
2004-2005	1,407,900	-	157,270	-	1,565,170	39.96%		1,516,370	48,800
2005-2006	1,413,994	-	91,165	-	1,505,159	-3.83%		1,409,492	95,667
2006-2007	1,725,526	-	1,096,995	390,973	3,213,494	113.50%		1,929,938	1,283,556
2007-2008	2,777,826	786,672	3,045,995	1,106,127	7,716,620	140.13%		5,111,607	2,605,013
2008-2009	3,148,306	634,455	6,061,035	908,690	10,752,486	39.34%		6,989,136	3,763,351
2009-2010	4,013,670	722,967	5,637,163	283,436	10,657,235	-0.89%		6,960,854	3,696,382
2010-2011 (11-Months)	4,255,703	523,902	3,595,626	159,873	8,535,104	-12.52%		6,075,067	2,460,037

is expected at around 3.6 to 3.7 million tonnes, up by 8 to 10 percent compared with the imports in the year 2010. Coal is being imported in Pakistan for clinker/cement production and not for power production.

The increase in demand for coal prompted the Karachi Port to dedicate space at the coal yard in Keamari Island for storage of the imported coal. The coal after being off-loaded from ships is transported from the berths to the coal yard in open top dumper trucks that spill coal on their way to the yard, where it is stored in the open. With an increase in volume of coal imports there has been an increase in the size of the coal yard at Keamari. The coal yard now covering an area of about 12.5 hectares is studded with circular mounds of coal piled up to heights of over 25 meters at some places.

Efforts have been made by KPT to restrain the hazardous coal dust from being carried away by the strong coastal winds towards populated areas by sprinkling water, but that has not produced satisfactory results since excessive sprinkling results in increase in the moisture contents of the coal and thus decreases its market value and utility.

Coal dust has been posing potential risk of a major explosion as the Keamari coal yard is situated adjacent to the Keamari oil terminals since the coal dust accumulates and forms a thick layer on top of the large tanks containing different types of highly inflammable petroleum products. This has increased the risk of igniting the highly flammable products through coal dust explosion hazard.

KPT has done little to address the occupational safety and health guidelines for coal dust handling and has installed a new sprinkler system. The water spill from the sprinkler system would form coal slurry and may flow untreated into the sea causing damage to fisheries and other marine fauna and flora that may still be there.

Here it may be pertinent to note that the building of container terminals is invariably followed by construction of a terminal to handle dirty cargo at a distant location. Handling coal at a distance close to a container terminal poses major risks to the health of population resident in the neighborhood. The grave situation emerging from the present location of the coal yard at the Karachi Port demands relocation of the handling of dirty cargo from the Keamari area to another site.

In realization of the pressing need to have a dirty cargo handling at an environmentally compatible site, Port Qasim Authority (PQA) had invited Expressions of Interest (EoI) in July 2006 from foreign and national firms. Six companies were pre-qualified for the project and PIBT qualified as the most competent bidder. The NOC for development of Bulk Cargo Terminal was awarded to PIBT by PQA on 30 years build, operate and transfer (BOT) basis. The agreement with Pakistan International Bulk Terminal Ltd was signed in November 2010 to establish a USD 175 million modern bulk coal and cement terminal with a backup area of 25 hectares.

1.3.5 Objectives of Project

The Project aims to:

- Provide a modern facility for import of Coal, and export of Clinker and Cement by development of a dedicated

terminal incorporating state-of the-art bulk handling technology, reliable and proven safety design features and strict environmental control systems.

- Respond to the need of construction of dirty cargo terminal away from container and general cargo handling terminals to avoid the risks to the health of the population resident in the neighborhood.
- Respond to the security needs and contribute to segregation of transport related infrastructure facilities by creating a new Dirty Cargo handling Facility at a green field site in Port Qasim identified by PQA.
- Support the industrial growth process of the north zone which needs rapid transportation of imported coal from the port and of clinker and cement from up-country destinations to the port and also adequate storage capacity for dirty cargo at the port.

1.4 Environmental & Social Impact Assessment (ESIA)

1.4.1 Justification for ESIA Study

Section 12 of Pakistan Environmental Protection Act 1997 and Pakistan Environmental Protection Agency (PEPA) Review of IEE/EIA Regulations 2000 require that all development initiatives in Pakistan have to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA), depending upon the size and severity of impacts anticipated during construction, commissioning and operation of the project.

1.4.2 Categorization of the Project

PEPA Review of IEE/EIA Regulations 2000 categorizes projects in Schedule I, which may require i) an IEE or ii) Schedule II which require an EIA. Ports and harbors having gross ship displacement of less than 500 tons are covered by Schedule-I, while Schedule-II covers ports and harbors having ship gross displacement exceeding 500 tons. The Dirty Cargo Terminal falls under Schedule II as it involves shipping activity having gross displacement above 500 tons; accordingly it will require an EIA.

1.4.3 Purpose of ESIA Study

The main purpose of this ESIA Study is to respond to provisions of Environmental Protection Act 1997, and to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Dirty Cargo Terminal project and related activities that would take place concurrently or subsequently. The ESIA study is conducted for the purpose of:

- Describing the existing environmental setting of the project area;
- Summarizing the project activities in relation to the environment;
- Ascertaining applicability of relevant rules and regulations to the location and operations;
- Undertaking the ESIA from the perspective of environmental and social aspects in the project area, and suggesting mitigation measures for sustained development;
- Identifying the environmental consequences of siting the project and inception of associated activities;
- Identifying conditions that may require detailed design, and specification on activities during construction and operations of the project, besides measures necessary to mitigate the adverse environmental consequences;
- Assessment of impact of handling the dirty cargo and consequential hazards
- Ensuring the adequacy of proposed mitigation measures to deal with residual impacts after implementation of the Project.

1.4.4 Methodology Adopted for ESIA Study

ESIA study adopted the following procedure for making assessment of impact of different activities during the construction, commissioning and operational phases on microenvironment and macro environment of the project activity areas:

1) Scoping Exercise

Holding meetings with PIBT Project Officials and other stakeholders to:

- Discuss and define the magnitude of study in the light of scope of work.
- Plan a work schedule for collecting baseline data needed for assessment of status of microenvironment of PIBT project site, and its surrounding i.e. macro environment, and
- Obtain information on location and technology alternatives and on dirty cargo handling options.
- Incorporating views and comments of different stakeholders and their concerns on the project so as to prepare a generally consented document for approval of the decision makers.

2) Literature Reviews

Preparation of this study has input from field data collected by experts on different components of the environment during their visits to the site, meeting with PIBT Officials, EPA Sindh, Port Qasim Authority, stakeholders and the archives of the consultants. EMC contacted PIBT for the collection of project specific data such as design, site specification, soil survey, construction activities and operations besides HSE and Environmental Management and Emergency Response Plans which PIBT would adopt for the management of Bulk Cargo Terminal. The information so obtained was reviewed for better understanding of project by experts prior to conducting detailed site visits of project area.

Additionally latest authenticated published data on the physical and social environment of the project area was reviewed to compare/correlate with the information obtained during the surveys.

3) Surveys

EMC organized surveys for collection of information on settlements around project specific location within 5 km radius, considered here as forming the boundary of the microenvironment for ESIA study, through socio-economic surveys conducted by relevant experts. Issues related to project were discussed with stakeholders including relevant departments. Surveys were conducted by ecologists /marine biologist to investigate the marine ecosystem of the microenvironment to generate baseline data for impact assessment.

4) Monitoring & Analysis

EMC acquired the services of SUPARCO to conduct ambient air quality measurements for 24 hours to examine and establish air quality profile of the site.

5) Identification of Aspects

The aspects identification and significance determination process is fundamentally important to investigate the incidence of impacts at different stages of the Project and their assessment. This step gives an inventory of the aspects. The aspects identified during this step cover all activities during construction/operations, production and services in order to determine those which have or can have significant impact on the environment.

6) Assessment of Anticipated Impacts

Team Leader in association with environmental experts at EMC analyzed the identified aspects and assessed the anticipated impacts that may entail modification of the environment at Project site. This step involved the use of collected data for identification of impacts on human health and the environment and risks involved in different activities at the construction, commissioning and operation phases of the project.

7) Preventive Measures & EMP

Based on the impacts identified, mitigation and control measures were proposed by environmental experts at EMC in order to minimize the adverse impacts of construction of jetty and associated facilities and their operations on the environment. All mitigation measures were discussed in detail with the proponent representatives and an environmental management plan (EMP) has been developed to implement the mitigation measures in true spirit. A monitoring plan has been incorporated in the EMP to monitor the impact of activities and performance of mitigation measures and to identify positive/negative changes in the environment.

8) Documentation & Review

This is the final step that completes the ESIA study. The data generated during and for the study by experts of the respective field were compiled by EMC office staff and reviewed by Team Leader as the study progressed. The report was finally reviewed by Team Leader, who analyzed the information, assessed the potential environmental impacts in the light of national and international guidelines and organized the Report in the present form.

1.5 Report Set-Up

This document presents the environmental and social soundness assessment of the proposed Dirty Cargo Terminal project. It contains the following sections:

Section#1 Introduction and Objectives, introduces the project, gives its objectives, need for ESIA, categorization and methodology adopted for conducting the ESIA.

Section#2 Legislative and Administrative Framework, gives an overview of policy and legislation along with International Guidelines relevant to offshore terminals and associated environmental and social aspects.

Section#3 Description of Project, describes the Coal, Clinker and Cement Import/Export Terminal Project and associated facilities;

Section#4 Environmental & Social Baseline, provides a description of the microenvironment and macro environment of the project area with regards to the environmental & social baseline conditions.

Section#5 Screening of Alternatives, presents the system alternatives to the proposed project, including the siting alternatives evaluated for the proposed terminal and the alternative technologies considered for the proposed cargo handling facilities as well as dredging to create the berthing and turning basin.

Section#6 (Stakeholder Consultation): presents the objectives and outcomes of the stakeholder consultation conducted during the ESIA process.

Section#7 Potential Environmental Impacts of proposed development and recommended mitigation measures, describes the potential environmental and social aspects and of the proposed dirty cargo terminal on the different features of the micro and macro environment, and using the general guidelines present a screening of potential environmental impacts at the design, construction and operation stages. The screening process includes the residual impact as a result of adoption of mitigation measures that may be needed for minimizing the impact.

Section#8 Environmental Management Plan, presents the environmental management and monitoring plan.

Section#9 Conclusion & Recommendations, summarizes the findings of the study and presents its conclusions and recommendations.

1.6 ESIA Study Team

This ESIA Report has been prepared by Environmental Management Consultants (EMC). EMC organized the following team for the purpose of conducting the environmental assessment and preparing the report:

Table 1.1: ESIA Study Team

Sr. No.	Name of Expert	Designation
1	Engr. Syed Nadeem Arif	Project Manager
2	Mr. Saquib Ejaz Hussain	Dy. Project Manager & ESIA Specialist
3	Dr. Mirza Arshad Ali Beg	Team Leader & Senior Environmental Assessment Specialist
4	Dr. Iqbal Ali	Senior Hydrologist
4	Dr. Shahid Amjad	Senior Oceanographic & Marine Biology Expert
5	Dr. Badar Munir Ghauri	Senior Expert on Air Quality Monitoring
6	Dr. Mansoor Imam	Senior Waste Management Expert
7	Dr. Viqar Husain	Senior Geologist
8	Ms. Zulekha Soorma	EHS Advisor
9	Ms. Kaneez Fatima Mamdani	Senior Sociologist

02 LEGAL AND ADMINISTRATIVE FRAMEWORK

The success of environmental and social soundness assessment in ensuring that development projects are environmentally and socially sound depend on the capability of regulatory institutions for environmental management. Sustainable development is a concept that has emerged over the past three decades to describe a new framework aimed at economic and social development whilst maintaining the long-term integrity of the ecological and social system. The principles of sustainable development are in the process of being incorporated into national policies and legislation in Pakistan through various statutory instruments.

This Section of the ESIA Report describes the policy, legal and administrative framework in addition to the institutional set-up relevant to the environmental and social assessment of the Coal, Clinker and Cement Import /Export terminal at Port Qasim Project. It includes the National Legislations and International Guidelines on conducting assessment of environmental and social impacts. In view of the possibility of financing for the project from IFC, the Guidelines of both local and IFC are presented.

PIBT Ltd, the proponent of this project will comprehensively follow the relevant requirements of policy documents, legislative framework and recommendations described in national and international guidelines for the Port and Harbor projects. Mitigation measures that have been proposed in the light of relevant guidelines will be integrated in the Environmental Management Plan (EMP) which has been formulated for the better management of environmental as well as social aspects and residual aspects, if any.

2.1 Policy Framework

The Pakistan National Conservation Strategy (NCS), which was approved by the Federal Cabinet in March 1992, is the principal policy document for environmental issues in the country. The NCS signifies the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant to the proposed project are biodiversity conservation, restoration of rangelands, pollution prevention and abatement, and the preservation of cultural heritage.

Pakistan is a signatory to the Convention on Biological Diversity, and is thereby obligated to develop a national strategy for the conservation of biodiversity. The Government of Pakistan constituted a Biodiversity Working Group, under the auspices of the Ministry of Environment, to develop a Biodiversity Action Plan for the country, which was completed after an extensive consultative exercise. The plan, which has been designed to complement the NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country. The Pakistan Environmental Protection Council (PEPC) has approved the action plan and steering committees at the federal and provincial levels have been formed to implement it.

Mid-term Review of NCS: Key Findings

An overview of the key environmental issues facing Pakistan is as follows:

- Per capita water availability in Pakistan has been decreasing at an alarming rate. In 1951, the per capita availability was 5300 cubic meter which has now decreased to 1105 cubic meter just touching water scarcity level of 1000 cubic meter.
- Almost all fresh water resources are severely polluted

due to discharge of untreated industrial and municipal wastes. Pollution of coastal waters due to waste discharges and oil spills coupled with reduced freshwater flows is resulting in declining fish yields.

- About 55 percent of population has access to a relatively safe drinking water source. Potable water quality, assessed against WHO standards, fails to meet all the specified criteria, confirming evidence of extremely high pollutant loads.
- Approximately 35 percent of population has access to adequate sanitation facilities.
- Air pollution is on the rise, especially in urban areas. Recent surveys conducted by Pakistan Environmental Protection Agency revealed presence of very high levels of suspended particulate matter (about 6 times higher than the World Health Organization's guidelines). 'Smog' also seriously affects almost entire Punjab during December and January every year.
- Noise pollution has become a serious issue in major urban centers.
- Of about 54,850 tons of solid waste generated daily in urban areas, less than 60 per cent is collected. No city in Pakistan has proper waste collection and disposal system for municipal, hazardous or healthcare wastes.
- The deforestation rate has been estimated at 0.2-0.5 percent per annum. Forest cover, which was 4.8 percent of total land area in 1992, could hardly be increased substantially despite all efforts.
- Degradation and encroachment of natural forests, rangelands and freshwater and marine ecosystems are resulting in loss of biodiversity. At least four mammal species, including tiger, swamp deer, lion and Indian one-horned rhinoceros, are known to have become extinct from Pakistan while at least 10 ecosystems of particular value for the species richness and uniqueness of their floral and faunal communities are considered to be critically threatened.
- Desertification affects over 43 million hectares of land annually.
- Pakistan is a highly energy in-efficient country. It uses approximately same amount of energy to generate 1 dollar of GNP as the USA.

The situation just mentioned is the result of a number of constraining factors including high population growth rate, prevailing poverty, unplanned urban and industrial expansion, insufficient emphasis on environmental protection in the government policies, lack of public awareness and education and above all the ailing economy which has caused deficiencies in institutional capacity and resources for effective environmental management.

The mid-term review of the NCS led the Government of Pakistan (GOP) and United Nations Development Program (UNDP) to jointly initiate an umbrella support program called the National Environmental Action Plan-Support Program (NEAP-SP) that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability and poverty reduction in the context of economic growth. The primary objective of NEAP is to initiate actions and programs for achieving a state of environment that safeguards public health, promotes sustainable livelihood, and enhances the quality of life of the people in Pakistan. The NEAP identifies four primary areas, (1) Clean air (2) Clean water (3) Management of solid waste (4) Ecosystem management. The plan also presents five additional areas of concern (i) Management of fresh water resources (ii) Marine pollution (iii) Toxic and hazardous substances handling and disposal (iv) Energy conservation and management (v) Compliance with international treaties and protocol.

Studies conducted by GOP and Donor Agencies in Pakistan have identified a number of environmental concerns with regard to energy, water and air pollution, waste management, irrigated agriculture, and biodiversity. These studies suggest an overall degradation in the quality and impoverishment of renewable natural resources such as water, forests and other flora as well as key biological habitats. The GOP, private sector and civil society have, with few exceptions, not responded positively to meet the challenges from these concerns.

2.2 Statutory Framework

The Constitution of Pakistan distributes legislative powers between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal List covers the subjects over which the federal government has exclusive legislative power, while the Concurrent List contains subjects regarding which both the federal and provincial governments can enact laws.

Provisions for environmental protection and resource conservation are mentioned in The Constitution of Pakistan under "Environmental Pollution and Ecology", and it is a subject in the Concurrent Legislative List, meaning that both the Federal and Provincial Governments may initiate and make legislation for the purpose.

The development of statutory and other instruments for environmental management has steadily gained priority in Pakistan since the late 1970s. The Pakistan Environmental Protection Ordinance, 1983 was the first piece of legislation designed specifically for the protection of the environment. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards were established in 1993.

2.2.1 Pakistan Environmental Protection Act, 1997

Pakistan Environmental Protection Act was introduced in December 1997 to provide for protection, conservation, rehabilitation and improvement of the environment, for prevention and control of pollution and for sustainability of all development activities. The Act is the basic legislative tool that empowers the government to frame regulations to protect the environment. It broadly applies to air, water, soil, and noise pollution. The salient features of the law are:

1. The Act covers the air, water, soil, marine and noise pollution including pollution caused by vehicles.

2. The Act provides for fixing the National Environment Quality Standards (NEQS) and their strict enforcement. For default, the Government has been empowered to levy a pollution charge.

3. The Government has been empowered to issue environmental protection orders so as to effectively deal with and respond to the actual or potential violation of the law leading to environmental degradation.

4. Under this Act no project including construction activities or any change in the existing physical environment can commence unless the fulfillment of pre-requisite to IEE or EIA has been conducted and its approval obtained from the Responsible Authority, in the present case from Sindh EPA.

5. The imports of hazardous waste into the country has been banned and the transport of hazardous substances and dangerous chemicals or toxic material or explosive substances etc. has been regulated, through licenses, under prescribed rules and procedure.

6. To ensure compliance with the NEQS, the law provides for an appropriate mechanism including the installation of devices so as to control the pollution caused by motor vehicles.

7. A fairly high level body called, Pakistan Environmental Protection Council, headed by the Prime Minister and comprising the Chief Ministers of the provinces, relevant Ministers of the Federal and provincial governments, representative of trade, commerce and industry and members of the academia, has been constituted to formulate policy and provide guidelines for enforcing the law.

8. For the effective implementation of the provisions of the law, the Pakistan Environmental Protection Agency, headed by a Director General with other staff has been constituted. This Agency is responsible for enforcing the policy and implementing the provisions of the law. On the same pattern, Provincial Environmental Protection

Agencies have been created in each province.

9. There has been established Provincial Sustainable Development Fund, regulated and managed by a Board.

10. The Environmental Tribunals with exclusive jurisdiction to try serious offences have been provided. The law also provides for the appointment of Magistrates to try minor offences. Appeal against an order/judgment of a Magistrate lies before the Court of Session, whose decision is final. Appeal against the judgment of Tribunal lies to the High Court. Stringent punishment through heavy fine and imprisonment has been prescribed.

11. The Act also empowers the Federal Government to make rules for the implementation of international environmental agreements and conventions to which Pakistan is a party.

The enactment of the Pakistan Environmental Protection Act (PEPA), 1997 has conferred broad-based enforcement powers to the environmental protection agencies. The publication of the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations (IEE-EIA Regulations), 2000 provided the necessary details on the preparation, submission, and review of initial environmental examinations (IEE) and environmental impact assessments (EIA). In addition to the PEPA, 1997, Pakistan's statute books contain a number of other laws that have clauses concerning the regulation and protection of the environment.

The Provisions of rules and regulations have been enacted; they include National Environmental Quality Standards (Self-monitoring and Reporting by Industries) Rules, 2000; Environmental Samples Rules, 2001; Provincial Sustainable Development Fund Board (Procedure) Rules, 2001; Pollution Charge for Industry (Calculation and Collection) Rules 2001; National Environmental Quality Standards (Environmental Laboratories Certification) Regulations 2000; Pakistan Environmental Protection Agency (Review of Capital IEE/EIA) Regulations 2000; Provincial Sustainable Development Fund (Utilization) Rules 2002; Composition of Offences and Payment of Administrative Penalty Rules 2002 and Hazardous Substances Rules, 2002.

The Federal Government has established two Environmental Tribunals one each in Karachi and Lahore. The Karachi Tribunal has jurisdiction over the provinces of Sindh and Baluchistan while the Lahore Tribunal covers the provinces of the Punjab and the NWFP. The High Courts have designated senior civil judges as Environmental Magistrates to take all contraventions punishable in respect of handling of hazardous substances and pollution caused by motor vehicles.

2.2.2 Pak-EPA Review of IEE and EIA Regulations 2000

Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 promulgated under PEPA 1997 were enforced in June 2000. These Regulations define the applicability and procedures for preparation, submission and review of IEE and EIA. These Regulations also give legal status to the Pakistan Environmental Assessment Procedures prepared by the Federal EPA in 1997.

Accordingly the Environmental Protection Agencies, including Sindh EPA are bound to conduct a preliminary scrutiny and reply within 10 days of the submittal of the IEE/EIA report. These regulations require submission of a monitoring report to the concerned EPA after completion of the construction, followed by regular monitoring reports, in the case of EIAs, during subsequent operations. EPA is bound to approve or disapprove the report within a period of four months or else the EIA would be deemed approved.

This regulation also provides procedures for classification of projects on the basis of expected severity of the adverse environmental impact and lists them into three separate schedules. Projects that may not have significant impacts on the environment are included in Schedule-A, and they therefore require an IEE. Schedule-II includes Projects having potentially significant environmental impacts and such projects require submission of an EIA. Schedule-C includes those projects which do not fall in Schedules I and II and do not require an EIA or IEE but require an environmental approval to be sought.

Placement of Bulk Cargo: Coal, Clinker and Cement Terminal Project in Schedule-II is based on its severity and

has been discussed separately.

2.2.3 National Environmental Quality Standards (NEQS)

Pak EPA under the provision of PEPO of 1983 issued the National Environmental Quality Standards (NEQS) for municipal and liquid industrial effluent, industrial gaseous emissions and motor vehicles exhaust and noise in 1994. It required all units coming into production after 1st July 1994 to comply with the standards. Those already in production at the time of S.R.O were required to comply starting 1st July 1996. The Pak EPA could not implement the NEQS for many reasons, including lack of implementation capacity and resistance from industry.

With the legislation of PEPA-1997 the Pak EPA revised the NEQS with full consultation of the private sector, industrialist, trade and business associations, and NGOs. Revised standards cover discharges limits of effluents into inland water, sewage treatment plant and the sea. The NEQS for municipal and liquid industrial effluent standards cover 32 parameters, while for industrial gaseous emissions they specify limits for 16 parameters, and the standards for motor vehicles prescribe maximum permissible limits for smoke, carbon monoxide and noise. The NEQS are primarily concentration based. The limits on industrial effluents are neither industry specific nor have they any relationship with the quantum of production. The NEQS prohibit dilution of effluents, and requires keen monitoring for effective implementation. NEQS in Pakistan does not have standards/guidelines for threshold concentrations for sensitive land use soils. The proponent would be required to comply with the NEQS with respect to the effluent discharges, air and noise emissions.

2.2.4 Self- monitoring and reporting rules 2001

The Self-Monitoring and Reporting System (SMART) aims to make the country's industry owners and operators responsible for systematic monitoring and reporting of their environmental performance.

By implementing this system, the government has in fact transferred the responsibility for examining and evaluating industry's environmental performance to individual industrial facilities. Apart from saving EPAs considerable expense, time and effort, this measure has enabled industry owners and operators to make long-term provisions for eco-friendly production. The reported data enables government agencies to assist industrial units in controlling their pollution levels.

All industry owners, majority being small or medium scale operators have not responded to the Self-Monitoring and Reporting System and efforts are underway to bring them in the SMART network.

Proposed Dirty Cargo Terminal Project should because of its severity fall under the Category A of industrial categorization and reporting procedure for SMART. Regular environmental reports on priority parameters will be sent to the relevant authorities as per the requirements of ESIA approval.

2.2.5 The Biodiversity Action Plan

The key for protecting the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of the National Conservation Strategy and in becoming a signatory to, and in ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss.

This ESIA study has addressed all aspects of conservation, including Wildlife, and forest. It has specifically addressed the mangrove tree removal aspect and suggested mitigation measures.

2.2.6 The Sindh Fisheries Ordinance, 1980

The Sindh Fisheries Ordinance, 1980 regulates fishing in

the public waters, including the coastal areas, of Sindh. It empowers the government of Sindh to issue licenses for fishing in public waters, put restriction on the type of equipment that can be used for fishing, restrict fishing in certain areas or of certain species of fish, regulate the onshore trade of fish catch, and regulate the fish processing industry. Article 8 of the Ordinance prohibits the discharge of wastewater to public waters without the consent of the Director Fisheries.

Sindh Fisheries Department has been informed of the establishment of the Dirty Cargo Terminal at the site under consideration.

2.2.7 Antiquity Act 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain such articles of archaeological significance. Under the Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity
- If an archaeological discovery is made during the course of the project, it should be reported to the Department of Archaeology, Government of Pakistan.

The Act of 1975 is considered quite effective, provided it is administered appropriately. For its proper administration, the federal department of Archaeology needs adequate staff which has not been provided to it. Civic agencies authorized to grant permission for new constructions must keep in view the provisions of the Act. It has been suggested that the Act must be amended to make compulsory registration of the antiquities and the owner of the property be made responsible for preservation of the antiquity.

This ESIA Study has not found any antiquity artifact in the area concerned and does not find that the said Act would apply to siting of the Dirty Cargo Terminal under consideration.

2.2.8 Sindh Cultural Heritage (Preservation) Act, 1994

The Sindh Cultural Heritage (Preservation) Act, 1994 is the provincial law for the protection of cultural heritage. Its objectives are similar to those of the Antiquity Act, 1975. None of the sites protected under this law has been identified in the vicinity of Project site.

2.2.9 Forest Act 1927

This act empowers provincial forest authorities to declare any area as forest. The proposed project is not in forest declared area; however, mangroves will have the prime importance and their conservation will be considered when the project is executed.

The Forestry Departments manage official forestry reserves and have expressed concern about the level of woodcutting, camel breeding which has taken place in the area. IUCN as well as some responsible terminal operators in PQA have undertaken plantation of mangrove trees in a systematic manner.

The Proponent will be required to adopt conservation practices at the proposed project site at the pre-construction, construction, operation and post-operation stages.

2.2.10 Sindh Wildlife Protection (Second Amendment) Ordinance, 2001

Sindh Wildlife Department is responsible for protection of wildlife in the Province. The Department's concerns are limited to areas designated as game reserves, national parks or wildlife sanctuaries and to protecting species afforded protection under the law. So long as the law is not being contravened they have no official interest in activities carried on outside game reserves, national parks and wildlife sanctuaries. The Department nevertheless has the

powers to halt illegal activities outside the protected areas.

Sindh Wildlife Protection Ordinance 1972 was enacted to protect wildlife resources of the province directly, and other natural resources indirectly. It classifies wildlife by degree of protection, i.e., animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Ordinance specifies restrictions on hunting, and trade in animals, trophies, or meat. The Ordinance also provides for the creation of three classes of special protected areas: National Parks (Section 15), Wildlife Sanctuaries (Section 14), and Game Reserves (Section 16).

The 2001-Amendment to Sindh Wildlife Protection Ordinance (1972) allows carrying out activities for exploration of oil and gas in wildlife sanctuaries of national park areas in the province. The Ordinance relates to oil and gas exploration activities in Kirthar National Park, which was declared protected area under Sindh Wildlife Protection Ordinance 1972.

The Wild Birds and Animals Protection Act, 1992, the West Pakistan Wildlife Protection Ordinance 1959, the Wildlife Protection Rules and the Forest Act, 1927 provide for the protection of flora and fauna in the territory, including vegetation and protected forests.

As the Project area does not have any wildlife protected area in its vicinity nor does it fall under the flyway zone of migratory birds, no provision of this law would be applicable to it.

2.3 Environmental and Social Guidelines

Two sets of guidelines, the Pak-EPA's guidelines and the World Bank Environmental Guidelines are reviewed in this Report. These guidelines address the environmental as well as social aspects relevant to the proposed project.

2.3.1 Environmental Protection Agency's Environmental and Social Guidelines

The Federal EPA has prepared a set of guidelines for conducting environmental and social assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the environmental and social guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below:

- Guidelines for the Preparation and Review of Environmental Reports,
- Guidelines for Public Consultation,
- Guidelines for Sensitive and Critical Areas,

It is stated in the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 that the EIA or IEE must be prepared, to the extent practicable, in accordance with the Pakistan Environmental Protection Agency Environmental Guidelines.

1. Policy And Procedures For Filing, Review& Approval Of Environmental Assessments

These guidelines define the policy context and the administrative procedures that will govern the environmental assessment process, from the project pre-feasibility stage, to the approval of the environmental report.

This ESIA Study has followed the procedures laid out in the PEPA 1997 and Review guidelines 2000, and the ESIA will be submitted to the EPA Sindh in whose jurisdiction the project will be implemented. The PEPA has, however, been given the right to review any environmental report at any time and the power to revoke the decision of the provincial EPA, if it deems this to be necessary.

2. Guidelines for Preparation & Review of Environmental Reports

It requires proponents to prepare terms of reference for the environmental assessment reports. It requires that all studies should contain baseline data on the area and must contain an assessment of the potential environmental impacts and the recommended mitigation measures.

The guidelines have been duly followed while preparing this ESIA.

3. Guidelines for Public Consultation

These guidelines are part of the package of regulations and guidelines. They provide assistance throughout the environmental assessment of project by involving the public which can lead to better and more acceptable decision-making. The guidelines envisage that public involvement, if undertaken in a positive manner and supported by real desire to use the information gained to improve the proposal, will lead to better outcomes, and lay the basis for ongoing positive relationships among the stakeholders.

2.3.2 World Bank Guidelines on Environment

The principal World Bank publications that contain environmental guidelines are listed below:

1. Environmental Assessment-Operational Policy 4.01. Washington, DC, USA. World Bank 1999

2. Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross- Sectoral Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991

3. Environmental Assessment Sourcebook, Volume III: Guidelines for Environmental Assessment of Energy and Industry Projects. World Bank Technical Paper No. 154, Environment Department, the World Bank, 1991

4. Pollution Prevention and Abatement Handbook: Towards Cleaner Production, Environment Department, the World Bank, United Nations Industrial Development Organization and the United Nations Environment Program, 1998

The first two publications listed here provide general guidelines for the conduct of an IEE/EIA, and address the IEE/EIA practitioners themselves as well as project designers. While the Sourcebook in particular has been designed for the Bank projects, and is especially relevant for the impact assessment of large-scale infrastructure projects, it contains enormous information which is useful to environmentalists and project proponents.

2.3.3 Equator Principle

The Equator Principles (EP) comprises a series of standards for the management of environmental and social issues in financing development projects globally. Once adopted by banks and other financial institutions, the Equator Principles commit the adoptees to refrain from financing projects that fail to follow the processes defined by the Principles. The private sector banks which developed the Equator Principles chose to model the Equator Principles on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). The Equator Principles have become the de facto standards for banks and investors on assessment of major development projects around the world.

Project financiers may encounter social and environmental issues that are both complex and challenging, particularly with respect to projects in the emerging markets. The Equator Principles Financial Institutions (EPFIs) have consequently adopted these Principles to ensure that the projects they finance are developed in a manner that is socially responsible and reflects sound environmental management practices. By doing so, negative impacts on project-affected ecosystems and communities are avoided where possible, and if these impacts are unavoidable, they are to be reduced, mitigated and/or compensated for appropriately. It is believed that adoption of and adherence to these principles offer significant benefits to institutions, their borrowers and local stakeholders through their borrowers' engagement with locally affected communities. It is therefore recognized that the role of the institutions as financiers affords them opportunities to promote responsible environmental stewardship and socially responsible development.

EPFIs therefore consider reviewing these principles from time-to-time based on implementation experience, and in order to reflect ongoing learning and emerging good practice. These principles are intended to serve as a common baseline and framework for the implementation by each EPFI of its own internal social and environmental policies, procedures and standards related to its project

financing activities. The institutions will not provide loans to projects where the borrower will not or are unable to comply with their respective social and environmental policies and procedures that implement the Equator Principles.

The Equator Principles apply to projects over 10 million US dollars. The Principles state that adopting financial institutions will provide loans directly to projects only under the following circumstances:

1. Principle 1: Review and Categorization

The risk of the project is categorized in accordance with internal guidelines based upon the environmental and social screening criteria of the IFC. Projects are classified, relating to social or environmental impacts, in Category A (significant impacts), Category B (limited impacts) and Category C (minimal or no impacts).

2. Principle 2: Social and Environmental Assessment

For all medium or high risk projects (Category A and B projects), sponsors complete an Environmental Assessment, the preparation of which must meet the National and International requirements and satisfactorily address the key environmental and social issues.

3. Principle 3: Applicable Social and Environmental Standards

The Environmental Assessment report addresses baseline environmental and social conditions, requirements under host country laws and regulations, applicable international treaties and agreements, sustainable development and use of renewable natural resources, protection of human health, cultural properties, and biodiversity, including endangered species and sensitive ecosystems, use of dangerous substances, major hazards, occupational health, and safety, fire prevention and life safety, socio-economic impacts, land acquisition and land use, involuntary resettlement, impacts on indigenous peoples and communities, cumulative impacts of existing projects, the proposed project, and anticipated future projects, participation of affected parties in the design, review and implementation of the project, consideration of feasible environmentally and socially preferable alternatives, efficient production, delivery and use of energy, pollution prevention and waste minimization, pollution control (liquid effluents and air emissions) and solid and chemical waste management.

4. Principle 4: Action Plan and Management System

Based on the Environmental Assessment, Equator banks then make agreements with their clients on how they mitigate, monitor and manage those risks through a 'Social Environmental Management Plan'.

5. Principle 5: Consultation and Disclosure

For risky projects, the borrower consults with stakeholders (NGOs and project affected groups) and provides them with information on the risks of the project. The borrower has to consult the project affected communities in a structured and culturally appropriate manner. The process will ensure free, prior and informed consultation for affected communities.

6. Principle 6: Grievance Mechanism

The borrower will establish a grievance mechanism as part of the management system.

7. Principle 7: Independent Review

Assessment, preparation of Assessment Plan and consultation process.

8. Principle 8: Covenants

Incorporation of Covenants linked to compliance. Compliance with the plan is required in the covenant. If the borrower does not comply with the agreed terms, the bank will take corrective action, which if unsuccessful, could ultimately result in the bank cancelling the loan and demanding immediate repayment.

9. Principle 9: Independent Monitoring and Reporting

An independent expert is consulted during the life of the

loan for Category A and, if necessary in Category B.

10. Principle 10: EPFI Reporting

Each EPFI commits to report publicly at least annually about its implementation processes and experience on Equator Principles.

This ESIA study has adequately addressed the Equator Principles applicable to risky projects as stated hereunder:

A. Principle 1 (Review and Categorization): The study has reviewed the National and International Laws and Guidelines on different environmental aspects and has categorized the Dirty Cargo Terminal Project in Schedule-A (Major Hazard), requiring EIA.

B. Principle 2 (Social and Environmental Assessment): The Study has been prepared to respond to the National and International requirements and to satisfactorily address the key environmental and social issues.

C. Principle 3 (Applicable Social and Environmental Standards): For the purpose of this EIA Study, primary data on the baseline environmental and social conditions have been generated wherever necessary to address the requirements of National laws and regulations; applicable International Treaties and Agreements; sustainable development and use of renewable natural resources; protection of human health, cultural properties, and biodiversity and other physical, ecological and socioeconomic issues required to be addressed under this Principle.

D. Principle 4 (Action Plan and Management System): Chapter 5 of this study screens the potential environmental impacts and proposes/provides Mitigation Measures to reduce the severity of impact. The study also includes the Environmental Monitoring and Management Plan, Contingency Plan and Disaster Management Plan.

E. Principle 5 (Consultation and Disclosure): Being a risky project of Schedule-A, the public consultation is limited to the scoping sessions with stakeholders and an extensive socioeconomic survey of the villages/hamlets that are all outside the boundary of the Project area. The surveys and consultation meetings have established that no resettlement or temporary relocation or acquisition of land is involved.

F. Principle 6 (Grievance Mechanism): This Principle will not apply since 'no' resettlement or temporary relocation or acquisition of land is involved.

G. Principle 7 (Independent Review): Being placed in Schedule-A, an independent review may be needed.

H. Principle 8 (Covenants): The EIA study has incorporated Covenants linked to compliance. Moreover, No Objection Certificates are issued to Proponents of Project under conditions of compliance with the Mitigation and Performance Monitoring Plan. Needless to say that if the proponent does not comply with the agreed terms, Sindh EPA is authorized to take corrective and even coercive action.

I. Principle 9 (Independent Monitoring and Reporting): This Principle will be applicable to the Dirty Cargo Terminal Project since it is a high risk project.

J. Principle 10 (EPFI Reporting): The concerned EPFI may safely commit to report publicly at least annually about its Equator Principles implementation processes and experience.

2.3.4 IFC Performance Standards on Social and Environmental Sustainability

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions electing to apply them to projects in emerging markets. Together, the eight Performance Standards establish standards that the Proponent is to meet throughout the life of an investment by IFC or other relevant financial institution.

The objectives of Performance standards are given below:

- To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence
- To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities , and the environment
- To ensure that affected communities are appropriately engaged on issues that could potentially affect them
- To promote improved social and environment performance of companies through the effective use of management systems.

1. Performance Standard-1: Social & Environmental Assessment and Management System

This Performance Standard seeks to:

a. Identify and assess social and environment impacts in the project's area of influence;

b. Avoid, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment;

c. Ensure that affected communities are appropriately engaged on issues that could potentially affect them; and

d. Promote improved social and environment performance of the project through the effective use of management systems.

Under this Standard, the project is required to establish and maintain a social and environmental management system appropriate to the nature and scale of the project and in accordance with the level of social and environmental risks and impacts. The management system is required to incorporate the following elements:

- Social and Environmental Assessment;
- Management program;
- Organizational capacity;
- Training;
- Community engagement;
- Monitoring; and
- Reporting

This ESIA study has been conducted to respond to requirements of national legislation and international Guidelines and just as well fulfills the above requirements of the IFC Performance Standards PS1.

2. Performance Standard-2: Labor and Working Conditions

This PS seeks to establish, maintain and improve the worker-management relationship; promote fair treatment, non-discrimination and equal opportunity for workers, and compliance with national labor and employment laws; protect the workforce by addressing child labor and forced labor issues; and promote safe and healthy working conditions, and to protect and promote the health of workers.

The Sponsors of proposed project and their contractors will be required to adhere to this PS, in particular with regard to compliance with national labor and employment laws; employment of child labor, and promoting safe and healthy working conditions, besides protecting and promoting the health of workers.

3. Performance Standard-3: Pollution Prevention and Abatement

The PS 3 seeks to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, and to promote the reduction of emissions that contribute to climate change. The Standard requires the project to consider during its entire lifecycle ambient conditions and apply pollution prevention and control technologies and practices that are best suited to avoid or, where avoidance is not feasible, minimize or reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective.

PS 3 will be applicable to all stages of the Dirty Cargo Terminal Project. Various aspects of pollution prevention

and abatement of the proposed project are discussed separately in this report.

4. Performance Standard-4: Community Health, Safety and Security

The PS 4 seeks to avoid or minimize risks to and impacts on the health and safety of local community during the project lifecycle from both routine and non-routine circumstances, and to ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security. The PS requires the project to evaluate the risks and impacts to the health and safety of the affected community during the design, construction, operation, and decommissioning of the project and establish preventive measures to address them in a manner commensurate with the identified risks and impacts.

The present assessment addresses the requirement of PS 4 for the proposed project, and has evaluated the impacts of siting the Terminal on health, safety and security of the community in the microenvironment as well as the macroenvironment. The Environmental Management Plan also addresses company community aspects.

5. Performance Standard-5: Land Acquisition and Involuntary Resettlement

This PS aims to address the adverse impacts associated with land acquisition and involuntary resettlement caused by the project. The PS seeks to:

- avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs
- mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected
- improve or at least restore the livelihoods and standards of living of displaced persons
- improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.

The Dirty Cargo Terminal project site is dedicated to establishment of facilities of similar nature. Moreover there is no settlement or hamlet within the designated area. Land acquisition by the Project will therefore not cause any involuntary resettlement.

6. Performance Standard-6: Biodiversity Conservation and Sustainable Natural Resource Management

The PS 6 seeks to protect and conserve biodiversity, and promote sustainable management and use of natural resources through adoption of practices that integrate conservation needs and development priorities.

The present environmental assessment addresses the potential impacts of the proposed project on the biodiversity. This ESIA has recommended measures for the conservation of flora, fauna and other natural resources.

7. Performance Standard-7: Indigenous Peoples

The PS 7 seeks to address the impacts of the project on the indigenous people. Specifically, the objectives of the PS are to:

- ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples
- avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner
- establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project

throughout the life of the project

- foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples
- respect and preserve the culture, knowledge and practices of Indigenous Peoples

No indigenous people - with a social and cultural identity distinct from the existing dominant society that makes them vulnerable to being disadvantaged in the development process of the proposed project are known to exist in and around the proposed site. No such people were found in the area during the present study either. Therefore, this PS is not applicable for the proposed project.

8. Performance Standard-8: Cultural Heritage objectives have been set in the IFC performance standards to achieve sustainable development.

The objectives of this PS are to protect cultural heritage from the adverse impacts of project activities and support its preservation, and to promote the equitable sharing of benefits from the use of cultural heritage in project activities.

No sites of cultural heritage are known to exist at or in the immediate vicinity of the project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites. This PS will therefore not be applicable to the Project.

2.3.5 IFC- Environment, Health & Safety Guidelines for Ports, Harbors and Terminals

The EHS Guidelines for Ports, Harbors, and Terminals are applicable to commercial ports, harbors, and terminals for cargo and passengers transfer. Shipping (including repair and maintenance of ships), fuel terminals, or railways are addressed in separate industry sector EHS Guidelines, specifically the EHS Guidelines for Shipping, Crude Oil and Petroleum Product Storage, Railways, respectively.

The IFC-EHS guidelines for Ports, Harbors and Terminals have been thoroughly reviewed and applied while assessing the impacts of proposed activities of dirty cargo terminal project.

2.4 Acts, Regulations, Guidelines & Policies on Port Activities

2.4.1 Ports Act 1908 & Pakistan Territorial Waters & Maritime Zones Act 1976

The Ports Act 1908 ensures safe shipping in the sea and prevention of pollution in waters. Pakistan Territorial Waters and Maritime Act 1976 regulates the exploration, development, conservation, and management of living and nonliving resources in Pakistan's Exclusive Economic Zone (EEZ), which extends up to 200 miles from the country's coastal zone.

Ports Act 1908 and Pakistan Territorial Waters and Maritime Zones Act 1976 will both apply to the Project. The Project proponent will be mandated to ensure safe shipping of the ships and to adopt measures for prevention of pollution of the sea and the resources in Pakistan's Exclusive Economic Zone (EEZ), which extends up to 200 miles from the country's coastal zone.

2.4.2 Port Qasim Authority Act, 1973 (Modified in 2002)

This act empowers PQA to prepare master plan and a master-program for development of the port area. Environmental control and prevention of pollution in the port area are also responsibilities of this authority. This act encourages promising proponents to conduct EIA or IEE prior to any development in the port area. Clause 71B and 71C, explains the responsibilities of authorities and the penalties for non-compliance. Both the clauses are stated hereunder:

1. 71B (Port to be Pollution Free, etc)

- The authority shall be responsible for maintaining the marine environments of the port's limit in order to ensure that the sea, land and air are free from pollution.
- No owner or master of the vessel or any industry, manufacturing establishment, mill, factory or any kind, cargo handling company, terminal operator, etc. shall discharge any solid or liquid waste, oily, noxious radioactive and hazardous substances, bilge discharges, residues and mixtures containing noxious solid and liquid wastes, de blasting of unwashed cargo tanks and line washing, garbage, emission of any effluent or waste or air pollution or noise in any amount concentration or level in excess of NEQS, or standards, which may be specified, from time to time, by the Authority of Port limits.
- Any person contravening the provision of sub-section (2) shall be liable to penalty as determined and noticed by the authority from time to time for each contravention in addition to the charges for cleaning of port and removal of pollution there from.

2. Section 71C (Environmental Pollution)

No proponent of the project shall commence construction or operation unless he has filed with this authority an IEE or, where the project is likely to cause an adverse environmental effect, an EIA, and has obtained from authority approval thereof.

The authority shall:

- Review the IEE and accord its approval, or required submission of an EIA by the proponent; or
- Review the EIA and accord its approval subject to such condition as it may deem fit to impose, or require that the EIA be re-submitted after such modification as may be stipulated.

2.4.3 Coastal Zone Regulation 1991

Coastal Zone Regulation (CZR) 1991 concerns the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters. It extends on the beach up to 500 meters from the high tide line (HTL) and includes the land between the low tide land (LTL) and the HTL.

Setting up of new industries or expansion of existing industries, handling of hazardous wastes, discharge of untreated wastes and effluents, dumping of municipal wastes as landfill or otherwise, mining of sand, rocks and sub-strata materials and land reclamation within the CZR is forbidden, except for the purpose of construction of ports, harbors, jetties, wharves, quays, bridges and sea links.

CZR specifically lays down that reclamation for commercial purposes such as shopping and housing complexes, hotels and entertainment activities shall not be permitted. However, separate guidelines for construction of beach tourist resorts/hotels in CZR-III are provided for a no development zone (NDZ) for 200 meters from the HTL and within the area between the HTL and LTL is defined. With the prior approval of the ministry of environment and forests, two-storey structures can be built in this NDZ

This EIA Study has taken cognizance of Coastal Zone Regulation 1991 in screening the potential environmental impact of siting the dirty cargo terminal.

2.4.4 Maritime Policy of Pakistan

The National Maritime Policy of Pakistan was approved and notified on October 16, 2002. The policy advocates "Management of Assets in a judicious manner with conscientious regard to the environment and international law". The objective of the policy is "protection and conservation of maritime environment/ecosystem" and section IV of the Policy holds the Port Authorities responsible to protect the maritime environment within their prescribed limits. This includes tasks of monitoring and combating spills of all kinds.

2.5 International Treaties and Conventions

Pakistan is signatory/member to various international treaties and conventions on conservation of environment and protection of wildlife. The country is obliged to adhere to the commitments specified in these treaties. The United

Nations Conference on Environment and Development (UNCED), 1992 emphasized on Protection, rational use and development of resources; preventing further degradation and reducing the risk of long term irreversible effects; conservation of biodiversity, and sustainable use of genetic resources.

World Heritage Convention obligates the states to ensure identification, protection and transmission of natural heritage to future generations. A world heritage site is a site (natural or cultural) recognized by the international community (World Heritage Convention founded by the General Conference of UNESCO in 1972) as possessing universal value, and coming under a collective responsibility.

Other international conventions and programs to which Pakistan is a party relate to biodiversity conservation, for all of which there is a national legislation. Three conventions dealing with species are:

1. Convention on Conservation of Migratory Species of Wildlife Animals, adopted in Bonn, Germany in 1979 which Pakistan ratified in 1987;

2. Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), signed in Washington in 1973 of which Pakistan became a party in 1976;

3. Convention on Biodiversity (CBD), singed in Rio de Janiero in 1992 which Pakistan ratified in 1994.

4. Convention on Wetlands of International Importance especially as Waterfowl Habitat, signed in Ramsar in Iran in 1971, to which Pakistan became a party in 1978; and

5. Convention Concerning the Protection of the World Culture and Natural Heritage, signed at United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris in 1972.

2.5.1 International Convention on Biodiversity

The International Convention on Biodiversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity, and to integrate these plans into national development programmes and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

2.5.2 Convention on Wetlands of International Importance, (RAMSAR) 1971

Pakistan is a signatory to the RAMSAR Convention. The principal obligations of contracting parties to the Convention are:

- To designate wetlands for the List of Wetlands of International Importance
- To formulate and implement planning so as to promote wise use of wetlands
- To carry out Environmental Assessment before transformations of wetlands, and to make national wetland inventories
- To establish nature reserves on wetlands and provide adequately for their wardening and through management to increase waterfowl populations on appropriate wetlands
- To train personnel competent in wetland research, management and wardening
- To promote conservation of wetlands by combining far-sighted national policies with coordinated international action, to consult with other contracting parties about implementing obligations arising from the Convention, especially about shared wetlands and water system
- To promote wetland conservation concerns with development aid agencies
- To encourage research and exchange of data

So far 18 sites in Pakistan have been declared as wetlands

of International Importance or RAMSAR Sites. Of these, there are about 45 game sanctuaries and reserves spread over an area of 0.90 million hectares in Sindh. None of these wetlands have been included within or close to the project area. Haleji Lake and Kinjhar (Kalri) Lake are the two lakes designated as Wildlife Sanctuary. These freshwater lakes are internationally important areas for breeding, staging and wintering water birds. They are however at 70 km and 150 km distance from dirty cargo terminal project site in Port Qasim.

2.5.3 IUCN Red List

IUCN has published red list, it includes those species that are under potential threat of extinction. These species have been categorized as endangered, vulnerable in decline, lower risk species and data deficient species that may be at risk of extinction in the wild. Red list of mammals found in Pakistan is attached in the Annexure.

No faunal species that fall under the IUCN Red List category were observed during the surveys at the site for the ESIA study.

2.5.4 Kyoto Protocol

The Kyoto Protocol to the United Nations (UN) Framework Convention on Climate Change (the Kyoto Protocol) addresses the emission of greenhouse gases. Greenhouse gases are naturally occurring and man-made gases that absorb infrared radiation and thus may enhance atmospheric warming. The Kyoto Protocol aims to reduce emissions of six greenhouse gases, including CO_2, methane (CH_4), and nitrous oxide (N_2O) by 2008-2012. Article 2 of the Kyoto Protocol calls on the participating governments to implement policies that enhance energy efficiency and encourage measures to limit or reduce emissions of greenhouse gases. The Kyoto Protocol was opened for signatures on March 16, 1999, at the UN Headquarters in New York. After signing the agreement, each government must ratify it before it becomes officially adopted. As of July 24, 2002, 84 parties have signed the agreement, and 22 nations have ratified the agreement. The Kyoto Protocol will become effective 90 days after it has been ratified by at least 55 Parties to the United Nations Framework Convention. This will represent at least 55 percent of the total 1990 CO_2 emissions from developed countries. The Pakistan has signed and acceded to the agreement.

2.5.5 International Maritime Conventions

PIBT and its suppliers will comply with International Maritime Conventions in the import/export of Coal, Clinker and Cement. These will include the conventions of the International Maritime Organization, International Labor Organization, United Nations, World Health Organization and others as appropriate.

MARPOL 1973 (modified in 1978): Ship-generated waste is regulated globally as part of the implementation of the International Convention for the prevention of pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78). The requirement of MARPOL 73/78 is established in 20 Articles, two Protocols and five annexes; these include contamination by oil, noxious liquid substances carried in bulk, harmful substances, sewage and garbage. Pakistan is signatory to all five annexes. Nevertheless, pollution prevention practices consistent with MARPOL requirements will be adhered to during all the phases of project. The Project proponent will be mandated to ensure safe shipping of the Carriers and besides adopting measures for prevention of pollution of the sea, will follow the International Convention for the prevention of pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78).

London Convention 1972: In 1972, The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter defines a Black List of toxic substances, and a Grey List of less hazardous substances that may only be dumped under a prior special permit, the dumping of any other wastes not specified in these lists requires a prior general permit. In 1990 this Convention was amended to require signatory countries to consider whether an adequate scientific basis exists for assessing the environmental impact of a substance (i.e. dredged material)

before issuing a permit for dumping. Pakistan is signatory to the London Convention and a Notification came into force on 8th April 1995.

The Project Proponent will follow the procedures adopted by the other units based in Port Qasim area for dumping the wastes including dredged material.

Laws of Seas: The UN Convention on the Law of the Sea was adopted and opened for signature in 1982. On November 16th 1994, it entered into force for 68 countries. Pakistan is signatory to the convention. It establishes a basic structure of obligations, objectives and principles covering all sources of marine pollution that include:

- Pollution by vessels (operational and accidental discharges from ships), and
- Dumping (the deliberate disposal of wastes at sea by ships, aircrafts, platforms, or other manmade structures).

The Project proponent will be mandated to ensure safe shipping of the Carriers and follow the Laws of Seas for prevention of pollution by vessels, besides taking measures to avoid dumping of ship wastes into the seas.

National Fire Protection Association (NFPA) develops fire safety codes and standards drawing upon the technical expertise of persons from diverse professional backgrounds that form technical committees. These committees address concerns about specific activities or conditions related to fire safety. The members of these committees use an open consensus process to develop standards for minimizing the possibility and effects of fire.

The standard also incorporates, by reference, technical standards developed by a number of other professional organizations, such as American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), the American Petroleum Institute (API), the American Concrete Institute (ACI), and the American Society for Testing and Materials (ASTM).

The codes and standards used would be explicitly mentioned in the detailed design. The technical design would mostly be based on the technical standards and guidelines provided along with the NOC issued by PQA with international codes, guidelines and standards with proper justification that are currently applicable.

2.6 Administrative Framework

Environmental issues are governed by three levels of the government viz. Federal, Provincial and Local Government. The Ministry of Environment and Local Government is the Ministry at the Federal level, which oversees the affairs of the environment in the country. The Provincial Governments have designated the Ministries of Local Government to oversee matters related to the environment at the provincial level. The Provincial EPAs are directly under the respective Provincial Ministry of Local Government and Environment. Sindh EPA is placed under the Ministry of Environment and Alternative Energy, GoS.

2.6.1 Institutional Setup for Environmental Management

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided over by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals.

The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the proposed projects, and provide their approval (or otherwise).

The proposed project would be located in Sindh Province. Hence this EIA Report will be sent to the Sindh EPA for review and issue of No Objection Certificate (NOC).

The GoS involvement in local government and municipal affairs has been devolved to the Environment Department of the CDGK. However, the devolution program has not been implemented since an environment officer, required to oversee the environmental issues has not been

appointed. Coordination of the environmental monitoring activity continues as a provincial subject and is assigned to Provincial EPAs, in this case EPA Sindh, which has been duly authorized to enforce environmental compliance.

The main organizations responsible for providing services in the areas where the Project will be established include the Port Qasim Authority directly and the Maritime Agency of Pakistan.

03 DESCRIPTION OF PROJECT

3.1 Location of Proposed Terminal

The proposed bulk dirty cargo terminal for handling of Coal, Clinker and Cement will be located in Port Muhammad Bin Qasim, along Phitti Creek Channel at approximately 45 km from the open sea. Its jetty will be located in Kadiro Creek. The trestle for connecting the jetty to the back-up area will be built over the same island on which the existing trestle of PROGAS and FOTCO Oil Terminal are located and will also run parallel to the two terminals just named. The Storage area will be located just north of Korangi Creek on the east of microenvironment of the trestle will be the same that has been in use.

Port Qasim handled 12.64 million tons of liquid cargo, 3.605 million tons of dry cargo, and 756,000 TEUs of general cargo during the financial year 2009-10, with a year-on-year growth rate of 17 percent. The principal imports at Port Qasim include: chemicals, coal, crude oil, furnace oil, iron ore and wheat, while principal exports include rice and clinker/cement. The available accommodation for vessels in Port Qasim is shown in Table 3.1.

3.1.1 Seaside Access

The proposed location for the jetty will be adjacent to the main navigation channel of Port Qasim. The jetty will be set back from the main channel to avoid interference with the traffic in the main channel. Night navigation is possible at Port Qasim at present. The width of the channel does not restrict the passing of two large ships, while its draught allows for the ship size to more than 55,000 metric tons deadweight DWT during high tide.

Port Qasim Authority (PQA) carries out the dredging and maintenance of the channel as well as the turning circle, and the approaches to the berth. PQA ensures a minimum depth of navigation channel at -12.0 meters; but it has decided to undertake deepening and widening of the main navigation channel to -15.5 meters for access of ships of 75,000 DWT. There is no congestion in the channel at present.

3.1.2 Hinterland connections

The existing road network of PQA extends from the national highway to the storage yard onshore. A new road needs to be built to provide direct access to the terminal. This road will connect the terminal with the National Highway to the road network of the Country. The Karachi - Peshawar main railway line runs at a distance of about 13 km; a branch line connects the main line with the facility at Pakistan Steel Mill. The PQA has land reservation for extension of the railway line to the proposed site of PIBT.

Table 3.1: Accommodation for vessels at PQ

Name	Total Length (m)	Draught (m)	Dedicated for
Iron Ore & Coal Berth	279	11.5	Pakistan Steel
Marginal Wharf	800	10-10.5	Oil/Bulk Cargos
Fotco Oil Terminal	280	11	Fotco
Engro Vopak Terminal Limited	325	11	Chemicals/LPG
Qasim Int. Container Terminal	600	12	QICT
Progas		6	Progas
Fauji Akbar Portia Marine Terminal		11.5	FAP
Total	2.284		

Source: PQA

Figure 3.1 shows the location of the proposed bulk terminal site on satellite imagery. The proposed site for the Dirty Cargo jetty and the back-up area is shown in the figure 3.2, extracted from the Port Qasim Master Plan.



Figure 3.1: Location of the proposed bulk terminal site on satellite imagery.

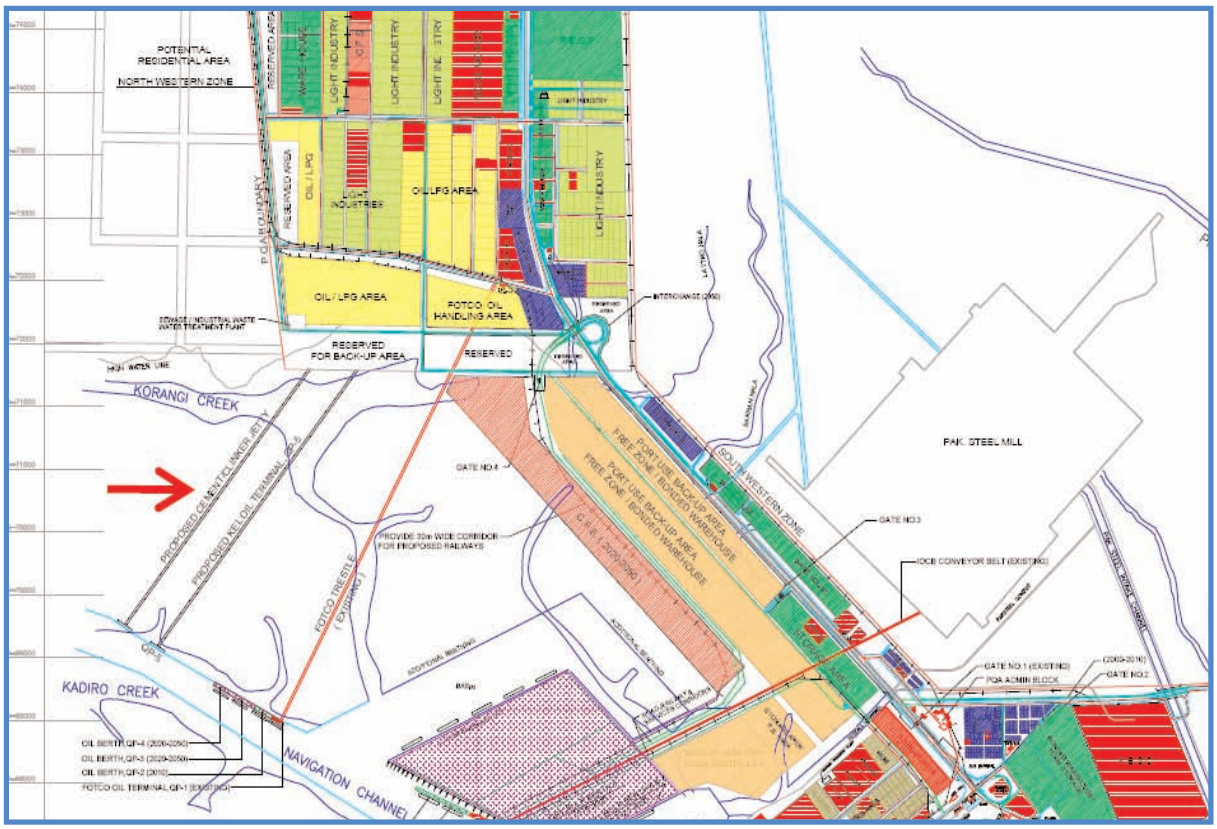


Figure 3.2: PQA Master plan showing location of proposed dirty cargo jetty and the backup area (Source: PQA)

3.2 Civil Engineering and Construction Works

3.2.1 Jetty Design Criteria

The alignment of the jetty will be straight in east-west direction, and will have sufficient length to accommodate two Panamax vessels bow to bow simultaneously. According to design estimates, two berths will be required, one for coal and the other for cement/clinker. In order to reduce the length of the jetty to the zone where ships have their hatches, the sterns of ships will slightly overhang the jetty structure. Two additional mooring dolphins, one at each end of the jetty, will ensure that despite the stern overhang, ships will be safely moored. The quay is required to have a depth of -15.5 meters, to accommodate 75,000 DWT bulk carriers.

The width of the jetty is defined by the space requirements of the equipments to be installed on the platform of the jetty (coal un-loader and cement/clinker loader). Discharge conveyors need supports at every 7.5 m interval, while the elevated gallery for loading conveyor needs supports at each 30 m interval. At these locations the jetty needs to be extended by concrete beams.

Fenders will be fixed waterside along the jetty at intervals of 30 m to ensure that the vessels, while approaching at an angle and not parallel, hit the fenders and not the concrete structures.

1. Design Loads

Live Area Loads for jetty: The projected jetty does not have any adjacent stacking area and there is no uniformly distributed traffic load behind the quay apron, adjacent loads may therefore not be necessary.

Vertical and Horizontal Quay Crane Loads: The vertical wheel load of loader and unloader are a maximum of 580 kN/wheel, while the horizontal load is maximum 10 percent

of the vertical one. The conveyors have a weight of 1.5 ton per lineal meter including supporting steel structure and live load. Traffic load for heavy vehicles (such as heavy mobile cranes) may add a maximum 500 kN point load in one field of 7.5 x 7.5 m.

Additionally an impact coefficient of = 1.2 needs to be applied to account for local effects and for designing the crane beam. Considering the entire system the impact coefficient may be neglected.

Cranes will require a tie down for storm conditions, if found necessary by the manufacturer/supplier. Tie-down forces may be assessed to be 1,000 kN per tie-down pit. At both rails one jack-up area with max. 5000 kN point load is required. For unloading the crane, loader and other equipment from heavy cargo vessels the jetty will need specific strengthening over a length of approximately 22.5 m.

At the end of the jetty structure buffer tops have to be arranged on both sides, which need to have the capacity to withstand a load of 800 kN each from the cranes and loaders.

All mentioned load and forces as well as a footprint for anchor tie-down pits and jacking-pads will have to be confirmed by the contracted crane manufacturer during detailed crane design and in collaboration with the civil works contractor.

2. Mooring forces

Design of the new jetty will need to consider bollard pull forces of 1,500 kN according to EAU 2004 for vessels of approximately 95,000 tons displacement. Spacing between bollards will be 30 meters. Design of anchors will include single load of one bollard distributed over adequate length with respect to bending and shear stiffness of the capping beam.

Design of the entire system will assume the mooring force to act horizontally and perpendicularly to the jetty. For the design of local reinforcement around the bollards mooring forces may be assumed to act in all applicable directions.

3. Berthing Forces

Berthing energy will be derived on the basis of data in Table 3.2 on dimensions of the design vessel (displacement in particular) and the berthing conditions.

Table 3.2: Design Vessel

Parameter	Unit	Large Design Vessel	Small Design Vessel
Overall length	m	255 m & 294 m for 2 & 1 vessel berthing resp.	140 m
Beam	m	32.3 m	18 m
Draft	m	14.3 m	8 m
Ship height to main Deck	m	20 m	11 m
Maximum capacity	DWT	75,000	10,000
Displacement	Metric ton	95,000	15,000

For the design of the fenders a maximum hull pressure of 200 kN/m^2 may be accepted. The distance between ship hull and quay wall can be checked with sufficient space remaining for compressed fenders.

4. Temperature Induced Loads

Constraint forces resulting from the differences of temperatures will be considered according to the relevant Pakistani Standards. It may be noted that crane rails are continuously welded and have no expansion joints in their rails).

5. Restraint Forces

Connection between concrete bodies (e.g. capping beams and crane beams eventually without extension joints, etc) needs to account for a full restraint cross-section. The following significant loads need to be considered:

- Shrinkage (according to Eurocode 2)
- Temperature (Temperature induced loads)
- Adequate value for heat of hydration (depending on

cement used, working sequence, curing of concrete, etc.

- Settlement

Restraint forces may be calculated using a non-linear approach for the reinforced cross-section. Guidelines are available from Eurocode 2.

6. Set-back of the jetty

The set back of the jetty structure will need to be optimized. The optimum solution is to set back the jetty at 80 meters, which from nautical experience appears to be ready for future developments to increase the channel depth to -15.5m CD. A lesser set back of 50 m has been proposed which would on the one hand require lesser investment and maintenance dredging but will make berthed vessel susceptible to unstable movements created by the vessels passing-by the jetty, which increase the chance of breaking of the mooring ropes. An alternative considered is extension towards the PROGAS berth, which has a smaller water depth and no set back. It will therefore be ascertained at the outset if excessive dredging in the neighborhood would expose the PROGAS structures to stability risks.

7. Quay Design

The layout of the bulk terminal development at Port Qasim comprises the construction of a new quay wall with approximately 439 m total length, a trestle with a conveyor belt connecting the jetty with the storage yard of 2440 meter length, together with storage yard and on-shore facilities.

The proposed jetty will be an open piled structure with deck area of 439 meter length. The superstructure consists of Cast in situ capping beam (approximate size 1.4 m deep x 1.8 m wide) on top of piles. The 350 mm thick Pre-cast RC slab panels will be placed with cast in place structural screed on top of it. The substructure consists of two types of piles. The vertical piles below crane tracks consists of 1500 mm diameter cast in place RC bored piles spaced at 7.5 m 900 mm diameter Steel are proposed in middle portion of jetty structure to resist strong lateral loads.

The width of the deck will be variable and according to provisions it will be between 19 meters and 32.5 meters, and up to 36.5 m at the location of the berth office.

At the seaside end, the jetty will be up to 29 m in width which will enable the vessels to conveniently make the manoeuvring.

At the connection to the trestle there will be a platform for a berth office, a mini workshop and parking space for shovel-loaders and other vehicles. Part of this platform will be located below the quay conveyor gallery.

An elevation of the jetty of CD +7.0 m is selected to ensure that the pile caps can be prepared above water level and the jetty surface is not flooded. The water depth at the jetty front line is assumed to be CD -15.50 m at the second stage. In the first stage the berthing basin shall be dredged up to a depth of -12.5 m CD.

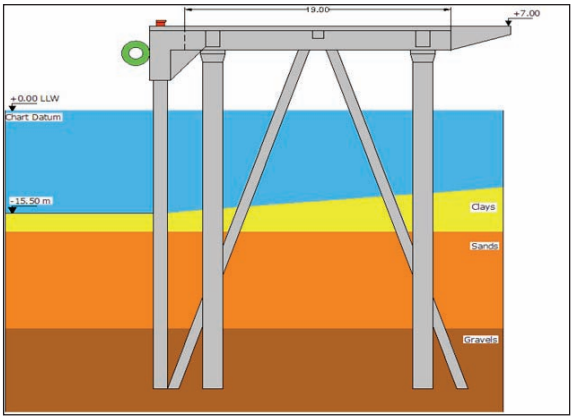


Figure 3.3: Schematic Drawing- Cross Section of Piled Jetty

- The quay will be of open berth quay type supported by concrete and steel piles. The horizontal support will be provided by an A-steel-frame.
- The quay deck will be formed by a combination of pre-cast and in situ poured concrete elements.
- The piles will be spiral welded tubular steel piles with different dimensions between 500 mm and 1400 mm diameter. Alternatively drilled piles with in situ concrete will be used.
- Subject to the results of detailed engineering the piles will be designed to penetrate approximately 5 to 10 m into the gravel layer; and geological data on soil and rock stability may demand socketing at some locations.
- Should steel pipes be used the steel pipe will have sufficient thickness at the end of lifetime of 40 years; in

addition the piles will have a concrete filling in the upper part.

The quay furniture includes:

- Fenders every 30 meters (type and spacing to be specified in the fender study)
- 150 ton pulling force bollards at 30 m spacing
- Safety ladders
- Crane rail PRI85R with buffer stops
- Crane locking points and crane tie down points
- Cable ducts will be fixed to the conveyor supports, the elevated cable channel for the crane and loader power supply will be fixed to the conveyor supports of the coal conveyor. Consequently the jetty structure will not have ducts.

3.2.2 Dredging and Reclamation

1. Dredging

Dredging to the required depth for berthing of vessels of 75,000 DWT as well as maintenance of the required dredged berth will be the responsibility of the PIBT. Dredging in front of the jetty to accommodate 55,000 DWT will be made before delivery of the crane and loader. Dredging for 75,000 DWT ships will only be made when the approach channel has been dredged to -15.5m depth to accommodate ships of the said size.

Mode of disposal of the dredging spoil will be worked out before initiating the dredging operations. Alternatives available include landfill of the proposed storage area, and transfer to a site identified by PQA. Geotechnical investigations at the site indicate that the top silty Clay/ Clayey silt is unsuitable for using in Reclaimed Area, since use of such material in Reclaimed Area will encounter undesirable large settlement of the area on long term basis. However material of Layer II and Layer III is usable for Reclaimed Area. The thickness of this material is generally 3 to 6m and hence can be considered for the purpose of reclamation of the back-up area that will be used as storage area.

This may entail problems of disposal of the dredged materials and material transfer through 2.5 km mangroves swamp. According to geological investigations the material dredged from the site consists of soil that was eroded during the process of creek formation. As such the eroded material may be used for restoration of land that would be dredged.

In case the dredging requires cutting hard rock, the dredging process may result in destabilizing the creek system which is already under stress. Geological investigations at the site indicate that the layer from El. -10.0 to -28.4m consists of very dense, Sandy gravels/ Clayey gravels & Clayey sand. This is sufficient reason to use the dredged material for reclamation instead of dumping it elsewhere.

2. Reclamation

The storage area comprises a large depression, which will have to be filled in to level +5.50 m with some extra height to compensate for expected settlement.

The entire reclamation material could be provided from offshore sources. These reclamation materials shall be placed by bottom dumping and thereafter by the rain bowing method. Side dams constructed in Christmas-tree fashion from quarried rock or large geo-bags will be used to manage the reclamation plan. This alternative has been subjected to geological investigation and it has been found that the layer from El. -10.0 to -28.4m consists of very dense, Sandy gravels/ Clayey gravels & Clayey sand and not hard rock. As such excavation of gravel for land filling at the site is not likely to modify the coastline.

The reclamation up to the formation level (base of pavement base layers) will be further compacted to sufficient bearing capacity. High Impact Compaction or Vibro Compaction methods will be applied.

An alternative method for consolidating and reducing the settlement to an acceptable extent for operations would be overloading combined with vertical drains to accelerate the settlement process. This method can be applied on soils with no large-sized gravels.

3.2.3 Approach Trestle & Causeway

A 2.4 km trestle bridge is proposed for connecting the Jetty to the on-shore storage area. The site area proposed for the alignment of Trestle structure covers mainly Mangrove land. The construction of Trestle bridge will require a corridor

along alignment of Trestle bridge by removing Mangroves and dredging for the channel of about 50m width and depth to about El.-3.0m.

Based on geological investigations on site and in view of operational requirements, it has been recommended that the Trestle structure should be supported on Pile Foundations. The piles shall penetrate into bearing strata. Soil Profiles show that the subsoil below El -15.0m CD PQA may be considered as bearing Strata. The Pile may penetrate 5 to 15m below this level, depending on required Pile Capacity.

Pile Capacity: Based on geological investigations it is suggested that bored piles shall be considered for this project, since driven piles may have drivability problems.

Two alternative locations are available for siting the trestle bridge:

Alternative 1: The trestle is supported by a pair of piles at 12 m space each. This pair of piles is connected by a concrete beam, which supports:

- A 3.5 m wide bridge for heavy trucks, such as mobile cranes, emergency vehicles and trucks to carry heavy parts of the bridge. Further such plant can be used for transport of large imported machinery to the storage area. Bridge girders are made of prefabricated concrete.
- A steel truss structure carrying 2 conveyors. The steel structure has a span of 12 m.
- At the jetty end of the trestle a platform shall be built to support the transfer station and will house the jetty office and a small workshop.

Trestle piles will be designed to support an access bridge for maintenance, fire fighting and other services. The access bridge will consist of pre-cast RC slab-beam deck. The planned dimensions of pre-cast deck are 4 m wide x 12 m long. The dimensions of pile trestle will be 1.6 m wide x 1.4 m deep x 7 m long. Two cast concrete bored piles of 1,200 mm diameter will be provided for each trestle.

Alternative 2: The trestle is supported by single piles every 12 m (or larger distance subject to results of structural design requirements). The piles only carry the steel structure truss construction for the conveyors. The top of the truss will be covered by a reinforced 10 mm thick 2 m wide steel plate with side protection. This platform can be used as small road for pick-ups (maximum 3.5 ton) with small spare parts, mini buses for labor transport, mobile workshops, police, customs, small fire brigade vehicle and ambulance.

In this option trestle will be provided to support only conveyors. No full road access will be provided up to the jetty. The size of trestle will be 1.6 m wide x 1.4 m deep x 2.15 m long. Single cast in place concrete pile of diameter 1,200 mm will be provided at 12 m spacing.

In both alternatives the trestle also carries utility ducts for water and electrical services. As the access only has one lane, there must be a passing point on half the way.

The land reclamation goes far into the creek. Therefore it is possible to have a straight line between the storage area and the jetty, avoiding bends and transfer stations in the middle. To save transfer stations it is necessary that the trestle conveyor goes directly to the main transfer tower. The definition of the exact position of the trestle would be left to detailed design, which will take into consideration the space required for the rail yard on the terminal. Space for the rail yard may require the shifting of the start of the trestle not exactly at the corner of the concession area but slightly to the East.

3.2.4 Earth Works

Earth works are required for the following items:

- Placing of the pavement in the storage area
- Leveling works for road and railway tracks
- Rain water drainage
- Fresh water and sewerage system
- Electrical network-system
- Excavation for building foundations
- Dam for the stacker

Large settlement of soil is expected at the initial stage of operations, hence substantial earth works may have to be postponed to be taken up in phase 2. The storage area, for example, will not be paved in phase one. For rain water drainage there will be only a few ditches at unused areas. At

phase 1 there will be no stacker and no railway siding and hence no earthworks will be involved for these items.

3.2.5 Storage Yard Design Criteria

The storage area is planned at nominally CD +5.50 m after settlement.

The gate office, administration building, workshop building and electricity substation with generators, cement silos and compressor station are arranged at this level.

Coal and clinker will be stacked in open storage; the maximum stack height will be 15 m. The density of the cargo in the storage is significantly higher than on a conveyor where it is loose. The compacted wet coal density can be up to 1.2 ton/m³; clinker can have a density of up to 1.52 t/m³. Consequently loads to the ground can be 180 kN/m² for Coal and 224 kN/m² for clinker respectively. Soil analysis will indicate, if the ground can carry such load, and the type of settlement expected. In the first few years it may be required to limit the stack height to ensure stability of the ground and there is no soil failure. In the clinker stack (high requirement for dryness) the drainage slope shall be 2 percent, in the coal stack there shall be 1 percent slope. The initial area elevation will be prepared in such manner that planned levels and slopes will be reached after settlement. As the subsoil is not uniform, settlement will not always be as predicted. Should the storage yard after some time be so uneven that proper operation is not possible, the surface would be realigned.

The storage area can only be paved once the soil has settled.

3.2.6 Storage Yard Design

1. Layout

Two alternatives were offered for siting the storage yard; the one offered initially was approximately 280 m wide and 880 m long with parallel sides, which is in conformity with the technically and economically optimal dimensions for a coal and clinker stack because stackers can travel long distances, although they have limited outreach in cross travel direction. The other and final alternative has a trapezoid shape and is 542 m long in south-north direction, 316 m at the southern boundary and 606 m at the northern boundary. For automatic stackers the length of the area is rather short. As the east and west boundaries are not parallel, it is difficult to fully utilize the area.

The arrangements of storage zones follow the principle to minimize the length of conveyors.

Despite the above limitations it is imperative to achieve optimum area utilization. A critical factor that needs to be addressed is the rail track. It should be possible to handle one complete train of 570 m (1872 ft, the maximum length permitted to go north) on this plot of land. The minimum rail radius is 350 m, which is so large as to require their laying at the west boundary from north to south in the same orientation as they enter the site.

Directly adjacent to the rail yard will be the coal stack (stack 1). Since the initial settlement of the reclaimed area is expected to be high and also uneven for stacker rails, overhead conveyor (marked 7) will be used to drop the coal. This conveyor will be supported at each 50 m interval. During detailed engineering it will be decided if supports will be on piles (not sensitive to settlement) or on flat foundations with adjustable alignment. The conveyor is not sensitive for horizontal settlement but sensitive for horizontal misalignment which can be caused by uneven settlement. Since this stack is located directly at the rail track, shovel

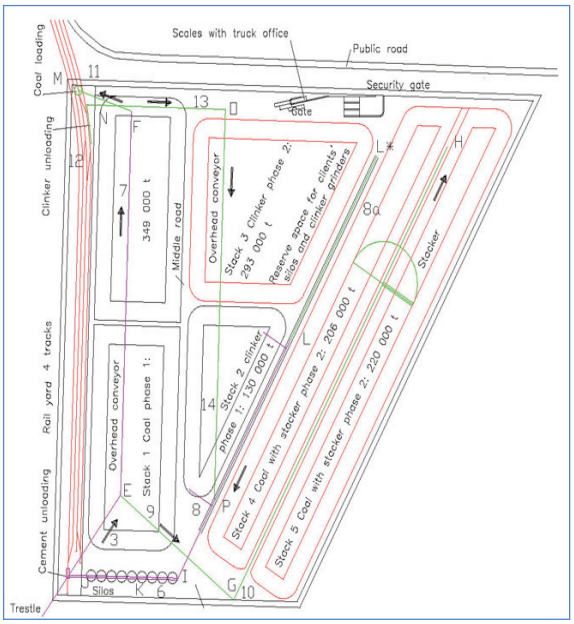


Figure 3.4: Proposed Storage Layout

loaders will be used to take the coal from the stack and directly load it into wagons.

The northern boundary with the adjacent road is partly required as rail entrance and partly as truck gate.

The eastern boundary is the longest side of the allocated area where stack can be arranged. Therefore at phase 2, when the soil is consolidated, coal stacks with stacker and stacker feeding conveyor (marked 10) will be arranged along this boundary, as well as stack 5 between boundary and conveyor (10) and stack 4 west of this conveyor. The stack will have a length of approximately 560 m. Due to unfavorable shape of the plot of land, there remains a triangular shaped area between coal stack 1 (phase 1) and coal stack 4 (Phase 2).

At phase 1 the southern end of this area will be used as clinker storage stack number 2. The trucks delivering clinker will drive on top of the stack and discharge the cargo. Dozers will distribute the clinker and make the surface even.

At the east side of stack 2 there will be ground conveyor, number 8, with mobile feeding hopper, which is used to discharge the clinker stack and transport the clinker via the ongoing conveyors to the ship loader.

At phase 2 the clinker storage will be extended by stack 3 as an additional stack in the north.

The cement silos (marked K) will be located at the south to make conveyor routes short. The cement truck unloading station (marked J) is also suitable for wagon unloading (once rail tracks are laid) and is located at the south west corner of the site. From there the cement is transported by elevator and conveyor to the top of the silos.

The collection conveyor below these silos also collects clinker from conveyor (marked 8) and is being extended to the trestle conveyor. At Phase 1 there are only terminal roads going from the gate to the cement truck unloading station with routes around the coal stack 1 and parallel to the clinker discharge conveyor (marked 8). Other roads will be built at phase 2 once the soil has consolidated. These are roads to the West of stack 1 and around all other stacks.

2. Pavement

Roads will be asphalted; at phase 2 storage areas will be paved with rectangular concrete blocks. After uneven settlement at the storage stacks, the stone blocks will be taken up and laid to the planned level. Uneven settlement of roads normally is not critical. As loads on roads are lower, low settlement is expected on roads compared with storage areas; hence roads normally will not need realignment and will be asphalted. Some minor sensitive areas at the gate with scales and at the cement unloading station will be paved and not asphalted. The reason is that realignment after settlement will be convenient.

3. Dam for stacker with rails

The stacker at phase 2 will operate on an approximately 4 m high dam 10 m wide at the top and with 40 degree slope at the sides. The purpose of the dam is to significantly improve efficiency of the stacker and reduce the open surface of the coal. At both sides of the dam there are rails for the stackers mounted on sleepers which are supported by ballast.

3.3 Terminal Operations

3.3.1 Berth Capacity

The decisive indicator for the berth capacity is the congestion point. This parameter can be defined as the point where the terminal loses its capacity to berth vessels at any given time as they arrive. Light congestions usually start to build-up, once the target berth occupancy rates are exceeded. When congestion becomes cumulative and effective measures are not taken, the queuing of vessels tends to soar rapidly.

Port Qasim Bulk Terminal will feature a jetty with a length of 439 m. The mooring dolphins at both ends of the quay wall sum up the total berth length to approximately 520 m, which is sufficient to accommodate two Panamax vessels at the same time with a distance bow to bow of 30 m. Experience has shown that berth occupancy rate should not exceed 70% for a bulk terminal. A significant portion of the time a ship is occupying the berth is not productive. When the ship waits for:

a. high water for arrival or departure (fully loaded large ships can only pass the channel around high tide)

b. berthing - departure

c. custom and Authorities clearance

d. crane or loader changing hatches

e. the equipment cannot handle cargo

There are other factors potentially extending the ship's stay at the port. Should there be no night navigation the ship must leave the berth not later than approximately 2 hours before dusk. If the ship it is not ready or high water is too late, the ship must wait until next morning. As the voyage on the approach must be considered for arriving and departing ships it theoretically could happen, that the morning high water is too early and the evening high water is too late. This suggests that prohibition of night navigation, as at present, drastically increases unproductive time and thereby significantly reduces the potential throughput of the terminal. It is of outmost importance that arrangements for safe and secure night navigation are completed and are continuously maintained.

A crane or any other mechanical unloading equipment cannot discharge 100 percent of the cargo without manual support. Shovel loaders must be dropped into the hold to bring the coal from the corners into the reach of the grab. Further, coal will stick in the vertical side frames of the hold. Labor with special poles must clean the side frames. This is a lengthy process to be considered in the capacity calculation.

It is quite obvious that generally with small ships the percentage of unproductive time is higher than with large ships. Consequently large ships will have a positive impact on the possible yearly capacity.

Relatively small specialized cement vessels (around 15,000 DWT) can be an exception. They have one loading point in the middle; consequently there will be no hatch changing times and no trimming times. Normally these small ships can arrive and depart at any time, as they are not subject to tidal and night navigation restrictions and therefore only have minor unproductive times.

Ships arriving with coal and departing with cement and clinker will also have a positive effect. When the loading berth is free, these ships could turn into a good opportunity to be used as clinker carriers, once they have been totally cleaned but have already a small draft. With such practice waiting time for high water and daylight can be eliminated for small

Table 3.3: Port Qasim Bulk Terminal Capacity Calculation - 2 Berths

	Units	Phase 1			Phase 2		
Import /Export Commodity		Import Berth 1 Coal	Export Berth 2		Import Berth 1 Coal	Export Berth 2	
			Cement	Clinker		Cement	Clinker
Cargo Quantity	t/year	4,100,000	3,300,000	1,000,000	7,500,000	3,300,000	1,000,000
Ships							
Maximum Ship Size	tdw	55,000	55,000	55,000	75,000	55,000	55,000
Smallest Ship Size	tdw	20,000	10,000	15,000	20,000	10,000	15,000
Average Ship Size	tdw	40,000	20,000	40,000	50,000	20,000	40,000
Number of Hatches	pcs	6	5	6	7	5	6
Average Cargo Per Hatch	t	6,670	4,000	6,670	7,140	4,000	6,670
Selected Equipment							
Number of Cranes or Loaders	pcs	1	1	1	2	1	1
Number of Hatches per Equipment	pcs	6	5	6	3.5	5	6
How often to change Hatch each equipment	No/ship	9	7	9	5	7	9
Crane lifting Capacity	t	38			38		
Tara		35%			35%		
Grab weight	t	13.3			13.3		
Grab contents	t	24.7			24.7		
Cream Digging cycles	No/h	80			80		
Nominal cycles/h	No/h	75			75		
Average cycles efficiency / conveyor loading for loaders)							

Table 3.3: Port Qasim Bulk Terminal Capacity Calculation - 2 Berths

	Units	Phase 1			Phase 2		
Import /Export Commodity		Import Berth 1 Coal	Export Berth 2		Import Berth 1 Coal	Export Berth 2	
			Cement	Clinker		Cement	Clinker
Average cycles/h exept clean up		0.75	0.95	0.90	0.75	0.95	0.90
Cream Digging capacity (1 crane)	No/h	56.3			56.3		
Nominal capacity (free digging) / belt feeding	t/h	1980			1980		
capacity for loading, 1 machine							
Average capacity (technical), 1 machine	t/h	1,850	1,700	1,500	1,850	1,700	1,500
Required Belt Capacity	t/h	1,390	1,615	1,350	1,390	1,615	1,350
Density (loose on conveyor)	t/h	1,850	1,700	1,500	3,700	1,700	1,500
Required conveyor capacity	t/m3	0.85	1.00	1.20	0.85	1.00	1.20
Belt width	t/h	2,175	1,700	1,250	4,353	1,700	1,250
Belt section	mm	1,600	1,600	1,600	1,600	1,600	1,600
Required belt speed	m2	0.295	0.260	0.295	0.295	0.260	0.295
	m/sec	2.05	1.82	1.18	4.10	1.82	1.18
Time Calculation							
Average net loading/unloading time Technical equipment availability Average waiting for high water (arrival) Average waiting for day light	h/ship	28.8 90%	12.4 95%	29.6 95%	18 92%	12.4 95%	29.6 95%
(arrival and departure)	h/ship	6	0	0	6	0	0
Mooring							
Clearing in and open hatches	h/ship	0	0	0	0	0	0
Trimming	h/ship	0.5	0.5	0.5	0.5	0.5	0.5
Time to clean one hold (crane needed)	h/ship	1.5	1.5	1.5	1.5	1.5	1.5
Extra clean up time for the last hold	h/ship	N.A	1	1	N.A	1	1
Hold cleaning.	h/ship	1	N.A	N.A	1	N.A	N.A
Crane or loader changing hatches Unexpected	h/ship	1	N.A	N.A	1	N.A	N.A
stops	h/ship	7	N.A	N.A	4.5	N.A	N.A
Clearance out	h/ship	1.5	1.2	1.5	0.8	1.5	1.5
Average waiting for high water (departure)	h/ship	2.9	0.6	1.5	1.4	1.5	1.5
Leave the berth	h/ship	1	1	1	1	1	1
Unproductive times per ship	h/ship	0	6	6	0	6	6
Gross unloading time / loading time	h/ship	0.5	0.5	0.5	0.5	0.5	0.5
	h/ship	20.9	12.3	13.5	16.2	13.5	13.5
	h/ship	49.7	24.7	43.1	34.2	43.1	43.1
Performance per day							
Lunch break, prayer, shift change	h/day	2	2	2	2	2	2
Working hours/day	h/day	22	22	22	22	22	22
Days per ship	d/ship	2.26	1.12	1.96	1.55	1.12	1.96
Average net performance per day	t/d	17,700	17,900	20,400	32,300	17,900	20,400
Berth occupancy calculation							
Occupancy for commodity	days/a	232	184	49	232	184	49
Total operation days of berth	days/a	232	233		232	233	
Expected bad weather	days/a	10	10		10	10	
Holidays with plant stop	days/a	5	5		5	5	
Planned Maintenance	days/a	10	10		10	10	
Total days required	days/a	257	258		257	258	
Berth occupancy rate		70.4%	70.7%		70.4%	70.7%	

If there is more than approx. 70 % occupancy there is normally risk of queuing for random ship arrivals. For cement/clinker we use a slightly higher occupancy rate as we expect a large portion of vessel with short round trips to gulf states, making arrivals more on schedule than ships from more distant locations.

ships.

The terminal operator will try to encourage the terminal clients to select such ships, as would increase maximum capacity. This should not be difficult, as also the cargo owner would optimize shipping cost.

Applying the projected traffic volumes for the terminal, following berth occupancy calculations have been made (Table 3.3).

Assuming a maximum berth occupancy rate of 70% for import and 75% for export as well as the split of coal, cement and clinker vessels as outlined in the traffic forecast a maximum quayside terminal throughput capacity of approximately 11.8 M metric tons can be achieved in the second phase of the project.

3.3.2 Ship Loaders and Unloaders Capacity

The quayside layout will feature un-loader cranes for imported coal and ship-loaders for cement and clinker. The grab un-loader will have an outreach of 28.50 m and the ship-loader an outreach of 27.00 m. Therefore both equipments will be able to service Panamax vessels.

Concerning the grab coal un-loader, the crane lifting capacity is 38 tons, corresponding to 35% to grab weight (13.3 tons) and 65% (24.7 tons) to grab contents. With a nominal productivity of 70 cycles/hour, and assuming an average efficiency of 75%, a net productivity of 56 cycles/hour can be obtained. This means an average technical capacity of 1,390 tons/hour of net unloading rate.

The features of the loader/un-loader equipments are the following:

1. Grab un-loader

- Lifting capacity: 38 t
- Lift/lower speed: 180 m/s
- Trolley travel: 260 m/s
- Gauge: 15 m
- Belt width: 1600 mm 45° trough
- Capacity: around 1500 t/h
- Hopper capacity: 2.5 times the grab contents (approx. 62 t)

2. Ship-loader

- Belt width: 1600 mm
- Belt speed: Cement 1.8 m/s Clinker 2.3 m/s
- Capacity: Cement: 1800 t/h, Clinker 2500 t/h
- Telescopic chute: Cleveland (or equivalent), max. length approx. 25 m
- Slewing angle: 90º to the east, 70º to the west



Figure 3.5: Example of Grab Unloader for Coal

For the ship-loaders, the nominal capacity is assumed at 1,700 tons/hour for cement loader and 1,500 tons/hour for clinker loader, with efficiencies of 95% and 90% respectively, which amounts to average technical capacities of 1,615 tons/hour and 1,350 tons/hour for cement and clinker respectively (Table 3.4).

It is planned to commence operations in the first year with one grab crane for coal, one unloader for clinker and another unloader for cement, in order to reduce the initial capital expenditure, to achieve satisfactory equipment utilization and provide from the very beginning of terminal operations two berths, one for coal vessels and one for cement/clinker. In the course of cargo volume development, additional gantry cranes and ship-loaders will be procured. Following quay loaders and un-loaders have been calculated (Table 3.5):

Table 3.4: Capacity of Loaders and Un-Loaders

Capacity Parameters	Coal	Cement	Clinker
	Grab Unloader	Loader	Loader
Crane lifting Capacity	38		
Tara	0.35		
Grab weight	13.3		
Grab contents	24.7		
"Cream Digging" cycles	75		
Nominal cycles/h	70		
Average cycles efficiency	75%	95%	90%
Average cycles/h except clean up	52.5		
"Cream Digging" capacity	1,850		
Nominal capacity	1,730	1,700	1,500
Average capacity (technical)	**1,300**	**1,615**	**1,350**

Table 3.5: Number of Unloaders & Ship loaders (accumulative)

Phase	Grab unloaders for coal	Ship loaders for cement and clinker	Stackers for coal	Tripper at overhead convey or for coal	Tripper at overhead conveyor for clinker
1	1	1	0	1	0
2	2	1	1	1	1

In the first phase there will be only one crane. A high quality machine must be deployed, as the total import volume will depend on this crane. Sufficient strategic spare parts must be available to minimize risk of stand still.

The number of quay cranes suggested by the above table (3.5), will be necessary to dispatch the stipulated cargo volumes, this is in compliance with the total terminal capacity derived from the possible berth occupation and size of the storage yard.

3.3.3 Technical Performance of the Unloader

Contact of the grab closing ropes with the coal cannot be avoided; hence it is important that during lifting and trolley drive the grab closing ropes do not move, which they would do, if the trolley design of a container crane would be used. There are several ways to avoid this, and this must be sorted out during the crane tendering phase. With a grab crane it never can be avoided that some coal sticking to the grab surface falls down when it moves from the ship hold to the



Figure 3.6: Example of Cement Loader

crane receiving hopper. There is a movable spillage collection plate to avoid that this coal is dropping into the water. The receiving hopper has side wind shields with the possibility of dust suppression water spray. A hopper discharge conveyor and a transfer conveyor move the coal to the quay conveyor.

The operator can move the cabin with a separate trolley to the position with the best view. The operator would not withstand the continuous acceleration and braking of the main trolley.

Hanging at ropes below the grab, a shovel loader must be moved from the quay into the hold for clean up (and vice versa after completion of clean up). The receiving hopper is designed to allow passage of the shovel loader. Behind the hopper there is space for the grab to reach quay level.

To minimize loads to the jetty, bogie arrangements must be in line with the jetty pile spacing.

3.3.4 Technical Performance of the Loader

The ship loader has a gantry and a slewing lifting and lowering boom. An intermediate conveyor transfers the cargo from the belt tripper at the quay conveyor to the central slewing point. There the cement is collected by the boom conveyor and transferred into the telescopic loading chute.

The slewing point is set as far to the waterside as possible, to reduce the weight of the boom and have space for the counterweight. A cascade type telescopic chute such as Cleveland chute is used to minimize dust escape during loading.

To reduce the fall down height of clinker the boom can be lifted/lowered. For cement the maximum conveying angel is + 8°.

3.3.5 Conveyor belts capacity

The connection between the jetty and the storage area requires two conveyor lanes, one for imported coal (land direction) and the other for cement/clinker (sea direction). An additional third conveyor could be installed, parallel to the coal conveyor, the space for that has been reserved in the layout. The capacity of these separate conveyor belts must be in accordance with the capacity of the quayside loader/un-loaders, to be able to evacuate as much as the loaders/un-loaders can.

3.3.6 Layout of the Jetty-Apron

In order to avoid impediments to reach the productivity targets, the layout of the jetty-apron must be well organized and sufficiently dimensioned. Thus following apportionment of the jetty deck is planned:

- 4.5 m distance between quay wall and gantry rail track at bollards locations, 2 m at other locations.
- 15.0 m wide rail track; the transfer of coal between the grab and the bunker will be done within the portal area of the crane; the transfer of cement/clinker from the belt loading quay conveyor and the telescopic chute will be done through an intermediate conveyor and the slewing and up and down boom.
- 2 m jetty deck behind the crane for drive gear maintenance access
- 5.75 m from the back rail track for two conveyor belts (one for discharge of coal, and space for future white line) supporting beam at 7.5 m distance for conveyor supporting columns.
- 13 m supporting beams at 30 m spacing for the quay gallery containing the cement/clinker loading quay conveyor.

3.3.7 Storage Yard

The arrangement of the storage yard was adapted to the final dimensions and shape of the available area. Coal is stored in open stacks arranged parallel to the west and east boundaries of the area. Clinker is stored at the remaining V-shape between the coal stacks. Area allocation is as follows:

- 5 Silos of 18 m diameter with 10,000 t capacity each at the western part of the storage area.
- Coal stack 1 (phase 1) is located along the future rail yard (phase 2) at the west boundary almost over the whole length of the area. The stack will receive the coal from the ship via an overhead conveyor running 17 m

above the ground. A tripper will take the coal off the belt and dump it on both sides of the conveyor. The coal will build up a natural slope. Since with this technique the stack is not wide enough to store necessary coal dozers, it will be used to spread the coal sideward. This is not a perfect solution however it is the only economical and safe option, as long as a detailed soil analysis is not available and the area has not become consolidated. Trucks collecting the coal will be loaded by shovel loaders directly at the stack. At phase 2 shovel loaders can directly load the coal onto wagons.

- Clinker stacks 2 and 3 will be located in a triangle formed by the gate area and coal stacks 1 and 4. Trucks delivering the clinker will dump the clinker directly onto the stack. At phase 2 there is an overhead conveyor feeding the stack with clinker arriving by train. At the east side of the clinker stacks there is a storage discharge conveyor with feeding hopper for shovel loader.
- Coal stacks 4 and 5 will follow the clinker stacks eastwards. These stacks will be constructed at phase 2. At this phase a stacker will also be introduced.

3.3.8 Handling Equipment in the Storage Yard

The features of the handling equipment for the storage yard are the followings:

1. Overhead conveyor for coal and clinker

In phase 1 there will be an approximately 400 m long conveyor (marked 7) at a height of 17 m with supports every 50 m with gangways on both sides. On the conveyor there will be a movable belt tripper lifting the belt, making a loop in the belt and dropping the coal from the conveyor and guiding it downwards. At the initial stage the coal will form a 15 m high cone with approximately 40 m diameter under the tripper. The tripper will automatically move 1 m forward when the coal stack reaches the 15 m height. The stockpile will get elongated in this manner until the total length of the area is filled. Storage discharge will be done by shovel loader and trucks into a hopper at the end of the stack. This is a simple and economical system that requires no stacker and no stacker rails and can be availed with low investment. However, to achieve sufficient storage capacity, a dozer working on top of the stockpile is required to push the coal sideward, thus increasing the storage area and capacity.

- Conveyor length: 400 m
- Stacking height: 15 m
- Belt width: 1600 mm
- Belt speed: 4.1 m /sec Capacity: 3700 t/h

In phase 2 there will be a similar overhead conveyor to stack clinker arriving by wagon.

- Conveyor length: 408 m
- Stacking height: 15 m
- Belt width: 1200 mm
- Belt speed: 2 m /sec
- Capacity: 1500 t/h

2. Stacker for coal

- Rail gauge: 8.0 m
- Outreach: 45 m
- Stacking height: 15 m
- Belt width: 1600 mm
- Belt speed: 4.1 m /sec
- Capacity: 3700 t/h

3. Mobile hopper

For maximum flexibility clinker will be loaded to the conveyor with shovel loaders via a mobile hopper.

4. Cement Silos

Silo trucks, and also wagons (in phase 2), will deliver cement. Generally trucks and wagons will discharge by the bottom. However, single trucks can also discharge into cement silos pneumatically; a hose is connected to the silo truck and the tank is pressurized to carry the cement to the top of the silos. The silos have aerating floors fluidizing the cement. When there is no clinker the cement can flow onto the cement/clinker conveyor below the silo.



Figure 3.7: Example of Coal Stacker



Figure 3.8: Example of Mobile Hopper

5. Clinker Handling

Clinker will arrive with overland tipper trucks, which will drive on top of the pile and tip their cargo. Dozers will distribute the cargo. For ship loading shovel loaders collect cargo and load it to the conveyor system via a mobile hopper. The stack discharge conveyor collects the clinker and transfers it to the cement conveyors, where it goes further for ship-loading.

3.3.9 Wagon/Truck Loading/Unloading

1. Cement Wagon/Truck Unloading

At the south west corner of the terminal there will be a combined truck wagon unloading station with 2 positions. One position will be used for trucks and wagons, while the other for trucks only. At phase 1 there will be only truck unloading. Cement wagons and trucks can be discharged by:

- Pressurizing the tank of the vehicle and pumping/blowing the fluidized cement into the silo or



Figure 3.9: Examples of Cement Silos with mechanical Elevator at Brunsbüttel Port

- Opening the bottom, fluidizing the cement by air pressure and letting the cement flow out by gravity.

To save energy and avoid expensive trucks/wagons with pressure tanks the bottom discharge method has been selected. A bottom discharge station can also be used for unloading pressure tank vehicles in a very flexible way. Below the unloading position there is a receiving hopper with a discharge conveyor. The conveyor feeds a bucket elevator lifting the cement to the top of the silos. At the top of the silos air slides guide the cement into the different silos. The rail and road of the unloading station is approximately 3 m above ground level. The wagons will be pulled into the unloading station by a winch. The winch always pulls the wagons one by one. Then the first wagon will be uncoupled and pulled uphill into the unloading station, which is located at a dead end rail track. In front of the unloading station there is a rail switch. Once unloaded the wagon rolls back by gravity and the switch guides the wagon into the empty wagon track.

Apart from the advantages for easy wagon handling, the raised wagon unloading station also offers the advantage that the receiving hopper with discharge conveyor will not be below ground water level.

There are 2 unloading positions but only one conveyor line with a capacity of approx. 1000 ton/hour. At the unloading station only one cement grade can be handled at a time. This would need coordination between arrival of trains and wagons.

The compressor station has sufficient backup capacity to unload one truck only at a time pneumatically, while each silo has its own cement feeding pipe from the ground to the top for connection with the truck. This will help handling cement grades arriving uncoordinated. It would need a larger compressor station and more energy to unload several trucks simultaneously with the pneumatic system; this aspect will be attended to at Phase 2 of the Project.

2. Clinker Wagon Unloading

Trucks will directly discharge onto the clinker stack. For large quantities of clinker arriving with wagons a rotation dumper would present the ideal equipment. A rotation dumper is an installation to turn the wagon by 180°. When the wagon is upside down the clinker will be discharged by gravity. However, the quantities of clinker expected by wagon do not justify an advanced system, in particular at phase 1 when there will be no wagons. At phase 2 the wagons will be partly unloaded by opening the side gates of the wagons. The rest will be discharged by a hydraulic grab crane. An underground conveyor will collect the clinker. Ongoing conveyors will guide the clinker onto the clinker stack. The wagon clean up will be made manually through the side gates.



Figure 3.10: Example of Wagon Unloading with Hydraulic Crane and Wagon Side Openings

3. Coal Truck/Wagon Loading

Wagons can be loaded at stack 1, while trucks can be loaded at stacks 1, 4 and 5 using shovel loaders. The coal arriving from the ship can also be directly loaded onto Wagons (phase 2 only) and trucks. At the end of the overhead conveyor (marked as 7) there is a hopper with a truck loading gate. The belt tripper of conveyor (7) has a movable chute guiding the coal either onto the stack or on the belt. When the hopper is full, the tripper always will feed stack 1.

For direct wagons loading there will be a conveyor from the above hopper to the rail tracks. Above one of the rail tracks there will be a hopper with discharge gate to load the wagons.

4. Radio Controlled Shunting Machine

Wagon loading and unloading has efficiency when the operator of the loading or discharge station controls the wagon movements. Therefore a radio controlled shunting machine has been adopted for the PQA track. A shunting



Figure 3.11: Example of a heavy duty radio controlled shunting machine at EMO Rotterdam wagon loading.

machine is a locomotive with a speed of up to only 3 m/sec. A standard locomotive would normally not be able to move the trains with creeping speed at the loading station over a long time as the motors would be overheated.

During the detailed design phase movement of the wagons under large slope outside the terminal boundary would be taken into account and the final PQA rail line arrangement will be adopted accordingly. It is anticipated that PIBT will settle for a smaller and cheaper shunting machine, instead of the one suggested above.

3.3.10 Miscellaneous Terminal Components

1. Sprinkling system

For pollution control at dirty bulk cargo terminals, it is necessary to minimize dust escape. Coal is not allowed to remain dry since such conditions can create an explosion hazard. Vacuum filters would not work with wet coal and hence pollution control will be achieved by a water spraying system that will be installed for dust suppression at PIBT. The water spray system will also be in place at transfer stations between conveyors.

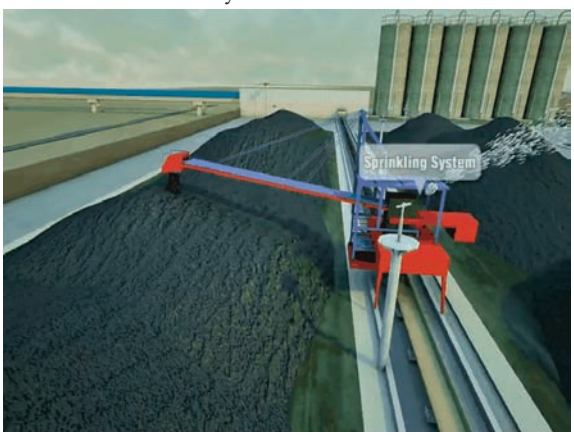


Figure 3.12: Proposed Sprinkling System

2. Magnetic extractor

To avoid damage to conveyor belts, several magnet separators will be installed for catching magnetic iron and materials from the belt.

3. Other components

Platform scales with load cells will be located at the gate to register the weight of incoming and outgoing trucks. Belt scales are generally used to estimate the quantity of loaded and unloaded materials onto and from the ship. The final quantity of cargo is estimated by ship survey.

Cement trucks are unloaded pneumatically. A large compressor station supplies the compressed air. Vacuum dust bag filters are used to clean the air escaping from the top of the cement silos and at conveyor transfer stations. The filters are cleaned by compressed air impulses.

Sampling equipment or samplers are required to be in place to collect samples of cargo for the quality control.

A fleet of shovel loaders will load coal to trucks, clean the ship, hold and reload clinker to the conveyors for export. Clinker will arrive in tip trucks. The trucks will discharge their load at the top of the stack. Dozers will distribute the clinker on the pile. Dozers will also be used to compact the imported coal.



Figure 3.13: Example of Magnetic Extractor

3.3.11 Manpower Requirements

The following considerations regarding manpower requirements are based on experiences with manning schemes of terminals with similar size and type. The figures represent a reasonable basis for the commercial appraisal of the terminal development plan.

Many terminals operate with their own staff as well as external personnel. For the following calculations it is not differentiated between both groups of employees. Manpower requirements are presented as a whole to give an

overview of staff requirement. The following issues need to be considered for staffing:

- Generally terminal operations will be provided on a 24 hour basis, 7 days a week. For regular staff disposition a 2-shift system has been well proven in Pakistan (each shift 12 hrs.)
- When there is change of shift there must be an overlapping staff rotation for key operators. The operators of central control room, cranes, loaders, stackers, dozers and shovel loaders may leave their position only when the relieving staff has taken over. To ensure continuous high performance, back up staff is made available for these positions. As an example crane driver, ship loader operator, deck men and one extra jumper/joker should rotate. As such lunch and toilet breaks should not stop operations.
- Training and motivation of staff is key to increase productivity and to reduce claims. Strong motivation and sufficient experience is key to improvement of performance. As such, excessive use of casual labor shall be avoided. As a consequence, constant training of staff shall feature prominently in future manpower development.
- Key personnel, which is critical for achieving competitive quayside performances, i.e. crane / loaders operators, supervisors, etc., will be selected by focusing on their skills.
- Multi-functional training of staff for equipment operators is proposed for reducing headcount.

3.3.12 Utilities

1. Drainage System

In Port Qasim intensive rainfalls are rare; however the storage surface needs to remain prepared in case of rains so as to drain the storm water. Water spray used for dust suppression will also need to be drained. Most of the spray water will evaporate, but the remaining would need to be drained. Initially there will be only a drainage ditch between the public road and the terminal and another one at the east of the clinker storage discharge conveyor at 8.

After the area has consolidated the final drainage system will be installed, which most will most likely be at phase 2, when the pavement would be laid and that will require effective drainage. Storage areas will slope towards the access roads. At the fence an open ditch would be provided for collecting the water. Drainage pits will be provided at the middle of the road at approximately each 50 m interval with pipes leading the water to the outside ditch. A small settlement basin will be provided in the southwest corner. If there is water accumulation in the basin, this will be used for spraying the storage area, while the overflow of water will, after suitable treatment be recycled for spraying and would not be allowed to flow into the sea.

2. Fresh water & fire fighting network

Unless there is a fully functional public drinking water network, drinking water and water available from PQA supply sources will be delivered by truck. Drinking water will be directly delivered to the office building.

It will be ensured that coal dust does not come into contact with sea water; PQA water supply will be used for dust suppression. A ring line and a line along the centre road will provide water to the stack. There will be an industrial water tank with a pumping station close to the settlement tank. When there is water in the settlement tank, this water will be pumped into the water pipe system through a filter. One water pipeline will be laid along the trestle.

Industrial water supply will not be sufficient to fighting large fire. There will be a pumping station on the trestle at the Korangi Creek which will pump salt water into the system for fire fighting. To avoid excessive corrosion the pipes will be rinsed thoroughly after each event.

Total estimated water requirement during construction phase is 20,000 gallons per to be met through tankers. A total estimated water requirement during operational phase is 95,000 gallons per day to be provided by PQA.

3. Sewage system

The office building and the workshop building will be connected to the public sewage system. Should that not exist, there will be septic tanks at these buildings to collect the waste water. The waste water would either collect by special

trucks or drained after treatment into the creek. The jetty building will have an independent septic tank with a small treatment plant with outlet. It is estimated that during operations of PIBT around 8000-10,000 gallons of sewage will be generated per day which shall be treated before final discharge to comply with National Environmental Quality Standards (NEQS). The sewage generated from campsites during construction phase shall also be treated in septic tanks before discharge.

4. Electrical Power Supply

General: According to the input requirement from PIBT the main power source will be the own power plant on the terminal. It has to operate the terminal mostly in an island mode in a reliable way. Beside the power plant a link to the public grid of KESC is considered for the future but is uncertain. A substation at the terminal area next to the road has to be foreseen as the interface to KESC. The needed equipment is considered at the substation northwest. The load of KESC is limited and will be maximum 5 MWel.

The main combustible will be Heavy Fuel Oil (HFO), but natural gas is going to be included as an option. Therefore flexi-fuel engines have been chosen in the final design. Coal was also analyzed as an option because of the relative low price, but a comparison between the different fuel systems and cost estimations has led to the conclusion that a 15 MW coal power plant would cause too high investment costs. Also space requirements and load variations have been exclusion criteria for a coal power plant.

Fuel Conditions: To increase the reliability of the power generation process the generator sets of the power plant shall be equipped with flexi-fuel technology. The gensets will be capable to run the process with Heavy Fuel Oil (HFO), Diesel Oil (DO) and Natural Gas (NG). It shall be possible to switch over from HFO to LFO and Gas without load reduction. According to the suppliers proposal the engine type could work as diesel process or otto-combustion process. The main combustible will probably be HFO.

Heat recovery: To optimize the generation process a heat recovery system can explicitly increase the efficiency. Two examples in Pakistan are Attock Gen (156MWe) and Nishat Power (200 MWe). Both operate with HFO-Gensets (each 16.5 MWE), heat boiler, and steam turbine. The operation modus is base load with around 8,600h/p.a.

A basic calculation for Port Qasim has shown; in full load condition (all engines) a recovery system would be able to generate steam to operate a 1 MWe steam turbine. The additional costs to realize the complete steam system are estimated with about 15 million USD. But another aspect is the limited space on the terminal.

Conclusion from this discussion is:

Implementation of a similar heat recovery process at PIBT would be inefficient. The main reasons are the smaller engines, the load profile of the consumers and the lack of heat demand at the terminal area.

However, a small application of a heat recovery system should be realized as the main source to heat up the HFO.

Natural gas: Comparison of fuel based electricity generation costs shows the highest economical rating for natural gas. It is recommended to verify the possibility of gas supply at PIBT in short terms and in the future.

Most suppliers of gensets are able to equip their engines with flexi-fuel applications. If natural gas would be an option to feed the engines it should be realised. Depending on the available amount of natural gas it also could be reasonable to fit out only the two smaller engines with flexi fuel application.

Further advantages of natural gas driven engines are the higher flexibility in standby operations and lower emission rates.

Utility network: For the terminal an 11 kV network is foreseen for the main distribution and will be sub distributed and transformed at substations. The main switchgear at the power plant is arranged with a three-part busbar. The middle part locates the power generation and the outside bus bars are feeding the loop systems and transformers. That configuration provides proper flexibility in case of failures and maintenance. As mentioned before a link to the KESC utility is planned. It will be limited to 5 MWel.

The 11kV electrical distribution system shall be an open-loop

distribution system. The system shall start at the power plant and connects the different 11 kV substations at the terminal, trestle and jetty. The distribution loops shall route around the site through underground ducts and manholes. All electrical power and lighting, communications, and security shall be installed underground in ductbanks with manholes / handholes. There will be arranged two separate systems, one power system and one data system.

Load Consumption: Based on HPC's specified equipment the following power demand has been calculated as follows:

Total load (kW) Phase 1: 6.213

Total load (kW) Phase 2: 2.498

Total load (kW) Phase 1+2 : 8.711

Power Plant Layout

Configuration: The power plant shall be sized to provide prime power for all possible load conditions in standalone operation. The main point to be evaluated is the alternation of load. The conveyor belts, the cranes and the general consumers are to be considered. The cranes are to be considered as constantly shifting loads. A shifting load of 1.5 MW in case of full load operations in Phase 1 shall be assumed. The cranes are equipped with frequency converters. Those units are capable to feed back the power in case of lowering the load.

During low load operation the conveyor belts and cranes will be out of service. The Administration Building, the gates, outdoor lighting and other general loads have to be fed. Around 500 – 800 kW is assumed as average maximum load in low load mode.

After modeling, analyzing and simulating, the study cases have led to a configuration of 4 gensets with 3,750 kVA and one genset with 1,500 kVA in prime mode. Low load and peak load demand have been calculated. The calculation concept shows all electrical parameters like load flow and voltage drop for the different study cases.

The maximum output range of the power plant shall be 16.5 MVA according to 13.2 MWe. The maximum demand has been calculated with 6.2 MWe. The case study for maximum load shows that at this point one big and one small genset are in standby modus. The other genset is running with partial load and is able to handle the peak requirements. That ensures the required reserves for maintenance and failure mode.

One 1,500 kVA unit is intended to be operated at low load and standby. The size of one generator is enough to run the 11 kV network in a stable way.

Emergency: Beside the main generator sets an emergency diesel genset is required for black start purposes and as a backup power unit for the power plant. Nominal voltage of that generator shall be 0.4 kV and it has to fed the safe part of the low voltage distribution. The system shall be sized to provide proper starting power (black start) for all required auxiliary units including tankfarm and fuel system.

That genset unit is not intended to feed the 11 kV network. The emergency power of the Port Network will be served from the 1,500 kVA genset in Diesel Oil Modus. This secures a safe power supply in nearly all cases.

Pollution Prevention: Nowadays in Pakistan, HFO plants do not use any catalysts or gas cleaning systems to reduce NOx, SOx and particular emissions. However, to fulfill the commitment of "protecting the environment" as well as the conditions of governmental approval PIBT considers it important to take mitigation measures to reduce pollution. Diesel oil and especially natural gas could reduce the emissions without additional cleaning technology.

Another issue might be a limit of noise nuisance. According to the limits appropriate exhaust silencer, ventilation silencer, and other noise protection provisions would be required to be implemented.

Control systems: The power generation and the distribution network are forming a complex plant structure. Generally the control units are decentralized and are working in a closed way. For example, every genset has its own PLC-system. In addition the power plant PLC system controls the interaction between the gensets and handles the synchronization to the network. As well alarm messaging, energy management, and other services are implemented into the power plant PLC-system. The work place to operate the system will be in the control room at the power plant.

Furthermore an Ethernet TCP/IP shall connect the administration building and other services to provide functionality according to a Building Management Systems (BMS). The idea of that concept is to implement one system for the whole terminal with an open standard instead of different standalone systems

Security: The security system at the perimeter fence will be furnished with vibration control system and speed dome cameras at 6m poles. The special vibration wire system at the fence is tripping an alarm signal in case of trespassing. The CCTV camera will be focusing to the point of action. The information and status of the system will be displayed at the monitoring system in the main gate.

Outdoor lighting: The outdoor lighting system shall provide uniform and adequate in-service illumination at the terminal, jetty and trestle areas.

At the terminal area and jetty, pole lamps with 30m height have to be arranged, equipped with 600 W lamps as mentioned in the lighting calculation. A switch cabinet per pole lamp is intended to supply the lamps and provide electrical circuit points to other outdoor devices. The constructions above the stacks shall be equipped with 1000 W lamps to secure a proper illumination for handling.

The outer perimeter of the terminal area shall be illuminated with 150 W lamps installed at the terminal fence.

The trestle has to be installed with 58 W fluorescent lamps equipped with electronic ballast. Protection level is IP 66. The lamps should be arranged at the steel construction.

5. Lights

Roads on the terminal will be provided with lighting arrangement. The ring road lights will also illuminate the fence. Conveyor lines and equipment will have their own lighting arrangement.

6. Compressor station

To save energy, trucks and wagons will generally be gravity discharged through the bottom and there will be no pneumatic transport with the following exception:

In case a truck has a different grade of cement, which is at that time is being transported on the mechanical transport line; the truck would be unloaded pneumatically. The cement trucks will be unloaded using compressed air of 2.5 bars pressure. The floor of the cement silos are facilitated with aeration panels fluidizing the cement. Filter bags of the dust collection units are automatically cleaned by air injection.

A small central compressor station at the utility area will deliver the compressed air. At the jetty there will be dust filters with their own individual compressor.

3.3.13 Buildings

1. Main building

At the middle of the south boundary a workshop with spare parts store, administration and operation office and community building will be built. The main control room of the terminal will also be integrated.

2. Berth office

At the connection between trestle bridge and jetty a berth office including small workshop, community rooms and security & watch and ward rooms will be built.

3. Gates

The gate complex at the middle of the north of the terminal will have separate in and out tracks consisting of the security check and the weighing documentation zones. It will be located directly at the public road. Trucks and limousines would first enter a security control gate with large concrete protection side walls and strong movable barriers. The truck will then proceed to the in-weighing scale, where the driver will get instructions as to where to go. There will be another exit weighing scale. The gate office will be located between both scales.

An ISPS-Code port security gate will be located at the access from the terminal area to the trestle. This gate also will control traffic on the trestle.

3.3.14 Other major terminal facilities

1. Fencing

The storage area will be surrounded by a brick wall or mesh wire fence. In case of a mesh wire fence a net with fine openings will be fixed at the north boundary. This will micro locally reduce the speed of the wind leaving the terminal with the result that some of the coal clinker dust particles blown by the wind will settle down within the area and not outside. Additionally tall trees with dense canopy (recently imported mangrove species that has been planted on the city streets of Karachi) will be planted all along the boundary wall.

2. Conveyor foundation

Foundations are provided to support drive stations, tail stations of conveyors and transfer towers. Conveyor operations involve vertical forces from weight of the material being transported, and horizontal forces in the drag, besides the relatively small vertical weight force due to sagging of conveyor belt which is borne by the sleepers with ballast or by small foot foundations. The overhead feeding conveyors need strong foundations at each 50 m interval.

3.3.15 Railway connection

According to the Port Master Plan of PQA a common port user rail track will connect the eastern area of the port with the Pakistan Railways mainline. This track passes by at approximately 850 m north of the coal-cement-clinker terminal site. According to the PQA survey plan the level of the PQA railway track is at approximately 11 m higher level than that of the terminal site. The necessary railway network will be provided by PIBT inside the terminal and will be connected with the track for the mainline.

The rail connection that will be suitable for tank type cement wagons and open top coal and clinker wagons will be obtained during phase 2. It has been assumed that maximum 30 percent of the cargo will arrive or leave the terminal by railway. Wagons arriving with clinker will be used for loading coal once they have been discharged and cleaned.

The rail yard on the terminal will be located at the western boundary. Trains will be up to 570 m in length. Tracks will be sufficiently long. The site is not long enough for tracks of 570 m, and hence the tracks will extend outside the storage area.

1. Cement unloading tracks

The cement truck/wagon unloading station will be located at the south west corner of the terminal, which will be provided with one track for loaded wagons and another track for empty wagons. The wagons will be unloaded sequentially. The unloading station is at level 3 m above the track. A shunting winch will pull one full wagon into the station and after discharge the wagon would run back by gravity via a rail switch onto the track designated for empty wagons.

2. Clinker unloading track

The unloading station will be located close to the fence. Arrangements will have to be worked out with PQA to locate the unloading station outside the allocated terminal area in order to unload a full 570 m block train without separation of wagon couplings. Alternatively the train length will be reduced to about 450 m. Since there are limitations on space for switches and roads, the full length of the site cannot be used for the clinker train. The full train would stand on the terminal and would be pushed intermittently through the unloading station. When all wagons are empty, the complete train will be pushed outside the terminal boundary. This implies that the track length should ideally be 570 m for the loaded train and 570 m for the empty train, making a total of 1140 m.

3. Coal loading track

The terminal will be provided two track systems 1) for Direct loading during ship discharge and 2) Wagon loading from stack 1.

a) Direct loading during ship discharge: For coal loading the train will be pushed through the loading station located close to the northern fence. It can either go discontinuously one by one wagon length or continuously at very low speed. The above scenario for track length of clinker unloading is also valid for coal loading. The tracks will be arranged in such manner that after unloading the wagons would directly pass on to the coal loading station. Wagon handling would thus be very economical, since the wagons would be utilized to the outmost and there would be no transport cost for empty wagons.

b) Wagon loading from stack 1: One rail track will be located parallel to the coal stack number 1 for loading from the stockpile. For operational flexibility switches will connect some of the rail tracks. Three tracks will go uphill to the PQA rail. During operation the rail gate will not be closed and will be guarded by security arrangement.

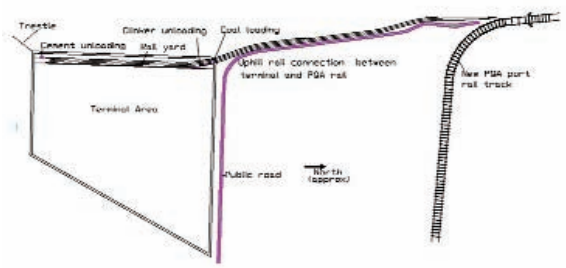


Figure 3.14: Railway Connection to the Terminal

3.4 Phasing Concept

In order to minimize capital expenditure in the initial years for terminal development when the cargo throughput volumes at the facility may still be low, it is proposed to postpone the development of selected equipments to a time when the cargo volume development requires additional capacity, and the income of the terminal allows the operator to invest in more equipments.

An important milestone in the development of the terminal will be the time when approach channel has been deepened to -15.50 m below CD by PQA. At that time bulk carriers of 75,000 DWT will be able to access the terminal. This suggests higher volumes of cargo to be loaded/unloaded per call, which would increase the capacity of the quayside by reducing the number of total calls, and consequently the time spent in approaching, mooring, hatches opening, clearance, etc. This would imply optimization of the other components of the terminal, such as conveyor belts and storage area to be able to equilibrate the new level of capacity performed by the quayside.

Two phases have been planned. According to the traffic forecast and the calculation of capacity, the second phase will be implemented once the volume of imported coal is higher than 4.0 million, i.e. in the year 2020. At that time a second coal unloader will be necessary and also more space would be demanded for the storage yard.

1. Phase 1

One 38 ton grab crane with conveyor system and one overhead conveyor will place coal onto open stacks 1. Shovel loaders will load the coal to trucks (for overland transport) directly at the stockpile. This gives maximum flexibility to separate cargoes of different owners. Clinker will be stored also on open yards, while cement will be stored in silos. Cement and clinker will be transferred to the ship-loader via the trestle conveyor and the jetty gallery conveyor.

All required buildings and utilities will be built in this phase.

2. Phase 2

To meet higher expected coal quantity one additional unloading crane and the stacks 4 and 5 with a stacker working between these stacks will be implemented. As a consequence the conveyor speed will be increased, and more space in the storage yard will be needed. Operation principles will not change however.

A railway yard with wagon loading and unloading stations will be built in this phase.

04 ENVIRONMENTAL AND SOCIAL BASELINE

This Section of the ESIA report describes the current social and environmental baseline conditions of the microenvironment and the macroenvironment of the proposed Coal, Clinker & Cement Terminal Project site. The baseline has been described in terms of the following parameters:

- Physical Environment
- Physical Oceanography
- Meteorology and Climate
- Air Quality
- Terrestrial Ecology and Birds
- Marine Ecology
- Noise
- Waste Management, and
- Social and Economic Condition.

4.1 Methodology for baseline survey

Environmental Baseline conditions were determined by surveys that were conducted following the ASTM Standard D6008-96: "Standard Practice for Conducting Environmental Baseline Surveys". The information for the baseline was collected through: i) Field surveys; ii) Consultation with stakeholders including the Project Proponent; iii) Desk-top surveys including review of published data and the archives of EMC and associates, and iv) Data purchase.

Field surveys were carried out to describe environmental / social conditions of the macroenvironment that includes the Port Qasim and its neighbourhood; the microenvironment, which includes the micro sites at the Jetty on Kadiro Creek, the land mass separating the Kadiro Creek from Korangi Creek and the shoreline housing the FOTCO, PROGAS and the proposed Storage site. The following surveys were undertaken as part of the ESIA process: i) Air quality; ii) Noise; iii) Soil and groundwater; iv) Seawater and sediment quality; v) Bird survey, Marine biology and Ecology.

4.2 Description of Microenvironment & Macroenvironment

The microenvironment of the project site comprises i) the Kadiro Creek System, where the Project jetty will be located, ii) the 2.6 km strip of land/mudflat over which the 2.4 km trestle bridge will be constructed to connect the Jetty with the on-shore storage area, and iii) the back-up area at a location adjacent to the western boundary of PQA on the north of Korangi Creek, south of the Oil/LPG area designated in the PQA Master Plan, and on the west of FOTCO facility.

The coastline of the microenvironment lies between Korangi creek inlet and Kadiro Creek and encompasses three islands: Bundal Island, Buddo Island and Khiprianwala Island and two large and deep openings towards the sea viz. Phitti Creek Mouth that forms the Approach channel of Port Qasim and the Kadiro Creek Mouth.

The macroenvironment of the Project extends over Port Mohammad Bin Qasim, the navigation channel and hinterland stretching from the Port area to the National Highway in the north, and from Ghaggar Phatak on the east to Mehran Highway on the west. The near shore macroenvironment of the proposed bulk terminal comprises a number of creeks, islands, wetlands, marshes and mangrove forests and forms the far west extension of the Indus Delta. Phitti creek is the largest among the group of creeks developed on the western parts of the

former delta of the Indus River. Phitti Creek is connected to a system of creeks including Jhari, Kadiro, Korangi and Gharo Creeks. The eastern coast has tidal creeks with mangrove and mudflats which are linked with a network of creeks. The sea bed at the east and southeast coast is generally smooth and regular as is apparent from the bed contours. The land slope is gentle, generally ranging from 1/500 to 1/1000.

swampy. The Malir River drains into the Gizri Creek.

The Geographical area of the macroenvironment extends over the Union Councils (UC)s: Ibrahim Haidery, Rehri, Gulshan-i-Hadeed and Ghaggar of the administrative district #17 Bin Qasim. It is spread over Korangi Creek on the west and UC Ibrahim Haidery, Rehri, Chashma Goth, Korangi Fish Harbor, the deep sea fish harbor and salt works along the coast; Lath Basti, and Juma Goth in the



Figure 4.1 shows the macroenvironment of proposed coal, clinker and cement terminal.

Some smaller creeks branch off these major creeks forming a big network of the Indus delta. This network of creeks is a very sensitive ecological area of the delta and has all the characteristics of the deltaic behavior.

A chain of small Islands such as Bundal, Buddo, and Khiprianwala are off shoots of Indus Delta formation system and are either sand banks or swamps partially submerged at high tide. Extensive vegetation of mangrove also exists. The islands are mostly flat and

northwest; the PROGAS jetty, FOTCO Jetty, IOCB, EVTL, and Port Qasim Industrial Area in the east; the Steel Mills in the far east, and the navigation channel of Port Qasim and the large mudflat covered by mangroves forest in the south.

4.2.1 The Port Qasim

The Port Muhammad Bin Qasim was originally built to cater to the needs of Pakistan Steel Mills. Its inception was linked with the establishment of Pakistan Steel Mills,

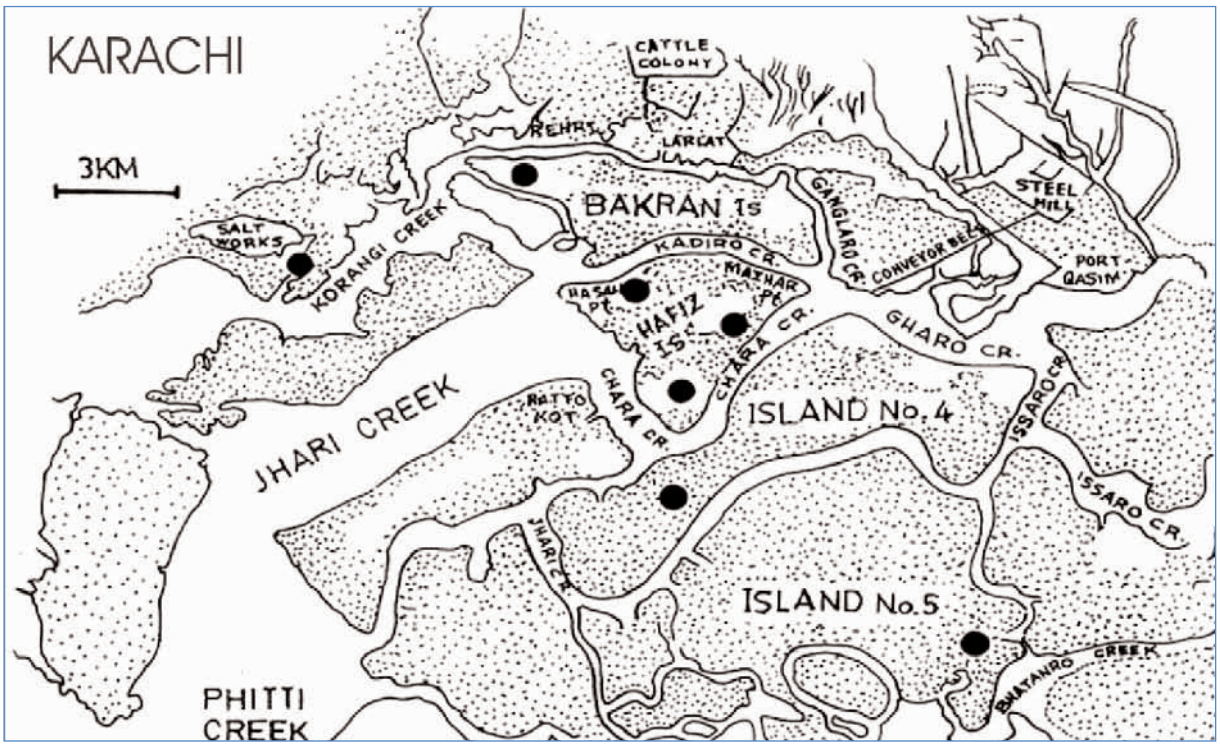


Figure 4.2: Interconnection of Creeks

primarily for the purpose of facilitating the transportation of imported raw material. Phitti creek houses the Port's approaching navigation channel has a total length of 43.7 km from Buoys Number 1 and Number 2 to the marginal wharf turning basin. The channel has three sections:

i. The exposed Outer (Ahsan) Channel between the open sea and Bundal Island;

ii. The sheltered Inner Channel from Bundal Island to the Iron Ore and Coal Berth (IOCB);

iii. The 'Reach' from the IOCB to the marginal wharf.

The Iron Ore and Coal Berth (IOCB) was completed in 1980; four berths were constructed thereafter and another

Table 4.1: Existing Channel Parameters (Source: PQA)

	Dredged Depth (m) (below CD)	Width (m)	Length (km)
Outer channel			
Buoy No. 1/2 to Bundal Island	14.7	Varies from 200 to 250	15.1
Inner Channel			
Bundal Island to the IOCB	13.0	200-250	25.1
Reach Channel			
(IOCB to QICT-2)	13.0	Varies from 250 to 450	3.0
Turning Basin adjacent IOCB	13.0	600 diameter	-
Turning Basin adjacent QICT-1	12.5	450 diameter	-
Turning Basin adjacent MW 1-4	11.5	450 diameter	-
Turning Basin adjacent LCT	10.0	450 diameter	-
Berthing Basin IOCB	13.0	50 wide	-
Berthing Basin QICT-1	11.5	50 wide	-
Berthing Basin MW 1-4	10.5	50 wide	-
Service Jetty & its approaches	5.0	75 wide	-

three were added subsequently on the marginal wharves to handle bulk cargo including wheat, rice, cement, fertilizers, coal, machinery/plants and raw material for Pakistan Steel. Since the early 1990s, the site of Port Qasim Authority has seen the establishment of sizeable storage sheds and manufacturing/processing units that include three car manufacturing units, edible oil refineries and large scale chemical and fertilizer plants, in addition to establishment of a number of bulk oil terminals.

4.2.2 Main Components and Facilities at PQA

All development projects at the port are being undertaken in private sector on BOT basis. The following facilities have been established at Port Qasim Authority.

1. Liquid cargo Terminal (LCT), with handling capacity of 4 million tonnes per annum, has been developed through joint venture of by M/s Felda, Westbury and Qasim (FWQ) at a cost of US$ 15 million. LCT has been in operation since August 2009.

2. 2nd Container Terminal is being developed by DP World at a cost of US$ 300 million with handling capacity of 1.175 million TEUs per annum. The Terminal is likely to be completed this year (2011).

3. The Grain & Fertilizer Terminal developed by M/s Fauji Akbar Portia at a cost of US$ 135 million with handling capacity of over 4 million tonnes per annum has been in operation since October 2010.

4. LNG Floating Terminal is being developed by M/s GasPort with handling capacity of 3 million tonnes LNG per annum. The terminal has yet to commence construction.

5. An LNG Terminal is planned to be developed by Granada group of Companies at a cost of US$ 274 million with handling capacity of 3.5 million tonnes per annum.

6. A terminal (EVTL) has been developed to cater for liquid chemical imports by Engro Chemical Pakistan in collaboration with Vopak of Netherlands, on BOT basis, at a cost US$ 115 million. Operational since January 1998, the terminal can accommodate 75000 DWT class vessels with designed capacity of 4 million tonnes per annum. Engro Vopak Terminal Limited at present has total capacity of 82400 cbm it comprises 10 mounded bullets, 2 spheres and 9 tanks.

7. Engro Corporation is following a fast track approach to develop the LNG import terminal in order to bridge the gap between supply and demand of natural gas. The Project is primarily based on developing infrastructure to facilitate LNG flow into the NG pipeline network in Pakistan, which is seeking a short term solution for its energy sector. The cost of proposed development is 450 Million USD.

8. To enhance production and export of value added textile products, GOP plans setting up a "Textile City" on 1250 acres in the Eastern Industrial Zone of PQA. PQA has transferred 1250 acres of land for the purpose. This is to facilitate vendors and suppliers of raw material and emergence of downstream and support industries, and also create employment opportunities besides earning valuable foreign exchange for the country.

9. The KESC Thermal Power Plant spread over an area 223 acres of land with 1260 MW power generation capacity has been developed at a cost of Rs.1.4 billion and is operational since 1984.

10. Indus Motors Automobile Plant developed through joint venture between Toyota Company of Japan and House Habib is of Pakistan at a cost of US$100 million over an area of 105 acres of land, the plant is operational since 1993.

11. Engro Polymer Chemical Plant developed over an area of 30 acres of land at a cost of Rs.560 million to produce PVC and is operational since 2002. It has recently expanded its capacity and also produces caustic soda and chlorine

12. PPTA Plant is operational since 1998 with designed capacity of 0.43 million tonnes of annual production, the plant is spread over an area of 150 acres and has been completed at a cost of US$ 500 million.

13. Bin Qasim Fertilizer Plant has been developed by Fauji Foundation of Pakistan over an area of 350 acres of land at a cost of US$ 370 million; the plant is operational since 1998.

14. IFFCO Pakistan refinery is developed over an area of 15 acres at a cost of US$ 34 million, integrated with its bulk oil terminal. It is operational since 1993 and has manufacturing capacity of 0.4 million tonnes per annum.

15. BOC Gases, UK established over an area of 10 acres of land, the plant has been developed at a cost of Rs.1.25 billion production hydrogen gas, nitrogen gas etc. The plant is operational since 1998.

16. Engro Chemicals (NPK Plant) facility has been developed over an area of 30 acres of land at a cost of US$ 81 million to produce fertilizers of various types and has been operational since 1999.

17. Mapak Edible Oil Refinery was developed at Port Qasim through joint venture of Malaysia and Pakistan in 2006 with a refining capacity of around 0.4 million tonnes per annum at a cost of US$ 20 million.

18. The second Oil Terminal has been planned at a cost of US$ 51.4 million with handling capacity of 9 million tonnes per annum. The Terminal is expected to be completed by 2012.

19. The second Iron Ore & Coal berth is being developed at a cost of US$ 150 million with handling capacity of 8 million tonnes per annum to handle increased volume of Pakistan Steel Mills and to accommodate Al-Tuwairqui Steel Mills imports. The development of the Terminal will be linked with Pak Steel Expansion program.

20. PQA has plans for deepening the navigation channel for all weather 14 meter draught vessels at a cost of US$ 200 million on Design, Construct and Finance basis.

21. Besides capacity building projects, PQA has plans for providing infrastructure facilities in its industrial zones for construction of 26 KM long Dual Carriageway from National Highway T-junction passing through PQA commercial areas (Western Industrial Zone and Eastern Industrial Zone), ending at Sassui Bridge Ghaggar Railway Crossing, and up-gradation of Main Access Road and construction of two flyovers on BOT basis at the estimated cost of Rs. 6.00 billion.

22. PQA has also awarded contract for development of Infrastructure facilities for roads, water supply, sewerage and drainage in Eastern Industrial Zone to FWO and NLC at a cost of Rs. 8.88 billion for which work in progress.

4.3 Physical Environment

4.3.1 Topography

The Project macroenvironment has three distinct dominant topographic regimes: Ridges, Plains, and Coastal belt. The area north of project site comprises rugged topography that includes ridges and runnels upland. The area on the south follows the coastal strip of the Gharo and Korangi creek system that has been described in section 4.2 above.

4.3.2 Geology, Geomorphology & Soil

The geological formations in Port Qasim and its adjoining areas belong to the middle and upper Tertiary Periods. The soil formations found in the area are fresh and slightly weathered, recent and sub recent shoreline deposits. These deposits are derived from Gaj/Manchar formations of Lower Miocene to Middle Miocene/Upper Miocene to Pliocene age. Similar deposits are found all along the coastal belt of Karachi and adjoining areas. Geological investigations for the macroenvironment of this Project also suggest the presence of only middle and upper tertiary rock formations comprising fresh, and slightly weathered recent and sub-recent shoreline deposits. Principal constituents of the deposits are the inter-bedded sandstone and shale together with subordinate amounts of large sized gravels or conglomerate.

The Kadiro Creek area, which forms the microenvironment of the Project, does not exhibit much

geological and pedagogical diversity except that it is covered with mangrove supporting mudflats. The mudflats are recent deposits of the deltaic origin while their soil cover is the drift type that has been transferred with the flood flows. According to the Geological Survey of Pakistan the project area and its macroenvironment have only the middle and upper tertiary formations. The formations can be described as slightly weathered, recent and sub recent shore line deposits.

The seabed at the Project macroenvironment is underlain predominantly with sand and silt while the gravels and conglomerates upland are poorly transfixed with medium to coarse brown sand and are derived from Manchar formations of Pleistocene age. The Gaj formation consists mostly of limestone with sub-ordinate shales and sandstones. The limestone is hard, sandy and extremely fossilified; this formation overlies the Nari formation which consists of hard lime stone beds and shales. Conformably overlying Gaj formation is Manchar formation. Manchar formation of similar nature exists all along the coastline of Karachi and is found exposed in Clifton, Ibrahim Haidery, Gizri, and Korangi areas, that forms the microenvironment of the PIBT Project.

This formation is composed of sandstone, clay bed, cemented sand and gravel (pseudo conglomerate). Sandstone is thick, porous and friable and also contains bands of conglomerates. The clay has different colors including grey, brown, chocolate and orange, however the most widely occurring clay is light brown and dark grey in color. Sandy layers are also found inter bedded with clay and gravel.

Tidal Channel Creek: The geology of the Kadiro Creek and adjacent creeks in the microenvironment comprises tidal channel creek deposits, which constitute dark grey to black silt and clay with organic material.

Tidal Mud Flats have mud and sand dominantly composed of fine grained clay and quartz

Mangrove Swamp deposits are covered by natural mangrove vegetation.

The geological map of project area is shown in figure 4.3

The geomorphology of the microenvironment is dominated by tidal flats, channels and creeks. Tidal flats slope gently towards the sea from the high tide level down to a depth below the low tide level. The sea floor in tidal flats and major tidal channels, lies below the lowest tide levels. Like major tidal channels, tidal creeks flow across tidal flats; these are shallower than tidal channels and run down to low tide level. On muddy tidal flats, tidal creeks e.g. Kadiro, often display a dendritic pattern with widening courses and point bars. Tidal flats are composed of fine silty clay sediments. Clay particles flocculate on meeting salt water and settle down, and thus provide substrate for colonization of salt tolerant plants e.g. mangroves.

Configuration of the coast line of Phitti Creek and its adjacent tidal creeks is erratic; the deltaic creeks have no distinct sea boundary. Sand formation is brown in color and has grain size ranging from fine to medium. The sand thrown by sea waves on to the coast is carried inwards where it works-up into dunes by wind action. Beach and sea bottom material in the vicinity of Phitti creek mouth is predominantly composed of very well sorted fine micaceous sand. Acoustic images suggest fine to medium grained homogenous seafloor material, most probably clay/silt and fine sand.

Sub-Recent and Recent Deposits

Alluvial Deposits: Alluvial deposits are present mainly in flood basin and streams; they consist of poorly sorted, unconsolidated/loose gravels, sand and silt.

Stream bed Deposits: These deposits consist of material brought down by streams and laid down in their channels comprising loose fine to coarse sand, gravels, pebbles and boulders.

Piedmont and Sub-piedmont Deposits: The sub-recent deposits in the area have been mapped as un-differentiated piedmont and sub-piedmont deposits consisting of loosely packed boulders, cobbles, pebbles and coarse to fine stand.

The soil in the microenvironment is derived from part of the Indus plain, which has built the large deltaic channels and the extensive mud flats carved out by the tidal channels. This soil mainly constitutes silty clay, clay, sandy silt, dense gravelly sand, hard clay and shale.

Geotechnical evaluation of the microenvironment has, through analysis of borehole data, identified the following sediment types from top to bottom in the project area:

- The Subsoil at the proposed dredged levels will be hard clay followed by very dense sand, gravels, and loosely cemented conglomerate.
- Soil investigations suggest that dredging can be executed routinely with a Cutter-Suction dredger.

The subsoil below existing seabed, at the proposed Dredging area, is essentially soft Clay and loose Silt/Sand.

Layer	Composition
Sea bed	The sea bed mainly covers tidal land, with elevation at location of boreholes varying from +3.0 to -0.3m.
1st layer	Encountered from seabed level; it extends up to El. -2.6 to El. -7.5m;.It is very loose to loose, Sandy Silt and soft to firm Silty Clay.
2nd Layer	Encountered in R-BH-3, R-BH-4 & R-BH-6, and not encountered in Borehole R-BH-1, R-BH-2 & R-BH-5, this layer consists of medium dense to dense, fine Sand extending up to El.- 7.1m to El. -7.8m.
3rd Layer	Encountered only in R-BH-1& R-BH-2, it consists of medium dense, Sandy Silt and stiff, Clayey silt. It extends up to El. -8.6 to -9.0m.
4th Layer	Encountered only in R-BH-4; it extends up to El. -12.0m, and is composed of very hard Clay
5th Layer	Extending up to El. -10.1m to -19.5m, this layer consists of very dense, sandy gravels/ Clayey gravels
6th Layer	Extending up to maximum drilled depth of El. -25.0m, it consists mainly of medium hard Shale/ Siltstone/Sandstone in stated sequence. Lenses of Limestone were also found at varied horizon.

Similar composition distributed in layers has also been recorded for the FOTCO Jetty located at the mouth of dredged channel, at about 3 km from proposed coal, clinker and cement terminal. The soil at this site has the following composition:

Sea bed :	tidal land
0.0 (surface) to 8.0 m :	clays
8.0 m - 14.00 m :	sands
14.0 m - 17.0 m :	clays
17.00 m - 25.00 m :	sand
25.00 m downwards :	gravel
	Hard rock not encountered

Subsoil Stratigraphy

Dredging Area:

- The subsoil within dredging levels of about -18.0m to -20.0m CD PQA has been found as generally soft to stiff Silty clay/ Clayey silt and loose to medium dense (dense at places) Sandy silt / Silty sand.

The seabed slopes at 12%-20%, from the mangroves towards Navigation Channel. This slope is suggested as having been stabilized over the years and similar slopes are expected to remain stable after dredging.

Usable Material from Dredging:

- Top Silty Clay/ Clayey Silt is unsuitable for using in Reclaimed Area, since use of such material in Reclaimed Area is vulnerable to undesirable settlement of soil over long term duration.
- Material of Layer II and Layer III is suggested as usable material for Reclaimed Area. The thickness of this material is generally 3 to 6m.

4.3.3 Seismic Conditions

Karachi District is situated close to the junction of three tectonic plates (Indo-Pakistan, Arabian and Eurasian Plates). The seismic hazard in the Indus Delta and the estuaries of the passive continental margin is mainly from the intra-plate active faults, principally the Rann-of-Kutch

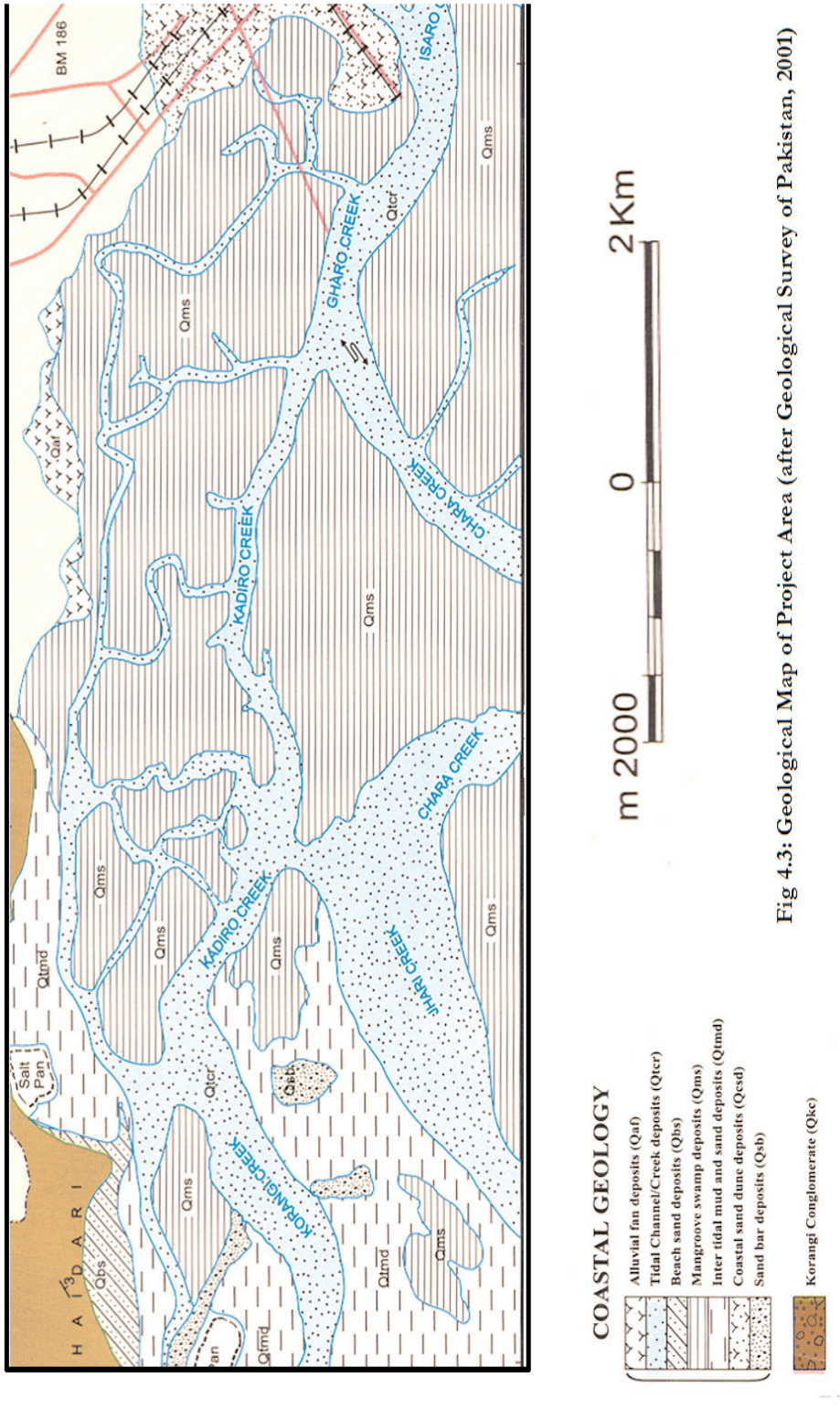


Fig 4.3: Geological Map of Project Area (after Geological Survey of Pakistan, 2001)

Fig 4.3: Geological Map of Project Area (after Geological Survey of Pakistan, 2001)

- Karachi Fault (also known as Karachi-Jati-Allah Bund fault), the Pab-Null Fault and their respective strands. The Rann-of-Kutch Fault passes close to the Eastern industrial Zone of Port Qasim.

The coastline of Karachi has three other segments namely the Jhimpir fault, the Pab fault, and the Surjani fault. These are the intra-plate active faults that pose major earthquake hazard in the Indus delta and the estuaries of the passive continental margin. The orientation of the Rann of Kutch - Karachi fault is roughly east-west; it is 225 km in length and is responsible for the production of earthquakes of considerably high magnitude of up to 7.6 M on Richter scale and of IX to X intensity on the Modified Mercali (MM) scale. The Pab fault on the other hand is 135 Km in length and is oriented north-south.

On the basis of the study of the seismic potential of the active faults viz. Rann of Kutch and Pab faults over their entire length, along with analysis of historical and instrumental records of the Pakistan coastal zone the risk factor for this region is estimated to be 7.7 to 8.2 M for the former and 7.2 to 7.8 M on Richter scale for the latter.

According to the United States Geological Survey (USGS) the Karachi-Makran coast in the Arabian Sea is seismically quite active. A high seismic activity of Karachi-Makran offshore is indicated by a large number of seismic shocks of 4 to 5 M on Richter scale. Generally the areas which are prone to frequent small intensity earthquakes also suffer from major earthquakes (>7) periodically. This period may vary from 50 to 100 years. A list of earthquakes with inland epicenters, since 1977 to date which affected the Indus Deltaic Creeks is given in Table 4.2.

The Geological Survey of Pakistan has defined the area of Port Qasim, where the site under study is located, to fall in Seismic Zone 2B region. This suggests the possibility of moderate to major seismic hazard i.e. probability of earthquakes of intensity VI to VIII MM scale and 5.6 to 6.6 M on Richter scale. From the charts published (such as figure, the peak ground level acceleration (PGA) for this zone is 28%. The seismic risk factor of 0.3 is advisable and will need to be incorporated in the design for constructions and installations in the coastal zone, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (VI to VIII MM).

The seismicity in the Karachi and at Project site is considered to be low. According to the published data the Project area lies in zone of low seismic activity, with acceleration ranging from 1.6 to 2.8 m/sec^2. A factor of 2.8 m/sec^2 will, on the other hand, have to be taken for a maximum credible earthquake (MCE). The design of the Bulk terminal must take these values into consideration.

Table 4.2: List of Earthquakes in Indus Deltaic region and surroundings within latitude 23.0-25.0 ^{o}N and longitude 67.5-71.0 ^{o}E

DATE	LAT. (^{o}N)	LONG. (^{o}E)	DEPTH (km)	MAGNITUDE RITCHER SCALE)
26-09-1977	25.4	68.2	33	4.5
25-11-1982	25.6	67.9	33	4.9
17-12-1985	24.9	67.4	33	4.9
24-12-1985	24.8	67.6	33	4.7
10-09-1991	24.4	68.7	33	4.8
19-09-1991	24.3	68.7	33	4.7
23-04-1992	24.3	68.8	33	3.7
24-12-1992	25.2	67.7	33	3.6
05-02-1993	24.6	68.9	4.3	4.3
26-01-2001	23.4	70.32	7.6	7.6

4.3.4 Tsunamis

Major damages done by Tsunamis, the impulsively generated seawater waves that are a result of underwater

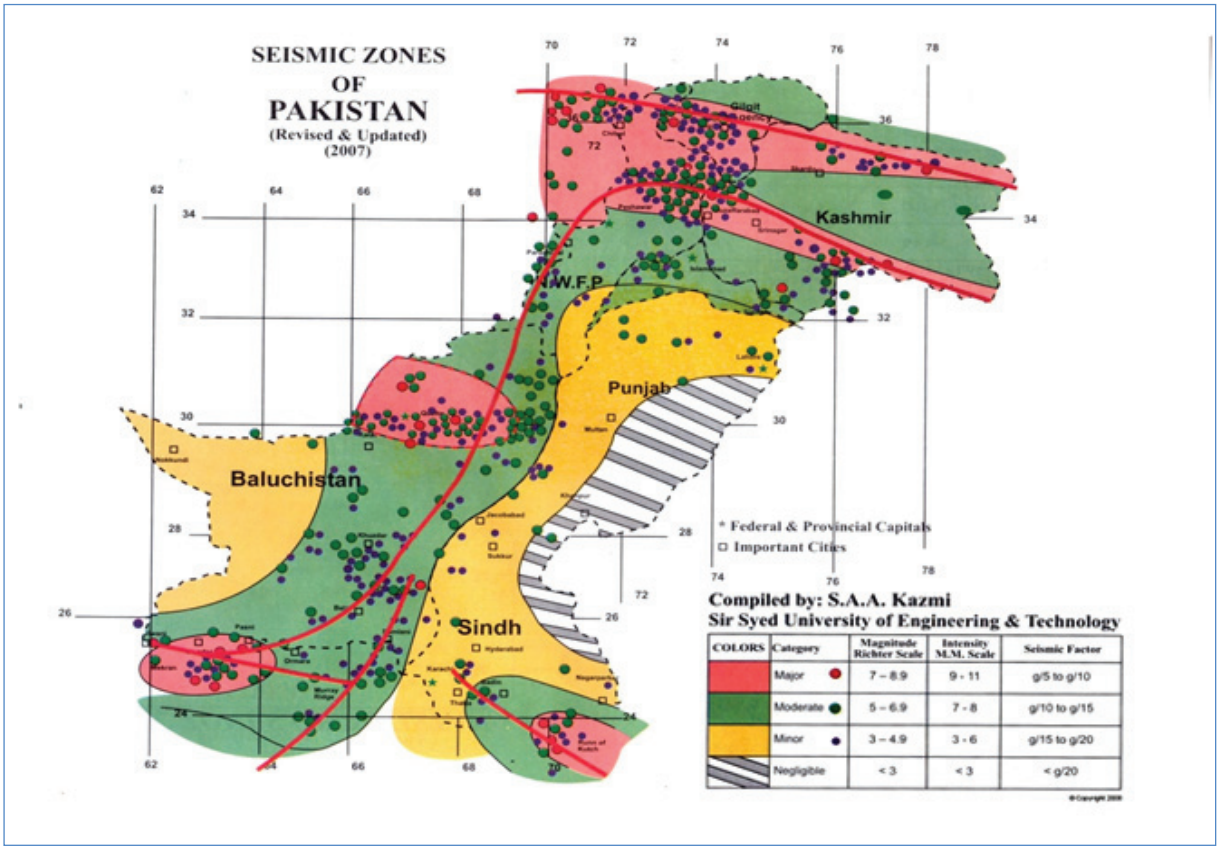


Fig 4.4. Seismic Hazard Zones of Pakistan

earthquakes, have not been recorded for the coastal area south of Karachi. There are, however, evidences of a 1.2 m tsunami generated by an offshore earthquake of intensity 8 M in 1945, which caused only minor damages in Port Qasim area. This event was followed by another Tidal wave that was recorded in 1953. The Tsunami of December 26, 2004 had no impact on the macroenvironment of the Port Qasim area.

Tsunamis in Indo-Pak region are relatively rare. Destructive tsunamis that may have occurred in the Arabian Sea have not been documented. The oldest known tsunamis in North Indian Ocean are:

a. 326 BC

b. 1st April and 9th May 1008

c. 1884

d. 26th June 1941

e. 27th /28th November 1945 (origin Makran)

The 1945 Tsunami having a magnitude of 8.3 on Richter scale was the deadliest. It originated off the Makran coast in Pakistan and was centered at 97.6 kilometers SSW of Pasni, 98.5 kilometers SE of Gwadar, and 408 kilometers West of Karachi. It reached a height of 40 feet in some Makran ports and caused great damage to the entire coastal region. The fishing village of Khudi, some 30 miles west of Karachi, was wiped out completely. All the inhabitants and their huts were washed away. The towns of Pasni and Ormara were badly affected. Both were reportedly under water after the tsunami.

At Karachi, the tsunami arrived from the direction of Clifton and Gizri. It ran along the oil installations at Keamari and flooded a few compounds. The waves were 6.5 feet or 2.0 meter high when they reached Karachi. There was a delay of more than one hour between the

main shock and arrival of the damaging tsunami at Karachi. Such events are less likely to occur in the north of the Arabian Sea.

The sea is 3.36 meter (11ft) below the road level at FOTCO and 2.7 meters (8.8 ft) below the average ground level at Native Jetty in the Manora Channel. This would suggest that a tsunami of magnitude similar to the 1945 Tsunami would affect the 2.5 meter contour on the beach front at Clifton but not the 5 to 9 meter contour from Korangi Creek to Ghaggar nala. A tsunami wave of magnitude higher than 5 meter would nevertheless be a matter of concern to the reclaimed areas along the sea front in the DHA, Korangi- Ibrahim Hyderi-Rehri- Lath Busti and Port Qasim area.

4.3.5 Hydrology

1. Water Resources and Drainage

The existing bulk water supply system for Karachi City shown in Figure 4.5 has a capacity of 600 mgd as summarized in Table 4.3.

The existing bulk water supply system conveys water to Karachi from two main sources, namely, Indus River

Table 4.3: Bulk Water Supply Capacity

Bulk Water System	Rated Capacity	Actual Supply
GK System*	280 mgd	300 mgd
Haleji System	20 mgd	30 mgd
K-II System	100 mgd	120 mgd
K-III system	100 mgd	100 mgd
Dumlottee Wells	20 mgd	0 mgd
Hub system	80 mgd	80 mgd
Total	600 mgd	630 mgd

**: downstream of Fore Bay*
Source: Karachi Water Supply Improvement Project, KW&SB

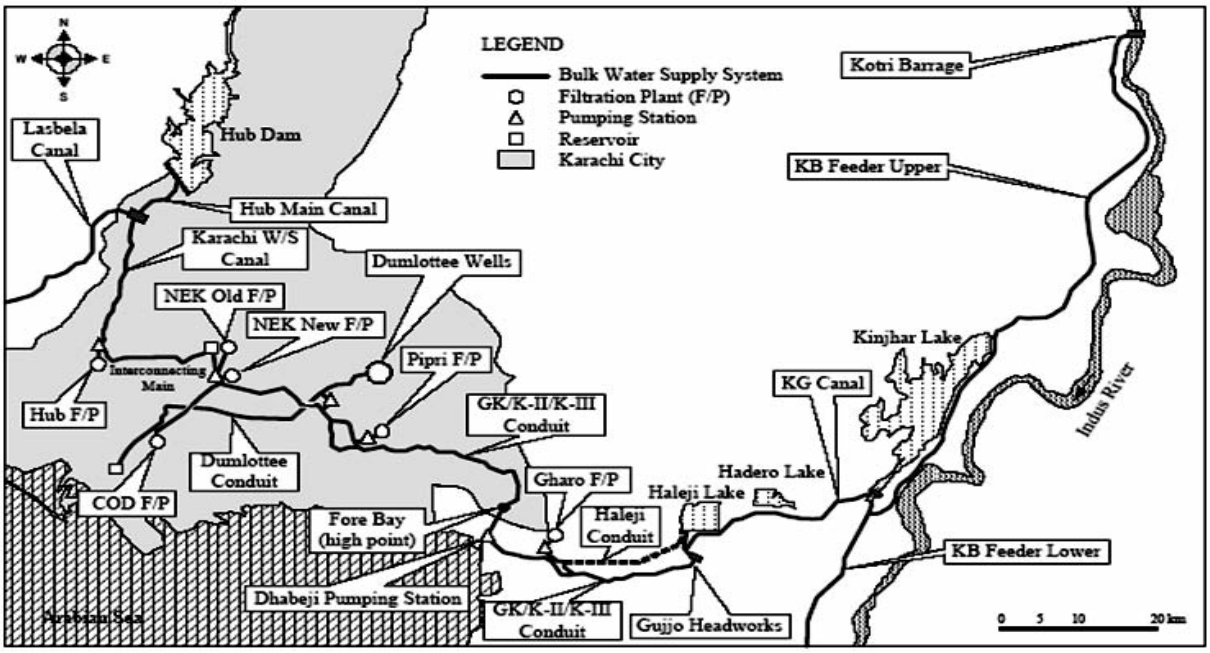


Figure 4.5: Existing Bulk Water Supply Network

through Kalri Baghar Feeder and Hub Dam across Hub River.

Karachi has been receiving its water supply from the Indus River since 1957 when the quota for urban supplies in Karachi from the River Indus was sanctioned. This allowed Karachi to take 450 cusecs (242 mgd or 1,100,000 m^3/d) from 16 October to 15 April (rabi) and 520 cusecs (280 mgd or 1,270,000 m3/d) from 16 April to 15 October (kharif) from the tail of the system at Kotri, through storage in Kinjhar Lake. Later, a presidential decree in 1988 increased this quota to 1,200 cusecs (645 mgd or 2,940,000 m^3/d).

Urban and industrial water for Karachi is taken from the Kotri Barrage and discharged through the Kalri Baghar Feeder Upper (KB Feeder Upper) to Kinjhar Lake. The right (west) bank command of 310,000 ha (3,100 km^2) gross is supplied by a single canal: the KB Feeder which also supplies Karachi 150 km west-southwest of the off-take. The KB Feeder Upper has a design capacity at its head of 9,075 cusecs (22,300,000 m^3/d) and terminates at the head of Kinjhar Lake. This is also the off take for the Right Bank Link Canal which, since it was opened in 1982, has enabled water from the KB Feeder Upper to be supplied directly to the KB Feeder Lower without passing through the lake. This allows unsettled silty water to be supplied to downstream irrigators and also serves to reduce sedimentation of the lake.

The Hub Dam is a multi-purpose dam (municipal, industrial and irrigation purposes) constructed on the Hub River approximately 50 km to the north-west of Karachi City. The construction of the dam started in September 1963 and completed after 18 years in September 1981. The construction of the Lasbela Canal and Hub Main Canal was completed in September 1981 and September 1982 respectively. The catchment area of the dam extends across two provinces namely Sindh and Baluchistan covering a total area of 3,410 sq miles (8,730 km2).

The water distribution network in Karachi covers 18 towns, 6 Cantonments and the Defense Housing Authority (DHA) Area. These 18 towns are included in 5 administrative water supply zones classified by KW&SB, as shown in Figure 4.6. Water is supplied through water trunk mains from water filtration plants, reservoirs, pumping stations or Dumlottee Wells in the city of Karachi. Bin Qasim is included in Zone-I and it receives its supply from a canal that takes off from Gujjo Headworks.

2. Surface Water, Groundwater and Seawater in Microenvironment

There is no inland surface water body in project area except the mudflat lying between the 9 meter contour and the coastline of Arabian Sea. There are quite a few springs including the Chashma at Chashma goth and some along the coastal road that runs along the base of the 5-9 meter contour that is conspicuous in the region.

The major industrial complexes including Korangi Industrial area (KIA), Landhi Industrial Trading Estate (LITE), Port Qasim Industrial Area and Pakistan Steel Mill are located in the proximity of the creeks adjoining Port Qasim. The KIA is located adjacent to Korangi- Kadiro creeks, LITE is situated close to the Kadiro-Gharo creeks and Steel Mill is located on the Gharo creek. The creeks adjacent to the mudflats are recipient of at least 25% of the total pollution load of Karachi through Malir River and about 15% that is directly discharged into the adjacent open sea coast or to the Gizri, Korangi and Gharo creeks.

Coastal villages such as Ibrahim Haidery, Rehri, Lath Basti are part of the macroenvironment that includes Korangi creek, Phitti creek, Kadiro creek and Gharo

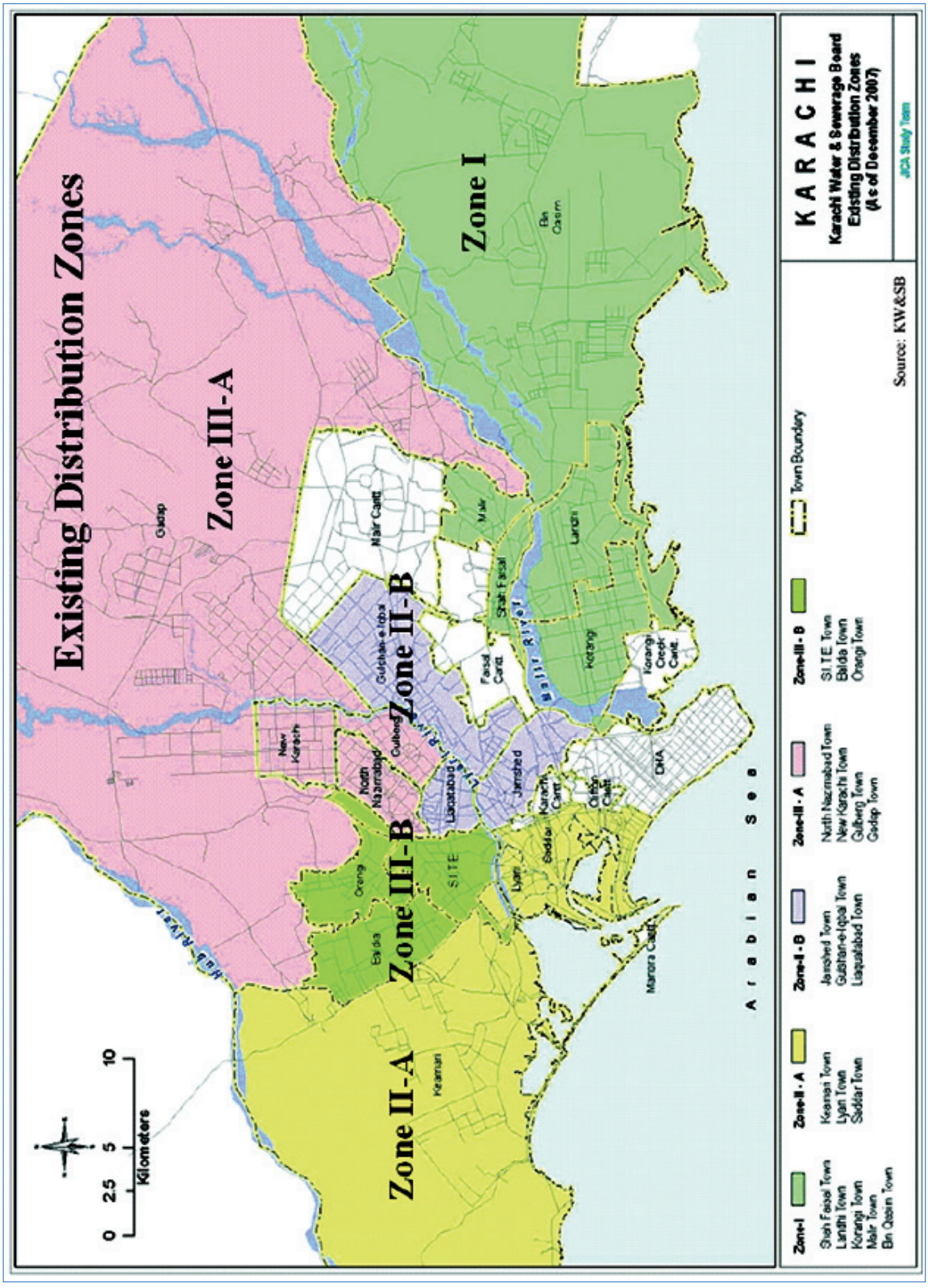


Figure 4.6: Present Water Supply Zones

Table 4.4: Present Water Supply to the Towns of Karachi

WTPs	Reservoirs/PSs			Town Supplied	Area
Gharo WTP (20 mgd)	9th mile PS (6 mgd)	through abandoned H S R Site		Jamshed Town	Central Karachi
Reservoir (5 mg)					
				Bin Qasim	South East Karachi
				Landhi	South East Karachi
				Korangi	South East Karachi
				Shah Faisal	South East Karachi
Pipri WTP (100 mgd)	through abandoned H.S.R Site			Jamshed	Central Karachi
Reservoir (16 mg)				Malir	South East Karachi
				Bin Qasim	South East Karachi
				Landhi	South East Karachi
				Korangi	South East Karachi
				Shah Faisal	South East Karachi
Dumlottee Wells	L S R (9 mg)	L S R PS 9.3 (mgd) T & CPS (3 mgd)	through abandoned H S R Site	Jamshed	Central Karachi
(supplied through				Shah Faisal	South East Karachi
the Dumlottee conduit)	T & C Reservoir (5.2 mg)			Lyari	Central Karachi
				Saddar	Central Karachi
Additionally watered from	Sydenham Reservoir (6 mg)			Jamshed	Central Karachi
GK/K-II/KIII/ conduits				Gulshan-e-Iqbal	North East Karachi
NEK Old WTP (25 mgd)	Manghopir PS (105 mgd)		Hub WTP	-	-
Reservoir (10 mg)	Agmer Nagri PS			Orangi	North West Karachi
				North Karachi	North East Karachi
				Orangi	North West Karachi
NEK New WTP (100 mgd)	High Lift PS (75 mgd)	University Reservoir (10 mg)	Sakhi Hassan PS	Gulberg	Central Karachi
Reservoir (10 mg)			Board Office PS	North Nazimabad	North East Karachi
				North Nazimabad	North East Karachi
				Orangi	North West Karachi
				Gulshan-e-Iqbal	North East Karachi
				Gulberg	Central Karachi
COD WTP (115 mgd)	Kidney Hill Res. (5 mg)			Jamshed	Central Karachi
Reservoir (16 mg)				Keamari	North West Karachi
				Lyari	Central Karachi
				Saddar	Central Karachi
				Jamshed	Central Karachi
				Liaquat Abad	Central Karachi
Hub WTP (80 mg)				Orangi	North West Karachi
Reservoir (15 mg)				Baldia	North West Karachi
				SITE	Central Karachi
				Gadap	North East Karachi

Source: Karachi Water Supply Improvement Project, KWSB

creek system which form an inter-related system of creeks receiving bulk of the domestic and industrial wastes generated in the southeast of Karachi.

The complex creek system southeast of Karachi is part of the Indus Delta. The Delta presents a major case study of adverse impact of the progressive reduction in fresh water discharge over a period of time. Whereas construction of dams and barrages has reduced the flow of freshwater into the Arabian Sea, the Indus Basin irrigation system per se has outlived its age. This is the conclusion of an extensive survey for the Ecosystem Research on Water Resource Management In Sindh West (Mirza Arshad Ali Beg, Yasmin Nergis, and Mughal Shareef, HEC Project 1196, 2008-2010) that supports the following hypotheses in quantitative terms:

- Industries, industrial estates, irrigation and municipalities as well as tourism activities have over-exploited the groundwater sources to the extent that critical limits of the hydrological potential of the region have been reached. Consequently the Indus delta as well as areas inland from the sea is at risk to seawater intrusion and of seismic events in the coastal areas.
- Diversion of Indus River water into irrigation canals and channels has depleted the Indus Delta of freshwater and induced seawater intrusion into extensive areas inland, besides waterlogging and salinizing the land in the terminal zones of the irrigation system in the coastal areas of District Thatta in Sindh West.
- The creek channels are no longer hyper-saline as is being maintained by several reports by concerned agencies. Contrarily the creek channels are hypo-saline for as long as the irrigation system is supplying the water to adjacent land.

The findings of the Surveys suggest that while the Indus delta has been deprived of the 8.2 MAF water flow thus virtually drying it up of the freshwater, the ecosystems adjacent to the canal command area have been salinized and water logged. This has resulted in dilution of the creek water with the seepage from waterlogged land areas and discharge from drainage canals to the extent that their salinity is no longer 40-43ppt, as is being reported, but has come down to 27ppt during the kharif season and after the rains.

The creeks are hyposaline with salinity in the 27 to 29 ppt range, the dilution having been effected by the seepage which has, according to the estimates exceeded the normal 10% and is rated at 15 to 25% as a result of cultivation of the water intensive rice crop that by the traditional system also requires puddling the fields, which is in line with the hypotheses proposed earlier [Mirza Arshad Ali Beg, Ecological Imbalances in the coastal areas of Pakistan and Karachi harbour, Pakistan Journal of Marine Sciences, 4(2), 159-74, 1995]. The observation with respect to waterlogging and salinization supports the hypothesis that the Barrage system of making water available at farm gates has outlived its age and is doing more harm than good to sustainable development through its distribution system.

Reduced water flow downstream Kotri has also resulted in land erosion and land submergence; the seawater current pattern has apparently assumed adequate potential energy to erode the surfaces of the land over the creeks and this is the reason that many of the islands between Mirpur Sakro and Keti Bunder have lost their identity, Lakha Island in Boharo being an example.

Chemical and bacteriological analyses of surface water, groundwater, seawater, and wastewater support the conclusions that:

1) Water still flowing during the period when there is no discharge downstream Kotri Barrage, is

contaminated with seawater that intrudes inland up to Kotri during the high tides in particular during the middle of the Lunar months and around the time of solar and Lunar eclipse.

2) Fresh water being supplied to Karachi marginally meets the drinking water quality standards, while treatment of wastewater remains unattended.

3) Extensive mining of groundwater has dried up the aquifer and it is barely recharged once in three years.

4) Extensive excavation of sand and gravel from the riverine areas has dried up the aquifer and flash floods are taking their toll, while excavation of sand from the coastal area has destabilized the coastline at several places.

The Malir River drains into the Korangi Creek/Ghizri Creek. Korangi Creek forms part of the Indus Delta that harbors the fifth largest single arid region mangrove forest in the world. Physico-chemical characteristics of water from different sources including seawater, groundwater, industrial wastewater, spring overflow in the macroenvironment of PQA are summarized in Table 4.5 - 4.6.

Sea water samples collected from Steel Mills intake and

Table 4.5: Summary of Water Analysis (Korangi- Ibrahim Hyderi- Rehri - Port Qasim Section)

Sr. #	Parameters/Analytes Descriptions	Results						
		Unit	666	667	668	669	670	671
1	Collection Time	Hr: mn	0550	0600	0649	0700	0910	0920
2	Sample Collection date	d.m.y	03.03.10	03.03.10	03.03.10	03.03.10	06.03.10	06.03.10
3	Temperature	°C	25.9	27.1	23.5	26.2	29.0	26.5
4	pH Value	SU	7.68	8.38	7.47	8.32	7.11	7.24
5	Color	App.	Susp	Susp	Muddy	Susp	Susp	Clear
6	Total Dissolve Solids (TDS)	mg/L	30010	42900	40000	43280	1932	1549
7	Conductivity	µs/cm	61200	68400	60000	67700	4040	3110
8	Dissolve Oxygen (DO)	mg/L	4.04	2.01	3.39	4.02	5.13	5.69
9	Chloride (Cl-1)	mg/L	14400	2281	21701	23230	770	630
10	Bicarbonate (HCO3)	mg/L	2401	22470	2108	2230	330	260
11	Sulfate (SO4)	mg/L	1901	970	940	1020	210	120
12	Nitrate (NO3)	mg/L	31.8	18.8	13.2	9.8	8.7	4.8
13	Carbonate (CO3)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
14	Calcium (Ca)	mg/L	830	1203	1170	1302	225	135
15	Magnesium (Mg)	mg/L	520	876	850	990	170	105
16	Sodium (Na)	mg/L	9900	14421	13190	14330	487	220
17	Potassium (K)	mg/L	231	259	312	270	113	27
18	5-Days BOD	mg/L	BDL	237	468	BDL	BDL	218
19	Chemical Oxygen Demand (COD)	mg/L	BDL	304	559	BDL	BDL	426
20	Mercury (Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
21	Lead (Pb)	mg/L	BDL	1.398	BDL	BDL	BDL	BDL
22	Cadmium (Cd)	mg/L	BDL	0.876	BDL	BDL	BDL	BDL
23	Arsenic (As)	mg/L	BDL	BDL	BDL	BDL	0.0418	BDL
24	Nickel (Ni)	mg/L	BDL	1.174	BDL	BDL	0.0621	0.2617
25	Zinc (Zn)	mg/L	BDL	8.984	3.289	BDL	0.5118	1.9146
26	Total Plate Count @37°C	Cfu	110	TNTC	TNTC	TNTC	TNTC	TNTC
27	Total Coliforms @42°C	Cfu	70	TNTC	TNTC	TNTC	TNTC	TNTC
28	Escherichia Coli @37°C	cfu	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve
29	Sodium Absorption Ratio (SAR)	:	66.09	76.84	71.31	72.53	5.94	3.44

666 -Sea Water (Pakistan Steel Mill-Channel). 667-Pakistan Steel Mill Sewage Effluent. 668-Sea Water Creek Ziarat Hasan Shah. 669-Sea Water/Stagnant way to Ziarat Hasan Shah. 670- Spring Water Baba Juman Shah. 671-Spring Water Drain to Dhabji.

outfall channels, and from Ziarat Hasan Shah had lower SAR ~66 76 but TDS varying from 30,000 to 43,280 at 26 and 27°C, pH 7.44 and 8.4, and DO ~4.0 showing dilution with wastewater discharges and concentration due to evaporation on the outside of the creek. Seawater at the Ziarat Hasan Shah beach Had SAR 71.3, TDS 40,000, DO 3.39 and pH 7.47 at 23.5°C. The samples from spring and the nala receiving the overflow from the spring show characteristics of groundwater having higher proportions of sodium and chloride ions.

Sea water samples collected from Lath Basti had lower SAR ~65 but TDS ~38700 at 26 and 28°C, pH 7.44 and 7.58, and DO ~4.0 showing dilution with wastewater discharges from the surrounding. The samples from boreholes show characteristics of groundwater having higher proportions of sodium and chloride ions. The water supply samples with SAR above 1.2 show characteristics of fresh water contamination with groundwater.

Wastewater samples collected from Korangi Industrial Area which is the outfall region of Malir River, had SAR values ranging from 2.79 to 5.56; TDS ranging from 1228 to 4310; low DO 0.39 to 0.62 and the high BOD and COD values in the samples; they are characterized as industrial

Table 4.6 Summary of Water Analysis (Korangi- Ibrahim Hyderi- Rehri - Port Qasim Section)

Sr. #	Parameters/Analytes Descriptions		Results					
		Unit	654	655	656	657	658	659
1	Collection Time	Hr: mn	1240	0104	0110	0150	0230	0240
2	Sample Collection date	d.m.y	03.03.10	03.03.10	03.03.10	03.03.10	03.03.10	03.03.10
3	Temperature	°C	26.5	26.6	26.6	28.6	29	28.9
4	pH Value	SU	7.44	8.45	8.17	7.58	7.28	7.06
5	Color	App.	susp	clear	clear	susp	clear	clear
6	Total Dissolve Solids (TDS)	mg/L	38700	228	232	38700	2410	1418
7	Conductivity	µs/cm	61500	496	496	64000	4990	2990
8	Dissolve Oxygen (DO)	mg/L	4.02	5.08	5.10	3.97	4.07	4.96
9	Chloride (Cl-1)	mg/L	20810	58	59	20808	970	528
10	Bicarbonate (HCO3)	mg/L	1940	70	72	1920	415	270
11	Sulfate (SO4)	mg/L	920	34	34	930	212	92
12	Nitrate (NO3)	mg/L	17.6	3.28	1.19	4.26	3.28	7.8
13	Carbonate (CO3)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
14	Calcium (Ca)	mg/L	1210	19	20	1220	312	120
15	Magnesium (Mg)	mg/L	965	11	12.0	970	230	115
16	Sodium (Na)	mg/L	12790	34	34	12770	330	195
17	Potassium (K)	mg/L	191	2.9	2.9	189	29.0	43.0
18	5-Days BOD	mg/L	37	BDL	BDL	BDL	BDL	BDL
19	Chemical Oxygen Demand (COD)	mg/L	57	BDL	BDL	BDL	BDL	BDL
20	Mercury (Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
21	Lead (Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium (Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
23	Arsenic (As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
24	Nickel (Ni)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	0.0268
26	Total Plate Count @37°C	Cfu	TNTC	210	140	TNTC	TNTC	TNTC
27	Total Coliforms @42°C	Cfu	TNTC	- ve	TNTC	TNTC	TNTC	TNTC
28	Escherichia Coli @37°C	cfu	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve
29	Sodium Absorption Ratio (SAR)	:	66.25	1.53	1.48	65.93	3.44	3.04

654-Sea water Lath Basti. 655-KDA Water Lath Basti #1. 656-KDA Line Water Lath Basti. 657-Sea Water Lath Basti. 658-Boring Water Cattle Farm. 659-Boring Water Cattle Farm 200ft.

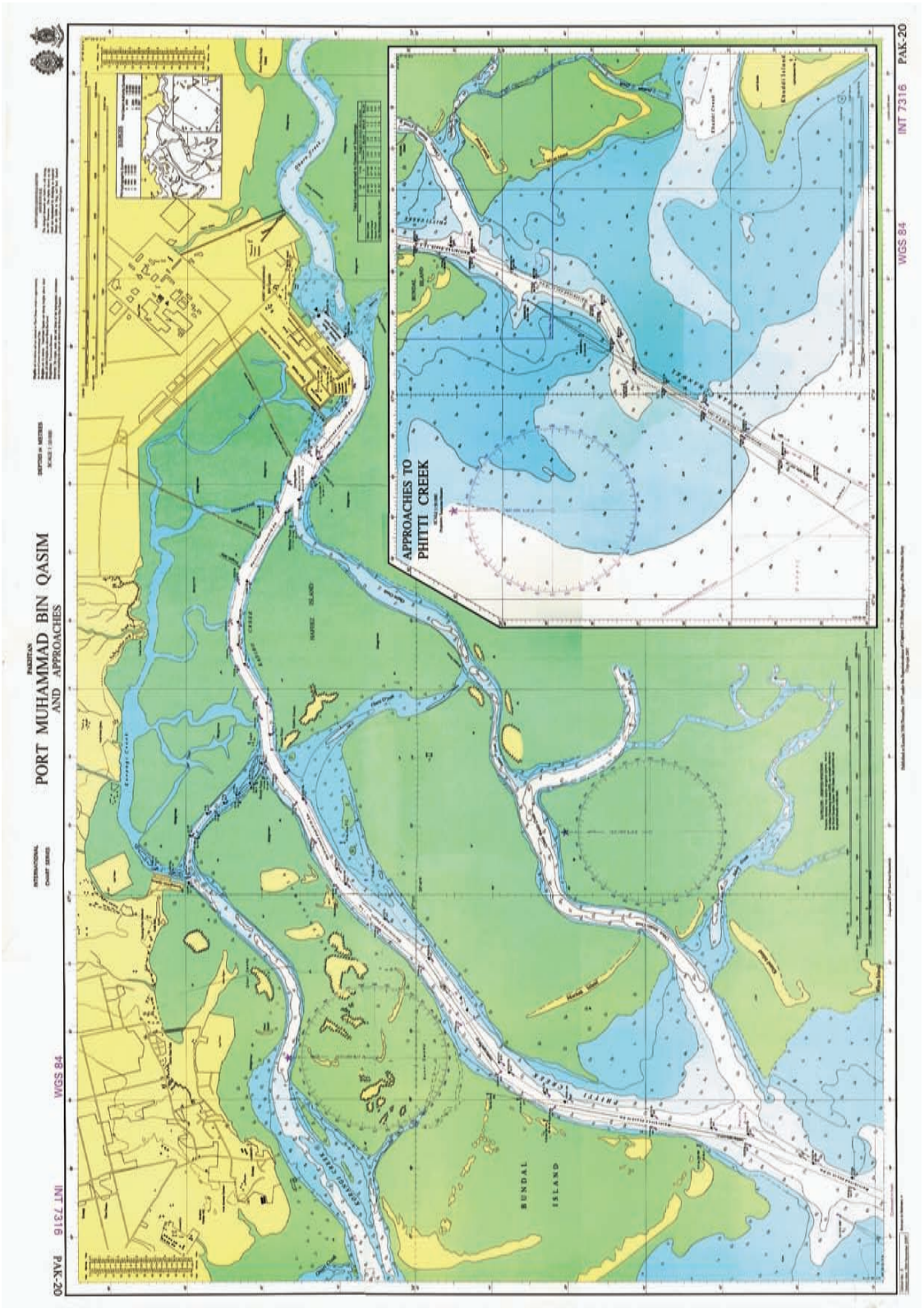


Figure 4.7: Admiralty Chart of PQA

wastewater mixed with sewage. The sewage is in higher proportion upstream while industrial effluent is dominant as the river enters its delta area. Seawater intrusion was noted at Malir River/Korangi Industrial Area during high tide. It was noted that the sample collected from here had SAR 57.68, TDS 22300, DO 0.82 and quite high BOD and COD, and is characterized as seawater contaminated with sewage and industrial effluent.

4.4 Physical Oceanography

4.4.1 Bathymetry

The nautical chart 'Port Muhammad Bin Qasim and Approaches' (International Chart Series Pakistan) shows water depths along the access channel, turning basin, both with maintained depth of -12.5 m, as well as some depth points around the proposed site for the terminal. More detailed bathymetric plan available shows water depths in the proposed quay wall line (for coal, clinker and cement terminal jetty) from west to east between 5.6 m and 8.4 m and for the quay wall from north to south between 5.6 m and 17.8 m. The slopes are pronounced (1:20) from north to south, across the channel, while they are almost horizontal along the channel.

4.4.2 Waves

The waves and their height at Karachi Coast vary with the season. During NE winter monsoon the wind speed is around 10 knots and the coastal waters are almost calm and the wave height is less than 1 meter. During SW summer monsoon the winds pick up speed of about 25 knots; the wave height on the Karachi Coast is then in the range of 3 to 4 meters. In the interim months i.e. inter-monsoon period the wave height is about 1.5 to 2.5 meters.

Pakistan lies to the north of the Arabian Sea. Its coastline is exposed to waves from the south, southwest and west. During the severe months of summer monsoons, the wind and waves originate from the southwest, while during the winter months the wind direction varies from directionless to 1.5-2.5 m/s. During winter both swell waves and local wind generated waves are observed at the coast.

For the swell waves, voluntary observations of weather data by ships of passage are considered to give realistic offshore wave data. For the locally generated waves, wind data from nearby coastal stations are considered sufficiently accurate.

Deep sea wave data, for the SW monsoon months (May to September) applicable to Pakistan coast is given in Table 4.7.

4.4.3 Tides and Surges

Tides along Karachi Coast are semidiurnal but diurnal inequality is also present. The effect of this inequality shows up in daily tidal cycle as there are two High Waters and two Low Waters which also vary considerably from each other in tidal heights. These are classified as HHW, LHW, LLW and HLW. The tides move from west to east i.e. the tide at the Hub River estuary arrives about 20 minutes earlier than at Karachi. Similarly the tides at Karachi Harbor arrive about 10 minutes earlier than at entrance of Port Qasim. When tides progress up the Phitti Creek their magnitude increases and there is a time lag. At Port Bin Qasim which is about 32 km from Karachi and about 25 km up the creek from the sea, the tides reach after 22 minutes. At Gharo Creek tides fall rapidly due to frictional effects and the gradual weakening of the tidal forces. At Gharo 60 km from the Phitti Creek entrance the tides are almost half of the mean sea tides at the entrance.

The tides at Port Qasim are predominantly semi-diurnal with a substantial diurnal component. The Mean Higher High Water (MHHW) to Mean Lower Low Water (MLLW) range is about 2.4 m at the port complex while the peak tide over diurnal range is about 3.5m. The tide levels at Port Qasim are presented in Table 4.8. The flow pattern within this large, relatively deep and generally stable creek system around Port Qasim is strongly influenced by tides and the presence of extensive inter-tidal flats.

Surges: Tidal data recorded at Port Qasim as well Karachi

Table 4.7: Deep Sea Wave Frequency Distribution Statistics

Resultant Wave Height (m)	Wave Period (Seconds) for Higher of Sea/Swell Height									
	0-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18	Total
0 to 0.5	2.6%	4.1%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	7.4%
0.6 to 1.0	1.1%	5.3%	1.8%	0.4%	0.1%	0.0%	0.0%	0.0%		8.9%
1.1 to 1.5	1.2%	6.7%	6.3%	2.2%	0.6%	0.1%	0.1%	0.0%	0.0%	17.3%
1.6 to 2.0	0.1%	3.8%	4.9%	2.9%	0.9%	0.2%	0.1%	0.0%	0.0%	12.8%
2.1 to 2.5	0.0%	2.8%	5%	3.6%	1.4%	0.4%	0.1%	0.0%		13.2%
2.6 to 3.0		1.3%	3.4%	3.2%	1.5%	0.5%	0.1%	0.0%	0.0%	10.0%
3.1 to 4.0		1.1%	4.9%	6.1%	2.9%	1.0%	0.3%	0.1%	0.0%	16.4%
4.1 to 5.0		0.2%	1.8%	3.3%	1.9%	0.8%	0.2%	0.0%	0.0%	8.3%
5.1 to 6.0		0.0%	0.5%	1.4%	1.1%	0.4%	0.1%	0.0%	0.0%	3.6%
6.1 to 7.0			0.2%	0.5%	0.4%	0.2%	0.1%	0.0%	0.0%	1.5%
7.1 to 8.0			0.0%	0.2%	0.2%	1.0%	0.1%	0.0%	0.0%	0.5%
8.1 to 9.0			0.0%	0.0%	0.0%	0.0%	0.1%			0.1%
9.1 to 10.0			0.0%	0.0%	0.0%	0.0%				0.0%
10.1 to 12.0				0.0%	0.0%					0.0%
12.1 or more										0.0%
Total	5.1%	25.3%	29.4%	23.9%	11.0%	3.7%	1.3%	0.3%	0.1%	100%

Notes:
1. Sea Area Coverage: 15-25 N, 60-70 E
2. Seasonal Coverage: May to September
3. Period of data: January 1949-October 1995
4. Blank indicates zero frequency whilst 0.0% indicates less than 0.05%
5. Total number of observations were 38143Source: EIA report of EVTL Terminal by Hagler Bailly Pakistan

Table 4.8: Tidal Levels at Port Qasim

Location	MLLW	MHLW	MLHW	MHH	HAT	LAT
Bundal Island	+0.6	+1.2	+2.3	+2.9	NA	NA
Hasan Point	+0.6	+1.3	+2.8	+2.9	+3.4	+0.6
Phitti Creek	01.0	+1.4	+2.1	+3.4	+4.00	-0.6

Port was analyzed for the separation of surges on the basis of the recorded values. Based on 1982 data, it was concluded that maximum surge was never more than 2.0 feet. When surge occurs at the rising tide, it builds up whereas during falling tide the interactive effect reduces its intensity. Although most of the storms resulted in the rise of sea level but the surge height was never critical. Nevertheless, the coastal topography being gentle and flat, even a surge of 2.0 feet during spring tide can create flooding.

Analysis of the tidal data on surges for Karachi for a 14 year period has been extracted and is recorded in Table 4.9.

4.4.4 Seawater Currents

The speed of sea currents is generally low: ~0.5 knots. The speed increases up to 1 knot during SW monsoon. The direction of the sea current is directly related with the prevailing wind system. The set is generally easterly in the SW monsoon and westerly in the NE monsoon. The slight difference in direction in the Western and Eastern part of Karachi Coast is due to circulatory pattern of the current around gyrals which are usually formed at the center of the sea. There is a clockwise gyre during SW monsoon and anti-clockwise gyre during NE monsoon (Quraishee, 1988).

Table 4.9: High tides and surges in past

Month	Height of tide (ft)	Height of surges (ft)
Jun58	9.7	1.3
Jul58	8.2	1.3
Oct58	9.6	1.4
Nov58	8.1	0.8
May59	9.9	1.8
Jun59	6.9	1.6
Jun59	9.2	1.5
Jun64	8.6	1.7
Jun70	8.4	2.0

Source: Quraishee G.S et al (1984)

Quraishee (1984, 1988) has also observed the existence of warm core eddies in the offshore areas of Pakistan.

4.4.5 Air & Seawater Temperature

According to UNESCAP Report (1996) the average annual sea-surface temperature in near shore waters along Karachi Coast Ranges between 20.7°C and 29.3°C as shown in Table 4.132. During winter months the temperature range is 20.7°C to 23.8°C whereas during summer months the range is between 27.9°C to 29.3°C. In the creeks along Indus Delta the sea-surface temperature generally ranges between 23.4°C to 29.5°C as shown in Table 4.10. Water temperature in tidal channels in the Indus Delta creeks have been reported form 19°C in January to 30°C in June

Table 4.10: Monthly distribution of temperature (°C) along the Pakistan Coast (UNESCAP, 1996)

	Jan	Temp.	Feb	Temp.	Mar	Temp.	Apr	Temp.	May	Temp.	Jun	Temp.
	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea
Indus delta	19.2	23.6	20.2	23.8	24.3	24.9	29.0	27.0	29.5	27.9	30.0	29.5
Karachi Coast	19.2	23.5	20.5	23.8	24.0	24.8	27.0	26.5	29.0	27.9	30.0	29.3
Gwadar	18.3	20.2	19.5	20.2	22.3	22.0	27.5	24.2	30.1	26.5	31.2	28.3
	Jul	Temp.	Aug	Temp.	Sep	Temp.	Oct	Temp.	Nov	Temp.	Dec	Temp.
	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea
Indus delta	29.5	28.7	28.0	28.5	26.5	27.0	27.0	27.8	23.5	26.5	19.5	23.4
Karachi Coast	29.3	28.0	28.0	28.0	28.5	27.3	27.2	27.0	27.5	24.4	27.0	20.7
Gwadar	29.2	27.3	28.5	28.0	29.4	28.3	27.0	28.0	23.1	25.3	20.1	23.2

Table 4.11: Sea-water Temperature of Creeks

Locations	Sea water Temp (°C)
Gizri Ck (top end)	21
Gizri Ck (DHA club)	20
Korangi Ck (Rehri)	22
Korangi Ck (Lath Basti)	23
PSO Oil Jetty	25
Phitti Creek	22.7
Jhari Creek	23
Chara Creek	23
Gharo Creek	24

(Harrison et al. 1994, Zaqoot, 2000). The temperatures at a depth of 100 m are lower and generally have an annual range between 19.5°C to 24.5°C.

4.4.6 Seawater Salinity

According to UNEP (1986) the salinity ranges from 3.55 to 3.69 percent in the inshore waters of Karachi and may rise to as high as 4.1 to 4.2 percent in the back water and tidal creeks. The average annual salinity in coastal waters along Karachi and Indus Delta ranges from 3.6 to 3.67 percent

Table 4.12: Monthly distribution of salinity along the Pakistan Coast (UNESCAP, 1996)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Indus delta	36.1	36.15	36.5	36.4	36.6	36.6	36.7	36.61	36.48	36.47	36.5	36.2
Karachi	36.0	36.2	36.5	36.5	36.5	36.6	36.7	36.6	36.5	36.5	36.5	36.2
Gwadar	36.05	36.26	36.53	36.55	36.58	36.65	36.74	36.68	36.55	36.55	26.54	26.3

Table 4.13: Salinity and Density of Creeks

Locations	Salinity Ppt	Density kg/m^3
Gizri Ck (top end)	33.95	1.025
Gizri Ck (DHA club)	33.4	1.025
Korangi Ck (Rehri)	37.8	1.028
Korangi Ck (Lath Basti)	36	1.027
PSO Oil Jetty	37	1.028
Phitti Creek	38.78	1.029
Jhari Creek	39.2	1.03
Chara Creek	38.41	1.03
Gharo Creek	38.44	1.029

(UNEP, 1996). The monthly distributions of salinity along Sindh coast are presented in Table 4.12.

The tidal channels in Indus Deltaic area are generally hyper-saline with salinity range of 3.8 to 4.5 percent over the year except during August and September when due to rainy season the runoff from Indus River reduces the sea water Salinity to 2.6 to 3.0 percent (Harrison et al., 1994). Low salinity values of 2.8 to 3.0 percent were reported by Rabbani and Khan (1988) for Khobar Creek of Indus Delta. Inside Karachi Harbor from Lyari River mouth to the mouth of Manora Channel the Salinity values in the range of 2.5 to 3.4 percent have also been reported (Zaqoot, 2000).

Until recently the Indus River had a largely river dominated estuary but increased utilization of the river for agriculture etc. has resulted in discharge to the Arabian Sea only during the summer southwest monsoon. During remaining nine to ten months the Indus River has no estuary due to elimination of the river discharge. As a result, the mangrove ecosystem has been adversely affected. The mangroves are degrading rapidly caused by a number of factors such as cutting, browsing and by reduced silt laden river water, besides increase in salinity in the creeks. These forests which covered 263,000ha in 1977 have recessed to about 160,000ha in 1990 (Kela, 1999, IUCN, 2005). The period starting from 1977 coincides with the timing when the chronic effects of irrigation system became apparent; the delta instead of pro-grading, had since started retrograding. The salinity value of 40 ppt or more is commonly observed in the near-shore mangrove areas. Hyper salinity and nutrient impoverishment are therefore major factors that have caused decline in mangrove forest cover.

4.4.7 Suspended matter

The suspended matter in the creek areas has an annual range of 25-170 ppm. The higher values were observed during the southwest monsoon period (usually May-August). The average suspended load during June-July was between 80-115 ppm. However, higher values (115-170 ppm) were also recorded at some places in the Phitti/Korangi/Kadiro Creek system. Lower suspended matter (25-50 ppm) was recorded from September to March each year when the river flow is considerably reduced. The suspended load in the creeks also exhibits variations with the degree of turbulence during the tidal cycle. During the flood season in the Indus River (June-September) the suspended load rises to about 1500 to 2000 ppm in the Kadiro creek.

The transparency of water (Secchi disc disappearance depth) depends on the magnitude of turbidity in the sea water. In Khobar creek the light penetration was up to a depth of <1.0 m. The maximum water transparency in the major creeks of the Indus Delta are 2.5-4.5m in the Gharo creek, 3.0-5.0m in the Phitti creek and 7.0m in the offshore water during the January - February period. The minimum values (0.5-1.0m) of sea water transparency in the Gharo/Kadiro creek, <0.2m in the Phitti creek and 0.2 to >2.0m in offshore area adjacent to the creeks, during the May to August period.

The turbidity values in the offshore waters adjacent to the delta are higher during southwest monsoon period than during the rest of the year. Turbidity values are also influenced by the strong tidal flux which reverses its direction during ebb and flooding. Generally the turbidity is higher during ebb tides, particularly in the shallow creeks. The turbidity is also high within the delta area and in the adjacent coastal waters during river runoff after the rainy season of southwest monsoon.

For reasons stated at 4.4.6, dense and extensive mangrove forest has changed to stunted growth of trees and reduction in the forested area. Dams and diversionary barrages also affect bed-load and suspended transport of sediments by capturing this material and preventing its uniform dispersal over mangrove areas during flood season. Thus the mangroves are deprived of an annual silting (and input of inorganic nutrients) and the depositional character of the mangrove environment is severely altered. Further, in the absence of flushing, distributary rivers in delta regions become silted and cease

Table 4.14: Concentration (ppb) of Cu in water of mangrove habitat of Karachi

Location	Average conc. +/- SE*	N**	Range)
Sandspit	1.5 +/- 0.49	7	1.06 – 3.26
Karachi Harbor	0.61 +/- 0.18	10	0.02 – 1.86
Korangi Creek	1.17 +/- 0.87	3	0.06 – 1.94
Port Qasim	3.06 +/- 0.63	5	1.89 – 5.17
Lat Basti	1.50 +/- 0.35	7	0.047 – 1.728
Chara Creek	0.78 +/- 0.49	3	0.31 – 1.79
Miani Hor	0.041 +/- 0.00	1	-

** South East ** North*

Table 4.15: Concentration of Cu (ppb) in sediments of mangrove habitat of Karachi

Location	Average conc. +/- SE*	N**	Range)
Sandspit	48.09 +/- 2.43	19	28.90 - 65.70
Pir Shams	57.60 +/- 0.0	1	-
Port Qasim	44.02 +/- 0.07	4	36.70 - 51.20
Lat Basti	69.02 +/- 8.09	3	56.90 - 85.60
Chara Creek	46.55 +/- 1.35	2	-
Korangi Creek	48.10 +/- 0.00	2	42.20 - 54.00
Miani Hor	9.80 + 0.0	1	-

Table 4.16: Average Concentration (ppb) of Fe in water in different mangrove habitats of Karachi

Location	Average conc. +/- SE*	N**	Range)
Sandspit	0.09 +/- 0.025	7	0.020 – 0.176
Port Qasim	0.099 +/- 0.039	5	0.016 – 0.211
Rehri	0.06 +/- 0.03	3	0.021 – 0.118
Chara Creek	0.094 + /-0.042	3	0.010 – 0.152
Karachi Harbor	0.042 +/- 0.114	10	0.019 – 0.059
Lat Basti	0.115 +/- 0.031	1	0.012 – 0.247

Table 4.17: Average Concentration (ppm) of Fe in sediments of mangrove habitats of Karachi

Location	Average conc. +/- SE*	N**	Range)
Location	Average conc. +/- SE*	N**	Range
Sandspit	25624 +/- 1778	19	6369-23440
Port Qasim	27489 +/- 2481	3	22678 – 31148
Lat Basti	23310 +/- 4105	3	17657 – 31545
Miani Hor	1248 +/-	1	-
Chara reek	30067 +/- 2515	4	22640 – 33120
Rehri	34436 +/- 2249	2	29982 – 344336
Phitti Creek	16480 +/- 9333	2	7240 – 25720
Bakran Creek	23900 +/- 866	2	23040 – 24760
Shamspir	17060 +/- 381	2	13280 20840

Table 4.18: Average Concentration of Ni (ppm) in surface sediments along Karachi Coast

Location	Average Concentration (ppm)
Sandspit	77.1
Rehri	52.4
Lat Basti	48.3
Port Qasim	55.1

to function. The filling and death of distributary rivers has occurred and is taking place in all major river deltas including the Ganges and Indus.

4.4.8 Heavy Metals in Sea Water and Marine Sediments

Some studies conducted during 1990-2000 on Heavy metals have shown higher concentrations of selected heavy metals in water and sediment samples collected from different localities along Karachi coast. Mangrove habitat has been shown to serve as sink for heavy metals. The sediments are major trap for metals followed by mangrove plants. According to Williams et al. (1996) detrital silicates and sulphides are the principal carriers of iron and other heavy metals and, therefore, make sediments a long term contaminant sink.

The order of accumulation in different sections of habitat is from sediment to pneumatophores to bark to leaves to twigs to flowers. The concentration of copper, iron and nickel in different components of mangrove ecosystem are presented in Tables 4.14- 4.18.

4.4.9 Salinity & Recent Changes in Monsoon Current System

The monsoon system that has been bringing rains to Pakistan comprises two system, one that travels over the tip of the Indian Peninsula into the Bay of Bengal in the east and the other that operates from the Gulf of Oman in the west Arabian Sea and travels into Baluchistan, the Khyber Pakhtunkhwa (KP) and Kashmir. It is initiated every year by input of solar radiation over the heat zone which covers a vast area from Nokundi-Sibi-Jacobabad-Multan-Mianwali and over to Gilgit. The period following the start of New Millennium is witness to above normal incidence of solar radiation. The year 2007 was for example witness to 10% above normal total duration of bright sunshine in Pakistan. It ranged for 6 to 9 hrs/day with increasing intensity of radiation ranging from 19 MJ/M^2 to 23 MJ/M^2/day and had an increasing trend from North to South.

The regular monsoon system was rendered inoperative by the persistence of the El-Nino and La-Nina effects in the earlier part of the first decade of the New Millennium. It may be recalled that the monsoon system on the western coast of India had become dormant for some seven to eight years. For the earlier four to seven years this system was unable to operate because of the persistence of the El-Nino effect. It was argued in an article in August 18, 2006 and subsequently presented at a Conference on Climate

Change. (Mirza Arshad Ali Beg, Climate Change Variations & Vulnerability Coastal Areas of Pakistan to Hazards of Climate Change, Paper presented at Euro-Asian Research and Training Workshop on Climate Change Management, Karachi University, June 30, 2007) that this system was broken by the powerful Tsunami of December 2004 which was caused by the 1000 km long and 4 km wide rupture under the Indonesian Seas that initiated the propagation of sea waves.

The powerful Tsunami waves were traveling at a speed of 700 km/hour and were cause for the disruption of the ocean current system of the Indian Ocean that had been operating under the El-Nino system. The Tsunami seems to have affected the Ekman effect whereby the slow moving deep layers of the western edge of the Indian Ocean current were forced to move rapidly. This disturbed the salinity of the deep layers of the Indian Ocean and flushed the Arabian Sea besides changing the equilibrium at the boundary layer between the surface and deep waters in the eastern boundary current of the Arabian Sea that contributes to the Indian Ocean Current.

The disturbance caused by the Tsunami to the underwater movement of the deep layers identified the Arabian Sea as a separate ecosystem that has developed into a highly saline system resulting from high evaporation leading to increase in salinity and higher heat content of the Sea. The increase in salinity was also caused by substantially reduced input of freshwater into the Arabian Sea. Freshwater flow into the Arabian Sea has been reduced from all sides by each country bordering this Sea. None of the rivers in East Africa, Arabian Peninsula, Gulf of Oman, Iran, Baluchistan, Sindh, the Tapti at Cutch Peninsula, the Narmada and all the rivers along the Western Ghat of India allows a reasonable flow of freshwater into the Arabian Sea. All the rivers have been dammed and have thus damned the Arabian Sea by making it hyper-saline. The hyper-salinity and high rate of evaporation are cause for retention of thermal energy and thus for raising the temperature of the Arabian Sea by at least 1°C to 1.5°C and higher near the shoreline. This small but significant rise is not a recent phenomenon but spans over at least half a century during which the Arabian Sea has been under serious stress while all the rivers failed to deliver freshwater into their delta and the sea.

It seems that the disturbance caused by the December 2004 Tsunami system was instrumental in setting off the 3-year temperature cycle on Karachi coast mentioned above and also initiated rainfall events though still below average in Sindh. This caused serious disturbances in the current pattern in the Arabian Sea leading to major cyclonic events thereafter. The disruption of the oceanic current system firmed up hereafter and thus there was revival of the past system when there would be heavy rains after periods of drought.

The west Arabian Sea system was expected in the year 2007 to cross into Maharashtra by June 09. Gonu had held up the monsoon system and when it faded away, other weather conditions turned favorable, and the powerful South West Monsoon took its annual course from the tip of the Indian Peninsula and over the Western Ghat to the Bay of Bengal and along the slopes of the Himalayas to Kashmir and finally to the plains in Pakistan. High temperatures, intense rainfall followed in these areas over the few days before the landing of Gonu. A punishing heat wave started sweeping across the country and pushed the mercury to 51 degrees centigrade in at least three cities, making June 09 one of the hottest days of the year.

Lahore sizzled at 48 degrees centigrade, a feat accomplished after 78 years. Islamabad was exceptionally warm at 43.5 degrees centigrade. Karachi fared a little better at 36.5 degrees centigrade, but high humidity (65 per cent), gusty winds and long-drawn spells of load-shedding caused outbreaks of power riots across the city. Sibi, Mianwali and Larkana bore the brunt of the heat wave where the mercury rose to 51 degrees centigrade, according to the data input by the Pakistan Meteorology Department.

The onset of high heat zone came to an end after India's annual monsoon rains gathered strength on the west coast of India or East Arabian Sea and reached Mumbai in two

days after their movement to the western region from the south.

Western System: On the western side of the monsoon belt, the west Arabian Sea had also witnessed major incidents during the 2007 monsoon season. Low pressure had developed high up in the air of the surface in the Gulf of Oman. This was suggested to be part of the South West Monsoon, which was brewing in the second week of May. North and west of this low, the air was hot and dry owing to high pressure up in the air. Such conditions are indicators of formation of a cyclone.

4.4.10 Cyclones & Storms

Tropical Cyclones contain heavy bands of clouds and cause heavy rains during landfall or sometimes cross along the coast farther away. Heavy rainfall occurs as the end result. The Arabian Sea is known to be frequented by general cyclonic storms and with regard to severity some of these had been among the worst cyclonic storms of the world. They have caused colossal losses to life and property in the coastal areas. A significant number of the cyclonic storms produced in the Arabian Sea move towards north and northeast and some of them land in Pakistan. However most of these cyclones which tend to move towards the southern coast of Pakistan quite often return towards the eastern coast of the Sea.

High heat content of the Arabian Sea that is adjacent to the extensive heat zone of Pakistan usually upsets the heat balance and thus also the water-balance of the region, particularly because it is the destination of windstorms. Tropical cyclones generally develop over Arabian Sea in low latitude i.e. 5-20 degrees north and dissipate after they move over land. The maximum frequency of tropical cyclone formation occurs in April, May and early June, and in the October-November period.

The month of June receives least tropical cyclones in the region. About 76% of tropical cyclones in Karachi approach from the south through the east. The one that came near the coastal area on May 12, 1999 changed its direction and hit the coastal area of Badin, however Karachi was safe from this cyclone as it is located in the peripheral area and only rain showers of moderate intensity were recorded. The cyclone in September 2006 proceeded towards coastal belt of Badin; but it did not hit the area and changed its direction. Although some cyclones have passed near the coastal belt of Badin but still it is classified outside the zone of cyclone activity for the Arabian Sea.

Soon after the beginning of June 07 the tropical cyclone Gonu visited the Coastal area of Oman for the first time in history and set the beginning of destruction over the coastal area of western Baluchistan. At this time it seemed that cyclone Yemyin was trekking westward south of Sindh and Baluchistan while also weakening, but numerical forecasts were indicating that a huge, strong system was developing high up in the sky diagonally on the path i.e. Arabia and Iran and thereby cutting off the impact and almost restraining the cyclonic system to proceed further from the Indus Delta and proceeding towards Karachi. On the night of July 3, 2007 Sindh especially lower Sindh received widespread rains, but luckily Karachi escaped from a high impact of this system. Scattered rains in Sindh with isolated heavy falls in eastern Sindh occurred.

The June 6, 2010 cyclone 03A, nicknamed Phet had landed on the coast of Oman and had lost its intensity. Moving in clockwise direction it poured heavy rains on Gwadar and Pasni. The rain bearing winds moved along the coastline towards Karachi. It touched Karachi only tangentially and brought 100 mm rainfall two days before it landed south of Thatta District.

The low cloud covers together with increased sunshine result in rise in temperature of landmass in the hinterland. For example Moenjo Daro recorded the world record of 55°C on May 25, 2010. Such high temperatures on vast territory has (i) turned large territory of Pakistan into an extensive heat zone, and (ii) raised the temperature of the North Arabian Sea by 1°C to 1.5°C. The heat zones so formed serve as the main heat engine and the significant rise in temperature of the Arabian Sea lead to high salinity gradients. Rise in temperature indicates onset of low-pressure zone on land and development of salinity steep gradient on the deep sea. The former parameter can attract rain bearing winds in case they are around, while the latter

Table 4.19: Cyclones & Storms during Last 15 Years

Sr. #	Year	Type/ Location of Cyclone	Wind Speed Range (km/h)
1.	November 1993	Tropical Cyclone/Northeast Arabian Sea	62 – 88
2.	June 1996	Cyclonic Storm/East Central Arabian Sea	62 – 88
3.	October 1996	Tropical Storm/Southeast Arabian Sea	62 – 88
4.	June 1998	Cyclonic Storm/Southeast Arabian Sea	62 – 88
5.	October 1998	Cyclonic Storm/East Central Arabian Sea	62 – 88
6.	May 1999	Very Severe Cyclonic Storm/East Central Arabian Sea	> 118
7.	May 2001	Very Severe Cyclonic Storm/East Central Arabian Sea	> 118
8.	September 2001	Cyclonic Storm/East Central Arabian Sea	62 – 88
9.	May 2002	Tropical Cyclone/West Central Arabian Sea	62 – 88
10.	May 2004	Very Severe Cyclonic Storm/Southeast Arabian Sea	> 118
11.	October 2004	Severe Cyclonic Storm/Northeast Arabian Sea	89 – 117
12.	September 2006	Tropical Cyclone/East Central Adjoining Northeast Arabian Sea	62 – 88
13.	02 June 2007	Tropical Cyclone/East Central Arabian Sea	62 – 88
14.	07 June 2007	Very Severe Cyclonic Storm/Northwesterly of East Central Arabian Sea	> 118
15.	21 June 2007	Tropical Cyclone (Deep Depression)/Northeast Arabian Sea	> 50
16.	07 June 2010	Tropical Cyclone/Northeast Arabian Sea	> 50

can nucleate cyclones/storms.

The Table 4.19 shows the movement of cyclones and storms in the Arabian Sea. The movement is generally in the west-north-westerly direction. Thunderstorm frequency is also low and is reported to occur at an average rate of 10 thunderstorms/year.

Coastal Sindh is more vulnerable than the west coast of Pakistan to storm surges, associated with the severe cyclonic storm generated in the adjoining Arabian Sea. The available data on cyclones and storm reveals that Pakistan is vulnerable mostly during the period from April through June while no storm has ever been observed during January to March (Table 4.20). The main cyclonic activity in the PQA Area takes place in the month of June. All the cyclonic storms that emerge in the Arabian Sea either curve sharply into the Gulf of Kutch or cross the Arabian Sea from East to West and end up at the coast of the Arabian Peninsula

Table 4.20: Month-Wise Intensity and Location of Storms in Arabian Sea

Months	Intensity of Storms on an arbitrary scale 0-4	Primary Area of activity
Jan	0-no storm	
Feb	0-no storm	
Mar	0-no storm	
Apr	2	S. Arabian Sea
May	3	S. Arabian Sea
Jun	3	N Arabian Sea
Jul	1	N Arabian Sea
Aug	1	N Arabian Sea
Sep	2	North and Central Arabian Sea
Oct	4-severe	South eastern Arabian Sea
Nov	4-severe	South eastern Arabian Sea
Dec	1	South eastern Arabian Sea

creating some storm surges at the coast (UNESCAP, 1996). When the cyclones cross the coast they are accompanied by storm surges, generally known as storm tides. The cyclones that cross the coast in the month of June have been found to

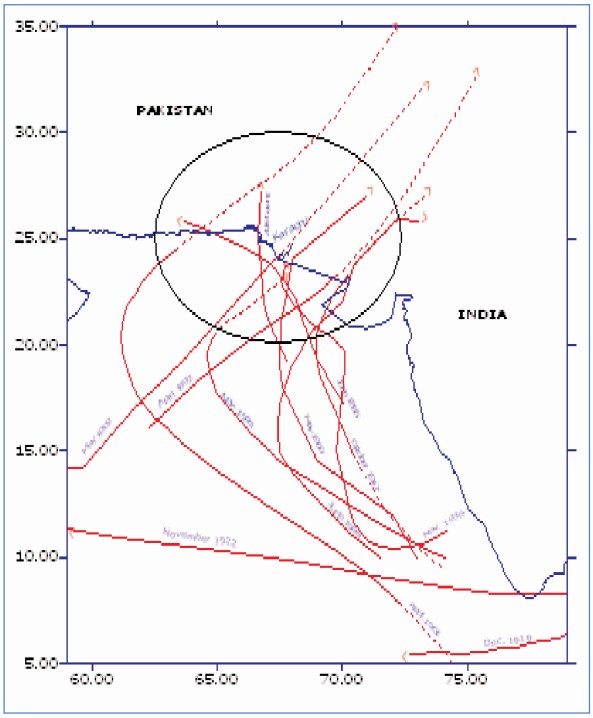


Figure 4.8: Historical Record of Tropical Cyclones within 300nm radius (encircled) of Karachi

generate winds of approximately 15-18 m/s.

Tropical cyclones form between Gulf of Cambay and Karachi. The size of the tropical cyclones is generally 270 - 720 Km with an average speed of 7 to 18 Km/hr. Majority of the cyclones land in the vicinity of Indus deltaic creek system creating storm surges of few feet height. In the creek system the tidal range is quite high which is favorable for the amplification of surges. If the peak surge does not occur close to the time of high tide, no major water level oscillations may occur in the region. Moreover, the SW monsoon wind also blows in June and adds about 0.3 m of surge to the current tides. Thus very high tidal level of over 4.0 m prevailing in the Port Qasim region may inundate the creek banks and erode the coastal areas.

Sometime the cyclones cross the deltaic coast itself. Cyclones generally constitute the strong winds having the speed of over 60 Knots and the central pressure may be as low as 980 mb. The wind and low pressure creates the storm surges which when combined with high tides, becomes a destructive force in the coastal area. Coastal erosion and inundation are commonly associated with storm surges. Beside the cyclones, several depression with less severe intensity frequently occur in the northern Arabian sea, which are also related with surges. These surges which are about 0.5 m in height, when combined with HHW becomes the potential source of the erosion thus creating high waves in the open sandy coast thereby increasing tide water level favoring tidal inundation.

4.5 Meteorology and Climate

4.5.1 Climate

The coastal meteorology and hydrography of Karachi is controlled by the seasonal change in the north Arabian Sea viz. monsoon system. The data collected for a number of studies along the Karachi coast show the influence of NE and SW monsoon winds. The meteorological conditions in the area around Port Qasim are characterized by generally hot and relatively humid conditions especially in the summers (April to October) when the prevailing wind is from the south west. The south west monsoon brings humid air in from the sea, but the rainfall is generally very low with nearly 80% of the 265mm of rain falling from July to September. Rainfall, when it does occur, is often torrential causing problems of drainage and erosion of the light and sparsely vegetated land.

The winters are short and mild from December to mid-February with the prevailing wind coming from the northeast with very little rainfall. The most important characteristics of the prevailing meteorological conditions are the generally high dusty conditions as a result of the aridity of the surrounding area; dust storms occur especially during the summer as well as winter monsoons. The higher winds during the south west monsoon tend to carry any air-borne contaminant inland during the summer months. In winter the winds tend to be light to

moderate in intensity.

The proposed dirty cargo terminal located in the coastal zone has a relatively mild climate, characterized by dry, hot and humid conditions. There is minor seasonal intervention of a mild winter from mid-December to mid-February into a long hot and humid summer extending from April to mid-September.

Variation of climatic parameters during the past few years is described hereunder:

4.5.2 Temperature

The air temperature in the coastal area of Karachi City is generally temperate throughout the year. During winter the range of variation of temperature is large for Karachi coast especially with respect to maximum and minimum temperatures. The air temperature for Karachi has an average annual range of ~6°C to ~42°C. The highest temperatures (40°C or above) occur in May, June and October. During SW monsoon in July and August the temperature is relatively moderate due to cloud cover but humidity remains high (~70%). The mean monthly maximum and minimum temperatures recorded during the last nine years at Karachi Airport Meteorological Station of Pakistan Meteorological Department are given in the Tables 4.21 and 4.22.

The above Tables indicate that the mean monthly maximum temperature in Karachi ranged between 32.0°C and 33.0°C during the 2001-2009 periods, while the mean monthly minimum temperature ranged between 21.0°C and 22.5°C. The mean maximum and mean minimum

Table 4.21: Mean Monthly Maximum Temperature °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	27.2	29.6	33.1	34.6	35.1	34.9	32.2	32.3	33.1	36.0	33.5	30.4	32.7
2002	27.0	28.2	33.3	35.4	35.6	35.1	32.2	31.6	31.4	36.5	32.7	28.1	32.3
2003	27.6	28.5	32.4	36.6	35.7	34.9	34.1	32.6	32.5	37.0	32.2	28.3	32.7
2004	26.6	29.9	36.2	35.4	36.8	35.6	33.8	32.7	32.8	33.7	33.1	29.4	33.0
2005	24.9	26.3	31.5	35.3	35.4	36.0	33.2	32.2	34.2	35.2	33.1	28.4	32.1
2006	26.0	31.3	31.8	34.0	34.6	35.3	33.8	31.0	34.2	35.0	33.4	26.3	32.2
2007	26.9	29.4	31.4	37.7	36.0	36.4	N/A	N/A	N/A	N/A	N/A	N/A	33.0
2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32.0
2009	26.2	29.8	33.0	36.0	36.8	35.7	34.5	33.0	32.8	35.9	33.0	28.6	32.9

Source: Pakistan Meteorological Department

Table 4.22: Mean Monthly Minimum Temperature °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	11.5	14.9	19.6	23.8	28.1	29.0	27.1	26.5	25.9	24.4	18.6	15.8	22.1
2002	12.8	13.8	19.5	23.9	27.0	28.2	29.6	25.6	24.8	22.5	17.7	14.9	21.7
2003	12.7	16.9	19.8	24.2	26.5	28.2	23.6	27.0	25.3	20.9	15.2	12.0	21.0
2004	12.9	14.5	19.1	24.8	27.3	28.8	27.5	26.3	25.3	22.4	18.0	15.4	21.9
2005	12.3	11.3	20.3	23.0	26.4	28.3	27.2	26.6	26.6	22.9	18.9	13.0	21.4
2006	11.7	18.1	19.6	24.5	27.5	28.5	28.3	26.3	26.8	25.7	19.4	14.0	22.5
2007	13.0	17.3	19.7	24.7	27.6	28.6	N/A	N/A	N/A	N/A	N/A	N/A	21.8
2008	10.1	11.1	19.6	24.0	27.3	29.1	27.9	26.8	26.6	23.8	17.6	14.9	21.6
2009	14.7	16.5	20.8	23.8	27.6	28.7	28.1	27.5	26.5	22.6	17.0	13.9	22.3

Source: Pakistan Meteorological Department

Table 4.23: Monthly Amount of Precipitation (mm) at Karachi Air Port

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	0.0	0.0	0.0	0.0	0.0	10.6	73.6	16.2	N/A	0.0	0.0	0.0	100.4
2002	0.0	2.4	0.0	0.0	0.0	N/A	N/A	52.2	N/A	0.0	0.5	0.4	55.5
2003	6.4	21.8	0.0	0.0	0.0	16.3	270.4	9.8	N/A	0.0	0.2	0.0	324.9
2004	13.7	0.0	0.0	0.0	0.0	N/A	3.0	5.6	N/A	39.3	0.0	4.3	65.9
2005	6.6	12.8	N/A	0.0	0.0	N/A	N/A	0.3	54.9	0.0	0.0	17.1	91.7
2006	N/A	0.0	N/A	0.0	0.0	0.0	66.2	148.6	21.9	0.0	3.1	61.3	301.1
2007	0.0	13.2	33.4	0.0	0.0	110.2	N/A	N/A	N/A	N/A	N/A	N/A	156.8
2008	8.0	Trace	1.1	0.0	0.0	0.0	54.0	37.5	Trace	0.0	0.0	21.0	121.6
2009	3.0	Trace	0.0	Trace	0.0	2.6	159.9	44.0	68.9	0.0	0.0	1.5	279.9

Source: Pakistan Meteorological Department

temperature during 1991-99 periods were 32.2°C and 20.9°C, which indicates that there has been a slight but significant rise in the mean minimum temperature during the last 20 years.

4.5.3 Precipitation

The mean relative humidity in summer is 60-70% while the mean relative humidity during winter is 25-30%. The rain fall in the Karachi coastal zone is extremely low and erratic; accordingly this region falls in the semi arid climatic zone. Table 4.23 shows the last nine years precipitation data recorded at Karachi Airport station.

The 9-years record for rainfall of PMD at Karachi Airport (2001-2009) suggests that July and August are the wettest months and that the maximum rainfall recorded in Karachi during 2001-2009 period was 270.4 mm during the month of July 2003, while the maximum annual rainfall was 324.9 mm during the year 2003, followed by 301 mm in 2006 and 279.9 mm in 2009. The wet years followed a 3-year cycle during the first 9 years of the New Millennium. The year 2010 was among the wettest years since Karachi City had witnessed more than 5 spells of 50 mm each during the month of July, three major spells of 60 to 100 mm in August and two spells of 25 and 10 mm each in the month of September.

Karachi was facing drought conditions in the past and rainfall was erratic at around 50 mm for three years followed by wet spells every third year. The average of two decades (70s and 80s) shows that rainfall varies between 150 and 250 mm during the years. For Karachi the average number of rainy days / year is less than ten. However, most of the precipitation usually takes place within a short spell of 2 to 7 days. About 50 to 65 percent of the total annual rainfall occurs during July and August while the southwest monsoon is on, another 15 to 25 percent of the annual rainfall occurs during NE monsoon in winter months (December - February). The rest of the rainfall occurs in the form of occasional cloud burst.

4.5.4 Wind Speed and Direction

The climate of Karachi is controlled by the seasonal changes in the north Arabian Sea. In summer, Southwest monsoon prevails with wind force ranging between 3.8 m/s and 14.1 m/s on account of low pressure prevailing over Nokundi-Sibi-Jacobabad-Multan-Mianwali axis in the Baluchistan – Sindh – Punjab region that forms the heat zone. Heavy storms of severe intensity are rare but strong gusts of winds take place abruptly due to changes in atmospheric pressure. The wind blows throughout the year with highest velocities during the summer months (from June to August), when the direction is southwest to west with wind speed exceeding 40 km/hr (22 knots) for about 70% of the time. Inter-monsoon transitions occur from October to November and March to May. The wind direction and speed between the summer and winter monsoon seasons are rather unsettled and large variations are noted both with respect to speed and direction. During winter or the northeast monsoon season (from December to March), winds blow from northeast and north, shifting southwest to west in the evening hours, with wind speed exceeding 20 km/hr (11 knots) only for 12% of the time. The strongest winds with velocities greater than 40 km/hr (22 knots) blow only for

Table 4.24: Wind Speed (m/s) at 12:00 UTS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	2.6	3.4	4.3	5.6	7.5	8.1	6.8	7.3	5.5	3.7	2.0	2.4	4.9
2002	3.6	3.9	4.0	6.5	8.5	8.2	9.8	7.3	7.7	3.3	2.9	3.2	5.7
2003	4.0	5.0	5.4	5.2	7.7	8.8	6.7	7.1	6.0	3.2	3.1	3.0	5.4
2004	3.4	3.7	4.0	6.0	8.0	9.0	10.0	9.5	7.3	3.8	1.0	2.5	5.7
2005	3.6	4.2	4.8	5.1	7.1	7.5	9.0	6.9	6.4	3.9	2.0	1.5	5.2
2006	2.0	3.0	3.0	6.2	8.0	7.7	8.3	6.2	4.7	4.2	2.2	3.0	4.9
2007	2.0	3.7	4.0	4.0	6.0	6.3	N/A	N/A	N/A	N/A	N/A	N/A	4.3
2008	4.3	7.6	8.2	10.5	12.6	7.6	11.0	9.3	8.7	6.6	5.1	3.9	7.9
2009	7.0	7.2	7.9	9.3	9.8	9.7	9.5	9.3	9.1	6.1	5.0	3.9	7.8

Source: Pakistan Meteorological Department

Table 4.25: Wind Direction at 12:00 UTS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	S54W	S43W	S42W	S45W	S46W	S45W	N52W	S59W	S44W	N56W	S45W	S06W
2002	S67W	S52W	S51W	S55W	S51W	S42W	S54W	S45W	S48W	S56W	N54W	S41W
2003	S60W	N50W	S45W	S48W	S45W	S68W	S60W	S47W	S43W	S54W	S50W	S27W
2004	N27E	S46W	S53W	S49W	S52W	S54W	S54W	S62W	S56W	S47W	S45W	N86E
2005	N63E	S51W	S50W	S52W	S63W	S48W	S54W	S49W	S87W	S54W	S52W	N23W
2006	S48W	S62W	S50W	S57W	S64W	S60W	S67W	S78W	S51W	S53W	S49W	N79E
2007	S30W	S62W	S47W	S55W	S58W	S47W	S41W	S55W	S60W	S48W	S48W	N45E
2008	N45E	S47W	S54W	S51W	S52W	S39W	S50W	S52W	S46W	S39W	S38W	N
2009	N45E	S45W	S41W	S58W	S46W	S46W	S56W	S49W	S56W	S42W	S39W	S45E

Source: Pakistan Meteorological Department

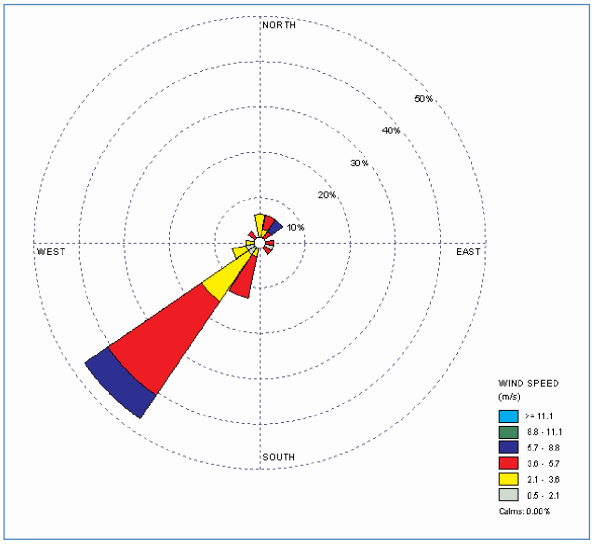


Figure 4.9: Windrose, Karachi Airport, Jan 2001 to Dec 2009

Table-4.26: Relative Humidity Data for Karachi

Month	Relative Humidity (%)	
	AM	PM
January	63	3.6
February	72	6.4
March	79	8.3
April	87	4.9
May	88	0.0
June	86	3.9
July	28	64.4
August	90	44.8
September	89	22.8
October	83	0.3
November	68	1.7
December	64	4.5

Source: Pakistan Meteorological Department

1% of the time. The air over the coastal area is generally saline and the wind usually carries aerosols containing sand and salt which resultis in severe erosion and corrosion.

The nine years wind velocity record (2001-2009) indicates that the velocity varies and ranges between 2.6 m/s to 12.6 m/s. The Tables 4.24 and 4.25 show the wind speed and direction respectively.

4.5.5 Humidity

Being on the coastline, the humidity level in Karachi generally remains high throughout the year. Annual range is from 50% (December, driest month) to 85 % (August, most moist month). Table 4.26 describes typical variation of humidity during the year 2006..

4.5.6 Visibility

Visibility depends on weather conditions such as fog, haze, rainfall and dust storms also to a certain extent on the amount of particulate matter present in the ambient urban atmosphere. Visibility in Karachi generally ranges up to 10 nautical miles. Haze generally prevails in the morning, which clears by noon. In SW monsoon period however, the visibility is reduced to about 2 to 5 nautical miles with sky mostly overcast while in NE monsoon sky is clear but the visibility is occasionally less than 1 nautical mile due to dust storms that frequent from the arid areas of Baluchistan. The hanging dust takes time but the fog dissipates by afternoon. This occurs less than 3 to 4 days in the winter.

4.6 Ambient Air & Noise Quality

EMC commissioned SUPARCO to undertake a baseline air quality monitoring survey at the proposed Coal, Clinker & Cement Terminal site. The survey has characterized the existing air quality in the vicinity of the Project site. Detailed description of the ambient air quality survey and the methodology is presented in Appendix-I.

A description of the environmental significance of these substances is provided in Appendix-I. Air quality standards are also discussed in Appendix-I. The results are summarized and compared to the International Standards air quality standards.

- The measured minimum maximum and mean concentrations of NOx was 13 ppb, 23 ppb and 16.2 ppb respectively. These levels of gas pollutants were well within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference of Appendix-I) for ambient air quality like USEPA, WHO and World Bank.
- The measured minimum maximum and mean concentrations of SO2 was 09 ppb, 16 ppb and 11.8 ppb respectively. These levels of gas pollutants were well within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference of Appendix-I) for ambient air quality like USEPA, WHO and World Bank.
- The measured minimum maximum and mean concentrations of CO were 1.0 ppm, 2.6 ppm and 1.5 ppm respectively. These levels of gas pollutants were well within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference of Appendix-I) for ambient air quality like USEPA, WHO and World Bank.



- The measured minimum maximum and mean concentrations of PM10 were 112 $\mu g/m^3$, 152 $\mu g/m^3$ and 124.4 $\mu g/m^3$ respectively. These levels were well within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference of Appendix-I) for ambient air quality like USEPA, WHO and World Bank.
- The measured minimum maximum and mean level of Noise was 68dB, 78dB and 74.8 dB respectively. These

levels of Noise were also within NEQS limits of 80dB(A).

4.7 Terrestrial Ecology

Terrestrial ecologies are, by definition, communities of species that interact in a land based habitat like a desert, a grassland, or a rainforest. The ecosystem of concern to the description of terrestrial ecology comprises the thin strip of land which is the Right of Way of the coastal road that separates the hill which forms the 9 meter contour line from the mudflat along the coastline of Arabian Sea. The coastal road starts from Ibrahim Hyderi and runs along the base of the 9 meter contour line to the FOTCO site where the PIBT would be located.

The limits of Port Qasim are reached at about 5 km past the shrine of Baba Kamal Shah. There is no residential area along the coastal road. As such communities of species that may interact on this thin strip of land do not exist. The community of species that interact in this microenvironment are to be found in the mudflat that is 2 to 3 meters below the road level.

4.8 Marine Ecology

It has been considered appropriate to describe here the marine ecologies that exist in the mudflats and along the shoreline up to the tide lines. The baseline described here relates to biological aspects of the marine environment in the neighbourhood of the proposed coal, clinker and cement terminal in Kadiro Creek.

The survey for description of marine ecology was aimed at identifying and if possible characterizing the mangrove ecosystem, marine organisms, their habitats, productivity, bird fauna of the creek system and the ecosystems in which they inhabit. The baseline surveys take into consideration the likely impact on the ecosystem by port development, and evaluate the ecosystems in terms of loss of habitat of any endangered organism that may be found in the mangrove ecosystem, among the marine flora and fauna of the mudflats, and may require special management during the development and operation phase of the Project.

4.8.1 Benthic Marine Habitats in PQA.

Random stations for Benthic Invertebrates were located by using a hand held Global Position System (Garmin GPS) along a transect at different locations to correspond to near zero tidal heights during the day light hours that would facilitate in survey of exposed mud flats, coastal habitats and the mangrove community within a radius of 2.5 Km from the proposed site.

The components that were considered necessary for undertaking the survey in order to establish an environmental baseline of the proposed area included Marine fauna and the associated ecosystems. Documenting all the plants and animals living in the port area was not considered. Instead, the dominant habitat component that may be adversely impacted by Project activities were examined. These included mangrove habitat, marine benthic invertebrates, mudflats, surface and burrowing habitats.

4.8.2 Marine Flora

1. Mangroves

The mangroves play an important role in the swampy ecosystems of the macroenvironment. They accumulate silt, stabilize shoreline, and prevent erosion of the coastline, and beaches. Their most important function is to provide food, shelter and to serve as nursery grounds for a variety of larvae and juveniles of marine organisms. They increase primary productivity of the coastal waters. The mangroves support a rich invertebrate fauna dominated by crustaceans and provide nutrient-rich habitat to a large number of juveniles of fish and shrimps. The Korangi and adjoining creeks also support a well established fishing industry.

The Avicenna marina is the dominant species of the mangroves in the Indus Delta. In the microenvironment of project area i.e. the Kadiro Creek system under study the most dominant species is also Avicenna marina that grew on the northern and southern banks of the Phitti Creek. The Mangrove population of Avicenna marina is highly dense at project site. The density of mangrove trees was estimated at between 50-60/100 m^2. The height of the individual tree within the established Avicenna marina habitat was greater than ~3 m.

The mangrove trees growing 200-300 m away from the creek (seawater) in the landward direction showed an overall decline in the height of the mangrove plantations. The

density of mangrove vegetation was randomly evaluated over an area of 100 m^2 within the proposed jetty location for Coal, Clinker and Cement terminal. The trees were characterized (visual observations) according to the arbitrary height of the plants.



Figure 4.10: Mangroves Density at Project Site in Kadiro Creek

- The height of mangrove seedling were characterized as <0.5 m
- Mangrove sapling height 0.5 -1.0 m
- Short mangrove trees were characterized as having 1-2 m height.
- Medium height mangroves trees were characterized as having 2-3 m height.
- High mangroves trees were characterized as having more than 3 m height.

Some sediment erosion was observed at the site. Well established mangrove plantations (mangrove trees of >2-3 m height) were found under stress due to eroding sediments in the channel as shown in figure 4.11. The factors responsible for the excessive erosion may be strong currents during ebb and flow of tides and also the waves generated as a result of moving vessels in the vicinity of the creek. However, low sediment load in the Indus River discharges and human activities including camel grazing was also observed which is responsible for uprooting the trees whose pencil-like roots



Figure 4.11: Strong erosional Sediment activity along the banks of Kadiro Creek forming microenvironment of Coal Terminal



Figure 4.12: Substrate is a mixture of clay and silt sediments which is favorable for mangroves growth and sustenance.



Figure 4.13: Exposed Roots and nematophores of Avicenna Marina at Project Site

were holding the sediment/mud. Their removal by the root destabilized the soil of the mud flat.

4.8.3 Marine and Benthic Fauna

1. Marine Benthic Invertebrates. (MBI)

The Marine Benthic Invertebrates (MBI) plays an important role in mixing the organically enriched bottom sediments. The MBI are a key linkage in transferring the energy from lower trophic level to the next higher trophic level in the food chain. The species distribution pattern of benthic invertebrates in the macroenvironment of project is randomly distributed, while a few species aggregate (Table 4.27-4.28). The distribution of invertebrates is dependent on the surface current that redistributes the planktonic larval form to locations away from where they were spawned they are hence random in their population densities. Aggregation is also a function of reproduction, where the benthic organisms tend to colonize together. Nematodes, Annelid

Table 4.27: Specie wise distribution of Marine Benthic Invertebrates and their distribution pattern in PQA benthic samples collected in close vicinity of the proposed jetty.

Species	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Brittle star (Amphiurid)	0.2381	0.2857	5	6	0.545356	Random
Annelida (Polychaeta)	2.9524	2.5714	6.8889	6	0.330937	Random
Mollusca (Gastropods)	3.9524	1.4286	16.6	6	0.010985	Aggregated
Ostracods	0.2857	0.4286	4	6	0.678836	Random
Crabs (pinnotherid)	4.8095	1.1429	25.25	6	0.000355	Aggregated
False Crabs	0.2857	0.4286	4	6	0.678836	Random

Table 4.28: Specie wise distribution of Marine Benthic Invertebrates and their distribution pattern in PQA benthic samples collected in close vicinity of the proposed jetty.

Species	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Hydrozoan	0.619	0.5714	6.5	6	0.369585	Random
Sea anemone	0.1429	0.1429	6	6	0.423695	Random
Amphipods	9.2381	3.7143	14.9231	6	0.020851	Aggregated
Nematoda	2	4	3	6	0.810439	Random
Tanaidacean	1.4762	0.8571	10.3333	6	0.11034	Random
Shrimp (Alpheus)	3.9048	1.2857	18.2222	6	0.005848	Aggregated



Fig 4.14: Mud skipper co habitats with crabs Uca spp in mudflats in macroenvironment

Polychaete worms, bivalve mollusk, Pinnotherid crabs, and species of Tanaidacean were by far the most dominant benthic species in the benthic samples collected from the project's macroenvironment.

2. Coastal Mudflat Habitats.

Coastal areas and the intertidal region is a complex area where the division between land and sea is unclear. Coastal intertidal areas have a diverse range of communities including sandy shores, mudflats, and mangrove forests. The Phitti-Kadiro Creek system has characteristic of very fine sediments from muddy to clayey. The sediment substrate was generally found to be high in organic content and with black mud just below the substrate.

The Habitat surveys were undertaken during low tides at daylight hours. Low tides facilitated in exposing submerged mud flat community. Appropriate statistical analyses were performed using statistical packages for data crunching and interpretation of results. Table 4.29 provides information on the statistics of the total number of samples, mean individuals in each sample along with variance, standard deviation and standard error of mean.

Table 4.29: Statistical parameters of the total number of stations sampled, mean individuals in each station along with variance, standard deviation and standard error of mean.

Station/Sample	Mean Individuals	Variance	Std Dev	Std Error	Total Ind.	Total Spp	Min	Max	Mean Confidence Interval
Sample 1	0.235	0.316	0.562	0.136	4	3	0	2	0.15
Sample 2	0.235	0.316	0.562	0.136	4	3	0	2	0.15
Sample 3	0.353	0.493	0.702	0.17	6	4	0	2	0.234
Sample 4	0.941	2.059	1.435	0.348	16	8	0	5	0.979
Sample 5	0.412	0.382	0.618	0.15	7	6	0	2	0.182
Sample 6	2.353	19.993	4.471	1.084	40	8	0	12	9.504
Sample 7	0.294	0.346	0.588	0.143	5	4	0	2	0.164

Table 4.30: Statistical parameters and dispersion pattern of species observed in the mudflats in the Coastal Habitat Survey conducted at each of the sampled stations at PQA

Invertebrate sp	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Metaplex disctincta	0.2857	0.4286	4	6	0.6788355	Random
Volutidae	0.2381	0.2857	5	6	0.5453557	Random
Caridean Shrimp	19.2381	2.2857	50.5	6	0	Aggregated
Eurycarcinus orientalis	0.2857	0.4286	4	6	0.6788355	Random
Marcinaria sp	0.619	0.4286	8.66	6	0.192137	Random
Cerithidae	0.2381	0.2857	5	6	0.5453557	Random
Bullia spp	0.2381	0.2857	5	6	0.5453557	Random
Barbatia spp	0.2857	0.4286	4	6	0.6788355	Random
Gafrarium spp	1.2857	0.4286	18	6	0.0063792	Aggregated
Telescopium spp	1.4762	0.8571	10.33	6	0.1103398	Random
Marcinaria sp	3.5714	0.7143	30	6	5.19E-05	Aggregated
Tellina (Tellinidae)	0.2381	0.2857	5	6	0.5453557	Random
Codakia(Lucinidae)	0.2381	0.2857	5	6	0.5453557	Random
Cerithium (Cerithidae)	17.2857	1.5714	66	6	0	Aggregated
Turritella(Turritellidae)	20.5714	1.7143	72	6	0	Aggregated
Nerita spp	0.1429	0.1429	6	6	0.4236949	Random
Polycheate (worms)	0.8095	0.8571	5.66	6	0.5375987	Random

The result of spatial dispersion of a population describes the spatial distribution of the individuals in the population. Temporal changes in dispersion generally occurs, and

different stages of the same species will often show different patterns of dispersion. The species distribution patterns observed in the mud flats at sampling stations at project area is given in Table 4.30.

Statistically, the dispersion of a Population determines the relations between the variance and the arithmetic mean. If the variance more or less equals the mean then the Population is said to be randomly distributed. If the variance is less than the mean the Population is termed as regularly distributed and if the variance is greater than the mean then the Population is considered to be an aggregate population that are known to be found in clumps. The highly aggregate populations of Caridean Shrimp Species, Cerithium spp, Turritella spp have been clumped together.

Cerithium species are a large group characterized by an upturned canal in their shell that protects the siphon and allows them to live just beneath the substrate. Cerithium spp are algae and detritus feeders and are common prey for predatory mollusks.

Turritella are by far the largest family group and also one of the oldest, being represented in the fossil record as long as 135 million years, during the Cretaceous Period. During their long presence on Earth, they have occupied every geographical locality and are ubiquitous.

3. Fishery in the PQA.

Pelagic Fish community includes powerful swimmers, which are exclusively carnivore in nature like predaceous



Fig 4.15: A Bivalves and Gastropod spp in muddy substrate at low tide in PQA during the survey



Figure 4.16: Small fishes (Carangoids) shrimps (Metapenaeus sp) and swimming crab (Portunids) are found in the open creek system (Phitti-Korangi-Kadiro)

fishes, croakers, sharks, carangids breams, perches, and sea snakes. Dolphin and seagulls are some important forms, which readily pick up fishes, shrimps, and cephalopods for food. In the mangrove ecosystem the predaceous forms are often small in size and easily wander among the mangroves at high tide. A 15-20 minutes fish trawl was conducted at selected station in the major creeks of PQA viz -a- viz Phitti-Korangi-Kadiro creeks. The fish species caught are given in figure 4.16.

The distribution and aggregation of fish in the project area is

Table 4.31: Distribution behavior of fish in Phitti-Kadiro Creek system

Species	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Mullets (Mugils)	1.5833	1.25	3.8	3	0.283189	Random
Sole fish (Cynoglossus sp)	1.3333	1	4	3	0.260453	Random
Carangoids	0.9167	1.75	1.5714	3	0.670141	Random
Pony fishes (Leiognathus sp)	2.9167	1.75	5	3	0.169987	Random
Shrimps (Metapenaeus sp)	8	2	12	3	0.007541	Aggregated
Swimming Crabs (Portunids)	1.5833	1.25	3.8	3	0.283189	Random

given in Table 4.31. The fish aggregation generally shows random behavior.

Ahmed (1983) reported 98 species of fish from mangrove swamps of Korangi-Phitti creek system. Out of these 98 species 46 species were fingerling or young stages while 52 species were either sub-adult or adult. Mudskippers have adopted themselves to live in this particular environment. Pleuronectiformes which represent bottom living fish move towards this area for their food. Many detritus feeders like clupeids, grey mullets etc. and small carnivorous fish like silver biddies and pony fish find this environment suitable for their living.

Ahmed (1988) has described in detail four types of fish groups in Korangi Creek and the adjoining creek areas; the permanent dwellers which are few; partial residents; tidal; and seasonal visitors in the mangrove habitat where over 180 species of fish have been reported. As many as 148 species of fingerlings or young stages and juveniles have been reported from the mangrove of Indus Delta (UNESCAP, 1996). More common larvae of fishes described for Korangi Creek and adjoining creeks in Indus Delta belong to the families Mugilidae, Gerreidae, Clupeidae, Nemipteridae, Gobiidae, Sciaenidae, Engraulidae, Sillaginidae and Lutjanidae. Their abundance from season to season varies. There are a number of settlements of fishermen along the creeks which depend on the fisheries resources of these creeks.

Benthic Fish Community: Benthic fish community includes detritus feeders, small and large herbivores, and small and large carnivores. In the mangrove ecosystem, the benthic community of the adjacent shallow water is a subject of interest. Here, the microbes decompose the plant litter into organic detritus that is a fundamental commodity of system energy. This detritus matter is picked up by the detritus feeders, such as fishes, shrimps and shellfish over the bottom, and carried to the littoral zone by wave action, and shared there by the intertidal fauna such as crabs, shrimps, mudskippers, and other invertebrates. Grey mullets, gizzard shads, flat fishes, many skates and rays are some of the fish which prefer to live on soft bottom and feed on bottom detritus. At low tide, when a large part of muddy bottom is exposed, crabs, mudskippers and waders are seen in large



Fig 4.17: Mud skipper (Balanus spp) emerging from its borrowing habitat located at high water mark









Figure 4.18: Juvenile mud crab, star fish, sole fish (Cynoglossus sp) and flat heads (Platycephalids) fish in PQA creek system





Fig 4.19: Local crab fisherman, excavating exposed mud flat at low tide to locate mud crabs and transporting them live in wet gunny bags in PQA.

numbers picking up their food which includes worms and different animals left behind by the receding tide.

Artisanal Crab Fishery: Local fishing community members from nearby villages fish for mud crabs Scylla serrata during low tide. The mud crab burrows in mudflats in close proximity to the mangrove plantation. The locals excavate the soft mud with bare hands during low tide. The crabs are caught from their habitats and kept alive in moist gunny bags (Figure 4.19). The gunny bag containing crabs are towed by a small wooden boat/polyfoam floater to be sold in the village for further processing and possibly for exports to foreign countries by the crab processing factory. The local fisherfolk community earns its livelihood through the capture and sale of mud crabs.

Cetaceans: The presence of Dolphins in the Phitti Creek has been reported by IUCN. The survey team did not see any dolphins in the area during the recent boat survey undertaken. Similarly, the team did not find any feeding turtles in the area nor any turtle tracks were found on the muddy shores. No turtle nest was observed. It is unlikely that the turtles would nest in muddy substrate, they prefer sandy substrates instead.

4.8.4 Birds Population

Korangi-Phitti-Kadiro-Gharo Creek system is reported to harbour 52 species belonging to 30 genera and 12 families as shown in Table 4.32. The Populations of Pluvialis squatarola (Grey Plovers), Pluvialis apricaria apricaria (Golden Plover), Charadrius mongolus atrifrons (Lesser Sand Plover), Numenius arquata arquata (Curlew), Limosa limosa limosa (Bartailed Godwit) and Xenus cinereus (Terek Sandpiper) are fewer in numbers in this creek system than the birds observed in Shah Bundar area of the Indus delta.

1. Endemic Birds of Indus Delta

The mangroves of the Indus Delta provide abundant food and shelter to a number of endemic species of birds. The common birds are Oystercatcher, Lesser Sand Plover, Greater Sand Plover, Grey Plover, Golden Plover, Little Ringed Plover, Kentish Plover, Sanderling, Dunlin, Curlew, Whimbrel, Marsh Sandpiper and Common Sandpiper.

Breeding activities of a number of endemic birds have been reported in the coastal wetlands. Little Tern, Common Tern, Gullbilled Tern, Yellow legged Herring, Lesser Black backed Gull and Great Black headed Gull.

2. Migratory Birds

The common migratory waterfowl of the lakes in the Indus Delta include a variety of ducks including Dunlin, Redshank, Coot, White Pelicans, Flamingoes, and Spoonbills. The Indus Delta also provides refuge for the rare species of birds such as Painted Stork, White Stork, Greater Knot, Crane, Ruddy Shelduck (SURKHAB), Greyleg Geese, Common Shelduck and Marbled teal.

Table 4.32: Biodiversity of bird fauna

S. No.	Family	Genera	Species	Population Status		
				A	C	LC
1.	Phalacrocoracidae	1	2			2
2.	Pelecanidae	1	1			1
3.	Ardeidae	4	7		4	3
4.	Phoenicopteridae	1	1			1
5.	Accipitridae	3	4		3	1
6.	Charadriidae	7	18	1	9	8
7.	Recurvistridae	2	2		-	2
8.	Laridae	5	11		5	6
9.	Alecedinidae	3	3		3	
10.	Meriopidae	1	1		1	
11.	Motacillidae	1	1		1	
12.	Corvidae	1	1	1		
		30	52	2	26	24

A = Abundant, C = Common, LC = Less Common *Source: Hasan (1996)*



Figure 4.20: Flock of migratory birds resting in Phitti Creek and sighted during survey



Figure 4.21: Black herons sighted during survey



Figure 4.22: Greater flamingos between 70-80 birds in flight sighted during survey

4.9 Socio-economic Considerations of the Microenvironment

The proposed Coal, Clinker and Cement Terminal Jetty will be located in Kadiro Creek, while the Onshore Storage Terminal will be sited at the 9 meter contour above Korangi Creek. Within the limits of Port Qasim, and above the high water line, there is no residential area. However, adjacent to these limits there are large urban settlements, including the PQA employees residential colony, Pakistan Steel Mills employees township Gulshane Hadeed across the National Highway, Union Council Ibrahim Haidery located at the mouth of Korangi creek, Chashma Goth, Rehri town, Lath Basti and Juma Goth.

The coastal towns of Ibrahim Haidery, Rehri and Chashma Goth, as well as the deep sea fish harbor and salt works along the coast are spread over an area of over 18,000 hectares. They form an outlet for the industrial activities as well as industrial emissions and waste discharges due to which the physical, biological as well as human environment has been seriously degraded.

There are no settlements or sensitive areas including archaeological sites or protected areas in the neighborhood beyond 3.5 km radius. The nearest human settlement from the proposed site is village Lath Basti which is 5 km west to the site. The dargah (shrine) of Noor Hasan Shah is located approximately at 9 km east to the site. Other settlements which lie in the north and northwest of the project area at more than 6 km are Goth Lal Mohammad, Goth Mohammad Keserani and Pipri Colony. The Port Qasim residential colony is located approximately 10 km northwest from the proposed site.

In the North and North East, the macroenvironment is scattered over the coastal area of Bin Qasim District, which includes the Union Councils of Rehri and Ibrahim Haidery besides the two settlements of Chashma Goth and Lath Basti. It extends from the Korangi Creek on the North west and along UC Ibrahim Haidery, Rehri, Chashma Goth, Korangi Fish Harbor, the deep sea fish harbor and salt works along the coast, Lath Basti and Juma Goth in the north; the PROGAS, QICT and FOTCO Jetties and Port Qasim Industrial Area in the northeast; the Steel Mills in the far east, and the large mudflat covered by mangroves forest in addition to the navigation channel of Port Qasim in the south.

At the Phitti Creek inlet (Approach Channel) there are four islands viz. Bundal Island, Buddo Island, Muchak Island and Khiprianwala Island. Buddo and Bundal Islands are the most prominent islands in Phitti Creek to the west of the Project site and at the entrance to Port Qasim. Buddo is about 6 km from Ibrahim Hyderi while Bundal Island is another 6 km from Buddo. Buddo and Bundal islands are

both fishermen's transit locations with a few clusters of huts. Buddo is still lush green with rich mangrove plantation although much of the vegetation has been removed/eroded and provides the area for camel grazing and breeding.

The 8 km long and 4 km wide Bundal Island is the largest island in the creek. Approaching from the opening to the sea, it has sand dunes but inland it has large clusters of mangrove trees. On proceeding further inland there are colorful flags hoisted indicating the presence of a shrine. An annual gathering is held here after Eid. The Fisher Folk Forum claims that about 4,000 trips are made by fishing boats every day near the Bundal coast. The fisher folk forum claims that the deep water channel has narrowed down due to changes that have been effected in the navigation channel.

PQA has claimed jurisdiction over the two islands and had at one time considered the Bundal Island as one of the potential sites for setting up LNG Terminal. This could not proceed further due to challenges on ownership from Sindh government. According to a letter sent on Sept 6, 2001 by EDO (Revenue) of Karachi "the ownership of these islands vests in the provincial government. In the past the government of Sindh has made allotments to DHA and PQA but these islands have not been allotted."

Ecology of the two UCs viz. Ibrahim Haidery and Rehri, which are the main constituencies of the macroenvironment of the proposed project site, has completely changed by having grown from villages dominated mainly by fishermen until the late 1950s with hardly 250 huts each scattered along the coast to attain the category of towns with population estimated by the local residents to exceed 50,000. Both of them are now the headquarters for Union Council Administration. Lath Basti and Chashma Goth have also grown from villages to small towns; they are both part of Rehri Union Council.

Residents of Ibrahim Haidery and Rehri were traditional fishermen involved in fishing business since the last few centuries. They have been joined by scores of migrants from coastal villages and towns like Shah Bunder and Keti Bunder on the east and west of Indus Delta respectively and also the Bangladeshis and Burmese who appeared here as cheap labor.

Lath Basti on the other hand is home for the Jat tribe, who were traditionally engaged in cattle and camel farming. The Jat tribe had migrated from the interior of Sindh and has been residing at the present site of Lath Basti for the last seven or eight decades. Juma Goth with its Railway Station and a large plot of land, designated to house the KCR displaced population, lies between Cattle Colony and Port Qasim Employees Residential area.

Major human settlements in the macro-environment beyond 5 kilometers from PIBT project site are the several large and small rural villages and urban townships. Table 4.34 gives the estimated population of these villages.

4.9.1 Demography

Population in the built environment of proposed PIBT site belongs to different clans and tribes. Traditionally, these clans/tribes had hereditary productive activities. For example, the Khaskhelis were agriculturists; the Jats were pastoral people, breeders of camels and suppliers of timber/fuel. The Memons and Shidis were merchants and traders, the Dablas were fishermen. These people served the clan communities and in exchange were maintained by them. All economic relations between the clans were those of barter. Cash transactions only took place between the Sardars (tribal chiefs) and Waderas (tribal elders) and through them with the outside world. This system guaranteed not only the economic independence of the village but also the supremacy of the feudal landlords. Survey of the villages in macroenvironment reveals that "Old Jokhio" used to live there before the industrial

Table 4.33: Population Data

S.#	Name Union Council	Areas/Description	Population as per Census of 1998
1	Ibrahim Haidery	Deh Ibrahim Haidery	43,583
2	Rehri	Deh Rehri & Ganhiaro	31,506

Table 4.34: Significant Population Centres in the Area

S. No.	Location	Rural /Urban	Population (Approx.)
1	Port Qasim Colony	Urban	1,260
2	Wireless Colony	Urban	238
3	Gulshan-e-Hadeed	Urban	20,000
4	Steel Town	Urban	12,000
5	Nasirabad	Urban	12,500
6	Railway Marshaling Yard	Urban	2,500
7	Nishtrabad	Urban	1,400
8	Edu Goth	Rural	2,400
9	Pir Nau Goth	Rural	1,000
10	Razzakabad	Rural	3,500
11	Abdullah Goth	Rural	1,050
12	Ranju Goth	Rural	750
13	Kamran Khan Goth	Rural	325
14	Allah Dino Goth	Rural	230
15	Muhammad Raheem Goth	Rural	250
16	Mai Hur Goth	Rural	230
17	Abdul Latif Goth	Rural	200
18	Muhammad Saleem Goth	Rural	180
19	Morund Khan Goth	Rural	200
20	Mayo Khan Goth	Rural	150
21	Ali Khan Goth	Rural	270
22	Asmaj Goth	Rural	85
23	Ahmed Goth	Rural	78
24	Khan Muhammad Goth	Rural	120
25	Allah Bakh Goth	Rural	80
26	Abdul Rehman Goth	Rural	70
27	Abdul Raza Goth	Rural	80
28	Muhammad Ahsan Goth	Rural	80

developments.

The population mix in UC Ibrahim Haidery is overwhelmingly Sindhi and Balochi speaking, followed by the Bengali-speaking people. Gulshan-i-Hadeed has a combination of all ethnicities with Sindhis forming the slightly larger group. Union Council Rehri is overwhelmingly Sindhi and Balochi, while the number of other clans is almost negligible.

The cattle colony is the center of cattle and meat trade in Karachi. The Cattle Colony is the dairy products shopping and supply center of Karachi. Its population is overwhelmingly Punjabi.

4.9.2 Employment and Living Conditions

The macroenvironment does not offer opportunities for employment and the population is primarily employed as cheap unskilled labor force in the industrial areas of PQA, LITE and KATI. Agriculture is limited to subsistence farming due to scarcity of water. In Juma Goth and areas close to Cattle Colony extensive areas are under cultivation of vegetables using the effluent from the cattle yards. Livestock herding is not a healthy and reliable income generating option, and the few livestock holdings in the settlements are primarily for household and domestic use, a source of dairy consumables. Skilled labor is rare and the categories of skilled laborers are mostly drivers, welders, plumbers and electricians. Government service is rarely available.

The population in the UCs can be broadly placed in three categories - fishing communities residing in small clusters of households down south along the coastline, labor class and workers employed in the industries in the area, and

very few white-collar workers. Majority being illiterate or lacking education, the people find employment either in subsistence farming or at best as casual and unskilled labor engaged in the surrounding industrial installations, with the Pakistan Steel, KESC Thermal power plant, Dewan/Pakland Cement factory and the Pakistan Railway Marshalling Yard being major employers. Numerous small villages in the UC have not been supplied with electricity despite the fact that high tension lines bring in power for numerous industries that have been established here.

Port Qasim colony, which is at a distance of about 10 kilometers from the project site, has a total estimated population of 2200 consisting of families of PQA's employees having average household comprising 8 persons. Port Qasim Colony has all the basic facilities of life including; electricity, telecommunication, gas, and drinking water. Transportation and access to main highway through the link road is available. Amenities and mosques are present. People working in PQA belong to low to high-income groups having average earning up to Rs 15,000 – 25,000 per month.

The population resident in UC Ibrahim Haidery and Rehri is totally dependent on low level engagements including fishing. The UCs surrounding the microenvironment of the proposed site at Khiprianwala, consist of scattered villages inhabited by old Jokhio tribe. Being farther away from the main highway they have not been provided with all the basic civic facilities and are among the underdeveloped areas of Karachi City District. The area is marked with poverty with average household income not exceeding Rs 7000.

The Settlements in the Korangi Creek area are fishermen's villages but the dwellers are engaged in other low level occupations as well. The employment and therefore earnings for a large section of population in the area is variable, heavily dependent on fisheries. Prawn, shrimp and crab fishing from inshore waters is the main source of income of the majority. However, quite a substantial segment of population is employed on deep-sea fishing boats. The relatively low level of income in this rural setting is reflected in the poor condition of housing, with water supply and sanitation being too inadequate. Some of these villages are now provided with electricity, connected by paved road and served by Public Transport.

4.9.3 Dependence on Mangroves

Mangroves are a valuable resource for many of the coastal villages. They are primarily used as a source of fuel and fodder and provide the feeding grounds for prawn and shrimp, besides protecting the land from erosion. The people have been overexploiting this resource over the years. IUCN has, in association with Sindh Forestry Department, initiated a program of mangrove conservation, replanting and sustainable management along the coastline of Rehri village. Engro Asahi Polymers has undertaken an extensive program of plantation of mangroves. They have a nursery where they cultivate the mangroves from the millions of propogules shed by the mature trees in the surrounding.

4.9.4 Education

Educational facilities in the surrounding area of the UCs Ibrahim Haideri and Rehri are limited to primary and secondary schools. Each village in the area has access to a primary school within a distance of three to four kilometers. There is also a high school in Ibrahim Haideri and Rehri that covers and meets the demands of nearby Deh. Availability and access to education may be regarded inadequate because of lack of efficient and effective schooling system to facilitate and promote literacy and education. Literacy rate among females is low, especially in adult females who are rarely literate.

Training in technical skills is inadequate. Skilled labor consists of drivers, mechanics, water pump attendants which are estimated to be less than 10% total labor force. Thus the resident population in the immediate neighborhood is not capable of being employed in skilled category as might be perceived by the PIBT Project in near future.

4.9.5 Health

Clean and safe water is one of the major problems being faced by the residents of UCs Ibrahim Haideri and Rehri.

Though the Karachi Water and Sewerage Board's pipelines bring in approximately 580 million gallons of water daily from the Indus river and Hub Dam to Karachi and route the bulk of it through Bin Qasim Town, yet a majority of the villages have not been given water connections and have to depend on ground water and other sources including the unhealthy springs, for drinking as well as domestic purposes.

Health problems of the UCs Ibrahim Haideri and Rehri are generally associated with water availability and quality aggravating sanitary conditions due to lack of facilities and reliable water supply. Health facilities are inadequate and sub-standard. Both UCs have one Basic Health Unit (BHU) and a primary health care unit (PHCU) but both units are understaffed and not well-equipped. For advanced medical aid treatment cases are referred to health centres at Quaidabad or city centres of Karachi.

4.9.6 Landscaping

The terrestrial environment around the UCs consists of sparse scrub and a few trees of Acacia nilotica, with some grazing from domesticated animals including camels, goats and cattle. The land adjacent to the coastline has deposits of poorly sorted, unconsolidated loose gravel, sand and silt. It has sand bar deposits comprising medium to coarse sand, which is being exploited for cut-and-fill in the construction industry, and for land preparation for the industrial zone and for reclamation of land area on extensive areas in the south. This has disturbed the landform during the last three decades and has irreversibly changed the landscape of the near-shore area.

4.9.7 Transportation Network

The built environment of the Project is served by the developed infrastructure of Port Qasim industrial area, Port Qasim International seaport, National highway and also the rail network which connect the macroenvironment with the city centre of Karachi and other cities of the country. The main access road from the National Highway, N-5 is a single 2-lane carriageway at present. However, it is planned to be dualized into a 4-lane divided road. The intersections are also proposed to be improved along with the various Port Development schemes being implemented at Port Qasim.

The composition of traffic is similar to other sections of National Highway passing through rural areas. Heavy traffic includes trailer, trucks and tankers that dominate the overall traffic stream. Road network within Port Qasim Industrial Zone is superior to other industrial estates in Karachi and roads are wide enough to support all types of vehicular traffic movement.

Beyond the PQA network, the project shall be connected with the various areas in Karachi and upcountry through the National Highway and the railway network. The PQA access road connects the proposed terminal to the National highway, N-5 which runs from Karachi to Peshawar and onwards to Afghanistan. From the National Highway, N-5 branch off different routes along National Highways leading to various other cities in the country. A link road starting near Steel Town connects the National Highway, N-5 with the Superhighway / Motorway, M-9 system near Kathore.

Main line of Pakistan Railways, running almost parallel to National Highway, N-5, links Port Qasim to other areas in the country especially to the Thar Parkar region providing opportunities for carriage of Coal and Clinker to the proposed terminal. However, development of a railway link between the proposed terminal and Pipri Marshalling Yard shall be required for making it a convenient and commercially attractive cargo movement facility.

4.9.8 Archaeological and Historical Sites

A review of investigations in the Port Qasim area and a visit to the macroenvironment of the project site, did not indicate existence of any feature or structure of cultural significance or of archaeological interest within the area of the proposed activity. There is a grave of a certain saint Baba Kamal Shah about 5 km on the northwest of site, said to be attracting some devotees. Shallow saline water spring near the shrine is an attraction for the devotees.

These features, however, do not suggest that the place has any historical or cultural significance. The other archaeological sites of ancient Port of Debal and the town of Bhambore are about 18 kms NW of the project site. The graveyard of Chowkhandi is 10 km from the project site. The old Ratto Kot fort is also at a distance of 10-12 km from project site.

05 SCREENING OF ALTERNATIVES

5.1 Screening of Alternatives

The Coal, Clinker & Cement Import/Export Terminal being established by Pakistan International Bulk Terminal (PIBT) aims at development of facilities to i) import steam coal for the current requirement of better calorific value fuel for clinker production in the cement industry in Pakistan, and ii) export clinker and cement. The alternatives examined for establishment of the said facilities are the following:

5.1.1 No Action, continuation with the existing condition:

This is not an acceptable proposition since the wide gap between supplies of better calorific value coal can only be met with sea/steam coal which is extensively being traded among emerging economies like China and India. Pakistan has some 187 billion tons of brown coal that needs to be upgraded for making it suitable for use in power production and other uses e.g. clinker production. Till such time that Pakistan has developed indigenous capacity to upgrade its coal quality, the import of steam coal will continue.

Production of coal and its use in power and cement manufacture is a global industry, with coal mined commercially in over 50 countries and used in over 70. Coal is readily available from a wide variety of sources in a well-supplied worldwide market. Coal is being transported to demand centers quickly, safely and easily by ship, rail and road. A large number of suppliers are active in the international coal market, ensuring a competitive and efficient market. Pakistan, despite having such a large reserve as 187 billion tons of brown coal is at the receiving end and is importing~ 4.5 to 4.6 million tons steam coal for its cement industry.

The demand for steam coal has grown manifold during the last one decade and is likely to continue for some time beyond the point when other fossil fuel resources will be exhausted. Moreover, the continuous rise in oil prices does not suggest that coal prices would also follow a similar trend. Coal prices, historically, have been more stable than oil prices. In the short term plan therefore steam coal will have to be imported in Pakistan to respond to the growing need for cement production whose export market is now well established.

In the long term plan the local coal will have to be adequately upgraded to the level desired for steam coal. With as much as 178 billion tons of brown coal being available locally, Pakistani coal will be able to take the front stage in global world trade. In the short term plan the terminal will handle import of steam coal besides the other bulk cargo including clinker and cement. In both cases the 'no action' alternative does not merit further consideration.

In similar manner export of clinker and cement needs to be handled at a bulk dry cargo handling facility to handle dirty cargo that includes cement and clinker. The no-alternative proposal accepts the current state of affairs and does not segregate the handling of clinker and cement from the other types of bulk cargo.

The 'no action' alternative therefore does not merit further consideration

5.1.2 Screening of Alternative Sites & Selection of Preferred Alternative Site

1. No Action Alternative, continuation at the Current Site

The '**No Action Alternative**' for siting the PIBT does not offer the much needed environmental advantages over the present system of having the imported coal handled at the open yard in Keamari area which is adjacent to the residential colonies that house the lower middle class populace of the port area. Coal is currently being transported from the berths to the open yard in open top dumper trucks that spill coal on their way. It is being stacked in an open yard on large hillocks, which are sprayed with water from sprinklers. The water draining from the heaps of coal is

allowed to drain untreated into the coastal water.

In view of the deficiency in not responding to the needs of environmental protection, the "No Action Alternative" does not need further consideration.

Selection of the preferred alternative system and site for establishment of Coal, Clinker & Cement Terminal at PIBT needs to be based on:

a) Substantial improvement in the current system of handling, storage and transportation of coal, clinker and cement.

b) Urgent need to provide better level of infrastructure service in handling coal, clinker and cement for storage, and shipping to meet the current and future demand for higher calorific value coal available for the cement industry, and to cater to the shipping requirements of clinker and cement export as bulk dry cargo.

2. Alternative Sites

Siting the PIBT has taken the following aspects into consideration:

- The operations of PIBT include a) harboring, berthing, off-loading coal to onshore storage site installations, and b) stacking of clinker in open storage shed and storing cement in silos. This demands a site that has facilities dedicated for off-shore and onshore handling of dry bulk cargo, besides storage yards.
- Handling and storage of coal is classified as hazardous. As such risks are involved from entry into the port area to unloading, and storage. Mitigation of the risks at a dedicated site equipped with necessary device and procedures has been found to reduce the risks.

Port Qasim Authority Master Plan has designated the following sites for locating the Terminals for handling dirty and dry bulk cargo: 1) The Iron Ore and Coal Berth Terminal (IOCBT), and 2) Space reserved as back up area adjacent to FOTCO oil terminal.

Alternative1, the IOCBT is a dedicated terminal meant to cater to the specific needs of the Pakistan Steel Mills and the same will not be available for another terminal. This alternative has therefore not been considered further.

Alternative 2 has in its proximity the PROGAS LPG Terminal including the Jetty and trestle, and the FOTCO Oil terminal and its units including the jetty, trestle and storage area. Locating the PIBT in the proximity of these terminals / jetties would not affect the traffic flow and operational activities of the Port or the navigation channel or the adjacent Terminals.

Alternative 2 additionally offers the advantage that it will be sited at sufficient distance from the navigation channel but in the same channel that is dedicated to facilities handling LPG by PROGAS and fuel oil by FOTCO. This site duly addresses the security and safety concerns since it is sufficiently distanced from other port installations. Alternative 2 would also offer the following advantages:

- Site is less exposed to open sea;
- PIBT jetty will be at 0.7 km from PROGAS and 1.5 km from FOTCO jetty;
- PIBT trestle will run parallel to PROGAS and will be separated by distance of about 1 km;
- Other jetties operational in the vicinity of the area are about 8 to 10 km from FOTCO Jetty. Hence locating the PIBT at alternative site 2 will not affect the traffic flow or the operational activities at the port. The optimal mitigation measures have been taken into account while selecting the site for the jetty and trestle, while the storage area will be above the shore line just past the trestle at the site designated in the PQA Master Plan;
- The Site adequately addresses the safety and environment issues of siting the bulk cargo terminal: PIBT;
- The Site considers minimal disturbance to ecosystem especially of the mangroves and other aquatic flora and fauna.

The Site at Alternative 2, designated and offered by PQA to PIBT has therefore been selected as the **preferred alternative.**

Siting the PIBT at the preferred site will conform to the following Regulations:

- Coastal Zone Regulation (CZR) 1991 concerning the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters; the coastal zone extends over the beach up to 500 meters from the high tide line (HTL) and includes the land between the low tide land (LTL) and the HTL.
- Setting up of new industries or expansion of existing industries, handling of hazardous wastes, discharge of untreated wastes and effluents, dumping of municipal wastes as landfill or otherwise, mining of sand, rocks and sub-strata materials and land reclamation within the CZR is forbidden, except for the purpose of construction of ports, harbors, jetties, wharves, quays, bridges and sea links.
- CZR specifically lays down that reclamation for commercial purposes such as shopping and housing complexes, hotels and entertainment activities shall not be permitted. However, separate guidelines for construction of beach tourist resorts/hotels in CZR-III are provided for a no development zone (NDZ) for 200 meters from the HTL and within the area between the HTL and LTL is defined. With the prior approval of the ministry of environment and forests, two-storey structures can be built in this NDZ.

The pre-construction stage of siting the PIBT will involve the following functions:

- Aerial and hydrographic surveys of the area with respect to bathymetry of the seabed, marine weather conditions, as well as onshore and near shore topography at the shore landing site
- Fulfillment of Safety and Security requirement for siting PIBT

5.1.3 Screening of Alternative Locations for Siting the PIBT Jetty, Trestle & Storage

The establishment of PIBT at Port Qasim comprises the construction of a new jetty with approximately 439 m total length, a trestle with a conveyor belt connecting the jetty with the storage yard of 2440 meter length, together with storage yard and on-shore facilities.

The PIBT Jetty will be located adjacent to and set back from the main navigation channel of Port Qasim, and will thus avoid interference with the traffic in the main channel. The proposed jetty will be an open piled structure with deck area of 440 meter length. The superstructure will consist of cast in situ capping beam on top of the piles. The sub-structure will consist of vertical piles below crane tracks and cast in place RC bored piles.

At the seaside end, the jetty will be up to 29 m in width which will enable the vessels to conveniently make the manoeurving. At the connection to the trestle there will be a platform for a berth office, a mini workshop and parking space for shovel-loaders and other vehicles. The water depth at the jetty front line is assumed at CD -15.50 m at the second stage. In the first stage the berthing basin shall be dredged up to a depth of -12.5m CD.

Dredging Requirements: Port Qasim Authority (PQA) will carry out the dredging and maintenance of the channel as well as the turning circle, and the approaches to the berth. PQA will undertake deepening and widening of the main navigation channel to -15.5 meters for access of ships of 75,000 DWT. Dredging to the required depth for berthing of vessels of 75,000 DWT as well as maintenance of the required dredged berth will be the responsibility of the PIBT. Dredging in front of the jetty to accommodate 55,000 DWT will be made before delivery of the crane and loader. Dredging for 75,000 DWT ships will only be made when the approach channel has been dredged to -15.5m depth to accommodate ships of the said size.

Mode of disposal of the dredging spoil: Alternatives available for disposal of dredging spoil include i) landfill of storage area, and ii) site identified by PQA. Alternative i) will require investigation on the suitability of reclaimed soil for reclamation of the back-up area that will be used as storage area. In both cases there will be problems of disposal of the dredged materials and material transfer through 2.5 km mangroves swamp. Geotechnical investigations at the site indicate that the top silty Clay/ Clayey silt is unsuitable for using in the reclaimed area, since use of such material in such areas will encounter undesirable large settlement of soil on long term basis. The material of Layer II and Layer III has

been found usable for filling reclaimed area. The thickness of these layers is 3 to 6m and hence can be considered for the purpose of reclamation of the back-up area that will be used as storage area.

Geological investigations at the site also indicate that the layer from El. -10.0 to -28.4m consists of very dense, Sandy gravels/Clayey gravels & Clayey sand. This does not suggest that dredging will require cutting hard rock. As such the dredging process may not result in destabilizing the creek system which is already under stress. The dredged material can therefore be used for reclamation instead of dumping it elsewhere.

Reclamation: The storage area comprises a large depression which will have to be filled in to level +5.50 m with some extra height to compensate for expected settlement.

The entire reclamation material could be provided from offshore sources. These reclamation materials shall be placed by bottom dumping and thereafter by the rain bowing method. Side dams constructed in Christmas-tree fashion from quarried rock or large geo-bags will be used to manage the reclamation plan. This alternative has been subjected to geological investigation and it has been found that the layer from El. -10.0 to -28.4m consists of very dense, Sandy gravels/ Clayey gravels & Clayey sand and not hard rock. As such excavation of gravel for land filling at the site is not likely to modify the coastline.

The reclamation up to the formation level (base of pavement base layers) will be further compacted to sufficient bearing capacity. High Impact Compaction or Vibro Compaction methods will be applied. An alternative method for consolidating and reducing the settlement to an acceptable extent for operations would be overloading combined with vertical drains to accelerate the settlement process. This method can be applied on soils with no large-sized gravels.

Set-back of the jetty: The set back of the jetty structure will need to be optimized. The optimum solution is to set back the jetty at 80 meters, which from nautical experience appears to be ready for future developments to increase the channel depth to -15.5m CD. An alternative is a lesser set back of 50 m which would require lesser investment and maintenance dredging, but will make berthed vessel susceptible to unstable movements created by the vessels passing-by the jetty, which increase the chance of breaking of the mooring ropes. Another alternative is extension towards the PROGAS berth, which has a smaller water depth and no set back. This will require confirmation that excessive dredging in the neighborhood would not expose the PROGAS structures to risks of stability.

Approach Trestle & Causeway: A 2.4 km trestle bridge is proposed for connecting the Jetty to the on-shore storage area. The site area proposed for the alignment of Trestle structure covers mainly mangrove land. The construction of Trestle bridge will require a corridor along alignment of Trestle bridge by removing Mangroves and dredging for the channel of about 50m width and depth to about El.-3.0m.

Two alternative structures are available for siting the 2.4 km trestle bridge for connecting the Jetty to the on-shore storage area:

Alternative 1: The trestle is supported by a pair of piles at 12 m space each. Trestle piles are designed to support an access bridge for maintenance, fire fighting and other services. The pair of piles is connected by a concrete beam, which supports:

- A 3.5 m wide bridge for heavy trucks, such as mobile cranes, emergency vehicles and trucks to carry heavy parts of the bridge. Further such plant can be used for transport of large imported machinery to the storage area. Bridge girders are made of prefabricated concrete.
- A steel truss structure carrying 2 conveyors. The steel structure has a span of 12 m.
- At the jetty end of the trestle a platform shall be built to support the transfer station and will house the jetty office and a small workshop.

Alternative 2: The trestle is supported by single piles every 12 m (or larger distance subject to results of structural design requirements). The piles only carry the steel structure truss construction for the conveyors. The top of the truss will be covered by a reinforced 10 mm thick 2 m wide steel plate with side protection. In this option trestle will be provided to support only conveyors. No full road access will be provided

up to the jetty.

In both alternatives the trestle follows a straight line between the storage area and the jetty, avoiding bends and transfer stations in the middle. The definition of the exact position of the trestle would be left to detailed design, which will consider space for the rail yard on the terminal. Space for the rail yard may require the shifting of the start of the trestle not exactly at the corner of the concession area but slightly to the East.

The Preferred Alternative: Based on geological investigations on site and in view of operational requirements, it has been recommended that the Trestle structure should be supported on Pile Foundations. The piles shall penetrate into bearing strata. Soil Profiles show that the subsoil below El -15.0m CD PQA may be considered as bearing Strata. The Pile may penetrate 5 to 15m below this level, depending on required Pile Capacity.

Storage Yard: The storage area is planned at nominally CD +5.50 m after settlement. The gate office, administration building, workshop building and electricity substation with generators, cement silos and compressor station are arranged at this level.

Coal and clinker will be stacked in open storage; the maximum stack height will be 15 m. The density of the cargo in the storage is significantly higher than on a conveyor where it is loose. The compacted wet coal density can be up to 1.2 ton/m^3 while clinker can have a density of up to 1.52 t/m^3. Consequently loads to the ground can be 180 kN/m^2 for Coal and 224 kN/m^2 for clinker respectively. Soil analysis will indicate, if the ground can carry such load, and the type of settlement expected. In the first few years it may be required to limit the stack height to ensure stability of the ground and to make certain that there is no soil failure. In the clinker stack (high requirement for dryness) the drainage slope shall be 2 percent, in the coal stack it will be 1 percent. The initial area elevation will be prepared in such manner that planned levels and slopes will be reached after settlement. As the subsoil is not uniform, settlement will not always be as predicted. Should the storage yard after some time be so uneven that proper operation is not possible, the surface would be realigned.

The storage area can only be paved once the soil has settled.

Two alternatives were offered for siting the storage yard; the one offered initially was approximately 280 m wide and 880 m long with parallel sides, which is in conformity with the technically and economically optimal dimensions for a coal and clinker stack because stackers can travel long distances, although they have limited outreach in cross travel direction. The other and final alternative has a trapezoid shape and is 542 m long in south-north direction, 316 m at the southern boundary and 606 m at the northern boundary. For automatic stackers the length of the area is rather short. As the east and west boundaries are not parallel, it is difficult to fully utilize the area. The arrangements of storage zones will follow the principle to minimize the length of conveyors. Despite the above limitations it is imperative to achieve optimum area utilization.

A critical factor that needs to be addressed is the rail track. It should be possible to handle one complete train of 570 m (1872 ft, the maximum length permitted to go north) on this plot of land. The minimum rail radius is 350 m, which is so large as to require their laying at the west boundary from north to south in the same orientation as they enter the site.

Directly adjacent to the rail yard will be the coal stack. Since the initial settlement of the reclaimed area is expected to be high and also uneven for stacker rails, overhead conveyor will be used to drop the coal. This conveyor will be supported at each 50 m interval. During detailed engineering it will be decided if supports will be on piles (not sensitive to settlement) or on flat foundations with adjustable alignment. The conveyor is not sensitive for horizontal settlement but sensitive for horizontal misalignment which can be caused by uneven settlement. Since this stack is located directly at the rail track, shovel loaders will be used to take the coal from the stack and directly load it into wagons.

The northern boundary with the adjacent road will be partly required as rail entrance and partly as truck gate.

The eastern boundary is the longest side of the allocated area where stack can be arranged. Therefore at phase 2, when the soil is consolidated, coal stacks with stacker and stacker feeding conveyor will be arranged along this boundary, as

well as stack 5 between boundary and conveyor and stack on the west of this conveyor. The stack will have a length of approximately 560 m. Due to unfavorable shape of the plot of land; there remains a triangular shaped area between coal stack of phase 1and coal stack of Phase 2.

The coal will be stored in open stacks arranged parallel to the west and east boundaries of the area. Clinker will be stored at the remaining V-shape between the coal stacks. Area allocation is as follows:

- 5 Silos of 18 m diameter with 10,000 t capacity each at the western part of the storage area.
- Coal stack 1 (phase 1) is located along the future rail yard (phase 2) at the west boundary almost over the whole length of the area. The stack will receive the coal from the ship via an overhead conveyor running 17 m above the ground. A tripper will take the coal off the belt and dump it on both sides of the conveyor. The coal will build up a natural slope. Since with this technique the stack is not wide enough to store necessary coal dozers, it will be used to spread the coal sideward. This is not a perfect solution however it is the only economical and safe option, as long as a detailed soil analysis is not available and the area has not become consolidated. Trucks collecting the coal will be loaded by shovel loaders directly at the stack. At phase 2 shovel loaders can directly load the coal onto wagons.
- Clinker stacks 2 and 3 will be located in a triangle formed by the gate area and coal stacks 1 and 4. Trucks delivering the clinker will dump the clinker directly onto the stack. At phase 2 there is an overhead conveyor feeding the stack with clinker arriving by train. At the east side of the clinker stacks there is a storage discharge conveyor with feeding hopper for shovel loader.
- Coal stacks 4 and 5 will follow the clinker stacks eastwards. These stacks will be constructed at phase 2. At this phase a stacker will also be introduced.

Handling Equipment in the Storage Yard: The features of the handling equipment for the storage yard are the followings:

Overhead conveyor for coal and clinker: In phase 1 there will be an approximately 400 m long conveyor (marked 7) at a height of 17 m with supports every 50 m with gangways on both sides. On the conveyor there will be a movable belt tripper lifting the belt, making a loop in the belt and dropping the coal from the conveyor and guiding it downwards. At the initial stage the coal will form a 15 m high cone with approximately 40 m diameter under the tripper. The tripper will automatically move 1 m forward when the coal stack reaches the 15 m height. The stockpile will get elongated in this manner until the total length of the area is filled. Storage discharge will be done by shovel loader and trucks into a hopper at the end of the stack. This is a simple and economical system that requires no stacker and no stacker rails and can be availed with low investment. However, to achieve sufficient storage capacity, a dozer working on top of the stockpile is required to push the coal sideward, thus increasing the storage area and capacity.

- Conveyor length: 400 m
- Stacking height: 15 m
- Belt width: 1600 mm
- Belt speed: 4.1 m/sec Capacity: 3700 t/h

In phase 2 there will be a similar overhead conveyor to stack clinker arriving by wagon.

- Conveyor length: 408 m
- Stacking height: 15 m
- Belt width: 1200 mm
- Belt speed: 2 m /sec
- Capacity: 1500 t/h

Stacker for coal

- Rail gauge: 8.0 m
- Outreach: 45 m
- Stacking height: 15 m
- Belt width: 1600 mm
- Belt speed: 4.1 m /sec

- Capacity: 3700 t/h

Sprinkling system: For pollution control at dirty bulk cargo terminals, it is necessary to minimize dust escape. Coal is not allowed to remain dry since such conditions can create an explosion hazard. Vacuum filters would not work with wet coal and hence pollution control will be achieved by a water spraying system that will be installed for dust suppression at PIBT. The water spray system will also be in place at transfer stations between conveyors.

5.1.4 Alternative Dredging Techniques

The dredging may be accomplished by two ways:

1. Mechanical Dredging

2. Hydraulic Dredging

The dredging technique is selected by a dredging contractor in light of the results of geotechnical investigation carried out for the project area. PIBT has already conducted geotechnical study for project site which will guide the contractor while selection of appropriate dregding technique. Table 5.1 presents a comparative analysis of the performance of mechanical and hydraulic dredging alternatives.

Table 5.1: Analysis of Mechanical and Hydraulic Dredging Alternatives

Dredges	Sedimentation Rate	Material capable of being Dredged	Production Rate	Comments
Mechanical Dredges				
Grapple Dredge	High	Very Soft Deposits	Low	Not suitable for hard materials
Dragline Dredge	High	Very Soft Deposits	Low	Not suitable for hard materials
Dipper Dredge	High	Hard Compacted Rock	Low	Inefficient use of scows for disposal of materials
Bucket Dredge	High	Clays, gravel and coarse materials	Low	High noise, high fuel consumption due to barges for disposal of dredged material
Backhoe Dredge	Moderate	Clays, gravel and coarse materials	Low	Compact size, can be equipped with turbidity controls
Hydraulic Dredges				
Hopper Dredge	Low	Loose sediments and un consolidated sand	High	Disposal of dredged material may require dredging operations to be suspended
Cutter head Suction Dredge	Low	All alluvial materials, compacted deposits and rock-like formations	High	Not designed for heavy sea conditions, floating pipeline can deposit dredge spoils in disposal area

06 STAKEHOLDER INTERACTION (CONSULTATION & DISCLOSURE PLAN)

6.1 Public Consultation & Participation

Public Consultation and Public Participation are two effective tools of social interaction. Public Consultation is an important tool to build up confidence between the stakeholders and the project formulators to minimize the risk of delay of project implementation. It also counters erroneous information, if any, about the project. It helps the project proponent (Pakistan International Bulk Terminal Limited; PIBTL) make informed assessments of public opinion about the project, and the nature and extent of opposition likely to occur during the implementation stage.

Public Participation, on the other hand, helps project implementation to a great extent. The purpose of involving the public in general and project affected persons, in the decision making process is to have a fair interaction with all community groups and ensuring them that every attempt would be made to minimize negative impacts of the project, and that adequate mitigation measures would be taken to compensate the loss of the affected persons, if any. Thus, it ensures partnering between the community and the project proponent leading to timely completion of the project with least social cost and disruption. Moreover, experience indicates that unexpected project effects on the local community generally give rise to significant issues and concerns among Project Affected Persons (PAPs). These problems get reduced when people are properly informed and consulted about the project and given the opportunity of being heard. Similarly, Non Governmental Organizations (NGOs) will frequently come forward to advocate on behalf of the stakeholders, including PAPs. By making NGO's party to the decision making process, future litigation at later stages can be avoided.

6.2 PIBTL's Policy of Public Consultation & Disclosure Plan

Since PIBTL's proposed Coal, Clinker and Cement Terminal project is a significant development in Kadiro/Korangi Creek, it has special consultation responsibilities. Effective project planning has required regular consultation with a wide range of project stakeholders. Based on an extensive public outreach program, including public meetings, public hearings, and individual and group consultations, the local community is well informed of the project objectives, likely impacts and essential provisions of compensation policy through the Project's conduct of the following activities:

1) Information dissemination campaigns using media, notice of meetings or information leaflets;

2) Holding Public/Stakeholder Consultation Meetings and Focus Group Discussions (FGDs);

3) Arranging interviews with the communities and their stakeholder groups;

4) Formation of focus groups involving key stakeholders, like local/community leaders, women, the poor, and other groups;

5) Setting up various committees for planning, implementation and monitoring of construction and operations; and

6) Involvements of the PAPs in a formal grievance redress process.

To discuss and seek opinion/suggestion from the communities and other stakeholders, their representatives were invited to participate in various meetings regarding project related issues involving impact mitigation and compensation procedures in light of IFC guidelines.

Guiding Principles: The project has followed International Finance Corporation (IFC) Performance Standard 1: Social and Environmental Assessment and Management Systems, in developing the public participation program for the PIBT project. A relevant objective adhered to in designing the public involvement program for the project is:

- To ensure that affected communities are appropriately engaged on issues that could potentially affect them.

Requirement 19 of this Performance Standard states "When local communities may be affected by risks or adverse impacts from a project, the engagement process will include consultation with them. …Community engagement will be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information."

Requirement 23 of this Performance Standard states "The client will respond to communities' concerns related to the project. If the client anticipates ongoing risks to or adverse impacts on affected communities, the client will establish a grievance mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected communities, and at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies. The client will inform the affected communities about the mechanism in the course of its community engagement process."

IFC Performance Standard 4: Community Health, Safety and Security and a relevant objective is to:

- To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances.

IFC Performance Standard 7: Indigenous Peoples and relevant objectives are to:

- To establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project; and
- To foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples.

International standards that are followed by PIBTL relevant to community engagement include:

- International Finance Corporation, 'Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets' (IFC, 2007); and
- The Core Values of the International Association for Public Participation (IAP2).

The project has striven to rely on the following IFC principles:

- Early engagement: Commencing engagement early is critical in building trust, mutual respect and in establishing relationships with communities. PIBTL will ensure that consultation activities are proactive, planned and delivered in a timely way.
- Long-term view: Establishing and maintaining relationships is a long-term investment. To enhance the value of community relationships, PIBTL will take a long-term view to engagement.
- Tailored at each phase of project: The outreach and engagement program will be tailored to each phase of the project. In developing the project, activities, issues and stakeholders associated with the phase will be considered and built into the engagement activities for that phase.
- Proactive, not reactive: PIBTL will set a proactive path for consultation and will consult in a strategic

manner, as opposed to being reactive and responding to grievances as they arise. A proactive approach to consultation will build credibility and relationships with the community.

- Managed as a business priority: PIBTL will ensure that engagement activities are planned and delivered through a systematic and consistent approach and that management responsibilities are assigned to each consultation activity.

The major objectives of PIBTL's public consultation program are to:

- Create awareness among local people about the project in general and its potential impacts (both positive and negative) on the community, and involve them in the decision making process from the very inception of the project with a view to build trust.
- Identify significant public concerns with a view to reduction of public resistance during implementation of the project. Make them feel that they are not ignored. Take them in confidence by providing them a role in the decision making process.
- Educate potentially affected communities/persons about the project.
- Solicit the views of affected communities on socio-economic aspects of the project. This process serves as an important tool for collection of information on both natural and human environment, which would not be possible through traditional approach of data collection.
- Produce a suitable plan for meaningful and responsive public involvement by incorporating the felt needs and preferences of communities as evolved through community interactions.

6.3 Identification of Stakeholders

Stakeholders are people, groups, or institutions that may be affected by, can significantly influence, or are important to the achievement of the stated purpose of a proposed intervention.

The Primary and secondary stakeholders were identified based on standard following definitions:

1. Primary Stakeholders are people, groups or institutions affected positively (beneficiaries) or negatively by the project;

2. Secondary Stakeholders are people, groups, or institutions that are important intermediaries in the project delivery process (e.g., the institutions, research organizations, government line agencies, or NGOs etc).

For the purpose of this project, the primary stakeholders are the fishing communities living in the macroenvironment of project area. However, it is pertinent to mention that the living population/ community settlements are located more than 3.5 km away from the proposed site designated by PQA for Coal, Clinker and Cement Terminal.

The stakeholders (primary and secondary) contacted /consulted during the project planning have been listed in table 6.1.

6.4 Methods And Approach

Initially public consultation in form of group discussions was carried out at different locations of the project area during the preparation of the Environmental and Social Impact Assessment (ESIA) with a view to minimize adverse impact of the project through creating awareness among the communities on potential benefits of the project. The meetings with communities were held during the months of Jan-Feb-March 2011. Moreover, Scoping session with major stakeholders was conducted on December 26 2010 at Hotel Regent Plaza, Karachi. The Scoping process identified data gaps relating to the quality of the marine environment baseline ambient air quality, baseline noise levels, Health & Safety issues, information about other planned developments in the area, Hazards and Risks associated with the constructed and operation activities of the Coal, Clinker and Cement

Table 6.1: People and Organizations Consulted

PRIMARY STAKEHOLDERS		
Goth Ibrahim Hyderi Settlement		
Goth Rehri Settlement		
Local Leaders/CBOs		
SECONDARY STAKEHOLDERS		
Organization	**Organization Type**	**Represented by**
Environmental Protection Agency (EPA)	Governmental	Mr. Imran Sabir and Mrs. Sunila Wasay (EIA Section)
NESPAK	Private	Mr. Riazul Huda (G.M, IS)
SSGC	Governmental	Ijazuddin Farooqui (G.M, HSEQ)
Port Qasim Authority	Governmental	Anwar Mehtab Zaidi, (Manager-Pvt. Sector Projects)
World Conservation Union(IUCN)	Non-governmental	Mr. Tahir Qureshi (Senior Expert on Ecology)
Sindh Coastal Community Development	Governmental	Aftab Ahmed Abro (DPD)
Shehri-CBE	Non-governmental	Mr. Roland Desouza (Member)
Bahria University	Private Institution	Dr. Yasmeen Nargis (Incharge-Environment Dept.)
Institute of Engineers	Private Institution	Mr. Nooruddin (Advisor) & Khalid Muneer (Member)
Institute of Architects	Private Institution	Anjum Adil (Chairman) & Arif Bilgrami (Member)
Progas Terminal, PQA	Private	Faheem Durrani (Manager Technical)
Daily Dawn	Private	Mukhtar Alam (Senior Reporter)
Daily Awami Awaz	Private	Hassan Javed (Reporter)
Institute of Environment Studies, K.U	Governmental	Dr. Moazzam Ali Khan (Director)
Pakistan International Bulk Terminal (PIBT) Ltd.	Proponent	Mr. Sharique A. Siddiqui (Chief Executive Officer)
		Mr. Zeeshan Liaquat (Project Coordinator)

Import/Export Terminal. Public Hearing on ESIA report will be conducted by Sindh Environmental Protection Agency (SEPA) in the Month of August 2011 which is a regulatory requirement under the provisions of Pakistan Environmental Protection Act, 1997 and rules and regulations framed there under. In order to have adequate participation of the communities and stakeholders at Public Hearing on the ESIA, a public notice will also be given in news papers for wide coverage and invitation letters will be distributed through EPA.

The details of such discussions are given in the following section.

Group discussions and consultation meeting were conducted with stakeholders particularly with the Korangi Fishing Harbor Administration, notables of fisheries community, etc. For this purpose semi structured questionnaires were used for data collection. These questionnaires were consisted of open and close ended questions.

The consultation team consisted of Environment & Social issues specialists and enumerators. In most cases, the team was accompanied by a local representative. The local representatives were instrumental in the selection of venues and timings for the meetings and focus group discussions. Local CBOs played a vital role to mobilize the community to attend public consultation meetings.

The comments expressed by the participants at public consultation and focus group discussions were noted (an outline of issues and concerns expressed by individuals, the community, NGOs and public agencies is detailed in the following table and elsewhere in this section). Similarly, the comments made by stakeholders at scoping meeting were noted.

These comments have been analyzed as socio-economically viable statements of the participants and have been reflected in the detailed engineering design as much as possible.

Since these consultation meetings/FGDs were an open forum for all, there was a representation from all groups by language, gender, age and income levels. This is a continuous process and will be continued until the issues pertaining to preconstruction, construction & operational phases of project are settled to the reasonable satisfaction of stakeholders, especially the affected local communities if any.

The result of the consultation was a clear identification of the issues perceived to be important by the community and stakeholders and the need to respond to those issues in the ESIA. Mitigation of potential environmental effects of concern to the community and other stakeholders has been incorporated into the project planning and will occur throughout the construction and operational phases of the project.




















6.5 Results of Consultation at The Planning Stage

According to the survey conducted by a team of independent experts it has come to know that there are no settlements or sensitive areas including archaeological sites or protected areas in the neighborhood beyond 3.5 km radius. However, it is predicted that the project may affect the livelihood of the communities residing in the macroenvironment who are mainly fisherman by occupation or are directly or indirectly related to fishing industry to earn their livelihood followed by unskilled labor, self-employed and service providers. Significant concerns expressed by the public/stakeholders during different meeting and focus group discussions are presented in Table 6.2.

Table 6.2: PUBLIC/STAKEHOLDER CONCERNS AND ACTIONS TAKEN

Person/Community/Organization	Concerns Raised	Actions Taken/Proposed
Pakistan Fisher folk Forum (PFF)	Livelihood of the people (fisherman) may be affected during the construction phase of the project. It is therefore demanded that PFF be involved in monitoring of project activities so as to minimize the impact.	PFF shall be engaged in monitoring of the construction activities of project
Local Fishermen	Some awareness/training programs related to skill development should be initiated for fishing communities.	Separate funds allocated to initiate such programs.
	Any loss to assets/houses of fisherman must be compensated.	Loss of assets/houses shall be compensated by PIBT at "Full Replacement Cost" as per World Bank Operational Policy 4.12.
	In case of any resettlement, compensation should be paid to the affected person directly.	In case of any resettlement, compensation shall be paid at full replacement cost with rehabilitation/livelihood assistance.
	Preference should be given to locals for unskilled jobs	For all unskilled jobs, local people will be employed.
	Local people should be informed in case of emergencies	Local people will be trained on emergency response
	Grievances of affected persons should be heard and resolved and there must be transparency in whole process	GRU (Grievance Redressal Unit) shall be formed under the supervision of sociologist and a legal advisor. Grievance Redressal system (filing of complaints/follow-up) will be easy and free of cost.
Environmental Protection Agency (EPA)	The impact of dredging and reclamation should be thoroughly studied and measures to be evaluated so that the activities have least impacts on mangroves and benthic communities. Measures must be taken to contain the dredged material that may otherwise cause sedimentation.	Dredged material will be disposed of into Coffer Dam at the site designated by Port Qasim Authority if the dredge spoil is found contaminated. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) will also be required prior to discharge. Site-specific discharge quality standards will be established in consultation with EPA depending on the type and toxicity of the effluents and the discharge location. In order to minimize the impact of sedimentation resulting from dewatering, all dredged material will be deposited within dikes equipped with control weirs. The dikes will contain the discharged dredged material and prevent re-deposition of the material due to waves or overflow. The weirs, used to discharge excess water, will be designed to reduce the discharge of fine sediment including benthic community back into the water column and to moderate the discharge velocity and volume. The benthic community is anticipated to be rehabilitated at the discharge site.

Table 6.2: PUBLIC/STAKEHOLDER CONCERNS AND ACTIONS TAKEN

Person/Community/Organization	Concerns Raised	Actions Taken/Proposed
Port Qasim Authority	Mitigation measures proposed in ESIA should be taken and monitoring should be done through IMC.	Mitigation measures will be taken and monitoring will be performed by IMC.
IUCN Pakistan	Lot of mangroves may be removed due to proposed project; therefore, a compensation plan must be made for loss of mangroves.	Strict monitoring of contractor's activities shall be carried out during the different stages of project. Any loss to mangroves shall be compensated by planting 4-7-10 mangroves for loss of one depending on the canopy. IUCN and IMC will monitor the implementation.
WWF Pakistan	There will be impact on benthic communities due to dredging operations. Mitigation measures need to be taken.	Benthic communities will recolonize themselves within 2 to 3 weeks after the completion of activity. No blasting will be done during dredging. Dredging operation will be monitored by IMC and all mitigation measures will be implemented.
Shehri-CBE	Traffic Impact Assessment should be done. Impacts on mangroves ecosystem should be strictly monitored and losses must be compensated. Coal dust emission analysis should be conducted and mitigation measures must be taken to control dust emissions.	Traffic Impact Statement (TIS) has been conducted by Engineering Associates (EA). Monitoring shall be conducted by IMC during the construction and operation phase. Close liaison shall be made with NGO's like Shehri-CBE as well as other stakeholders during monitoring of activities. Air dispersion modeling has been conducted and mitigation measure proposed in ESIA will be taken to control emissions.
Engro Polymers & Chemicals Limited	Port Qasim unlike other ports is green and is a home of Mangrove trees. We hope that these beautiful trees would not be uprooted to give way to the industry. We also expect that their effluent will meet EPA standards to avoid any impact on marine life. We coordinate and cooperate with our neighboring industries to handle emergencies by way of emergency dry runs. We would suggest they (PIBT) educate their neighbors about their hazards and get into this understanding, also for mutual benefits.	Removal of mangroves shall be avoided as much as possible through engineering solutions. Where necessary, mangroves would be cut but the same shall be compensated by replanting mangrove saplings in close liaison with IUCN and WWF Pakistan. Wastewater from the facility shall be treated to meet NEQS before final disposal. An emergency response and contingency plan has been prepared which shall be implemented. All the PIBT employees will be trained on emergency response procedures. PIBT shall also cooperate and coordinate with neighboring industries to handle emergencies.

6.6 Ongoing Community Engagement Plan for Construction & Operation Phases

Pakistan International Bulk Terminal Limited (PIBTL) will implement the following Community Engagement Management Plan as part of its Environmental (and Social) Management Plan (EMP) outlining a range of mitigation measures designed to avoid or reduce undesired community impacts during construction and operation phases of project.

This plan also establishes a basis and template for use by the project's Contractor(s) to develop their own plans outlining not only mitigation measures but to also incorporate the roles and responsibilities of the EMP.

The objectives of the Community Engagement Management Plan are:

- Establish and maintain positive community relations through effective communication and consultation.
- Effectively manage community grievances and comply with the project's Community Grievance Procedure (a detailed discussion of the CGP is included below).

The project recognizes the potential for creation of adverse impacts on the environment and within the local community, and the potential to make significant positive contributions if impacts are properly addressed. To achieve these goals, the project has developed an ongoing policy framework for mitigation and management of socio-economic impacts, and making long-term investments in the local community. PIBTL is committed to human development and protection of biodiversity in the project area by:

- Understanding the social, economic and environmental context of the project area;
- Working with stakeholders and engaging and maintaining dialogue with them to build relationships based on trust and mutual respect;
- Enhancing positive effects of our project while minimizing adverse impacts;
- Providing compensation commensurate with loss where impacts cannot be adequately remedied;
- Preserving a natural environment for future generations;
- Promoting human development in local communities;
- Providing employment and economic opportunity to local communities;
- Monitoring the success of environmental and social programs against reasonable benchmarks;
- Following recognized standards in our social and environmental activities as defined by IFC Guidelines and local requirements.

Interviews and public outreach programs with local communities and stakeholders consultation identified the following major social and economic issues of concern:

- Pollution discharges affecting human health and decreases in fish populations
- Loss of use of near shore boat mooring facilities
- Provision of basic quality of life amenities (jobs, services, resettlements and compensation for lost opportunity or livelihood);
- Increased traffic on main roads affecting mobility of cattle or "females in the course of tending to family matters".

Most of the issues described in meetings with the local community have been addressed in other segments of this report. While few direct impacts have been identified affecting the local community, PIBTL's on-going process will effectively monitor its activities and impacts both upon the environment and the socio-economic setting of the project. PIBTL will pro-actively address negative impacts that may develop over the course of construction and operation, and develop appropriate mitigation measures to provide satisfactory redress of project-related issues.

6.7 Community Engagement Responsibilities:

PIBTL is committed as well as required under its environmental approvals from the Sindh Environmental Improvement Agency to:

- create "no threat to livelihood of local fishermen and communities"
- repair or compensate any damages to boats or equipment caused by project components
- employ an Independent Environmental Monitoring Consultant for the life of the project who will submit quarterly reports on PIBT activities.

In addition, PIBT's Environmental Management Plan identifies a Site Environmental Coordinator charged with monitoring and evaluating permit compliance and environmental impacts associated with constructing and operating the project.

PIBTL has also designated a Community Liaison Officer (CLO), reporting to the project's General Manager, who is tasked to help manage and facilitate communications with the local community, including people making their living from fishing. The CLO's duties include providing the main point of contact with the local community, and transmitting concerns and complaints to the projects' management structure. The CLO is responsible for actively identifying and communicating with local community leaders, NGOs active in the area, such as Pakistan Fisher Folk Forum and loosely affiliated common-interest groups. The CLO is available to address questions about and concerns with project activities, and to provide information about jobs (especially during construction), opportunities to provide goods and services to the project, and opportunities for the project to pro-actively engage in promoting the health, welfare and quality of life for the local community. The CLO is charged with creating a positive relationship between the project, its contractors and the local community, managing and planning future public consultations, disclosure meetings and events, maintaining records, and leading dispute resolution proceedings. The CLO is responsible for implementation of the Community Grievance Procedure outlined below.

A outlined above, the major concerns expressed by the local community to date are described below:

Fishing Community: Impacts on fishing are potentially the most significant in terms of economically disadvantaged local persons who earn a subsistence living by fishing. While the local fishery is not significant for most, dredging and other construction related activities may temporarily affect fishing in the area of the project. The project will conduct a survey and comprehensive evaluation of how much fishing pressure exists in the immediate project area. The study will identify individuals or groups fishing in the area, and seasonality of fishing pressure, if applicable. Second, a determination of the duration of reduced fishing productivity will be developed based on construction estimates for timing and duration of dredging and other construction activities that may impact fishing. Once the survey is completed, the CLO, working with the local community and community leaders, will communicate these findings and develop a compensation program, appropriate to the circumstances, to be implemented by the project's General Manager. This program will span the estimated 18 month construction period and an additional 12 month period during initial operations. An on-going process, the CLO, working in consultation with the local community and the project, will propose modifications to the mitigation and compensation programs according to specific circumstances and as appropriate.

The CLO is responsible for communicating job and economic opportunities to the local community. His duties include establishing good relations with the local community and to act as a 'clearinghouse' for questions about how to apply for jobs, how to become qualified for bidding on provision of goods and services to the project, and similar economic opportunities. The CLO and GM will together develop a list of economic opportunities

targeted toward the local community to help create goodwill towards the project.

The following compensation plan has been adopted by PIBTL in response to project concerns expressed during the initial consultation process:

- Separate funds allocated to initiate programs such as training centers for fishing communities.
- Loss of assets / houses, if any, shall be compensated by PIBTL at "Full Replacement Cost" as per World Bank Operational Policy 4.12.
- In case of any resettlement, compensation shall be paid at full replacement cost with rehabilitation / livelihood assistance.
- For all unskilled jobs, the project will attempt to fill those positions from local applicants.
- Local community leaders and first responders will be informed and updated regularly on emergency response procedures.
- The project's Community Grievance Procedures will be easy to participate in and free of cost.

In addition to PIBT activities, the Project Contractor shall:

- be responsible for community affairs as it relates to industrial relations, human resources, procurement, and sub-contracting associated with the Contractor's Work;
- establish community affairs office(s) as appropriate to support the Contractor's community affairs activities. Such offices shall be located at sites that facilitate effective management of community affairs, industrial relations, recruitment and hiring without disrupting the Work;
- work with appropriate community leaders to reduce the adverse effects of their activities on the community, and to facilitate resolution of community unrest and disruptions resulting from Contractor's performance of the Work;
- confirm that its personnel and the personnel of its sub-contractors are appropriately qualified and trained to be aware of and manage local cultural issues to the extent required to minimize and manage local community disruptions arising as a result of Contractor's performance of its Work. PIBTL shall provide induction materials for new workers and necessary briefings for workers and Contractor(s) as required;
- comply with the Community Grievance Procedures detailed below.
- gain the prior approval from PIBTL before making any direct agreements with local communities.

6.8 Training On Community Relations

The CLO is responsible for ensuring that PIBTL's and the Contractor(s) workers and subcontractors receive adequate training in project-specific community relations, so as to be aware of health, safety and security issues as well as the standard of conduct expected when engaging with the community. Induction training for all new workers shall be provided and will cover at a minimum:

- General liaison and interaction with communities;
- Cultural sensitivities;
- Awareness-raising on health, safety and security considerations;
- Project Code of Conduct.

Additional training on community relations will be delivered through:

- Tool Box Meetings;
- Safety, Security, Health and Environment Safety Committee Meetings;
- In-House Training / Seminars;
- Notice Boards; and
- Newsletters.

6.9 GRIEVANCE MANAGEMENT

PIBTL has adopted the Community Grievance Procedure outlined below, which requires interaction, consultation, targeted information and timely resolution of legitimate grievances. This approach is aimed at building a reputation of responsiveness, concern and responsibility among the community, with a view to building and sustaining acceptance and support for the construction and operation of the project.

PIBTL and its Contractor(s) shall foster a sense of working with the local community and demonstrate that the Project takes a proactive stance to grievances.

PIBTL's grievance management system and database will comply with and has the flexibility to feed information into the Community Grievance Procedure. PIBT will also provide all Contractor(s) teams with training in Community Grievance Procedures.

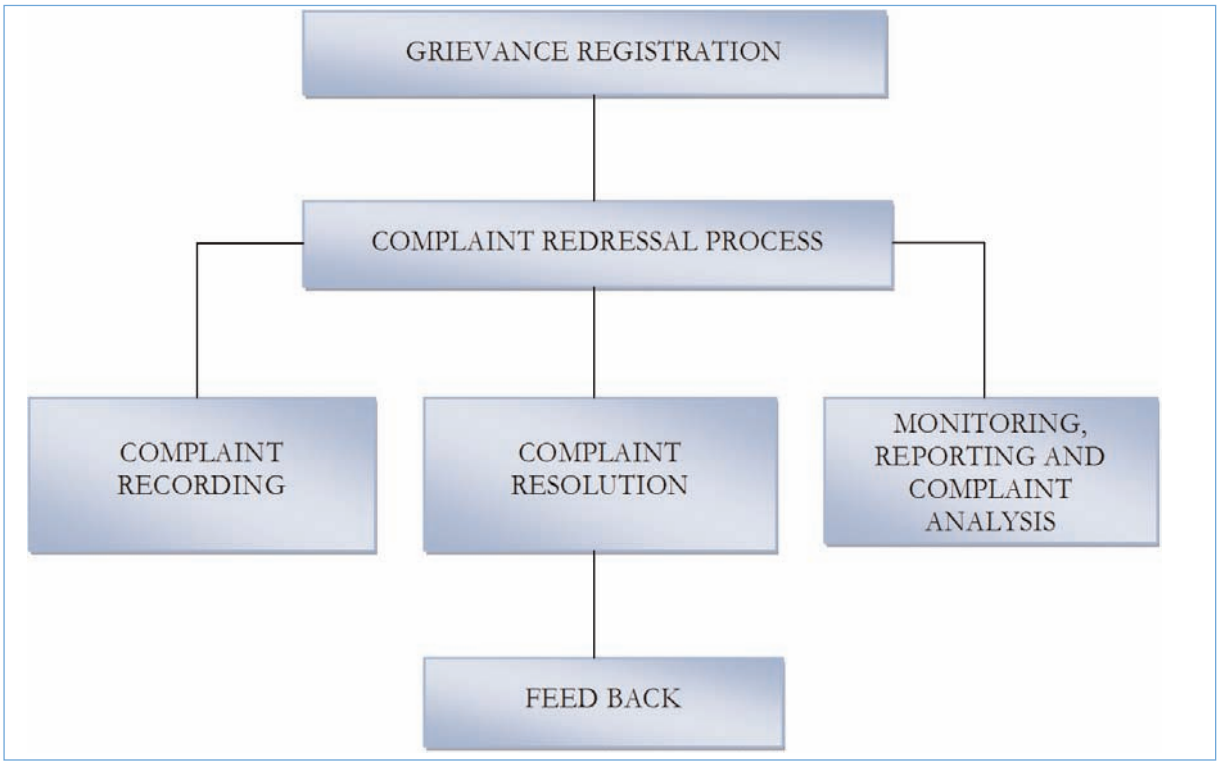
In implementing PIBTL's Community Grievance Procedure, the Contractor(s) shall:

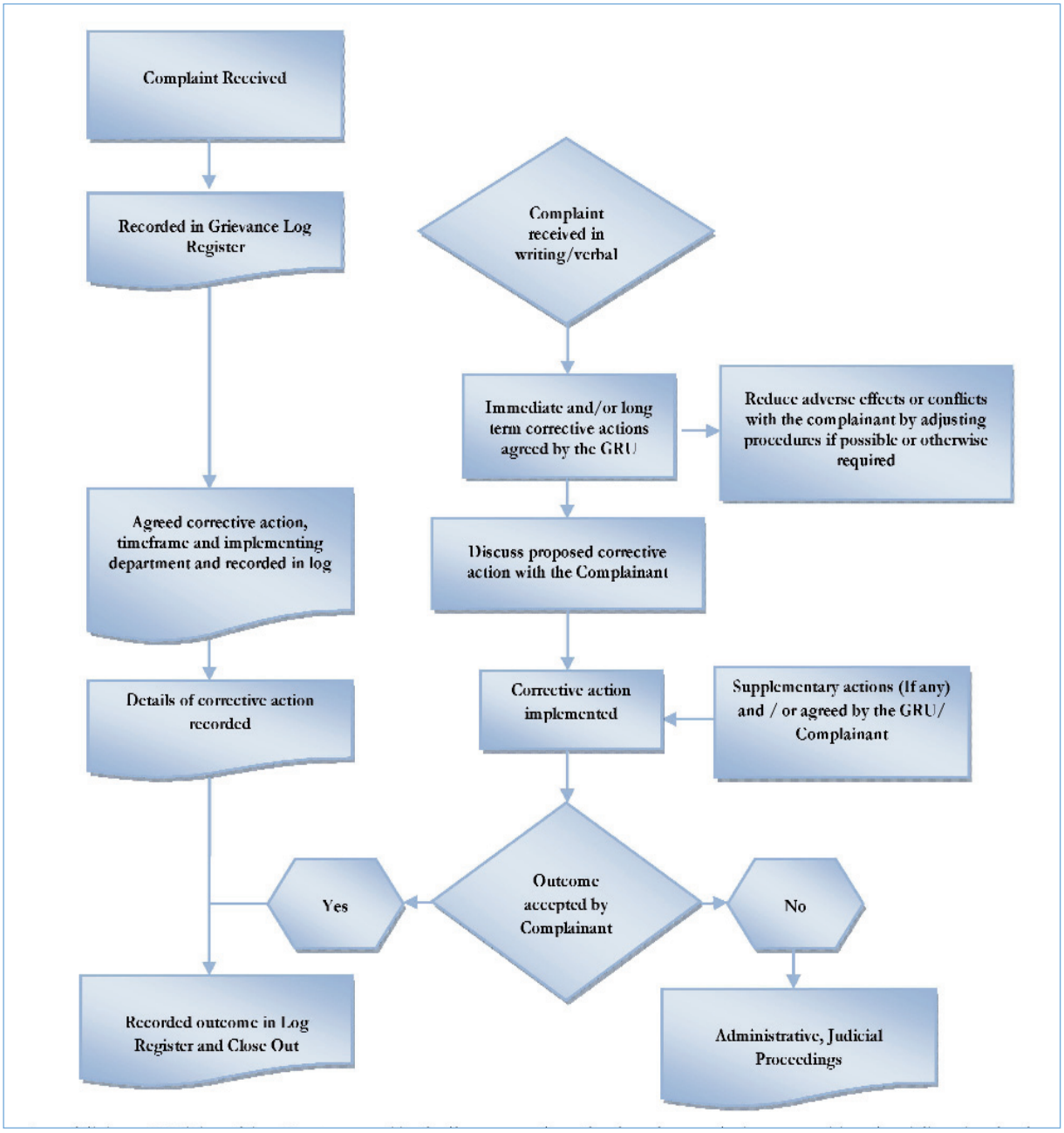
- Record all grievances using the template Grievance Form given at the end of this section;
- Assess and advise the resolution of the grievance in the time frame required by the assessment.

All grievances will be investigated and a response (outlining a resolution) provided by PIBTL/Contractor(s) as soon as possible and not more than 30 days after receiving the grievance. If more time is required for resolution, the person raising the grievance and PIBT shall be kept informed.

While the Contractor(s) is not prevented from initiating the grievance resolution, any corrective action taken must be in coordination with PIBTL.

PIBTL, through the CLO, will ensure that the details of the Community Grievance Procedure are publicized at community meetings and via posters and other means to all communities in the vicinity of the project.





In addition, PIBTL and its Contractor(s) shall ensure that the local populations working/residing in the local area receive necessary information for contacting and initiating a grievance through meetings, pamphlets and similar community outreach programs under the direction of the CLO.

PIBTL and its Contractor(s) shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of this Plan. The Contractor Plan shall describe the resources allocated to and responsibility for the execution of each task and requirement contained therein, and shall describe how roles and responsibilities are communicated to relevant personnel.

6.10 PERFORMANCE INDICATORS

Table 6.2 outlines the indicators used for measuring and verifying performance in relation to community engagement. However PIBTL may modify or add to these indicators to enhance the Plan based on learning from the performance indicators.

Table 6.2: Performance Indicators

ID No.	Performance Indicator	Measurement	Internal Assessment Frequency
1	Maximize use of the Project Community Grievance Procedure.	100% of grievances (except those related to worker issues) channeled through the Community Grievance Procedure.	Monthly
2	Resolution of Community Grievances.	75% of grievances resolved (from the Project perspective) within 30 days, categorized according to cause of grievance.	Monthly
3	Disruptions to work.	Number of hours lost due to community disruption categorized according to cause of disruption (to be coordinated with Security departments to ensure consistent reports).	Monthly
4	Compensation payments.	Amount of compensation paid as a result of Project impacts	Monthly

Grievance Application Form

GR No.	Copies to forward to:
Name of Complainant:	White (Original)- GRU
Date:	Pink (Copy)- Complainant
Time:	Name and Signature of Officer Receiving Complaint:
	Signature of Complainant:

INFORMATION ABOUT GRIEVANCE

Description of the Grievance(s)/Complaint/Redress sought:

INFORMATION ABOUT THE COMPLAINANT	
Surname / Family Name	
Full Name	
Residential Address	
Address on CNIC	
Present Address	
Contact Number	
Signature of Complainant	

Evidences Produced / Collected

- Community / Information Meetings
- Mails / Posts received
- Utility Bills
- Informal
- Other

TYPES OF GRIEVANCES/COMPLAINTS

1. Loss of Access to Land / Natural and Resources of Livelihood a. Fishing grounds b. Lands c. Pasturelands d. House e. Commercial Site f. Other (Please Specify)	**2. Damage To Property** a. House b. Land c. Livestock d. Other (Please Specify)	**3. Damage to Infrastructure / Amenities / Utilities** a. Road/Railway b. Bridge/Passageways c. Power/Gas/ Telephone Lines d. Water sources/ Drinking water e. Sewerage system f. Other (Please Specify)	**4. Decrease or Loss of Livelihood** a. Agriculture b. Aquaculture / Fisheries c. Animal husbandry d. Small Scale trade e. Other(Please Specify)	**5. Traffic Accident** a. Physical Injury b. Damage to property c. Damage to livestock d. Other(Please Specify)
6. Accidents Regarding Expropriation & Compensation **(Please Specify)**	**7. Resettlement Process** **(Please Specify)**	**8. Employment and Recruitment** **(Please Specify)**	**9. Construction Camp & Community Relations** a. Nuisance from dust b. Nuisance from noise c. Vibrations due to explorations d. Misconduct of project personnel/worker e. Complaint follow up f. Other(Please Specify)	**10. Other** **(Please Specify)**

07 SCREENING OF POTENTIAL ENVIRONMENTAL & SOCIAL IMPACTS AND MITIGATION MEASURES

This Section of the EIA Report presents the screening of potential environmental and social impacts of different activities of Coal, Clinker & Cement Terminal Project during its different stages of designing, construction and operation. Using the general guidelines as well as professional judgment this section evaluates the positive and negative impact of emissions and waste discharges on the airshed, watershed, fauna, flora and the living environment at the Kadiro Creek site that is off set from the Open Channel to Port Qasim Karachi.

The screening process, besides identifying significant environmental impacts and the residual impacts, suggests mitigation measures that would be adopted in order to reduce, minimize or compensate for the negative impact, if any.

The specific criteria used for determining the significance of impacts are identified for each resource, and the following assumptions are generally used when evaluating the potential project impacts:

- PIBT as project proponent will comply with all applicable laws and regulations;
- The construction phase of the project will proceed as described in Section 3; and
- PIBT as proponent will implement the mitigation measures and Environmental Management and Monitoring Plan in letter and Spirit.

7.1 Screening of Potential Environmental Impacts at Construction and Operations Stage

Environmental issues in proposed Coal, Clinker and Cement Terminal construction and operation primarily include the following:

1. Land Use
2. Dredged Materials Management
3. Air Emissions & Dispersion
4. Wastewater
5. Solid waste management
6. Hazardous Materials and Oil Spill Management
7. Noise Emission
8. Biodiversity
9. Natural Events
10. Traffic Management

7.1.1 Land Use

The PIBT site is located in the channel dedicated to facilities handling gas products viz. LPG and also the fuel oil viz. FOTCO. The selected site has the Jetty and the on shore Storage site in the Kadiro Creek, and is less exposed to open sea. The location of PIBT as described in chapter 3 has been carefully selected to reduce the impact on navigation and ecology.

The selected site will be offset by adequate distance from PROGAS Terminal and by the land mass that lies between Kadiro Creek and Korangi Creek. The trestle will follow a straight line between the storage area and the jetty, avoiding bends and transfer stations in the middle. The trestle will, while over-passing the said land mass, require removal of as many mangrove trees as the number of piles ~ 400 in number (2 piles at a distance of 12 m over 2.4 km).

Mitigation Measures

- Mitigation measures with respect to existing land use

and land tenure will not be needed since the land area has been sub-leased officially by PQA to PIBT.

- Likewise there will be no issues on loss of land, or loss of business; no involuntary resettlement is consequently required and no business may be considered lost on the acquired land.
- The selected site will be offset by adequate distance from PROGAS Terminal and by the land mass that lies between Kadiro Creek and Korangi Creek. The trestle will follow a straight line between the storage area and the jetty, avoiding bends and transfer stations in the middle. The trestle will, while over-passing the said land mass, require removal of as many mangrove trees as the number of piles ~ 400 in number (2 piles at a distance of 12 m over 2.4 km).

7.1.2 Dredged Material Management

Potential Environmental Aspects during Dredging: Dredging to the required depth for berthing of vessels of 75,000 DWT as well as maintenance of the required dredged berth will be the responsibility of the PIBT. Dredging in front of the jetty to accommodate 55,000 DWT vessels will be made before delivery of the crane and loader. Dredging for 75,000 DWT ships will only be made when the approach channel has been dredged to -15.5m depth to accommodate ships of the said size.

It is estimated that up to 0.8 million cubic meters of material will be dredged to create berthing basin for ship and subsequent disposal of the dredged material to the Reclaimed area or designated remote site about 4-5 km away.

Geotechnical investigations on the soil properties of the site suggest that the sub-soil at deep down levels will be hard clay followed by very dense sand, gravels and loosely cemented conglomerate.

- As such dredging can be executed routinely with a bucket ladder or cutter-suction dredger.
- No blasting will be involved during the entire site preparation and development phase.
- The dredging of a berthing pocket adjacent to the PROGAS site will not be significant compared with the maintenance dredging of navigation channel being carried out regularly by Port Qasim.
- The dredging operation is thus expected to have low intensity impact on geomorphology.

The dredging for the berthing pocket and disposal of spoil in the areas designated by Port Qasim Authority will have some negative impact on the geomorphology of the channel.

- Geotechnical studies undertaken for the PIBT have shown that the seabed slopes at 12%-20%, from the Mangroves towards Navigation Channel. The said studies cite reasons to believe that this slope has stabilized over the years and after dredging similar slopes would remain stable.
- Moreover Hydraulic model studies for Port Qasim carried out for over a decade find no significant impact of dredging and disposal of spoil on geology, geomorphology and hydrogeology.
- As such the overall impact of dredging on morphology will be confined to the microenvironment.
- No obstruction to the main navigation channel will be caused by construction and operation of the project. Similarly, no obstruction or filling up of any drainage channel in the area is envisaged but close monitoring of the dredging operations will ensure safety and security of the channel.

Dredging induces loss of the biota located within the dredged area of benthic organisms.

- The dredging process is a short time activity localized to the environment. Most of the area to be dredged consists of silty sand/soft bottom /soft bottom/rubble with little or no observed epi-faunal communities. Moreover the benthic population is restricted to the top 200 mm of the substrate. Once construction is completed, habitats and associated organisms have been found to re-establish/re-colonize themselves

quickly as the regeneration time is short (2-3 weeks) within the newly constructed berthing and turning basin (Source: National Institute of Oceanography, 2003).

- Moreover the top layer at the site has been found to be unuseable as filling material. As such it will be transferred to geobags and subsequently relocated to the dredged site for recolonization.

Dredging increases turbidity and suspended sediments.

- Siltation and sedimentation impacts at the dredging site are expected to be localized and short-term in duration. Potential impacts will be further reduced through the use of appropriate dredging technique. The increase in local water turbidity levels produced by dredging operations is directly related to the type and quantity of material being dredged. In addition, sloughing of the material along the side slopes of the cut and prop wash from operational tug boats operating in shallow waters alongside the channel can add to localized increase in water turbidity. According to the U.S. Army Corps of Engineers Manual entitled Engineering and Design – Dredging and Dredged Material Disposal (ACOE 1983), the increase in the level of suspended material appears to be concentrated in the immediate vicinity of the dredger.
- Suspended solids concentrations can reach levels of 30 mg/liter within 5 m (16 ft) of the dredger. However, such concentrations decrease exponentially from the dredger towards the water surface, as well as laterally and in the downstream direction. Typically, near seabed concentrations are reduced to less than 10 mg/L within a lateral distance of 300 m from the dredger, although these may extend farther in the downstream direction in the presence of a significant mean current to a distance of 1000 m (Hayes 2000).
- Other variables, such as particle size, may affect the distribution of suspended materials, but the turbidity effects are generally expected to be both short-term and localized in nature.
- For dredging projects similar to those proposed for PIBT, the typical adopted effluent concentration in the water column is ~30-35 NTU (Nephelometric Turbidity Unit) above background. To ensure that the effluent concentration does not exceed this value during this project, regular turbidity measurements will be carried out and operational procedures modified accordingly.
- It is envisaged that the excess dredged material will be temporarily placed on a geo-lined system (sandbank). Deposition of this material may impact an area in which the benthic habitat is characterized by soft bottom/sand. Although existing benthic habitat will be lost by placement of dredged material on the bottom, the excess spoils shoal itself may form a foundation for a new benthic habitat till such time the excess spoils are finally put back after the dredging operation is over.

Land reclamation will be achieved by placing dredge spoils from the 2nd and 3rd layers at the berthing basin and turning basin directly into large depression that needs to be filled.

Placing most dredged material directly into planned reclamation areas will avoid the need to re-handle the material, thus minimizing the potential sedimentation impacts from storm water run-off and re-deposition of material.

Some sedimentation could potentially occur due to transport of fine material into marine habitats during dewatering of dredged material.

Mitigation Measures

- In order to minimize the impact of sedimentation resulting from dewatering, all dredged material will be deposited within dykes equipped with control weirs.
- The dykes will contain the discharged dredged material and prevent re-deposition of the material due to waves or overflow.
- The weirs, used to discharge excess water, will be designed to reduce the discharge of fine sediment including benthic community back into the water column and to moderate the discharge velocity and volume. The benthic community is anticipated to be

rehabilitated at the discharge site.

An additional issue related to the dredging operation is the fueling of dredge barges and associated vessels. It is envisaged that a fuel barge will be used to transport fuel to the dredger.

Mitigation Measures

- A Spill Control Plan shall be prepared in consultation with Independent Monitoring Consultant (IMC) and the same will be implemented throughout the construction phase of project.

Prevention of coastal erosion and protection of project facilities against coastal flooding.

Mitigation Measures

- A comprehensive shore protection system around the perimeter of the project site is proposed to prevent coastal erosion and provide protection for project facilities against coastal flooding.

The storage area includes a large depression which, along with the entire back-up area needs to be filled in to level +5.50 m with some extra height to compensate for expected settlement.

- The reclamation up to the formation level will be effected with as much of the 2nd and 3rd layers from the dredging areas
- The compaction will be effected to sufficient bearing capacity. High Impact Compaction or Vibro Compaction methods will be applied.
- An alternative method for consolidating and reducing the settlement to an acceptable extent for operations would be overloading combined with vertical drains to accelerate the settlement process. This method can be applied on soils at PIBT which is mostly silty/clayey and has no large-sized gravels.
- Because many of the near-shore habitats around project site will be undergoing modification due to dredging and construction of shoreline protection, and because new habitats may still not have established themselves along the shoreline, the impact of compacting process on existing and new habitats will be minimal.

Potential Environmental Impacts during Dredging Operations: Dredging operations will continue during the Operation stage as part of O&M. Long-term operational impacts to the benthic communities on completion of dredging operations:

- Long-term operational impacts to the benthic communities within the approach channel and turning basin have, during the course of a decade of monitoring, been found to be nominal.
- Existing marine ecology including benthic communities may have been permanently altered during the construction stage though on short-term basis, but new habitats and organisms would most likely rapidly re-establish themselves in the previously disturbed area.
- Dredging during the construction stage may have altered the bottom layer in such manner as to establish habitats which did not exist previously.
- The dredge spoils during the operation stage will, after being drained, be placed using conventional fill placement techniques. Turbidity control booms will be placed as required around any fill areas not permanently contained. As with the dredging operation, it is expected that these control procedures will minimize adverse impacts on marine resources due to short-term sedimentation and turbidity effects.
- Due to natural current movements, it is not anticipated that there will be any long-term sedimentation impacts during operations.
- Natural currents and tides are expected to serve to minimize or restrain potential sedimentation to developing biological communities and prevent or minimize the need for additional dredging in this area.

Mitigation Measures for Dredged Material Management

- Attempts will be made to save the trees by replanting them at another site, may be at the fenced boundary. In case they have to be removed, their removal will be

compensated by planting four to six numbers for each mature or maturing tree removed. This would cause minimum disturbance to mangrove ecology during the construction and laying of the foundation piles for the trestle. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC.

- Turbidity will be monitored during dredging event to ensure compliance with relevant international standards. If the turbidity standard is exceeded, dredging will be slowed down or shut down temporarily, until modifications can be made to the dredging technique to bring the operation back to compliance.
- Prior to initiation of dredging activities, material/soil to be dredged will be evaluated for its chemical, biological, and engineering properties to ascertain if the dredged material can be used for reclamation or needs to be disposed of.
- Excavation and dredging methods shall be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material, especially if the dredged material includes contaminated soil. There are several dredging methods as discussed in chapter 05; which are commonly used depending on the depth of the sediments and environmental concerns such as the need to minimize sediment suspension and increase dredging accuracy.
- Use of techniques (e.g. silt curtains) to minimize adverse impacts on aquatic life from the re-suspension of sediments.
- To prevent loss due to erosion, exposed soil materials will be protected by surface treatment such as armoring, pavement and vegetation. No mitigation measures other than those sited above are needed except that the entire operation will be keenly monitored by the proponent and IMC.
- Dredged material will be analyzed in order to select appropriate disposal options (e.g. land reclamation, open water discharge, or contained disposal). Beneficial reuse of uncontaminated, dredged material such as that from the 2nd and 3rd layers at the dredging sites, will be given priority.
- The delivery of fill material to reclamation site at PIBT or site identified by PQA, will be organized by spreading and compaction of fill layers to avoid spillage into the water.
- Dredged material, in particular the 1st layer at dredging site, will be disposed of into Coffer Dam at the site designated by Port Qasim Authority if the dredge spoil is found contaminated. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) will also be required prior to discharge. Site-specific discharge quality standards will be established in consultation with EPA depending on the type and toxicity of the effluents and the discharge location.
- The filling/reclamation material could be provided from offshore sources. These reclamation materials shall be placed by bottom dumping and thereafter by the rain bowing method. Side dams constructed in Christmas-tree fashion from quarried rock or large geo-bags will be used to manage the reclamation plan.
- The compacting activity will need to be completed prior to the reestablishment of new near shore habitats around project area. When proposed works are complete, no anticipated adverse long-term operational impacts from site filling and soil settlement are expected.
- The shore protection system will be designed to withstand wave and surge conditions associated with the nominal 100-year frequency hurricane event.
- Shore protection along the reclaimed site will consist primarily of concrete caissons or equivalent systems. These shore protection systems will be installed in areas that have already been impacted by prior dredging activities. Therefore, no additional impacts are expected due to installation of the shore protection structures.

- During operation of the proposed Terminal, periodic bathymetric surveys will be conducted by PQA and PIBT within the berthing and turning basin to estimate changes, if any, in bottom elevation and locate areas of sediment accumulation.
- Inspection and monitoring of dredging activities will be conducted through an Independent Monitoring Consultant (IMC) to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.

7.1.3 Air Quality, Gaseous Emissions & Dispersion

Construction and operation of the PIBT would involve discharge of gaseous emissions from the offshore and onshore facilities. The impact on air quality will result during construction from land clearance and earthwork at the onshore site, besides operation of construction equipments, and generators, while during the operations phase it would be mainly from the offshore facility including the bulk cargo carriers, compressors, and the receiving units onshore.

Potential Construction Impacts: Earth works during construction will be required for the following activities: 1) Placing of the pavement in the storage area, 2) Leveling works for road and railway tracks, 3) Rain water drainage, 4) Laying fresh water and sewerage system, 5) Electrical network-system, 6) Excavation for building foundations, and 7) Dam for the stacker.

In the pre-construction phase the activities like site clearance, site leveling, movement of workers and materials, construction work (i.e. labor camps, offices, material storage and maintenance yards etc.) and construction of haul roads for movement of vehicles will induce dust emission, which would be the major pollutant.

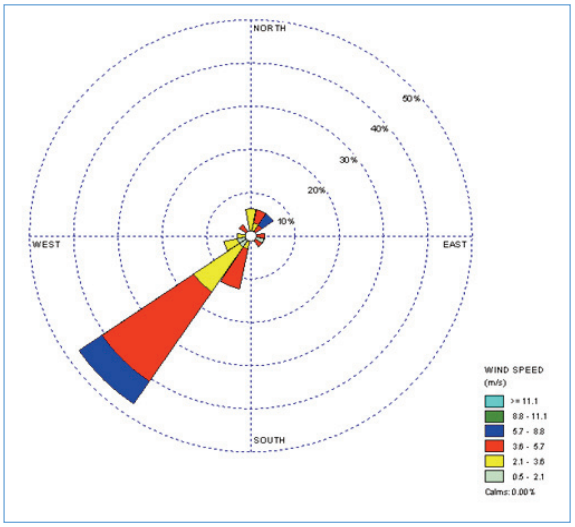
During the construction phase gaseous pollutants and particulate matter including aerosols and dust would be produced from construction equipment, dredgers, work vessels, trucks and other construction vehicles.

Site preparation will involve mechanical shovels and earthmovers for site clearance, cut and fill and other site leveling activities and trenching. Major construction activities will involve earth work, excavation and embankment formation, transport of construction materials, handling and storage terminal. These activities will involve earth and would generate dust particles, which will be mobilized by wind and affect the ambient air quality. These activities would cause a general increase in levels of suspended particulate matter in the ambient air. However, this increase in suspended matter concentration would be temporary in nature and localized to the preparation site. A marginal increase in the levels of oxides of nitrogen, carbon monoxide and hydrocarbons is envisaged due to movement of vehicles for transportation of construction material, besides diesel generators that would meet the power requirements during the construction phase. Wind erosion can cause dislodgement of fine soils particles. Transport of fine gravel in uncovered trucks on unpaved roads, fuel combustion during vehicle operations, concrete mixing and cement handling, diesel operated construction equipments, concrete mixing and cement handling, welding activities, Asphalt heating, mixing & laying contribute to air pollutants like particulate matter, Sulphur oxides, Nitrogen oxides, etc.

- Emissions of fugitive dust will depend on such factors as soil properties (i.e., moisture content, volume of spoils, and soil silt content), meteorological variables (wind speed and precipitation), and construction practices employed.
- Impact of above activities will be of short term duration and will be mitigated by adopting and maintaining standard operating procedures.
- The access to the site will be over existing paved road. However, the dusty tracks if any would be sprinkled with water to suppress dust emission.
- The movement of trucks bringing in construction materials would be kept covered to minimize dust nuisance.

Windy conditions prevail during the pre-monsoon period. As the land mass begins to heat up during the day, the resulting convection currents generate offshore winds

starting from the noon hour. Dust storms are known to occur. This is the time when the TSP as well as PM10 level is much higher than normal. These emissions are expected to be nominal and to occur when the different systems are in operation. Any potential for dust or particulate matter generation would likely occur during periods of high



winds or extremely dry periods, and are expected to be of low order and short duration.

- Given the expected low magnitude of these emission sources, the low frequency of occurrence, limited duration of occurrence, and the mitigation measures that will be adopted, dust and particulate matter emissions from construction and operation activities are not expected to be substantial.
- The predominant wind direction in the area is from the west that is from the sea to the land. The airborne dust and emissions from the construction site would be blown towards the adjacent land area. However, these would be limited to the construction period.
- Moreover Project site is located far away from urban areas and human settlements; as such dust emission from Project site will not create significant adverse impacts.

Mitigation Measures

- Construction impacts on air quality will be mitigated through construction management practices, including the use of appropriate dust suppression measures. Air quality impacts from operation of the project's power production system will be minimized by appropriate technology to reduce the impact of emissions to confirm to World Bank standards. The power production system will be designed for high-efficiency with advanced combustion controls to minimize fuel consumption and pollutant emissions.
- The construction contractor will be mandated to adopt SOPs to control dust emission by e.g. frequent sprinkling of water. Activities such as grading of aggregates which generate too much dust will not be allowed at Project site and will be carried out off site away from populated areas.
- During periods when the prevailing wind direction is north-easterly and strong enough to generate airborne dust naturally, consideration would be given to either wetting or avoiding works that would worsen such conditions. It is not likely that dusty conditions would occur often enough to significantly disrupt the construction works.
- Fugitive dust emissions will be minimized through the use of dredged fill material, which will be pumped in a slurry form through pipeline into dewatering basins located near the final reclamation areas. Construction equipment used for final grading will handle fill material with high moisture contents and minimal potential to generate fugitive dust. To further minimize emissions of airborne particulates, fugitive dust will be mitigated using the following measures, as necessary:
- Use of water on areas of exposed soils, if necessary;
- Final grading and landscaping of exposed areas as soon as possible.
- Emissions from vehicles and other engine-driven construction equipment will be temporary and cease once the project is completed. Nevertheless, mitigation measures including proper maintenance of construction equipment and controlling unnecessary idling of equipment will be implemented.

- All emissions from construction and operation must be in compliance with air quality standards in vogue. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant but would continue for the life of the Project. Regular monitoring and evaluation is recommended.
- The lack of other cumulative sources of NOx emissions within the region also protects against the potential for photochemical smog or acid rain generation.

Potential Environmental Impacts of PIBT Operations on Air Quality: PIBT operations will include movement of dredgers, marine vessels and vehicular traffic at the terminal; transfer of coal by the conveyor over the trestle to stacking are of the coal yard; transfer of cement through the silos to the ship, and of clinker from the long vehicles to clinker yard and from the clinker yard to the ships. These operations will generally generate heavy dust particulates besides gaseous pollutants including aerosols, GHGs including carbon dioxide, and nitrogen oxides. Similar emissions will also be discharged during project decommissioning but they are expected to be low in volume.

PIBT will have diesel or natural gas power generators for power generation as well as a back-up source of energy. In case of natural gas fuel source emissions would largely comprise CO_2, NOx, and water vapor; while diesel generators would emit gaseous pollutants that include NOx, SO_2, CO and particulate matter besides CO_2.

- New Power generators generally comply with International Standards; they will need to be regularly maintained to comply with the regulations.
- World Bank Environmental Guidelines for atmospheric emission of SO_2 and NOx from stationary combustion sources will be followed. Limits given in the guidelines are as follows: SO_2: Maximum allowable increase in ground level concentration = 50 $\mu g/m^3$ (one year average). NOx: 86 x 10-9 g/Joule heat input (fuel gas), 130 x 10-9 g/Joule heat input (when liquid fueled)

Vehicular traffic at the PIBT will include the trucks and bowzers bringing in supplies and taking the coal supplies to consumers over land. As the access to site and truck loading bays inside the PIBT storage yard will be paved, dust emission from these sources is less likely to pose any problem. The traffic generated by the operation will be normal and within the design capacity of roads in the area.

- Traffic management plan as described subsequently will be followed to regulate the incoming and outgoing vehicles and also their operation and maintenance.
- The operations at PIBT in particular the stacking of coal and clinker would generate heavy as well as fine particulate matter, which would tend to settle not far from the site. The prevailing winds are likely to blow away the airborne dust and other particulate matter from the terminal and storage area to inland locations.
- When background levels of dust are high, dust emissions from the stack will not be allowed to exceed 100 mg/m^3 levels.

Air Dispersion Model: Computer modeling has been adopted here to simulate the physical process of dust dispersion from a source and identify potential hazard areas surrounding the source with respect to health and safety. The simulation can be used for evaluation of dust control techniques to determine modifications necessary to improve dust control system.

The purpose of this dispersion modeling exercise is to estimate ambient ground-level concentrations of the emitted coal and clinker dust using the information about the emissions and nature of the atmosphere. In order to assess whether the fall out of emissions meets the ambient air objectives it is necessary to determine the ground-level concentration that may arise at different distances from the source. The current modeling has been carried out after:

1. Selection of a coal dust dispersion model

2. Collection of micro-meteorological data for the duration of sampling.

3. Modeling of dust dispersion using the above data.

Selection of Dust Dispersion Model

Model Overview: AERMOD developed by the AERMIC (American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee) were used to estimate. AERMOD model is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources). AERMOD is a steady-state plume model. In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function. AERMOD constructs vertical profiles of required meteorological variables based on measurements and extrapolations of those measurements using similarity (scaling) relationships. Vertical profiles of wind speed, wind direction, turbulence, temperature, and temperature gradient are estimated using all available meteorological observations. AERMOD requires only a single surface measurement of wind speed, wind direction and ambient temperature. Like ISC3, AERMOD also needs observed cloud cover.

Stability: The atmospheric stability category associated with maximum concentrations varies depending on the dispersion coefficient and the source height. The maximum concentration of pollutant generally increases with decreasing wind speeds. Wind stability class B (unstable), & D (neutral) were used. The mixing height (or depth) can be described as "the height above the surface through which relatively vigorous vertical mixing occurs". The mixing height is therefore well defined under neutral or unstable conditions and is undefined in stable conditions. A mixing height of 200 and 250 meters were assumed for neutral and unstable conditions respectively.

Meteorological Data Collection: The mean maximum and minimum daily temperatures, humidity, rainfall, sunshine, wind speed and direction for the year 2009 is described in Table 7.1.

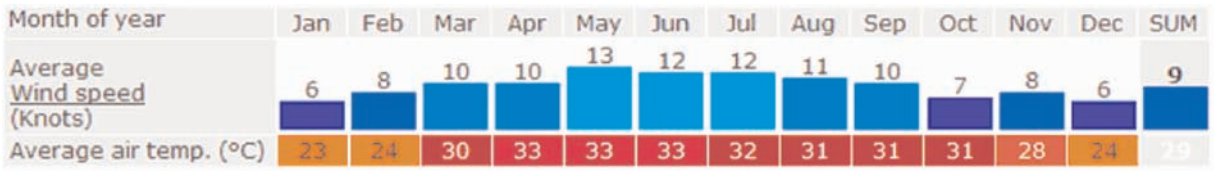
Wind Rose: Average Meteorological data recorded daily from 7 am to 7 pm local time at Jinnah International Airport for the January 2009 - December 2009, have been taken for

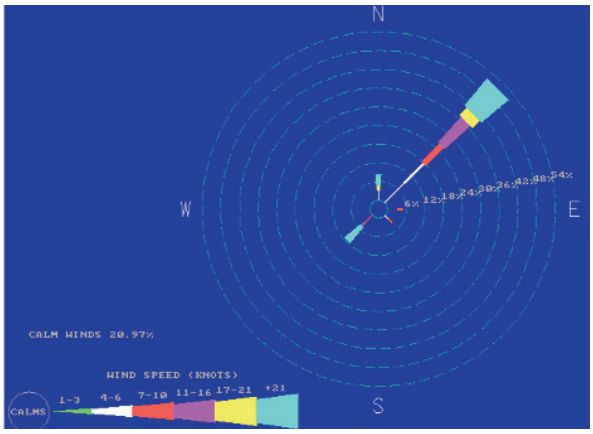
Table 7.1: Wind Data

Sr. #	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1	Mean air Temperature	18.9	20.3	24.4	27.5	30.0	30.9	30.0	28.6	28.1	27.5	24.2	20.3	25.9
2	Mean Max. Air Temperature	25.0	26.1	29.4	32.2	33.9	33.9	32.8	31.1	31.1	32.8	30.6	26.7	30.6
3	Mean Min, Air Temperature	12.8	14.4	19.4	22.8	26.1	27.8	27.2	26.1	25.0	22.2	17.8	13.9	21.1
4	Absolute Max. Air Temperature	31.7	33.9	41.1	43.9	47.8	45.6	43.3	37.2	41.1	42.2	37.8	32.8	47.8
5	Absolute Min. Air Temperature	4.4	6.1	8.3	13.9	18.3	20.0	22.8	22.8	20.6	13.9	8.9	3.9	3.0
6	Mean Relative Humidity (%)	54	61	58	75	78	78	81	82	80	70	59	55	70
7	Mean Precipitation (mm)	13	10	8	3	3	18	84	41	13	2	3	5	203
8	Max. Precipitation (mm)	69	51	56	131	60	183	392	428	252	69	41	66	676
9	Mean Sunshine (hrs)	279	244	295	306	319	213	118	130	225	301	279	273	2982
10	Mean Wind Speed (m/sec)	3.3	3.6	4.3	5.1	6.1	6.7	6.7	6.2	5.2	3.5	2.8	3.1	4.7
11	Wind Direction	NE	SW	SW	SW	SW	SW	SW	SW	W	SW	NE	NE	SW

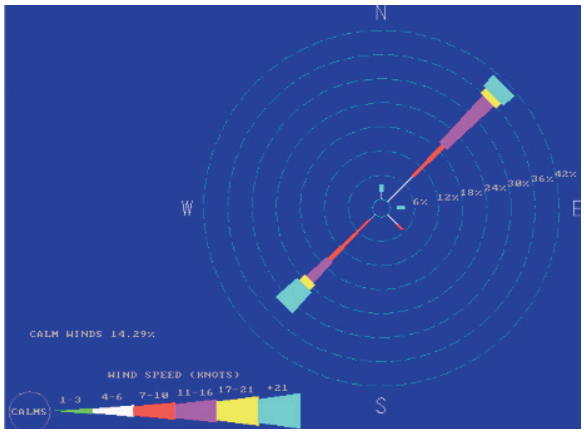
Wind Roses: Average statistics based on observations taken between January 2009 - December 2009 daily from 7am to 7pm local time.

(Ref: http://windfinder.com/windstats/windstatics_jinnah_airport_karachi.htm)

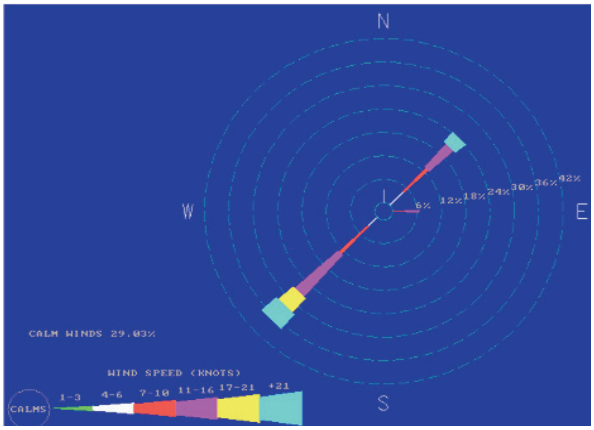




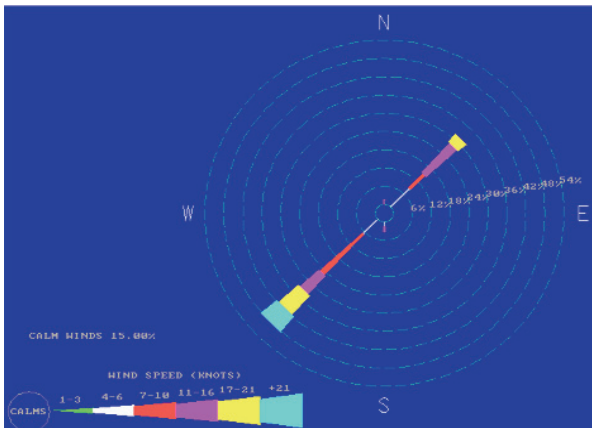
Hourly average wind at Karachi Airport for the months of January, 2009



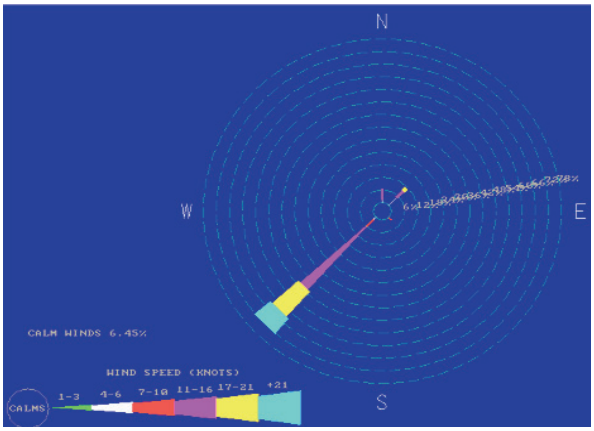
Hourly average wind at Karachi Airport for the months of February, 2009



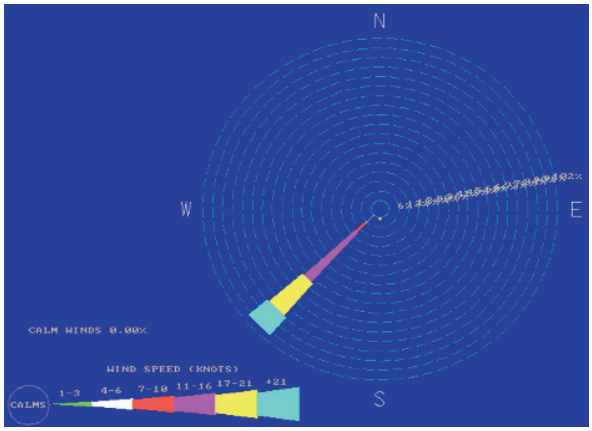
Hourly average wind at Karachi Airport for the months of March, 2009



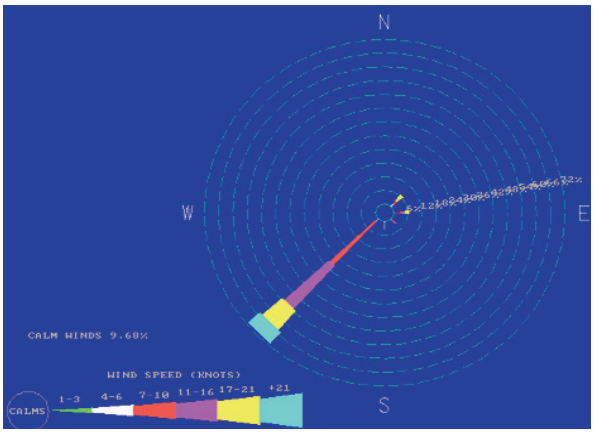
Hourly average wind at Karachi Airport for the months of April, 2009



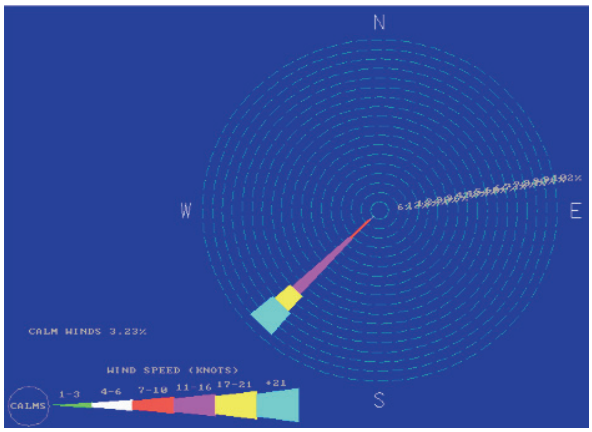
Hourly average wind at Karachi Airport for the months of March, 2009



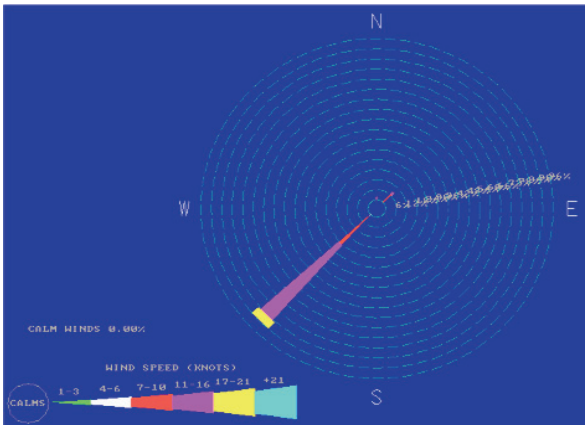
Hourly average wind at Karachi Airport for the months of June, 2009



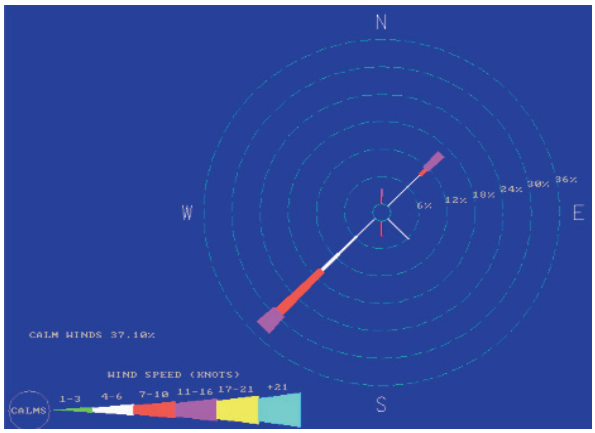
Hourly average wind at Karachi Airport for the months of July, 2009



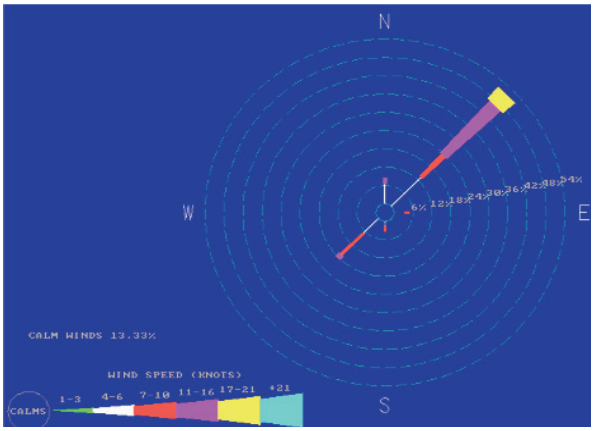
Hourly average wind at Karachi Airport for the months of August, 2009



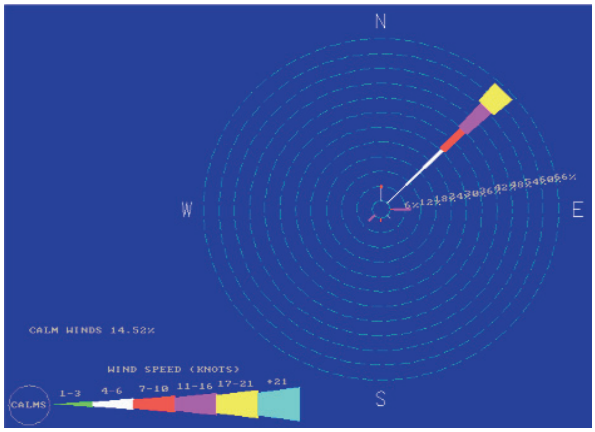
Hourly average wind at Karachi Airport for the months of September, 2009



Hourly average wind at Karachi Airport for the months of October, 2009



Hourly average wind at Karachi Airport for the months of November, 2009



Hourly average wind at Karachi Airport for the months of December, 2009

preparation of the Wind Rose (Ref: http://windfinder.com /windstats/windstatistics_jinnah_airport_karachi.htm).

Modeling Inputs:

1. Port Qasim is located 50 Km from Karachi, on the coast line of the Arabian Sea.

2. PIBT will be located at a distance of 15 kilometers from the National Highway thus having direct access to the hinterland.

3. In a two phased development PIBT will build capacity for handling up to 8 million tons per annum of Coal, Clinker and Cement. Terminal handling capacity can be further enhanced to twelve million tons per annum in future.

4. Terminal development: building a jetty for simultaneously operating two vessels, trestle, and storage yard.

5. Jetty Length: 460 M

6. Handling Capacity: 2 Vessels of Capacity 75,000 DWT

7. Trestle: 2.4 km, provided with two covered conveyors, one for coal imports and the other for Cement exports. The trestle will have capacity to add one more conveyor for enhanced handling in the future.

8. 2 Ship Unloading Cranes

9. 1 Cement and Clinker Unloading Crane

10. The jetty will be connected to the Storage Area by a trestle bridge.

11. Trestle piles will be designed to support an Access Bridge for maintenance, firefighting and other services.

12. Storage Area will be on reclaimed land spread over twenty five hectares or sixty two acres.

13. Storage Area will have capacity to store about 900,000 Tons of coal at any given time stacked in heaps of about fifteen meters height.

14. Two stackers will run in between the coal piles to stack coal being discharged from the ship and fed through the conveyor.

15. Ship Unloading Cranes(Coal): 02 (two)

16. Ship Loading Cranes(Cement): 01 (one)

17. Average Handling: 1,500 tons per hour

18. Coal Storage Capacity in Phase I & II: 775,000 Tons at One Time.

19. 2 Stackers to Stack Coal Piles.

20. Dust suppression water sprinklers will be located in the coal piles to contain coal dust.

Simulation of Emission Impacts: Coal handling operations at Pakistan International Bulk Terminal Ltd. Port Qasim, Karachi will produce fugitive dust emissions from:

1) coal unloading from ship,

2) continuous fall of coal from the conveyor to the active coal storage area,

3) removal of coal from active storage pile to long-term storage pile,

4) reclamation of coal from the long-term storage pile, and

5) wind erosion of the active and long-term storage piles.

Emission factors for these operations were based on emission equations published in the Canadian Council of Ministers of the Environment (CCME) study of fugitive coal dust emissions.

An hour-by-hour emissions estimation methodology was used with the goal of representing both continual emissions due to coal handling activities and sporadic bursts of emissions due to erosion during high wind episodes. As such, dispersion modeling results are indicative of both long-term (monthly, annual) and short-term maximum (24-hour) ambient air concentrations and deposition amounts. The entire 460 meters jetty (2 vessels of 75,000 DWT) and coal storage pile covers an area of approximately 25 hectares. The active coal storage pile comprises approximately 5% of the entire coal storage area.

The long term coal storage area is expected to experience far less frequent disturbance; they might experience much lower emission rates because a surface crust forms after the suspendable material is removed in a few erosion events between disturbances. In order to further reduce fugitive dust emissions from this area, water sprinklers will be located for dust suppression at the coal piles by Pakistan International Bulk Terminal Limited. Such water sprinklers will be able to reduce fugitive dust emissions from exposed areas by up to 90%. On an infrequent basis, a scraper may be used to move or reshape a portion of the long-term storage pile. Although this activity leads to fugitive emissions, it is a discretionary activity that can be curtailed if it causes unacceptably high emission rates. As such, these emissions were not represented in the modeling. A conservative approach of coal handling activity being 'on' during the entire year was used. This leads to a possible over-estimate of annual emissions, but is more representative of maximum short-term (i.e., 24-hour) emissions.

Erosion of a coal storage pile depends on the frequency of disturbance, the size of the storage pile, and the magnitude of short-term gust wind speeds. On a very infrequent basis, a sustained gust has a high enough speed to liberate a large amount of particulate matter from the active storage pile. For each hour of the year, the fastest wind speed was estimated and if this speed was higher than the threshold speed required for liberating dust from the active storage pile, calculation of dust emission for that hour was performed. This approach assumes that the erosion potential (amount of material available for suspension) is completely replenished each hour, which in reality is only true for active storage piles that are being continuously raked/disturbed.

The results from modeling the emissions of a facility were used to ensure that the regional air quality does not exceed the NEQS or deteriorate the air quality further.

Methodology for Emissions Estimation: Particulate matter emissions result from coal piles and the transport of coal. PM emissions from coal piles result from erosion due to wind. Particulate matter emissions also result from the agitation associated with coal handling (i.e. transfer from ship to conveyor belt, and conveyor belt to the piles on storage area). Coal will typically arrive by conveyor belts in the proposed project.

To estimate emissions from the coal pile, a worst-case quantity of coal stored has been used. AP-42 does not specifically address emissions from wind erosion of coal storage piles.

A fugitive emissions factor as published in an article titled "How to Control Fugitive Emissions from Coal-Fired Plants," (Power Magazine, June 1987), was used to estimate emissions. These estimates account for only the PM emissions associated with wind erosion. Actual emissions can be estimated based on the average amount of coal usually maintained in the storage pile.

Calculations: Annual emission from wind erosion of coal piles was calculated based on the following equation:

AEi (lb/yr) = Q x EFPM x ci

Where:

AEi = Annual emissions of chemical i, lb. / year

Q = Maximum potential

EFPM = Particulate Matter emission factor, lb. PM/ton coal stored; and

Ci = Chemical i mass speciation (equal to 1.0 for PM), fraction

Coal Handling: Emissions of particulate matter were calculated based on the maximum potential amount of coal that can be transferred. Actual emissions were based on the actual amount of coal transferred. An emission factor developed from procedures outlined in AP-42 was also used to estimate emissions.

Annual emission from coal transfer operations was calculated based on the following equation:

AEi (lb. /yr) = Q x [k x (0.0032) x (u/5)1.3 / (M/2)1.4] x Ci x (1 - CEi / 100)

Where:

Q = Maximum potential or actual amount of ash

generated used;

k = Particulate size multiplier, k = 0.74, for PM, k = 0.35 for PM10

u = Mean wind speed, miles/hr; and

M = Moisture content, percent

Ci = Chemical i mass speciation (equal to 1.0 for PM),

CEi = Chemical i emission control efficiency, percent.

The set of parameters within the brackets in the equation for an emission factor that estimates the amount of particulate matter emitted from the agitation of ash as discussed in Section 13.2.4 of AP-42. Values for the mean wind speed and moisture content was also found in Section 13.2.4 of AP-42. Partially enclosed transfer operations provide a control efficiency of 70% while fully enclosed transfer operations provide a control efficiency of 90 percent (Control Techniques for Particulate Emissions from Stationary Sources, Volume 2, EPA 450/3-81-005b, September 1982).

Coal Pile Storage

Q = 900000

EFPM = 0.09

Ci = 1.0 ppm

Emissions of PM10

AEi (lb/yr) = Q x EFPM x Ci

= 900000 x 0.09 x 1

= 2357550 lb. /hr

= 81000 lb. /yr

= 1.164 gm/sec

Coal Handling

Q = 900000

k = Particle size multiplier, k = 0.74 for PM, k = 0.35

u = 9 miles / hr;

M = 3.5 %;

EFPM = 0.09

Ci = 1 ppm

CEi = 90%

Emissions of PM10

AEi (lb. /yr) = Q x [k x (0.0032) x (u/5)1.3 / (M/2)1.4] x Ci x (1 - CEi / 100)

AEi (lb. /yr) = 900000 x [0.35x0.0032x (9/5)1.3 / (3.5/2)1.4] x 1 x (1 - 90/100)

= 900000 x [0.00112 (1.8)1.3 / (1.75)1.4] x (1 - 0.9)

= 900000 x [0.00112 (2.147) / 2.19] x 0.1

= 900000 x [0.00240464 / 2.19] x 0.1

= 900000 x 0.00011

= 99lb. /yr

= 0.0014 gram/sec

Main Assumptions

The following assumptions were made for the air dispersion model:

- The plume spread has a Gaussian (normal) distribution in both the horizontal and vertical planes; mean wind speed (a) is high enough to ignore the diffusion effect in the lee-ward direction, (b) is constant throughout the layer where the plume is being transported; and c) the wind speed remains constant during travel and for that particular period;
- The Pasquill Stability Categories considered are B & D (B: representing semi-turbulent conditions in summer within the transporting wind field and D: representing neutral conditions which prevail during winter months of Nov. to Feb. in the area);
- The emission rate is uniform and continuous;
- Turbulence is assumed same everywhere during the period under consideration;

Modeling Results

1. Coal Pile Storage Area (See Next Page)

Table-A: Average annual dispersion emissions of PM10for coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	100	200	300	400	500	700
22.5	1.44638	1.95104	2.295075	5.4932	13.17298	2.19728
45	3.55914	4.7359	4.91935	10.73198	16.30905	4.29279
67.5	2.46207	3.30993	3.747425	8.70005	15.17094	3.48002
90	1.33302	1.8135	2.1598	4.993875	11.53192	1.99755
112.5	1.1674	1.56598	1.736525	3.939525	8.04493	1.57581
135	0.82732	1.13061	1.390325	3.318575	7.2752	1.32743
157.5	1.01374	1.37514	1.593	3.6512	6.5649	1.46048
180	0.62803	0.85579	1.074075	2.607025	5.87613	1.04281
202.5	0.69758	0.94484	1.1008	2.5666	5.76985	1.02664
225	1.14504	1.54388	1.725025	3.79425	6.77603	1.5177
247.5	1.20692	1.6094	1.69935	3.838775	7.89042	1.53551
270	1.42727	1.90879	2.0056	4.4083	8.37774	1.76332
292.5	1.44313	1.92491	2.0455	4.5111	8.32743	1.80444
315	1.36487	1.80557	1.7874	3.928925	8.19987	1.57157
337.5	1.12905	1.52633	1.763225	4.10805	8.48973	1.64322
360	1.62006	2.1645	2.294725	5.044625	9.71726	2.01785

Table-A: Average annual dispersion emissions of PM10for coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	900	1000	2000	3000	4000	5000
22.5	2.85909	0.91803	0.37436	0.21993	0.15008	0.11126
45	6.80927	1.96774	0.86356	0.52379	0.3643	0.27378
67.5	4.82495	1.49897	0.62543	0.37115	0.25461	0.18939
90	2.68385	0.86392	0.35467	0.20645	0.1395	0.10254
112.5	2.27721	0.69461	0.29401	0.17517	0.12046	0.0898
135	1.68311	0.55613	0.22424	0.12947	0.08697	0.06364
157.5	2.02449	0.6372	0.26513	0.15573	0.10578	0.07798
180	1.27283	0.42963	0.17026	0.09791	0.06583	0.04831
202.5	1.38996	0.44032	0.18225	0.10692	0.07268	0.05366
225	2.25901	0.69001	0.29344	0.17377	0.11876	0.08808
247.5	2.31881	0.67974	0.29495	0.17837	0.1238	0.09284
270	2.75873	0.80224	0.35155	0.21221	0.14683	0.10979
292.5	2.77667	0.8182	0.35427	0.21359	0.14807	0.11101
315	2.57465	0.71496	0.32212	0.19805	0.13889	0.10499
337.5	2.24029	0.70529	0.29294	0.17233	0.11741	0.08685
360	3.12637	0.91789	0.39896	0.24049	0.1665	0.12462

Figure A: Color average annual contour map for coal storage emissions

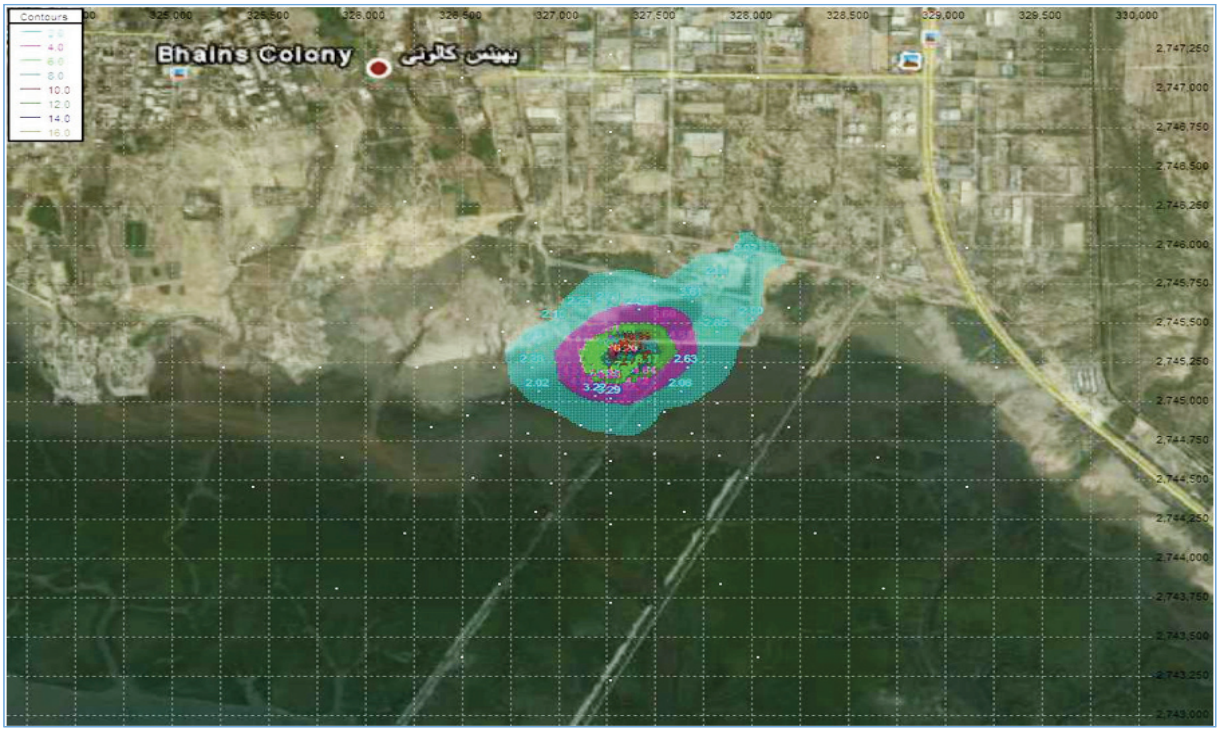


Table-B: Average monthly dispersion emissions of PM10 for coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	100	200	300	400	500	700
22.5	0.20518	0.27684	0.40588	21.37396	12.8938	7.67135
45	**0.505**	**0.67201**	**0.96623**	**29.0972**	**19.71913**	**13.44267**
67.5	0.34912	0.46935	0.68425	27.72857	17.82341	11.55967
90	0.18895	0.25707	0.38049	18.01958	11.21623	6.76981
112.5	0.16528	0.22168	0.32228	13.33887	8.4489	5.23607
135	0.11732	0.16034	0.23871	11.86462	7.49424	4.59036
157.5	0.14365	0.19485	0.28684	11.09631	7.31151	4.75746
180	0.08908	0.12141	0.18064	9.45985	5.98021	3.6286
202.5	0.0989	0.13397	0.1971	9.50149	5.85799	3.53614
225	0.16251	0.21917	0.3207	11.12695	7.37259	4.80517
247.5	0.17103	0.22802	0.32846	13.18165	8.19706	5.14483
270	0.2024	0.27063	0.39102	13.89371	8.88448	5.71083
292.5	0.20476	0.27315	0.39407	13.95041	8.96039	5.78389
315	0.19348	0.25592	0.36482	13.29569	8.52824	5.29544
337.5	0.16016	0.21653	0.31784	14.24587	8.92908	5.57
360	0.22974	0.30691	0.44325	15.58798	10.161	6.48794

Table-B: Average monthly dispersion emissions of PM10 for coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	900	1000	2000	3000	4000	5000
22.5	4.06918	3.24537	2.67439	1.94443	1.6986	0.69148
45	**7.90269**	**6.46904**	**5.44595**	**4.0929**	**3.62689**	**1.5928**
67.5	6.42647	5.17207	4.29553	3.15465	2.76754	1.15341
90	3.68095	2.96335	2.4631	1.81329	1.59131	0.65368
112.5	2.89943	2.34528	1.95652	1.45056	1.27731	0.54081
135	2.45169	1.95509	1.61225	1.17336	1.02564	0.41345
157.5	2.68853	2.17453	1.81073	1.33605	1.17354	0.48829
180	1.92769	1.53277	1.25996	0.91097	0.79372	0.31428
202.5	1.89552	1.51957	1.25923	0.92508	0.81163	0.33598
225	2.78971	2.28376	1.92137	1.43864	1.27111	0.5414
247.5	2.83217	2.28766	1.90822	1.41845	1.25171	0.54299
270	3.24482	2.64445	2.22141	1.66676	1.47569	0.64733
292.5	3.32267	2.71369	2.28018	1.70718	1.50897	0.65369
315	2.90073	2.34907	1.96936	1.48121	1.31509	0.59291
337.5	3.03543	2.43649	2.01934	1.48314	1.30127	0.54034
360	3.71284	3.03151	2.54837	1.9107	1.69007	0.73515

Figure B: Color average monthly contour map for coal storage emissions

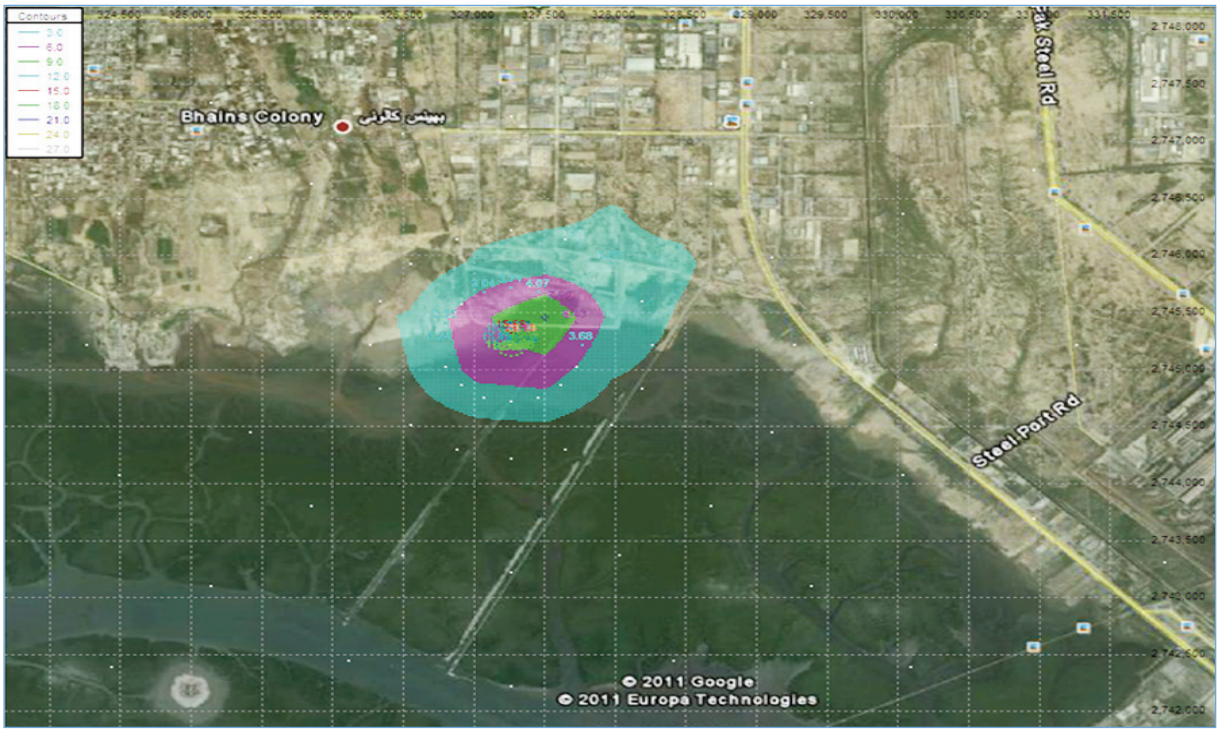


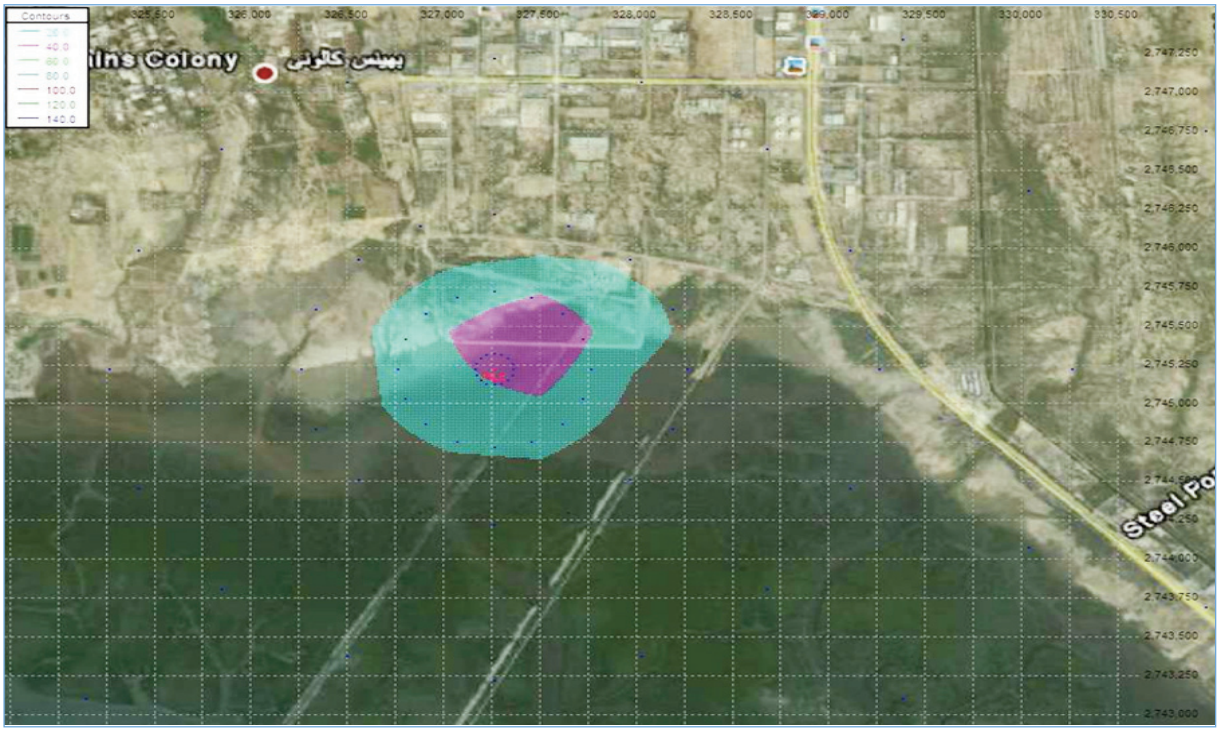
Table-C: Average 24-hourly dispersion emissions of PM10 from coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	100	200	300	400	500	700
22.5	1.97507	1.34866	1.00022	121.52585	61.25209	36.75257
45	**4.70642**	**3.27361**	**2.46046**	**142.77812**	**98.20392**	**66.31517**
67.5	3.33814	2.29023	1.7037	129.76184	87.50243	56.31527
90	1.85773	1.25546	0.92293	115.68747	53.62524	32.79103
112.5	1.5803	1.08639	0.80961	82.16576	40.82381	25.52605
135	1.1643	0.78219	0.57244	73.06165	36.16969	22.19683
157.5	1.40264	0.95253	0.70211	65.95322	35.97875	23.36859
180	0.87974	0.59177	0.4344	59.41307	28.73501	17.51914
202.5	0.96175	0.65382	0.48273	58.14949	28.054	17.05764
225	1.56038	1.06655	0.79112	67.60821	36.13277	23.62833
247.5	1.60697	1.115	0.83602	77.46193	39.79012	24.96883
270	1.90992	1.3209	0.98757	82.69476	43.39916	27.94483
292.5	1.9188	1.33048	0.99763	83.40163	43.7284	28.31161
315	1.78348	1.25018	0.94486	82.14931	41.15844	25.58751
337.5	1.54886	1.05544	0.78089	85.43397	43.21407	26.98227
360	2.1636	1.49769	1.12094	97.35491	49.35648	31.76288

Table-C: Average 24-hourly dispersion emissions of PM10 from coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	900	1000	2000	3000	4000	5000
22.5	19.62424	15.66119	12.91098	9.39483	8.21112	3.35757
45	**38.68412**	**31.62746**	**26.6081**	**19.98178**	**17.70178**	**7.76055**
67.5	31.21323	25.11444	20.85914	15.32779	13.45238	5.62268
90	17.98432	14.49298	12.0496	8.8677	7.77987	3.19127
112.5	14.22012	11.51183	9.60719	7.12329	6.27212	2.65357
135	11.90755	9.50809	7.8479	5.71759	4.99924	2.01637
157.5	13.16418	10.64124	8.85851	6.5352	5.74022	2.38836
180	9.34007	7.43054	6.10985	4.41949	3.85155	1.52842
202.5	9.2157	7.40161	6.14004	4.51443	3.96111	1.63928
225	13.71113	11.20878	9.41752	7.03616	6.21171	2.63562
247.5	13.80405	11.16523	9.32228	6.93848	6.12535	2.65853
270	15.90796	12.97134	10.89978	8.17916	7.24055	3.16719
292.5	16.25567	13.26108	11.13203	8.32308	7.35339	3.18196
315	14.11802	11.4706	9.63858	7.26633	6.45415	2.90384
337.5	14.73531	11.83886	9.81938	7.21952	6.33606	2.63248
360	18.204	14.85955	12.48645	9.35415	8.27096	3.59068

Figure C: Color average 24-hourly contour map for coal storage emissions



2. Coal Handling

Table-D: Average 24-hourly dispersion emissions of PM10 from coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	100	200	300	400	500	700
22.5	0.01835	0.01	0.00652	0.00468	1.23224	0.50869
45	**0.04459**	**0.02473**	**0.0163**	**0.01179**	**2.25614**	**1.02544**
67.5	0.03027	0.01657	0.01085	0.00781	1.88836	0.8029
90	0.01697	0.00914	0.00591	0.00422	1.11799	0.47646
112.5	0.01456	0.00799	0.00523	0.00377	0.86973	0.37518
135	0.01039	0.00555	0.00357	0.00254	0.7526	0.30985
157.5	0.01284	0.00694	0.0045	0.00321	0.80121	0.34875
180	0.0079	0.00423	0.00273	0.00195	0.59648	0.24364
202.5	0.00878	0.00475	0.00308	0.00221	0.57824	0.24236
225	0.01428	0.00777	0.00506	0.00364	0.8077	0.36488
247.5	0.01523	0.00841	0.00553	0.004	0.84825	0.36546
270	0.01794	0.00988	0.00648	0.00467	0.95159	0.42359
292.5	0.01809	0.01001	0.00659	0.00476	0.96322	0.43146
315	0.01712	0.00956	0.00633	0.00459	0.86224	0.37434
337.5	0.01417	0.00768	0.00499	0.00358	0.91211	0.38552
360	0.02019	0.01113	0.00731	0.00528	1.08086	0.48348

Table-D: Average 24-hourly dispersion emissions of PM10 from coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	900	1000	2000	3000	4000	5000
22.5	0.29396	0.19646	0.14256	0.08706	0.06029	0.05164
45	**0.62188**	**0.42936**	**0.31873**	**0.20036**	**0.14098**	**0.12156**
67.5	0.46921	0.31536	0.22994	0.14125	0.0982	0.08429
90	0.2793	0.1872	0.13575	0.0823	0.05669	0.04847
112.5	0.22186	0.15	0.1097	0.0675	0.047	0.04037
135	0.17851	0.1186	0.08548	0.05139	0.03521	0.03006
157.5	0.20493	0.13787	0.10025	0.06113	0.04232	0.03626
180	0.13907	0.09167	0.06573	0.0393	0.02685	0.02289
202.5	0.14167	0.09515	0.06912	0.04208	0.02908	0.02489
225	0.21907	0.14931	0.10953	0.06748	0.04686	0.0402
247.5	0.21796	0.14889	0.10994	0.06866	0.04824	0.04156
270	0.25595	0.17595	0.13032	0.08158	0.05727	0.04929
292.5	0.25956	0.17767	0.13126	0.08206	0.05757	0.04954
315	0.22791	0.1584	0.11845	0.07526	0.05331	0.04605
337.5	0.2257	0.15194	0.11064	0.06763	0.0468	0.04007
360	0.29142	0.19964	0.14743	0.09196	0.06448	0.05549

Figure D: Color average annual contour map for coal handling emissions



Table-E: Average monthly dispersion emissions of PM10 for coal handling (µg/m3)

Direction (Degrees)	Distance (Meters)					
	100	200	300	400	500	700
22.5	0.00995	0.01386	0.02126	2.6185	1.08097	0.62467
45	**0.02506**	**0.03464**	**0.05256**	**4.7943**	**2.17907**	**1.32149**
67.5	0.0166	0.02305	0.03522	4.01277	1.70616	0.99707
90	0.00896	0.01256	0.01942	2.37574	1.01248	0.59352
112.5	0.00801	0.01112	0.01697	1.84817	0.79727	0.47145
135	0.00541	0.0076	0.0118	1.59928	0.65843	0.37934
157.5	0.00682	0.00956	0.01475	1.70258	0.74109	0.43547
180	0.00414	0.0058	0.00899	1.26753	0.51773	0.29552
202.5	0.00469	0.00655	0.01009	1.22876	0.51501	0.30106
225	0.00772	0.01076	0.01651	1.71635	0.77537	0.46553
247.5	0.00849	0.01176	0.01788	1.80252	0.77661	0.46317
270	0.00992	0.01377	0.02099	2.02212	0.90012	0.5439
292.5	0.01011	0.01399	0.02127	2.04684	0.91685	0.55157
315	0.00976	0.01344	0.02031	1.83226	0.79548	0.48432
337.5	0.0076	0.01061	0.01632	1.93823	0.81924	0.47961
360	0.01121	0.01553	0.02365	2.29684	1.02739	0.61927

Table-E: Average 24-hourly dispersion emissions of PM10 from coal storage (µg/m3)

Direction (Degrees)	Distance (Meters)					
	900	1000	2000	3000	4000	5000
22.5	0.41747	0.30294	0.185	0.12812	0.10973	0.039
45	**0.91239**	**0.6773**	**0.42576**	**0.29958**	**0.25831**	**0.09476**
67.5	0.67015	0.48863	0.30016	0.20867	0.17911	0.06432
90	0.39781	0.28846	0.17489	0.12046	0.10301	0.03606
112.5	0.31876	0.2331	0.14343	0.09986	0.08579	0.03094
135	0.25203	0.18164	0.1092	0.07483	0.06388	0.02208
157.5	0.29298	0.21304	0.1299	0.08993	0.07705	0.02729
180	0.1948	0.13968	0.08351	0.05705	0.04864	0.01679
202.5	0.2022	0.14687	0.08943	0.0618	0.0529	0.01865
225	0.31728	0.23275	0.1434	0.09958	0.08543	0.03035
247.5	0.31639	0.23361	0.14591	0.10252	0.08832	0.03236
270	0.37389	0.27693	0.17337	0.12169	0.10475	0.03813
292.5	0.37754	0.27894	0.17437	0.12233	0.10528	0.03845
315	0.3366	0.2517	0.15993	0.11329	0.09785	0.03639
337.5	0.32288	0.23511	0.14372	0.09946	0.08515	0.03011
360	0.42423	0.31329	0.19542	0.13703	0.11791	0.04291

Figure E: Color average monthly contour map for coal handling emissions

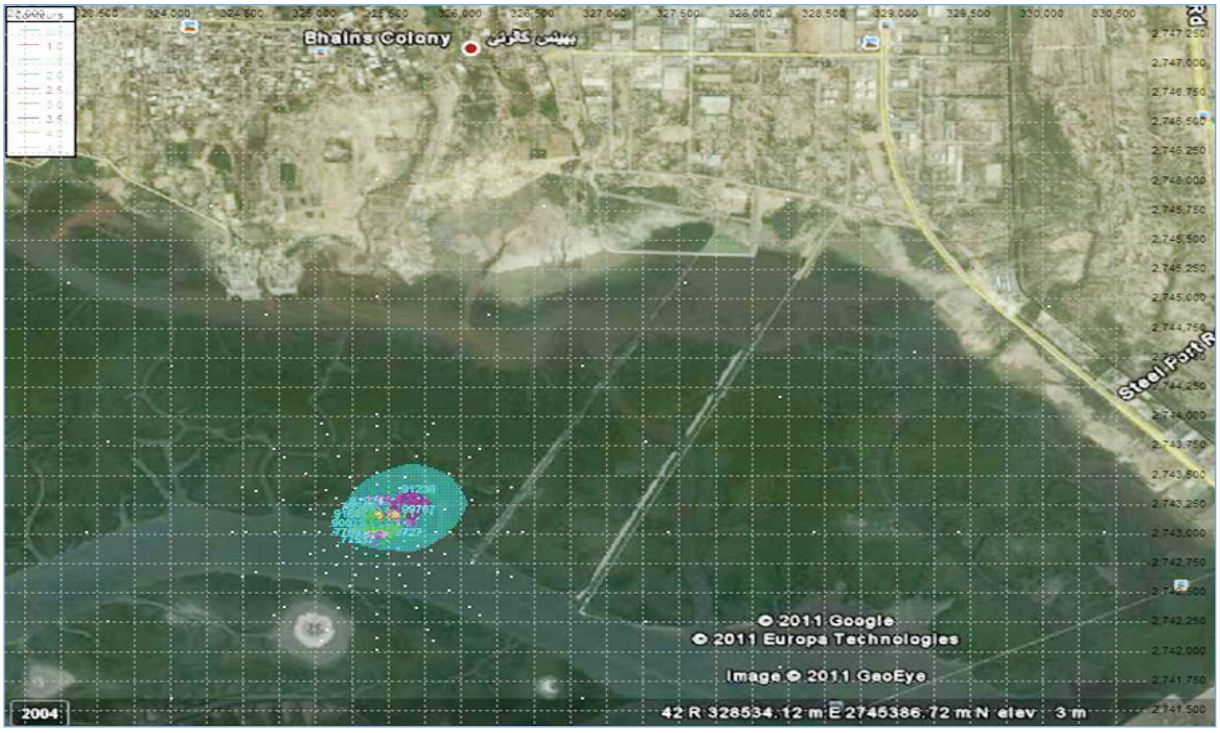


Table-F: Average 24-hourly dispersion emissions of PM10 for coal handling (µg/m3)

Direction (Degrees)	Distance (Meters)					
	100	200	300	400	500	700
22.5	0.04684	0.06521	0.10005	12.32236	5.08692	2.93962
45	**0.11793**	**0.16301**	**0.24733**	**22.56138**	**10.25444**	**6.21876**
67.5	0.07812	0.10846	0.16575	18.88361	8.02896	4.69207
90	0.04217	0.05908	0.09137	11.17989	4.76462	2.79302
112.5	0.0377	0.05232	0.07986	8.69726	3.75184	2.2186
135	0.02545	0.03575	0.05553	7.52603	3.09849	1.78511
157.5	0.03211	0.04497	0.06942	8.01214	3.48747	2.04929
180	0.01947	0.0273	0.04232	5.96484	2.43638	1.39066
202.5	0.02207	0.03083	0.04749	5.7824	2.42357	1.41674
225	0.03635	0.05062	0.07771	8.07696	3.64878	2.19071
247.5	0.03996	0.05534	0.08414	8.48247	3.65462	2.17962
270	0.04669	0.06479	0.0988	9.51588	4.23585	2.55952
292.5	0.04759	0.06586	0.10009	9.63219	4.31457	2.59563
315	0.04591	0.06327	0.09557	8.62239	3.74342	2.27913
337.5	0.03578	0.04993	0.0768	9.12108	3.85523	2.257
360	0.05277	0.0731	0.11131	10.80865	4.83479	2.91423

Table-F: Average 24-hourly dispersion emissions of PM10 for coal handling (µg/m3)

Direction (Degrees)	Distance (Meters)					
	900	1000	2000	3000	4000	5000
22.5	1.96457	1.42562	0.87057	0.6029	0.51636	0.18354
45	**4.29358**	**3.18731**	**2.00359**	**1.40981**	**1.21555**	**0.44595**
67.5	3.15363	2.29942	1.41252	0.98199	0.84286	0.30268
90	1.87204	1.35746	0.82302	0.56688	0.48474	0.1697
112.5	1.50004	1.09695	0.67498	0.46995	0.40371	0.14561
135	1.18603	0.85478	0.51391	0.35213	0.30062	0.10391
157.5	1.37872	1.00253	0.61128	0.42319	0.3626	0.12843
180	0.91671	0.65732	0.39299	0.26846	0.22891	0.07903
202.5	0.95155	0.69115	0.42085	0.29083	0.24892	0.08779
225	1.49307	1.09527	0.6748	0.46863	0.40204	0.1428
247.5	1.48888	1.09935	0.68661	0.48244	0.41564	0.15228
270	1.75948	1.30319	0.81584	0.57268	0.49295	0.17944
292.5	1.77665	1.31264	0.82058	0.57567	0.49542	0.18093
315	1.58401	1.18449	0.75263	0.53312	0.46049	0.17123
337.5	1.51944	1.1064	0.67634	0.46803	0.40073	0.14168
360	1.9964	1.4743	0.91965	0.64483	0.55488	0.20193

Figure F: Color average 24-hourly contour map for coal handling emissions



Discussion: It is observed from plots that the ground level concentration of fugitive coal dust (PM10) decreases with distance and is maximum in the direction of wind. The dispersion is maximum in direction of 45 degrees from north in most of the time of the year as governed by the local meteorology (Table 7.2); hence the North-East and South-East (only winter months) directions will be more affected by the emissions from coal storage and transport activity.

Table 7.2: Coal Handling

Direction Degrees	Distance Meters	Avg. Conc. µg/m3	Ave
45	400	22.56	24-HR
45	400	4.79	Month
45	500	2.26	Annual

Table 11: Coal Storage

Direction Degrees	Distance Meters	Avg. Conc. µg/m3	Ave
45	400	142.8	24-HR
45	400	29.1	Month
45	500	16.31	Annual

Conclusion: Air quality modeling has been attempted using AERMOD. Volume source modeling has been carried out for open pit coal storage and coal unloading activity using local meteorological data. Wind rose and stability diagram for the area were generated. This work examined different sources of coal dust generation and quantified dust emission rates (PM10) from coal handling and storage activities. Particulate matter emissions result from the agitation associated with coal handling (i.e. transfer from ship to conveyor belt). Coal typically arrives by conveyor belts in the proposed project. From the modeling exercise, coal dust concentration in µg/m^3 at various location/distances have been predicted and it was found that the resultant PM10 level at these locations will remain within the NEQS (Appendix-1). The model reveals that dust generated due to these activities does not contribute to ambient air quality significantly in surrounding areas beyond 400 to 600 meters in normal meteorological conditions. As seen from the coal dust dispersion from coal handling activity, addition to ambient level of PM10 is negligible as compared to fugitive erosion of coal from coal storage area (Table -10 & 11). As far as cumulative effect of these activities (Coal Handling & Coal Storage), maximum ground level concentrations are seen to occur at a distance of 400 meters from the source, and the distance between these two points is 2.5 kilometers, therefore emissions from coal handling will have minimum addition to emissions from coal storage area.

Combustion of fuel for power generation will have negative impact on the ambient air quality of the microenvironment of PIBT site. Exhaust emissions including particulate matter (PM), hydrocarbons, oxides of nitrogen, sulfur, and carbon may exceed beyond permissible levels. Control of air emission during construction and operation phases will be the responsibility of PIBT Ltd and their contractors.

Mitigation Measures

- The normal dust level at the Project site should be controlled by regular road sweeping.
- Dust suppression by water sprinkling is considered appropriate. An improved stockpile water spray system, designed to be effective in high wind



conditions and more efficient in where and when sprays are activated.

- For pollution control at dirty bulk cargo terminals, it is necessary to minimize fugitive dust emission. Coal is not allowed to remain dry since such conditions can create an explosion hazard. Vacuum filters would not work with wet coal and hence pollution control will be achieved by a water spraying system that will be installed for dust suppression at PIBT. The water spray system will also be in place at transfer stations between conveyors.
- Due to the dust controls being installed as part of the project, the proposed PIBT operations will marginally reduce dust levels in its microenvironment, and dust levels will remain well within permissible limits.
- Contractors and operators will be mandated to use new generators and to regularly maintain them so that the emission levels are within acceptable range. Mitigation measures including proper maintenance of construction equipment, generators and controlling unnecessary idling of equipment will be implemented. Air/fuel ratio will be maintained by engineers all the time to control emissions of CO and other pollutants due to incomplete combustion of fuel.
- It is envisaged that Selective Catalytic Reduction or any other alternative systems would be incorporated on board the ships to reduce NOx emissions.
- All emissions from construction and operation must be in compliance with air quality standards in vogue. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant but would continue for the life of the Project. Regular monitoring and evaluation is recommended.

7.1.4 Waste Water Discharge

Adverse effects on marine ecology generally result from deterioration of sea water quality due to discharge of ship waste, dispersion of dredging spoils and formation of turbidity plumes; changes in sea current pattern, bottom contamination during dredging leading to diminution of biota; physical loss of water covered areas; and changes in natural land habitat. Siting of a port terminal facility generally induces aquatic contamination, besides diminution of biota which may reduce fishery resources, and may increase the population of undesirable predator species.

Potential Environmental Impacts due to Waste Discharges during Construction

The impacts on the aquatic environment resulting from waste and wastewater discharges may result from:

- Proposed construction of berths during construction and operation phases,
- Pile driving, deposition of rubble, dredging, sand compaction and other construction work in water that cause re-suspension of sediments and turbidity plumes, release of contaminants and oxygen depletion,
- Re-suspension of sediments in water during dredging that leads to an increase in the level of suspended solids (SS) and the concentration of organic matter, and can cause dense turbidity plumes,
- Turbidity plumes are usually detrimental to aquatic ecosystems because of the effect of reduced light penetration through the water column,
- Re-suspended sediments can also be transported and re-deposited causing the smothering of benthic fauna and fishery resources,
- Sediment contamination is of concern in cases where the disturbance caused by dredging releases contaminants into the water column, either by solution or re-suspension of particulate matter, Geotechnical evaluation of soil have demonstrated that the sediments are not contaminated to significant level, as such the dredging is not expected to have an adverse impact on water quality. For the same reason, potential toxic impacts on aquatic biota due to bio-availability of contaminants are not expected.
- Guidelines of the London Convention recommend

that consideration be given to the environmental characteristics of marine disposal site. The actual location for disposal is to be chosen from the sites approved by the Port Authority, and the same will be used by the contractor appointed to undertake the dredging. In terms of water quality, consideration will be given to the potential effects of turbidity and the induction of contaminants that may be present in the dredged material into the disposal site.

- Disposal of dredging spoil from Port Qasim channel has been continuing since the mid-1970s and is being monitored by Hydraulic Research Laboratory, Wallingford (UK). To date no significant impacts from disposal have been reported.
- The dredged material however would be released into the sea either from the dredger's hopper or a barge and as the material is likely to comprise silts and clays, dispersal by currents during its fall through (the water column) could cause localized conditions of high turbidity at disposal site. The silts and clays are believed to be relatively well consolidated so it is likely that the majority of the disposed material would fall directly into the bed, reducing the potential for dispersion of low density material by thermal water layers. As the dredge spoil is released below the surface, turbidity is not expected to be high, although some low-density material may float upward on being dispersed.
- In case of disposal of dredged spoil in areas earmarked by the Port Authority for reclamation, the slurry will be properly contained in settling ponds to allow suspended solids to settle down and a relatively clean effluent will be released into the creek. The structure of the cofferdam especially designed to retain the dredged material is lined with geo-textile material to ensure sediment retention and low turbidity characteristics during the tidal surges in the containment area. The overall effect of the disposal operation is therefore not likely to cause significant turbid conditions.
- During the construction of PIBT it is possible that construction materials would either be lost accidentally or dumped intentionally into the marine environment. Although materials like rock, concrete, plastics, etc. are relatively inert, other materials such as metals, and hydrocarbons can cause deleterious effects on the water quality.
- Other than a large scale accidental spill of fuels or other mechanical fluids, the impact of an individual event is likely to be small and not significant in severity. However, the cumulative impact of a number of events over the construction period can have wider implications for aesthetic quality, fisheries and coastal ecosystems. In addition, large quantities of debris on the sea bed could hinder dredging operations. For example, a bucket dredger may encounter large sized debris, adding extra time and costs to the dredging operations.
- Piling operations associated with the jetty and trestle construction will produce small spoil material. Samples of the spoil material produced from mud flats may be tested for contamination and, if found heavily contaminated, the same would be disposed off-site. The dumping of this spoil otherwise would be restricted to the areas immediately adjacent to the jetty construction site.
- The estimated quantity of dredging spoil is considerably low and its disposal into the designated storage area is not likely to cause adverse impact on long-term basis.
- No handling and use of any contaminants during construction is required. Some oily wastes from construction equipment may be released but the same will be suitably removed by passing the waste through a sand trap.
- Operation of dredgers, tugs, work vessels cause oil spills and leakage of other substances into water and also discharge garbage. The MARPOL Convention 1973 - 78 will be strictly adhered to and all vessels working within the port will allow no chance of oil spills, garbage discharge, etc. As the construction activity is mainly towards the coastline, the impact on the Navigation Channel and the Sea will not be

significant.

Mitigation Measures

- Careful use of heavy machinery and equipment will minimize the impact due to release of contaminants during this short term activity.
- Mitigation measures to minimize the impact of sewage effluent will be adopted by having a septic tank/soak pit system at campsite.
- Disposal at designated site will be keenly monitored to ensure that the dredged spoil does not spill over back into the marine environment.
- In order to minimize any impacts from losses or spillages of site materials and wastes during construction, the contractor undertaking the construction work will ensure that there are no losses of potentially polluting materials to the water and that any spillage on land is removed and cleaned up immediately. This measure will ensure that substances such as fuels and oils are not left to soak away. A clause to ensure this aspect of SOP will be included in the contract package of the construction works. In addition, before commencing any work that could involve spillages of polluting materials, the contractor will produce an effective plan of prevention and clean-up.
- The resident engineer at site will be consulted and would approve such measures.
- A further clause in the construction contract would ensure that the contractor keeps all working areas, storage areas, waterways and berths clear of any rubbish, debris and obstructions at all times. All debris and rubbish will be regularly removed from the site.
- All possible precautions will be taken to provide for the safe storage and use of fuels, explosives, gas bottles and all other hazardous materials temporarily brought at site by contractor.

The negative impact on the soil due to discharge of wastes and wastewater during construction phase of the PIBT Project will be small, reversible, temporary, of short term duration and localized to the microenvironment. The impact on ground or sub-marine soil /water is likely to be insignificant.

Potential Environmental Impacts due to Waste Discharges during Operation Stage

- Possible waste discharge from ships that could be source of pollution of the marine environment are bilge water, ballast water, oily wastes, sewage, garbage and other residues in a ship operating at the terminal.
- Spills of oils, lubricants, fuels and other oily liquids may be other sources of water pollution. Once an oil or oily sludge is discharged into water, it is spread on the surface by winds and currents, forming a thin film on the surface.
- The oil film is biodegraded to form dense conglomerates/ tar balls, which sink and are finally deposited on shore.
- Concentration of oily compounds in water is an important indicator of low water quality particularly in recreation areas.
- Run off from coal stacks and other raw material storage, spills from bulk cargo handling and wind-blown dust are possible sources of contamination of water at the Bulk Cargo Terminal at Port Qasim.
- Toxic or harmful substances may be included in the runoff from coal, clinker and cement. Organic materials in runoff are decomposed to the inorganic form; they reduce dissolved oxygen level and increase the nutrient level in water.

Mitigation Measures

- Protection bunds shall be constructed along vulnerable stretches to prevent movement of run-off as well as excavated material into adjoining mudflats.
- Operation of the PIBT will not generate massive load of waste and wastewater. The wastewater and the run-off from coal yard will be stored separately,

adequately treated and then discharged at the designated receptacle.

- Safe handling and prevention of spills will be of prime concern at PIBT, which has a commitment to meet the emission guidelines for products handled at the facility. The transportation and storage system will be designed for zero leakage at the facility.
- The storm water runoff from the storage area and the berth will have relatively low level of contaminants and traces of oil, but considerable amount of sediments. Run off from the built surfaces will be allowed to flow through a series of catch pits leading to drains that discharge directly to the designated receptacles, where rain water could be harvested. The jetty platform and storage area will have hard surface. The storm runoff will be collected by open drains and discharged to the nearest storm water drain.
- rainfall in the area is however scarce and the run-off from the onshore area is likely to be minimal.

Discharge of untreated sewage and industrial effluent into the mudflats and the creeks can have potentially adverse effects on water quality. Only few industries in the Industrial zone of PQA are treating their industrial wastewater; a majority of industrial units and the cattle colony in the macroenvironment discharge their untreated wastewater into unlined channels that finally terminate into the waste stream only 5 kilometer from the PQA boundary. The untreated effluent does not meet NEQS and hence the seawater at this coastline is considerably degraded.

- This aspect of environmental degradation will have to be accounted for by periodic monitoring of quality of water and sediment.
- A monitoring program needs to be executed by the PQA to keep a close watch on the water and sediment quality and ensure enforcement of NEQS on port users. Monitoring would record any accumulation of contaminants and would be used as an indicator for targeting reduction of contaminating inputs.
- PIBT will have onshore facility to store diesel in adequate quantity for use by power generation as part of the jetty and the terminal. There is potential likelihood of small scale spillages near the diesel tank that may cause minor adverse impacts locally. Construction of the fuel tank will follow the provisions of the API in having a dyke constructed to contain the spilled contents of the tank.
- Sewage effluent will be treated in septic tank before its discharge into PQA sewerage system or creek waters.
- The ships calling on PIBT will be required to follow MARPOL 73/78.
- PIBT will create facilities for reception of Bulk Cargo carriers and ships bilge water, ballast and solid waste and for their treatment at their onshore facility.
- Adoption of SOP would be ensured. Observation on current practices at Karachi Port and Port Qasim indicate that the waste materials are discharged directly into harbor waters with no regard for subsequent environmental damage.
- PIBT will adopt the Environmental Management Plan and will have an appropriate hierarchy for management of Environment, Health and Safety issues.

7.1.5 Noise Emission

Port and Harbor projects such as PIBT involve short-term impacts during construction and long-term impacts during operation due to increased noise levels. Construction activities at PIBT will create noise and vibration nuisance by high level noise emission from construction equipment, truck traffic, dredgers, work vessels and other similar sources.

Potential Environmental Impacts due to Noise Pollution during Construction Stage: Construction and associated activities onshore and offshore the PIBT will raise the ambient noise levels in the microenvironment. These activities will include works such as pile driving, dredging, drilling, earthworks, besides operation of the

equipment such as compressors, generators and the vehicular traffic. The duration of the construction work is anticipated not to exceed 1.5 year.

The major noise generating sources during construction will include the generators, excavators, dredger(s), cranes, crusher, batch mixer etc. Being in the open air, the ambient noise level due to all the activities at the site may range between 70 to 75 dB(A). The major human settlements are more than 3.5 km beyond the proposed site. There is no developed residential area close to PIBT site.

At the Jetty it will be the acoustic effect would echo the noise especially during low tides. This may be more pronounced in case of sharp burst of noise such as during pile driving. However, the open land would dissipate the acoustic waves and the impact of noise emission would only feebly reach the shore. There are no structures, buildings or topographic features in the proximity of Project site onshore and thus the noise will hardly be perceptible beyond the microenvironment of PIBT.

Noise emission during dredging operations can impact the marine fauna. The ambient noise levels within the Project area are relatively low ~65-70 dB(A), in comparison with the noise emitted from a dredger. The area of dredging is relatively small which limits the significance of the impact. The species thought to be most vulnerable to noise are fish. It is likely that fish will be able to avoid noisy areas and hence this particular aspect will be of minor, temporary and local significance.

Table 7.3: Typical Noise Generating Sources

Description	Noise Levels dB(A) at 1 m from Source
Earth Movers	
Excavator	90-95
Crane	90-95
Trucks	84-88
Dozer	85-90
Dumpers	87-91
Wheel Loader	89-94
Tractors	76-96
Scrapers, Graders	80-93
Pavers	86-88
Trucks	82-94
Material Handlers	
Concrete Mixers	75-88
Cranes (movable)	76-88
Impact Based Equipment	
Pneumatic Wrenches	83-88
Cranes (derrick)	86-88
Stationary Equipment at Storage Terminal	
Pumps	69-71
Generators	71-82
Compressors	74-86

Noise levels from operation of construction equipment are shown in Table. 7.3. Construction workers operating the equipment are invariably exposed to noise level exceeding 85 dB(A). The construction workers who may be exposed to high noise are provided ear plugs to be worn as protective measures.

Equivalent sound pressure level (Leq) averaged over 8 hours is used to describe noise exposure in work place environment. The damage risk criteria for hearing as enforced by OSHA (Occupational Safety and Health Administration) stipulate that the noise levels up to 80 dB(A) are acceptable for 8 hour exposure per day.

World Bank Guidelines require ear protection equipment to be worne when the noise level in the work environment exceed 85 dB(A).

Based on the review of data for similar activities performed for other projects of similar nature in the Port Qasim Area, the expected ambient noise levels would be well below both the daytime and nighttime limit of 70 dB(A). Changes in sound level on local roads resulting from increased vehicular traffic during construction are not expected to be significant.

Potential Environmental Impacts due to Noise Pollution during Operation Stage

Operation of bulk cargo loading and unloading, transfer of bulk cargo from the jetty by the conveyors to the storage area, operation of the stackers and the sprinklers are not high impact activities. Noise emissions during project operation are expected to be lower and generally derived from facility operations such as the above.

Noise emissions from the marine vessels would mainly be generated by the operation of the vessel's engines. The

noise emissions from vessel engines are substantially attenuated by their placement deep within the confines of the vessel. Only one vessel will be using the berth at any point of time. The increase in noise emissions from marine vessels using the berth is not expected to result in significant increase in level (<3dBA). Additionally, sound emissions from marine vessels will occur on an intermittent and infrequent basis.

Operations at PIBT jetty and storage facilities are not expected to be particularly noisy. Noise level immediately outside these facilities may generally reduce to acceptable level of 70 dB(A). The conveyors are the only continuously noisy system around the facility. The noisy power generator would be housed in its own building, and its occasional use inside an adequately sealed structure would reduce the emission level from almost 90 dB(A) to less than 70 dB(A) at the boundary wall of the facility.

The most intrusive noise source would be the terminal related traffic especially on the road outside the storage area. Traffic movements into and out of the storage area would continue during the day time. However, vehicles could arrive and/or depart at any time.

The cumulative noise levels due to the combined operation of power generating units, ships loading /unloading, movement of machinery are estimated at less than 70 dB(A) at a distance of 500 m and 45 dB(A) at the boundary. As no major settlement is located within 3.5 km from the storage area, no adverse impact of noise on the community is envisaged.

Mitigation Measures

- The sources of noise during operation of the project include vehicular movements, ships offloading operations, intermittent sounding of blowing horns by the ships etc. The noise emission levels from these sources will be reduced significantly. However, the noise generated from the sustained use of generators housed in individual enclosures designed for outdoor installations will be permanent in nature and therefore require specifically designed housings to reduce impact of noise emission.
- As an occupational health and safety measure, the workers will, wherever necessary, be provided with ear protection equipment such as ear plugs and ear mufflers as per specifications to meet the World Bank guidelines. The World Bank guidelines for ambient noise level within industrial sites recommend daytime and night time limits of 70 dB(A). The NEQ Standard of the EPA for external noise levels is 85 dB(A) at 7.5 m. The IUCN report (1993) on the Environmental Review of Port Qasim area suggested noise level range from 35-45 dB (A) for small offices and 75-85dB (A) for maintenance areas.
- Periodic maintenance of construction machinery and transportation vehicles should be undertaken to observe low noise level limits.
- Transport of construction material to the site should be restricted to daytime operations.
- Overall, the impact of generated noise on the environment is likely to be insignificant, reversible and localized in nature and mainly restricted to the day hours and sufficient noise control measures would be undertaken.
- Plantations of dense canopy trees such as the mangrove species that have been planted on the medians on Karachi City Roads, and also the trees that may be uprooted at the 2.5 km strip of mangrove area, can provide a good sound barrier.

7.1.6 Solid Waste

A port and harbor project usually involves acquiring significant areas of land, clearing the sties, soil excavation and other activities, which affect land directly. Secondary impacts are those of induced developments related to the project, which would pace a stress on the land use. Port and Harbor projects attract industries and could lead to rapid growth of the region. The impact on land environment can be divided into two phases i.e. construction phase and operation phase.

Potential Environmental Impacts due to Solid Waste Disposal during Construction Stage

Solid waste generated at the PIBT during the pre-construction and construction stage will be mainly the over burden at the depression at the proposed storage area, and the material that forms the 2nd and 3rd layers at proposed site for construction of the jetty.

The over burden and the material contained in the two layers will be used to fill the depression. The material that forms the 1st layer at the said site is un-useable and the same will comprise the dredging spoil, which will be disposed of along with plants and vegetation that will be removed for land clearance to a nearby site where the material will be placed in geo-bags to conserve the marine biota.

The topsoil removed, and the material excavated for site preparation and construction will also be used for reclamation of land at the Storage site. The removal and storage of the gravely topsoil may lead to localized changes in the structure at the construction site but when placed near the reclamation site, the same will be put to good use.

Solid waste will be generated in the form of construction debris at the construction site and as trash and garbage from the construction camps, and stockyards; these will be suitably transferred to a landfill site to avoid unsightly conditions and land contamination.

Contamination of soil during construction phase is primarily due to allied activities. The solid and hazardous wastes generated from ships and from Port operations may contaminate land and water bodies if not disposed properly. Discharge of solid waste from vessels shall be governed in accordance with MARPOL Convention 1973 - 78.

Potential Environmental Impacts due to Solid Waste Disposal during Operation Stage

Hazardous wastes likely to be generated from proposed facilities are oily sludge from the ships and the power generators; sludge from wastewater treatment facilities, contaminated rags/trash etc. Discharge of solid waste from vessels shall be prohibited while in port in accordance with MARPOL Convention 1973 - 78.

Mitigation Measures

Following measures will be adopted to mitigate adverse impacts of solid waste disposal during construction and operation phase.

- The adverse effects of disposal of dredged material or other wastes from construction activities will be offset by including them in the land reclamation plan propose above.
- A record with respect to quantity, quality and treatment/management of solid/hazardous waste shall be maintained.
- Centralized waste management facility will be provided to collect all wastes during construction phase.
- The stockpiles, construction camps and other facilities will be located to the extent possible on land, which are devoid of vegetation.
- Material resulting from clearing and grading will not be deposited on temporary or permanent basis in the approach roads, streams, ditches or on another position which may hinder the passage.
- On completion of construction works all temporary structures, surplus materials, construction debris and wastes will be completely removed to avoid future land use incompatibility.
- Land disposal of construction debris, composite garbage and discarded top soil may impact surrounding soil quality. However, the impact is likely to be insignificant as the project proponent (PIBT) will take adequate measures to ensure that all waste generated at the construction site and at the labor camps is collected and disposed of in an appropriate manner in a landfill site or recycled for reuse where feasible.
- PIBT will dispose of the dredging spoil that comprises the un-useable material of the 1st layer at the proposed jetty site, along with plants and

vegetation that will be removed for land clearance to a nearby site where the material will be placed in geo-bags to conserve the marine biota.

- PIBT will also recycle the over burden at the proposed storage site and the material contained in the 2nd and 3rd layers at the proposed jetty site for filling the depression.
- Standard construction procedure will be implemented to ensure that the impact on surface drainage pattern and soil erosion is kept to the minimum. This will necessarily include avoiding blockage of natural surface drainage and developing appropriate drainage system in areas where it is unavoidable.

7.1.7 Impacts on maritime navigation

During construction of the PIBT Jetty, there may be occasional temporary obstruction to navigation while maneuvering of the floating construction equipment (piling barge). This will however be coordinated with Port Qasim Authority. As the PIBT Jetty is located in the Kadiro Creek and is well separated from the main navigation channel, there is no likelihood of obstruction to shipping during routine construction.

Likewise no obstruction to navigation in the main channel of Port Qasim is envisaged.

Mitigation Measures

No mitigation measures would be required.

7.1.8 Impacts on Ecology

The microenvironment of marine ecosystem of the proposed PIBT jetty is covered with medium to large sized mangroves some of which will be removed for construction of the jetty and the over-passing trestle. It is estimated that on shore ecology will not be much affected. Only part of the land required for the storage area will be used for construction. No unique habitat has been identified; it will nevertheless be ensured that any unique habitat if identified will not be lost. Similarly, terrestrial ecology will remain unaffected during the operation phase.

The biota at site is composed of terrestrial ecology, mangroves and marine ecology.

Terrestrial Ecology: The Kadiro and Korangi Creek ecosystem is vegetated with few plant species including the mangroves. Construction of the proposed PIBT, storage area and the over-passing trestle will not result in significant damage to this system. It is estimated that on shore ecology will not be much affected. Only part of the land required for the storage area will be used for construction. No unique habitat has been identified and it will be ensured that any unique habitat if identified will not be lost. Similarly, during operation phase terrestrial ecology will remain unaffected.

Potential Environmental Impacts on Terrestrial Ecology during Construction

The grading operation for the land preparation for storage area will cause removal of some sparse vegetation. This vegetation is a low grade scrub, abundant in the adjacent areas and all over Karachi. This scrub will have to be removed from an area of about 6 ha, which is devoid of local bird species and animals. No rare or endangered species of plants or animals are reported in the area. Removal of the scrub will hardly have adverse impact on the birds and aquatic animals.

Construction of the over-passing trestle from the jetty to onshore storage site will disturb the rich growth of mangrove trees between Korangi and Kadiro Creeks. Some of these plants will need removal at the location of the piles supporting the trestle. There will be an estimated loss of 450 mature or maturing trees. The rest of the plants shall remain intact. Despite the negative impact of small magnitude and of localized nature, there will be minimal disturbance of plant and animals in the area.

The proposed design will ensure that no damage is done to the mangroves and benthos. For construction of jetty, access to the area would be required and dredging activity would be undertaken. It is recommended that the dredged material is saved and refilled in the temporary canal on completion of work. This will help in replanting,

rehabilitation and re-colonizing of the mangroves and in localizing the impact to the microenvironment.

Mitigation Measures

- The construction contract should include provisions to limit the removal of bushes and mangrove to the bare minimum and restricted to the land area identified by PQA. The bushes and mangrove seedlings may, as far as possible be saved and transferred to the adjacent area. Other plants in the vicinity will need to be protected against damage by construction operations. The areas beyond the limits of site shall not be disturbed or damaged otherwise. Trees and shrubs will be planted around the boundary of the storage area to compensate for the loss of shrubs and shield the development from visual intrusion.
- On completion of construction, the temporary canal will be back-filled and mangrove saplings planted to ensure re-colonization.
- Loss of mangroves will be compensated by planting mangroves saplings in consultation with IUCN and IMC.

Potential Environmental Impacts on Terrestrial Ecology during Operation

The operations at the jetty will require special arrangements to safeguard against leakages and fugitive emissions of coal and clinker dust, which are hazardous when released into the atmosphere. The coal dust emission from the storage and transfer system needs to be controlled during operations. At the on-shore storage, the impact of fugitive emissions, during routine handling will have low impact on marine ecology including mangrove ecosystems. Fugitive dust emission is likely to be dispersed, diluted and carried away by the moist air in the marine environment.

Liquid effluent from offices and the facilities will be domestic sewage and will be treated using an appropriate system such as a septic tank to meet NEQS before discharge into the drainage system. The operations at the PIBT and storage facility will less likely have significant impact on terrestrial ecology.

Potential Environmental Impacts on Marine Ecology during Construction

Most studies on the impact of dredging on marine benthos show that dredging can result in a 30 to 70% reduction in species variety; some 40 to 95% reduction in the number of individual species and a similar reduction in biomass in dredged areas (Newell et al., 1998). Re-colonization and recovery of species is a complex process involving initial colonization by fast growing animals (opportunistic) species. In stable environments these are replaced and supplemented by a wider species diversity of slow-growing (equilibrium) species after cessation of dredging. In more disturbed habitats the community is dominated by opportunistic species, which do not move towards an equilibrium community of repeated environmental disturbance.

The dredging process has significant potential impacts outside the boundaries of the dredging site. The dredged material comprises a large inorganic particulate load and also contains significant quantities of organic matter. Such material has a lower specific gravity than inorganic components of the dredged outwash and is detectable at distances of over 3 km downstream of a dredger. Material derived from the dredging process may also be carried as a benthic plume for significant distances along the sea bed. The impact of dredging within the intensively exploited anchor dredged site is limited to the dredged area. Impacts include suppression of species variety, population density and biomass as well as differences in species composition compared with the surrounding deposits. Generally, there is no suppression of species diversity, population density or biomass of benthic macro-fauna outside the immediate boundaries of the dredged sites.

Other environmental impacts may be summarized as follows:

- Physical disturbance of nesting and spawning, destruction of habitats, especially disturbance of spawning habitats, physical removal of benthic

faunal communities, physical removal of protected plants disturbance of fish, shrimps and benthic faunal feeding habitats

- Detrimental effects of suspended sediments, turbidity and sedimentation, especially disturbance of fish spawning and nursery habitats, disturbance of fish and shrimp larval development, effects on the behavior of migrating organisms, effects on feeding of larval, juvenile and adult fishes and crustaceans, burial of benthic fauna communities, disturbance of benthic fauna development, enhancement of photosynthetic oxygen production of planktonic algae, and burial of benthic plants
- Degradation of water quality, especially in zones with low energy and in waters with sediments with high organic content, impairment of larval development of marine animals, impact on adult and crustaceans (e.g. bioaccumulation), impact on benthic organisms, enhancement of algal growth.

In the light of above description, the impact of dredging and reclamation for the proposed PIBT Jetty will have very localized impact on the macro-fauna near the site. Moreover, re-colonization of some species may occur after the construction of the proposed PIBT Jetty when the stable environment will prevail except for routine handling of coal.

Impact of turbidity plumes on aquatic species during dredging: When dredging and disposing of non-contaminated fine materials in estuaries and coastal waters, the major environmental impacts are associated with suspended sediments and increase in turbidity. All modes of dredging release suspended sediments into the water column, during excavation and during the flow of sediments from hoppers and barges. In many cases, the locally increased suspended sediments and turbidity associated with dredging and disposal is apparent from the turbidity 'plumes' which may be seen trailing behind dredgers or disposal sites.

Turbidity plumes are caused by the re-suspension of sediments in the water column. If suspended at sufficient concentrations for long periods of time, the penetration of sunlight through the water column may be reduced. Light is fundamental to photosynthesis of aquatic plant life such as algae and species associated with coral, and other organisms. Furthermore, increase in turbidity can cause clogging of gills and feeding structures of certain species (e.g. shellfish and filter feeding species including worms and mollusks). Similarly, young fish can be damaged if suspended sediments become trapped in their gills and increased fatalities of young fish have been observed in heavily turbid water. Adult fish are likely to move away from or avoid areas of high suspended solids, such as dredging sites, unless food supplies are increased as a result of increase in organic material. Hence, turbidity can reduce productivity and in extreme cases can be fatal. For maintenance dredging, the environmental impact is on the near-field; it is temporary and generally lasts over the period of dredging operations.

The degree of re-suspension of sediments and turbidity from maintenance dredging and disposal depends on the following variables:

- Characteristics of sediments being dredged (size, density and quality of the material),
- Method of dredging (and disposal),
- Hydrodynamic regime in the dredging and disposal area (current direction and speed, mixing rate, tidal state), and
- Existing water quality and characteristics (background suspended sediment and turbidity levels).

Considerable dredging activity is proposed for the berthing pocket and temporary access channel. This would last for about 12 months. Creation of turbidity plumes during dredging could adversely affect certain marine species. Dense plume of turbid water is expected depending upon the method employed for dredging. It is recommended that hydraulic dredging be employed to minimize the disturbance caused to the sea bed. The bed sediments to be dredged comprise fine materials, predominantly fine silty

sands, silt and silty clay. It is the finer material which tends to remain in suspension for relatively long periods of time, thereby causing significant impacts on transparency of seawater. Initial site investigations indicate that the bed sediments are reasonably well consolidated. It would be reasonable to assume that an efficient trailing suction or cutter suction dredger would remove most sediment only re-suspending relatively small volumes of particulate matter in low layers of the water column. In the low energy conditions of the sheltered creeks, it is anticipated that a majority of re-suspended material would soon resettle on the bed while any turbidity created would have no adverse long-term impact.

The dredging of berthing pocket of Kadiro Creek will have negative impact on the marine habitat and the benthos of the creek; this would adversely affect fisheries reproduction. However, carefully regulated construction program and disposal of spoil only in the designated areas as suggested and refilling of temporary canal would minimize and localize these impacts. In view of the greatly reduced the benthic habitat due to extensive dredging and disposal of spoils carried out for Port Qasim over the last decade, PIBT will ensure the adoption of careful methods to further reduce the impact of construction on marine ecology of the site.

No endangered species are reported to exist in the area. The Zoological Survey of Pakistan has very recently recorded two species of marine cetaceans — Indo-Pakistan humpback dolphin (Sousa Chinensis) and black finless porpoise (Neophocaena phocaenoides) — in the Korangi-Phitti creek system. The humpback dolphin species is classified as near threatened on the IUCN (International Union for Conservation of Nature) Red List and listed in Appendix 1 of the CITES (Convention on International Trade in Endangered Species). The black finless porpoise is classified as vulnerable on the IUCN Red list. But for the two species which will be given due protection if found in the PIBT area, the impact of construction activity on marine ecology will be small, temporary and localized to the microenvironment.

Mitigation Measures

The following measures can be adopted to minimize the impact of dredging in the Project area:

- Coffer dam especially designed to strain water without releasing considerable sediment load back into the marine ecosystem may be built to retain the dredged material for subsequent use of the dredged spoil for reclamation,
- Overspill may be reduced as far as practically possible
- Location of the discharge pipe at a suitable depth in the water needs to be ensured.
- Efficient trailing suction hopper dredger may be used wherever possible
- It is recommended that, as a minimum standard, the acceptable limit of 2,000 mg/l suspended sediment concentration of the World Bank guidelines should be adopted (World Bank Technical Paper 140). This limit is suggested to prevent covering valuable benthic species (e.g. shellfish) that are sensitive to increased suspended sediment concentration. Studies by Palermor et al (1990) and Appleby and Scaratt (1989) indicate that suspended sediment concentration of 500 mg/l and 1,000 mg/l at 500m distance from the dredger can be considered safe for fish because they are mobile and can avoid severe aquatic conditions. It is suggested that dredging should be restricted during critical spawning periods for shellfish.

Removal of Benthos by Dredging: During the dredging operations, there will be an inevitable loss of some benthic species. Some of the species could be of importance in themselves, or as a source of food for other marine fauna, including fish. The substrate within the proposed dredging area at PIBT site is consistent with that in the rest of the port area. It is also reported that the species found within the Project area are also found within the Port area. In addition, the sediment which will remain after dredging is likely to be very similar to that which exists at present. It is likely that the species from adjacent areas will re-colonize the dredged area following dredging. The exact composition of species, in terms of abundance and distribution, may not re-colonize the area initially as the area will first be

colonized by opportunistic species which are short-lived and reproduce rapidly. As the rate of siltation in the inner channel of the port is very low, yearly maintenance dredging is not required normally. Depending on the frequency of any maintenance dredging, this type of community may dominate or be replaced by longer-lived species.

MitigationMeasures

No particular mitigation measures are required.

Smothering of Benthos during Dredging: Sediments dispersed during maintenance dredging and disposal may resettle over the seabed and the animals and plants that live on and within the system. This blanketing or smothering of benthic animals and plants may cause stress, reduced rates of growth and reproduction besides being fatal in the worst case scenario. Generally sediments settle within the vicinity of the dredged area, where they are likely to have little effect on the recently disturbed communities, particularly in areas where dredging is a well-established activity. However, in some cases sediments are distributed more widely within the estuary or coastal area and may settle over adjacent sub-tidal or inter-tidal habitats possibly some distance from the dredged area. The most vulnerable species will be the sessile species such as sedentary worms and the slow moving species such as mollusks. The significance of this impact will depend on the amount of sediment in suspension, the sediment size distribution and the current movements around the dredging area.

The sensitivity of marine animals and plants to siltation varies greatly. In areas with high natural loads of suspended sediments, the relatively small increases in siltation away from the immediate dredging area are generally considered unlikely to have adverse impacts on benthic populations.

Mitigation Measures

The mitigation measures proposed to control turbidity plumes will also help mitigate the above impacts.

Release of contaminants during dredging and disposal: Dredging and disposal activities can potentially cause remobilization of contaminated sediment. Contaminated sediment may not be necessarily harmful to aquatic organisms living in the sediment due to contaminant's adsorption characteristics. However, if sediment conditions are changed such that contaminants can get released into the water column (either dissolved or as suspended particulate matter), then they may become bio-available and may cause toxic effects. The results of the sediment quality analysis indicate that the sediments to be dredged are not contaminated to any significant level. Therefore no adverse impacts are expected in terms of release of contaminants by dredging and uptake by aquatic organisms.

Mitigation Measures

No mitigation measures are suggested.

Impacts on Marine Animals during Construction Phase: The bottom sediments to be excavated for establishment of the PIBT comprise fine materials predominantly fine silty sands, silty clay and silt. Due to re-suspension of sediments, turbidity plumes are formed in the water column. If the material remains suspended for a long period of time at higher concentrations, there is a possibility that the penetration of sunlight through the water column may be reduced. Moreover, the turbidity can cause the clogging of gills and feeding structures of fish and shell fish and filter feeding species including mollusks and worms. Hence, the enhanced turbidity will lead to reduced productivity and may be fatal in extreme cases.

The excavation of the area for pile boring; dredging of the creek as well as reclamation for, and back filling of desired land will have negative impact on the habitat of the Project site and the benthos of the Kadiro Creek, which will be adversely affected if proper care is not taken during construction. There will be inevitable removal of some benthic species at the construction site. Some of the species could be important in themselves or as a source of food for other marine fauna including fishes of the adjoining area. It is a natural phenomenon that after construction phase is over the species from adjacent areas re-colonize at the site. The exact composition of species in terms of abundance and distribution may not re-colonize in the area initially but with the passage of time and stability in the ecology of the

area, the habitat may assume similarity in nature prior to the construction by long lived species. Since the construction phase is a short term activity, the impact may not be very significant because the severity of impact is dependent on the amount of sediment in suspension, sediment size distribution and the current movement in the operation area. It is anticipated that the turbidity thus caused would not have significant impact.

Mitigation Measures

Careful and regulated excavation, back filling and quality assured construction methods should be employed by the contractors. The foreign material for filling purposes should be contaminant free. These measures would minimize and localize the adverse impacts. Since the activity is short-term, the above-noted mitigation measures would be adequate and no special measures would be necessary.

Impacts of Operation on Marine Ecology: The operational activity involving shipping traffic, off loading of coal at jetty, filling of trucks and other associated activities at the PIBT. It will be mandatory for all shipping companies to follow the principles of safe navigation in letter and spirit to minimize accidents. Even if a ship runs aground it will face minimal damage since the channel is formed in mud and sand. There are no rocks in the vicinity of the channel. The PIBT storage facility has been designed keeping in view the standard international safety specifications for handling coal, clinker and cement. All necessary control measures have been incorporated to ensure that no fugitive emissions enter the marine ecosystem. The nature of the project is such that it will not have any impact on marine ecology. The liquid effluents from the offices will be treated to meet NEQ Standards, as such the possibility of contamination of the microenvironment hosting juvenile fish and other commercially important species is substantially reduced. The potential threat to the fish is from the untreated industrial and municipal sewage being discharged into the creeks, while the operation of PIBT will have no impact on the marine ecology of the area.

Accordingly establishment of the terminal is not expected to disturb the ecology of the core area to significant level. The project is also not expected to release any pollutants during its normal operations. Its location and operation is not expected to affect the breeding habitats of marine animals or migratory paths of any bird species. No adverse impacts are anticipated on the marine life during operation.

Mitigation Measures

The proponent shall develop a contingency plan to combat emergency situations. It will maintain an in-house capacity to deal with small to medium accidental spills. Added to this capacity is the participation of the Proponent in the Contingency Plan developed by and in implementation at Port Qasim. Standard Operating Procedures (SOPs) shall be implemented in letter and spirit.

7.1.9 Natural Hazards

Natural disasters may occur in the vicinity of the project area; these include severe storms and tropical hurricanes, flooding, and earthquakes. The impacts are expected to be low at PIBT project site within Kadiro Creek since its location is not critically exposed to open sea.

The Geological Survey of Pakistan has, however, defined the area of Port Qasim, where the site under study is located, to fall in a Seismic Zone 2B region. This suggests the possibility of moderate to major seismic hazard i.e. probability of earthquakes of intensity VI to VIII MM scale and 5.6 to 6.6 on Richter scale. From the charts published (such as Figure 7.2), the peak ground level acceleration (PGA) for this zone is 28%. The seismic risk factor of 0.3 is advisable and will need to be incorporated in the design for constructions and installations in the coastal zone, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM-VI to VIII). The seismicity in the Karachi and at Project site is considered to be low. According to the published data the Project area lies in zone of low seismic activity, with acceleration ranging from 1.6 to 2.8 m/sec^2. A factor of 2.8 m/sec^2 will, on the other hand, have to be taken for a maximum credible earthquake (MCE). The design of the PIBT terminal should take these values into consideration.

Major damages done by Tsunamis, the impulsively generated seawater waves that are a result of underwater

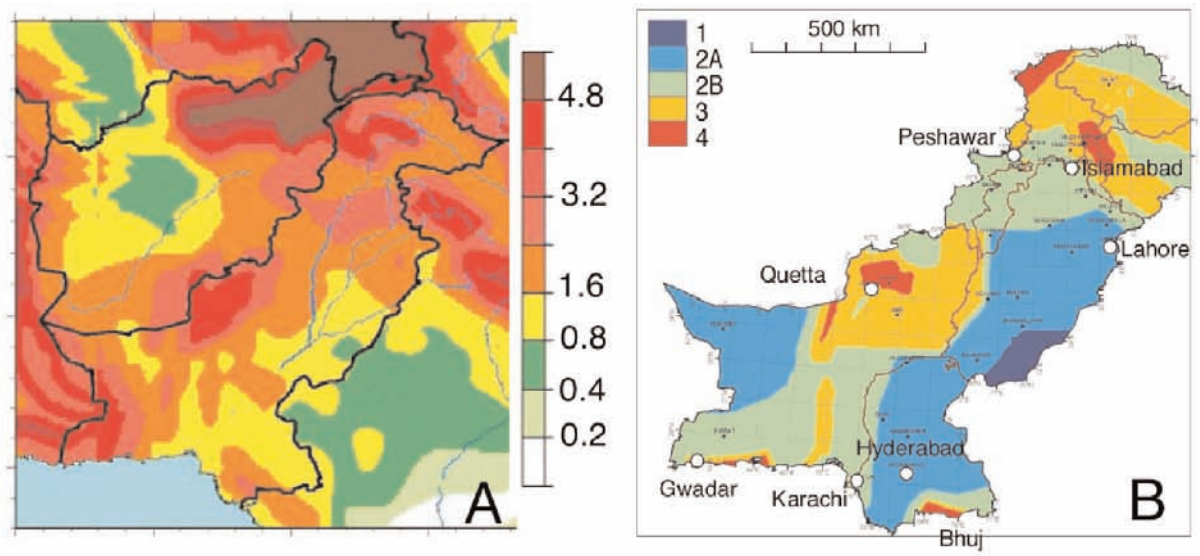


Figure 7.2: (A) GSHAP hazard map of Pakistan (Giardini et al. 1999; color scale indicates peak ground acceleration (m/s/s) with 10% probability of exceedance in 50 years) compared to (B) a recently revised hazard map following the 2005 earthquake (working group on Pakistan Hazard 2006; zonation 4 is most hazardous, 1 is least hazardous).

earthquakes, have not been recorded for the coastal area south of Karachi. There are, however, evidences of a 1.2 m tsunami generated by an offshore earthquake of intensity 8 M in 1945, which caused only minor damages in Port Qasim area. This event was followed by another Tidal wave that was recorded in 1953. The Tsunami of December 26, 2004 had no impact on the macroenvironment of the Port Qasim area.

Tsunamis are not expected to occur in the vicinity of the project area; yet, the mitigation strategies proposed to deal with hurricanes and surges of category 5 are considered sufficient to deal with tsunamis of high order.

Mitigation Measures

The mitigation strategies for each of the aforementioned natural hazards are discussed below.

- The PIBT facility will be designed to withstand a Category 4 hurricane and the remaining components of the facility will be designed for a Category 3 hurricane. These design parameters will protect against high winds, as well as storm surge and wave effects, associated with these relatively infrequent meteorological events.
- Shore protection structures will be designed to withstand the impacts from a 100-year storm events. Based on design evaluations, shore protection features will be incorporated to further stabilize the creek system and its operational features.
- PIBT design shall follow seismic zone 2B as well as a factor of 2.8 m/sec^2 will have to be taken for a maximum credible earthquake (MCE)

7.1.10 Protected Areas

There are no designated Protected Areas in the vicinity of the project area. This ESIA study has also not found any antiquity artifact in the microenvironment of area concerned. No sites of cultural heritage are known to exist at or in the immediate vicinity of the PIBT Project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites. There is therefore no likelihood of negative impact from the construction and operation of the facilities; as such, no mitigation will be required.

Mitigation Measures

In case any site(s) of archaeological significance is discovered during the construction phase of project; the contractor shall be liable to:

Table 7.4: Volume of Truck Traffic

Year	Port Traffic Generation scenarios	Truck Traffic generated at Port Qasim		
		Rigid Truck 2-Axels Single (1.2) 10.5 Tonnes capacity	Rigid Truck 3-Axels Rear Tandem (1.22) 23 Tonnes capacity	Total Daily Truck volume Generated
2014	Combined traffic for Coal, Cement and Clinker	1024	201	1225
2015		1261	248	1509
2016		1358	267	1625
2017		1451	285	1736
2018		1479	290	1769
2019 and Onwards assuming full traffic		1490	292	1782

- STOP the work
- Demarcate the area
- Notify the concerned department(s)

7.1.11 Total Anticipated Traffic

Volume of Truck Traffic: The total volume of heavy traffic anticipated due to operation of the proposed facility was estimated by summing up the traffic generated due to port traffic of coal, cement and clinker as shown in Table 7.4.

Volume of other Traffic: It is envisaged that in addition to the above truck traffic, the operations at the proposed terminal would also generate other forms of traffic consisting mainly of motorcycle, cars, pickups, vans, coasters, minibuses and buses, etc. used for the transportation of port

Table 7.5: Volume of Other Traffic

Road	Motor Cycles	Cars / Wagons	Buses	Mini buses	Pickups	Rigid Trucks	Trucks + Trailers	Total All Vehicles
Main Access Road	292	1566	828	284	540	1505	365	5380
Access Road	84	104	58	26	52	164	58	546

Source: Table 2.3.1: Daily Existing Flows on PQA Roads - Final Report on Strategic Planning Study for Port Qasim, Volume 3, May 2001.

Table 7.6: Total Daily Volume of Traffic due to the Proposed Terminal

Year	Motorcycle	Car, Jeep, Van, Taxis, Light Pickups	Minibuses, Coaster, Coaches	Heavy Pickups, Mini Truck	Buses	Rigid truck 2-Axels Single (1.2)	Rigid Trucks 3-Axles Rear Tandem (1.22)	Total Anticipated Volume	
								Vehicles	PCU's
2014	121	651	118	225	345	1024	201	2685	5864
2015	128	690	122	234	355	1261	248	3038	6827
2016	136	731	126	243	365	1358	267	3227	7276
2017	144	775	130	253	377	1451	285	3415	7715
2018	153	822	134	263	388	1479	290	3529	7916
2019 and Onwards assuming full traffic	162	871	138	274	400	1490	292	3627	8062
Passenger Car Equivalent	0.50	1.00	1.50	1.50	2.50	3.00			

staff /workers and other visitors. This traffic was estimated on the basis of the existing traffic at Port Qasim taking into account the anticipated commercial activity at the proposed facility. The Final Report on Strategic Planning Study for Port Qasim presents the following data for traffic flows on PQA Roads in May 2000 (Table 7.5).

Furthermore, the external traffic to and from Port Qasim was estimated to be around 8700 vehicles per day in the year 2010.

For the purpose of this analysis, about 20% of this traffic volume was assumed to be due to the proposed facility and was further projected over the analysis period with an average yearly growth rate of 6.0% for cars and motorcycles, 4.0% for the heavy pickups and mini-trucks and 3.0% for the minibuses and buses. The growth in vehicles registered in Karachi and the development of commercial activities at the proposed terminal were duly considered while selecting these average traffic growth rates.

Total Daily Volume of Traffic due to the Proposed Terminal: The estimated total daily volume of traffic due to the proposed terminal at Port Qasim is presented in Table 7.6.

Alternate Analysis with Articulated Trucks: An alternate analysis was also carried out to determine the total daily

Table 7.7: Alternate Analysis with Articulated Trucks

Year	Port Traffic Generation scenarios	Truck Traffic generated at Port Qasim		
		Articulated Trucks 6-AxlesTandem 6-AxlesTandem Tridem (1.2-222) 35.33 tonnes capacity	Rigid Truck 3-Axels Rear Tandem (1.22) 23 Tonnes capacity	Total Daily Truck volume Generated
2014	Combined traffic for Coal, Cement and Clinker	305	201	506
2015		375	248	524
2016		404	267	571
2017		432	285	717
2018		440	290	730
2019 & Onwards *		443	292	735

** Assuming the terminal to be operating at full capacity*

Table 7.8: Summary of Alternate Analysis With 70% Articulated Trucks - 6 Axle Trailers

Year	Motor Cycles	Car, Jeep, Van, Taxis, Light Pickups	Minibuses, Coaster, Coaches	Heavy Pickups, Mini Truck	Buses	Rigid truck 2-Axels Single (1.2)	Rigid Trucks 3-Axles Rear Tandem (1.22)	Total Anticipated Volume	
								Vehicles	PCU's
2014	121	651	118	225	345	305	201	1966	3707
2015	128	690	122	234	355	376	248	2153	4172
2016	136	731	126	243	366	404	267	2273	4414
2017	144	775	130	253	377	432	285	2396	4658
2018	153	822	134	263	388	440	290	2490	4799
2019 & Onwards *	162	871	138	274	400	443	292	2580	4921
Passenger Car Equivalents	0.50	1.00	1.50	1.50	2.50	3.00	3.50		

**Assuming the proposed terminal to be worked at full capacity*

volume considering about 70% Articulated Trucks used for the movement of coal, cement and clinker. The volume of truck traffic generated under this scenario is presented in Table 7.7.

The total volume of traffic generated this scenario is summarized in Table 7.8. The analysis shows that the total volume would be around 2,000 vpd (about 3,700 pcu's) in the year 2014 increasing to about 2,600 vpd (about 5,000 pcu's) by the year 2009 when the terminal is expected to be working at full capacity.

On the basis of Traffic Impact Assessment carried out for the project, it is concluded that:

- Upon completion of the two phases of the project, the terminal would have a capacity to handle about 8,000,000 metric tons of the dirty bulk cargo consisting of coal, cement & clinker,
- Keeping in view the historical trends in the import and export of coal, cement and clinker to/from Pakistan, the future prospects, and the maximum loading capacity of the prevalent truck types, it is forecast that heavy traffic consisting of about 1800 trucks per day would be generated during peak operating conditions.
- The total additional volume due to the proposed terminal is estimated to be around 3000 vehicles per day (vpd) or 5900 passenger car units (pcu's) per day in 2014 to about 3600vpd or 8100 pcu's per day in 2019 and beyond when the terminal would be operating at its full design capacity.
- While the initial traffic volume of 5900 pcu's can be accommodated on the circulation area consisting of 3-lane roads provided in the terminal complex, necessary measures shall be required to avoid queuing of vehicles and resulting congestion and delays and addition of another lane shall be required by the year the terminal starts operating at its full design capacity.
- Under an alternate scenario (summarized in Table 7.7) considering about 70% articulated trucks having a capacity of about 35.33 metric tons pay load, only 3-lanes shall be required for the movement of traffic in the terminal complex by the year 2019 and beyond.

Mitigation Measures

Mitigation of internal impacts of traffic movements would require various measures to be taken inside the proposed terminal complex including:

- Advanced/automated systems for security checking to avoid unnecessary delays and queuing of vehicles,
- Effective utilization of Road signs and markings for better guidance and control of traffic within the complex,
- Segregation of vehicular and pedestrian movements, and provision of walkways/footpaths
- Provision of designated parking and service areas for different types of vehicles and road connectivity of these areas.
- Preparedness/arrangements for incident management, especially in the event of breakdown of vehicles along the circulation areas inside the terminal complex.
- Well-designed road lighting system.
- Provision of proper turning radii for trucks
- Provision of sufficient lateral clearance and standard lane widths of 3.65m (12ft).

Mitigation of external impacts would require various measures to be taken by PQA outside the boundary of the proposed terminal complex including:

- Widening of the approach roads for carrying the additional traffic
- Provision of necessary guide signs and markings for better traffic control and, if necessary,
- Rerouting/scheduling of traffic movements to avoid traffic conflicts, congestion and delays within the PQA limits.
- Prioritization of the construction of flyovers/bridges planned within the PQA limits.

- Plantation of more trees to overcome air pollution due to vehicular exhausts.

1. Incidence Management: The additional traffic movements would call for greater preparedness for incidence management along the road network inside the PQA limits. Eventualities especially to be considered include:

- Breakdown of vehicles along main travel corridors/arteries causing queuing of vehicles, congestion and delays, and
- Traffic control under bad weather conditions such as heavy rains and poor visibility/fog in border to avoid accidents and losses.

2. *Interchange for Safer Entry/Exits:* Provision of interchange along the National Highway, N-5 for safer entry/exit movements is highly desirable and should be considered by PQA alongside the implementation of capacity enhancement programme since enhanced capacity would attract/generate more vehicular traffic, most of which would consist of heavy vehicles. Therefore the interchange planned at the entrance from N-5 should be prioritized in order to avoid unnecessary delays, congestion, environmental pollution, economic losses and any traffic accidents due to conflicting traffic movements.

3. Pedestrian Facilities: Although pedestrian movements shall be on a limited scale, pedestrian facilities shall be required inside the proposed terminal for safer movement of people walking around different terminal areas. Designated walkways/footpaths should be provided for movement of people from the gate of the terminal to various areas and proper signage and marking should be used for enhancing the pedestrian safety features.

7.1.12Socioeconomic Impacts of Proposed Coal, Clinker and Cement Terminal in Port Qasim

The cumulative impact on the National economy will be strongly positive. Significant additional resources will be realized by the nation as a result of this project, which is consistent with the government's long-term development plan. The additional licensing income, among other sources of additional income, will add to the government revenues and economic growth resulting from expanded and diversified business development in Pakistan in future.

It is estimated that a maximum of 400 to 500 full time construction jobs will be created during the construction phase of the project. PIBT will use faithful efforts to employ qualified Pakistani citizens in the construction and operation of the proposed project. A training program will be initiated by PIBT to recruit and train suitable citizens with the skills required during the project's construction and operational phases. Based on local populations and the potential number of available workers it is expected that up to 50 percent of the construction work force personnel will be hired from Karachi. The remainder of the construction and supervisory positions will be filled with experienced workers that will temporarily relocate to the area. Thus, construction activities will provide numerous new, temporary and permanent, work opportunities for both skilled and unskilled labor, as well as contribute significantly to the national economy. Because of the available labor pool, particularly of unskilled workers, and the diminishing needs of other large construction projects currently underway in Sindh, the demand for labor for this project is not expected to compete with or impede other ongoing development projects in the area.

In addition to creating construction jobs for an extended period (estimated at 2 years), job training will be made available to provide the appropriate personnel for civil, mechanical and other positions required by the construction. This action is consistent with the national goals of advancing both training and employment of its citizens in the high technology sector, and is particularly important to the young population of the Country as they emerge from school and enter into the workforce.

It is estimated that 100 to 150 permanent full time jobs will result from on-going operations and maintenance of the facility with a permanent annual payroll.

Major raw materials to be used during construction are expected to be purchased from the local market since significant amount of cement, aggregate or ready mix

concrete, and miscellaneous fabricated material may be sourced from different parts of country. Other required materials may also be purchased locally; such items include food, housing materials, ferries and other small marine vessels, household and office supplies, oils, chemicals and cleaning supplies. These purchases are projected to infuse the local economy with additional revenues over the estimated 2-year construction period.

The following features of the PIBT further uphold the statement about the cumulative impact of the Project on the National economy being strongly positive.

1. PIBT project is based on private public partnership mode of financing (BOT) which is very encouraging decision on the part of Port Qasim Authority (PQA) to invite private investment.

2. The project is transport related infrastructure facilities to support industrial growth through import of raw material in the form of coal and export of cement and clinker.

3. The project is capital investment rather than labor intensive.

4. This project is also in line with the government policy not to do the business but to facilitate the business by encouraging private investors and operators.

5. The sustainability and applicability of this project is sensitive towards estimation of the forecast of import (5.42 million tons) and export (5.044 million tons) target for the year 2038 besides revenue target of ($60.319 million).

6. The financial indicator of the project that is IRR and NPV seems to be adequate under the existing business environment.

7. The project success will also depend on international development economy trend with special reference to relevant countries from which import and export trading are expected.

8. Moreover, Pakistan relation with trading countries will also be a contributory factor towards this project.

9. Domestic economic growth which is exposing to risk of deteriorating law and order situation, surplus industrial production of cement and clinker which would pave way for export.

10. Power generation and other fuel required for the industry are needed to be increased.

11. Role of regulatory authority to ensure agreed provision of concessions/relief are to be ensured.

12. Role of industrial transport and international development economists are very important to provide guideline for right decisions at right time to explore potential for exports of cement and clinker products in question.

13. The distribution network infrastructure for transmission of goods through efficient and economical mode of transport.

14. The healthy competition and investment friendly environment would provide greater chances for exporting opportunities in the international markets.

15. The monitoring and project evaluation mechanism from international donor agency involved in this project would be supportive towards sustainability of this project.

16. The conducive environment with special reference to reduction in air pollution, would be effective for the labor working in the port area.

17. The project will improve the economy in terms of generating revenue by promoting export of excess production of cement and clinker.

08 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

This section lays out the Environmental Management Plan (EMP) for the works concerning the Designing, Pre-Construction, Construction and the Operation stages of the proposed Coal, Clinker and Cement Terminal (the Bulk Terminal) at Kadiro Creek in Port Qasim Karachi. The EMP is meant to provide an overall approach for managing and monitoring environment-related issues and to describe the institutional framework for implementing the EMP. The EMP will also serve as the benchmark for measuring the effectiveness of environmental protection and management. This can be achieved by specifying the monitoring, reporting and auditing requirements, with nominated responsibilities and timing to ensure the necessary mitigations measures are met. It also makes provision, as appropriate, for unforeseen events by outlining corrective actions which may be implemented in these situations.

The previous sections identified the environmental impacts of different activities during the pre-construction, construction and operation stages of the bulk terminal and mitigation measures to reduce the severity of the impacts. For successful environmental practices an essential requirement of the Pakistan Environmental Protection Act 1997 and the International Finance Corporation (IFC) is to develop an environmental management plan (EMP) to guide through the procedures to the management and employees of the organization for continual improvement. This EMP will be implemented by Pakistan International Bulk Terminal (PIBT) Ltd, the proponents of Coal, Clinker & Cement Import/Export Terminal project. The EMP outline the objectives, define the responsibilities of the project sponsors/owners and contractor(s), and lay down the required communication, reporting procedures and mechanism through which the proposed measures will be monitored. Contingency Plan is part of the EMP.

8.1 Objectives & Scope of EMP

The Rationale of this EMP is to propose environmental protection commitments to protect the environmental values that may be affected by the development of the proposed project works and to assist the administering authorities to decide the appropriate approval conditions for the project. The EMP is required to achieve the following objectives:

- Outlining measures to be taken during the implementation and operation of the bulk terminal to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels.
- Taking actions such as defining roles and responsibilities of the project proponent for implementation of EMP and identification of areas where these roles and responsibilities can be shared with other stakeholders.
- Defining the requirements for communication, documentation, training and management and implementation of mitigation measures.
- Taking actions required for assessing the effectiveness of mitigation measures employing the monitoring mechanism and identifying related parameters to confirm the effective implementation of these measures.

The scope of the EMP includes the following functional areas:

- Management systems: Those systems employed in the management of the PIBT's operational activities. It will include financial systems; engagement and supervision of contractors; purchasing policies, etc.
- Knowledge systems: Those processes which build knowledge and capacity on environmental issues, principles and sustainable behaviors. It will include

training; communications; campaigns; links with operational departments, etc.

- Energy management: The energy related aspects of the planning, design, construction, operation and maintenance of the PIBT's facilities.
- Water management: Aspects of supply, usage and disposal of water pertinent to the planning, design, construction, operation and maintenance of the PIBT's facilities.
- Materials management: Those services and activities which support the avoidance, resource recovery (e.g. reuse and recycling) and environmentally responsible disposal of solid and liquid waste materials.
- Planning, design and development: The planning, design and development of the PIBT's built form and associated infrastructure.
- Pollution prevention: Those aspects of planning and management which support minimization of air and water pollution and contamination of land resulting from daily routine activities.
- Transport: Programs, projects, systems and procedures which promote and support walking, cycling and public transport for trip-to-work, accommodation and other related travel.
- Biodiversity and open space: Those aspects of management and maintenance which support conservation and enhancement of biodiversity and environmentally sustainable use of open space across PIBT and other properties.

8.2 EMP Process

The EMP consists of the following areas and defines the methods and procedures for its implementation.

- Organizational structure; roles and responsibilities of project personnel;
- Specific requirements of implementation of EMP;
- Mitigation or impact management matrix;
- Monitoring plan with emphasis on specific parameters to monitor.

In the preparation of this plan several aspects concerning the siting, designing, construction and operation of bulk terminal have been taken into consideration. Additionally management related issues have been provided to guide through the procedures.

The PIBT will establish Health, Safety & Environment (HSE) department which will handle all environment related concerns and issues. The HSE manager will be the Head of HSE department and will be responsible for reporting directly to the Chief Executive Officer. To support HSE management system, HSE officer(s) will be appointed to coordinate with the contractor during construction process and also monitor the activities at all the sensitive areas during the construction and operations stages of terminal.

8.3 Project Background

The proposed terminal will provide a modern facility for import and export of Coal, Clinker & Cement by development a dedicated terminal incorporating state-of the-art bulk handling technology, reliable and proven safety design features and strict environmental control systems.

Following are the components of terminal:

A. Quay Design:

- A new quay wall with approx. 440 m total length
- A trestle with the conveyor belt connecting the jetty with the storage yard of approx. 2,600 m length.
- The proposed jetty is an open piled structure with deck area of 440 m length.
- The super structure consists of Cast in place capping beam (approx. size 1.4 m deep * 1.8 m wide) on top of piles. The 350 mm thick Pre-cast RC slab panels will be placed with Cast in place structural screed on top of it.

- The substructure consists of two types of piles. The vertical piles below crane tracks consists of 1500 mm diameter cast in place RC bored piles spaced at 7.5 m. 900 mm diameter steel are proposed in middle portion of jetty structure to resist strong lateral loads
- The width of the deck is variable according to necessities between 19 meters to 32.5 meters, and up to 36.5 m at the location of the berth office.
- At the seaside end the jetty is up top 29 m wide to make turning of vehicles easier.

B. Approach Trestle:

For connecting the jetty to the on-shore storage area a trestle bridge of approx. 2,400 m length is proposed.

C. Storage Area:

- The storage area is planned at nominally CD +5.50 m after settlement
- Coal and Clinker will be stacked in open storage; the maximum stack height will be 15 m.
- The compacted wet Coal density can be up to 1.2 t/m.^{3}
- Clinker can have the density of up to 1.52 t/m.^{3}
- Consequently load to the ground can be 180 kN/m^2 for Coal and 224 kN/m^2 for clinker respectively.

The potential environmental aspects that are likely to arise during designing, siting, construction and operation of the Coal, Clinker and Cement terminal are related to:

1. Land Use
2. Dredged Materials Management
3. Air Emissions & Dispersion
4. Wastewater
5. Solid waste management
6. Hazardous Materials and Oil Spill Management
7. Noise Emission
8. Biodiversity
9. Traffic Management

The ESIA has recommended mitigation measures to minimize the adverse impacts. These measures include the use of alternative options for siting, management and physical control, besides compensation for loss of mangroves, and are based on the understanding of sensitivity and behavior of environmental receptors in the project area, the legislative controls that apply to the project and a review of good management practices while operating in sensitive environments.

8.4 Management Approach

The environmental management will require specific approach in order to handle the issues effectively. Manager HSE will assign the roles and responsibilities to be performed during the construction and operations stages of Coal, Clinker and Cement terminal. It is expected that a certain degree of redundancy is inevitable across all management levels, but should be in the order to ensure that compliance with the environmental management plan can be cross-checked.

Compliance with EMP will be the responsibility of PIBT Management at each stage of project. PIBT Management will ensure that all executive activities during construction stage do not create adverse environmental effects. Contractor and sub-contractor will work in environment friendly manner under the supervision of HSE department of PIBT. All the regulatory agencies including Sindh EPA will be contacted as and when required to get advice for environmental management and they will be kept informed of the environmental conditions of the area periodically by PIBT management and their contractors/sub-contractors.

The contractor will carry out field activities as part of the proposed PIBT Project that includes relevant and subsidiary construction work. The contractor will have certain liabilities under the environmental laws of the country, which will be specified in the contract document with the PIBT Management.

Some of the approaches to be followed during the

environmental management practices are given below:

- Complying with the relevant legislation and regulations;
- Regularly reviewing of the impacts on the environment;
- Developing appropriate indicators to monitor core impacts;
- Setting appropriate annual objective, targets and publicly reporting on progress;
- Monitoring supplier's environmental management arrangements;
- Using sustainable materials for office supplies and environmentally safe raw materials with recycling options where appropriate;
- Communicating openly with internal and external stakeholder on environmental issues.

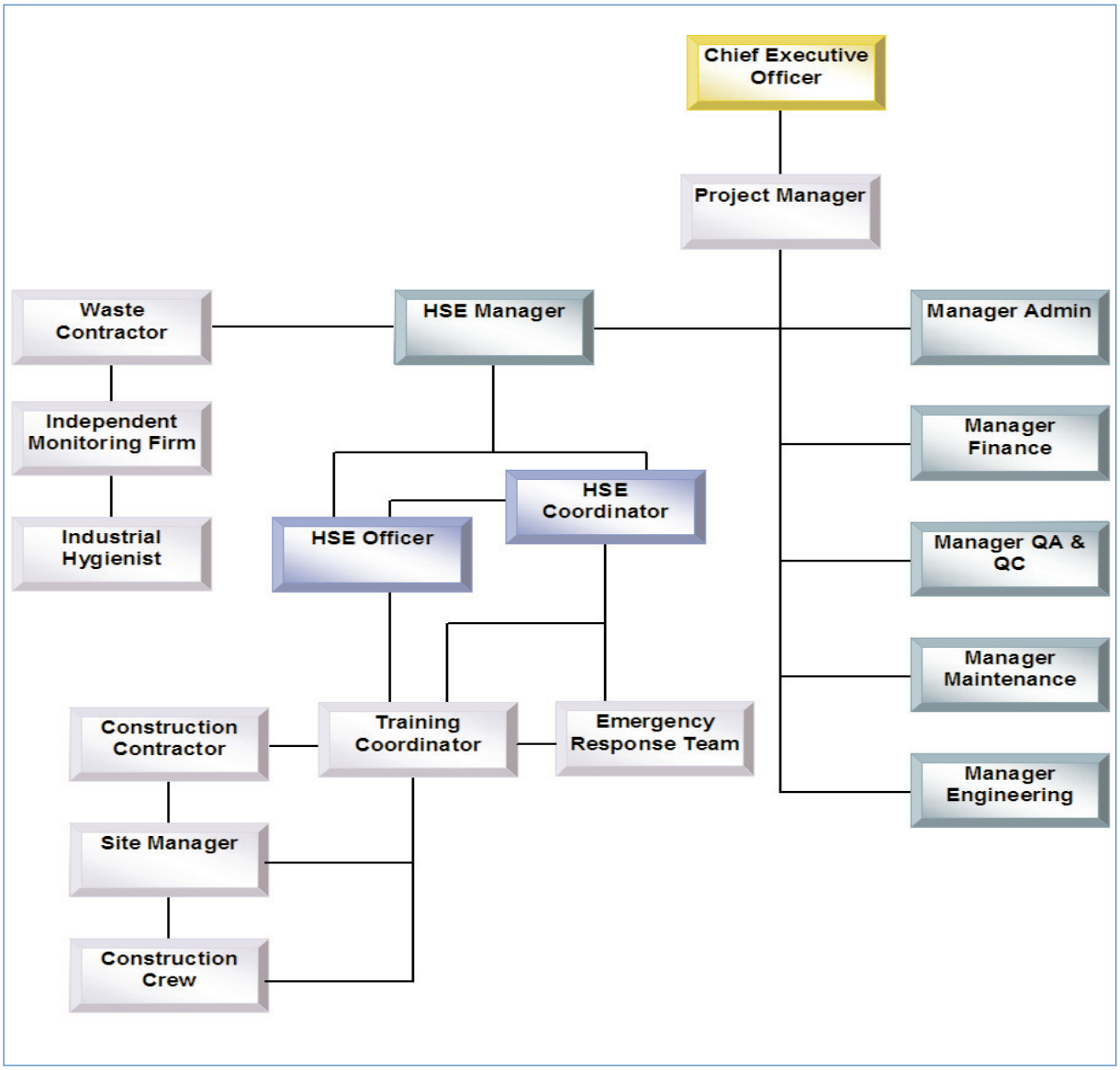


Figure 8.1: Suggested Organizational Structure for Environmental Management

8.5 Roles & Responsibilities

Environmental management will be the integral part of corporate policy of PIBT. Therefore, committing to reduce the environmental impacts will reflect the management approach and belief that good governance and performance in this area is synonymous with running a well managed efficient business. Overall responsibility for environmental performance rests with the Chief Executive Officer of PIBT while the daily management will be performed under the direction of Manager HSE. PIBT's HSE officer and contractor will execute environmental management under the supervision of Manager HSE during construction and operations. The contractor will carry out field activities as part of the proposed PIBT project that includes relevant and subsidiary construction work. The contractor will have certain liabilities under the environmental laws of the country, which will be specified in the contract document with the PIBT Management. The overall responsibility for all matters pertaining to environment will be that of the organisational head of assigned contractor.

A brief make-up of the roles and responsibilities of the system is given below:

1. Chief Executive Officer of CHHP

The Chief Executive Officer (CEO) of PIBT will regulate environmental management plan. Some of the key roles and responsibilities of CEO are given below.

- To consider and react to issues and solutions proposed by the HSE Department;
- To cooperate and consult the relevant environmental agency to perform better;
- To evaluate the progress of development and implementation of EMP;
- To approve any change in decision-making and authorities in consultation with Manager HSE, if appropriate.

2. Manager HSE

The success of EMP depends on proper and effective management provided by HSE manager. Following are some of the roles and responsibilities assigned to Manager HSE.

- To ensure that the points of views of staff, contractors and HSE officers are considered and placed likewise in the EMP;
- To identify issues and propose solutions for inclusion in the EMP review process;
- To improve coordination and exchange of information between top management, employees, and contractors;
- To contribute to actions required to deliver the management plan and ensure its continued development;
- To review EMP every year, tracking issues and changing EMP in accord with the solutions and suggestions;
- To monitor the progress of development and implementation of the EMP.

3. HSE Officer

The role of HSE officer will be authorized by HSE manager. The responsibilities of HSE officer will include:

- To integrate, as far as possible, the aims and objectives of different users within an agreed plan;
- To maintain a balanced, holistic approach to the solution of concerned issues in accordance with and compliance of legislative requirements;
- To provide professional guidance on questions relating to the environment management and issues raised by contractors/relevant personals;
- To develop the EMP process by its implementation.

4. Contractor

The overall responsibility for all matters pertaining to environment will be that of the organisational head of assigned contractor. The role and responsibilities of the contractor consist of the following:

- To carry out construction activities in environmentally sound manner;
- To coordinate with the HSE officer to resolve issues arising during construction phase;
- To manage and implement environmental management practices as given in the impact assessment report as well as HSE polices adopted/prepared by PIBT;
- To administer construction crew and reduce the environmental risks;
- To appoint a dedicated environment officer to understand and handle environmental issues more easily in coordination with PIBT's HSE officer/coordinator.

5. The Supervision Consultant

The PIBT shall appoint an Independent Monitoring Consultant (IMC) who will oversee that the construction activities are in consonance with the provisions of the ESIA. He shall be responsible for the preparation of monthly reports on the project progress. The consultant will maintain records, decisions made at meetings, progress on civil works, certified achievements and milestones, financial records, and any deviations from or changes to the contract plans. The consultant will assist the PIBT and contractor in preparing quarterly project progress reports, a project completion report, and monitoring and evaluation reports as required under the agreement.

8.6 Implementation Stages of EMP

Success of EMP will rest with its implementation. For that matter it will be necessary to establish an HSE department and organise a team with direct responsibility for putting the plan into practice. This set-up needs to be provided with adequate resources and an office base to execute the EMP in three stages, which include planning and designing; construction and operation.

8.6.1 Planning and Design of Coal, Clinker and Cement Import/Export Terminal Project

Implementation of EMP needs to take a start at the inception stage to handle the environmental issues much before they arise. The following are the three main components to consider in an EMP prior to start of construction:

A. Design of Terminal

It describes the project in terms of location, geology, seismicity, magnitude; infrastructure facilities available and their deficiencies; along with the mechanism for doing so. If any design parameter changes at the time of approval, PIBT will assess the environmental impacts that may arise from such changes. If the impacts are found to be different and in excess of those mentioned in the report, PIBT will develop effective mitigation measures to address the changes to minimise the residual impacts and seek approval for the required change from Sindh EPA.

B. Approvals

PIBT and contractor will, besides obtaining NOC from Sindh EPA obtain relevant clearance and necessary approval from the government and other agencies prior to commencing construction and operation. Furthermore, issuance of NOC from Sindh EPA will require the PIBT to plan for undertaking continuous monitoring, including self-monitoring and reporting.

The approval from Sindh EPA shall not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law in force.

C. Contractual Provisions

The requirements of environmental impact assessment with respect to mitigation measures shall be incorporated in the construction and operations plans and procedures. This will make it mandatory for the contractor to follow procedures and comply with environmental regulations.

8.6.2 Construction and Operation Phase

In order to implement EMP successfully during the

construction and operation phase, it is necessary to adopt mitigation measures, monitoring plan and emergency procedures in letter and spirit. Training will be required at each step and phase. Changes in management processes will be documented and made available to the employees.

A. Mitigation Plan

The environmental impacts and remedial measures, as well as responsible persons designated to ensure adoption of the mitigation measures are given in the mitigation matrix Table-8.1. A mitigation matrix is basically a mitigation plan. These impacts and mitigation measures have already been given in detail in the earlier chapters. The matrix presented here additionally provides the responsibility clause for construction contractor and proponent for adoption of mitigation measures throughout the project.

B. Emergency Procedures

In order to organise and manage occupational hazards and environmental catastrophes such as flooding, natural incidents and accidents, PIBT management will develop a contingency plan to deal with emergency situations that may arise during construction and operations as part of EMP. If required, non-conformities arising and remedies taken will be communicated and shared with the regulatory agencies.

C. Training

All employees will be trained appropriately to work on EMP effectively. Employees training will provide workers with information on minimising waste generation. The HSE officer/coordinator will determine the training requirements in consultation with contractor among the staff of both construction contractor, supervision consultant, Environment Specialist and PIBT's Manager HSE.

D. Monitoring and Review

Monitoring of different activities will be required to analyse the impacts of construction and operation on the environment. Self-monitoring and reporting tools will be adopted to carry out monitoring as per EPA rules and regulations.

HSE officer will coordinate with Manager HSE, who will be the in-charge of monitoring procedures. Monitoring techniques will be identified and the frequency of selected parameters for monitoring will be followed as per the monitoring plan given in Table-8.2. Manager HSE will keep a record of all non-conformities observed and report them along with actions to CEO for further action. Manager HSE will also report any impact anticipated along with his recommendations for further action.

The contractor shall take note of the recommendations relating to issues arising during monitoring of construction activities.

Review: Environmental assessment of the proposed project has been made on the basis of the project description, site visits, existing environmental conditions and expected changes in environmental parameters due to construction activities as well as during operation of the PIBT. Review of activities will take place after conceding changes in project design, record keeping and management plans subsequent to impact assessment study.

The environmental monitoring program will comprise of compliance monitoring, effects monitoring and post project monitoring with the objectives as described for each case as follows:

- Compliance Monitoring - to check compliance of the contractor(s) and the PIBT with the EMP;
- Effects Monitoring - to monitor impacts of the project activities in which there has been a level of uncertainty in prediction such as impacts on vegetation and to recommend mitigation measures if the impacts are assessed to be in excess of or different from those assessed in the ESIA; and
- Post Project Monitoring - to monitor residual impacts and complete restoration of sites.

Environmental monitoring is normally undertaken during both the construction and operational phases to

ensure the effectiveness of the proposed mitigation measures.

The compliance monitoring is principally a tool to ensure that the environmental control measures required in the ESIA are strictly adhered to during the project activity. The objectives of compliance monitoring will be to:

- Systematically observe the project activities;
- Verify that the activities are undertaken in compliance with the ESIA and EMP;
- Document and communicate any non-compliance so that any corrective measures required can be taken in a timely fashion;
- Maintain a record of all incidents of environmental significance and related actions; and
- Prepare periodic reports of the environmental performance of the project.

The mitigation plan will be used to monitor compliance. Where required, checklists will be used when monitoring compliance.

Compliance monitoring will be the responsibility of all organizations involved in the project, that is, PIBT, contractors, suppliers and supervision consultants. It will be carried out at the following levels:

- The PIBT's field staff;
- Supervision consultant's supervisory staff;
- The construction contractors' environment officers; and Suppliers.

Broadly, effects monitoring has the following objectives:

- To verify that the impact of the proposed project is within acceptable limits;
- To facilitate research and development by documenting those effects of the proposed project that can be used to validate impact-prediction techniques and provide a basis for more accurate predictions of future impacts;
- To immediately warn the project proponent and the regulatory agencies of unanticipated adverse effects or sudden changes in impact trends so that corrective actions can be undertaken, which may include modifications in the proposed activities or inclusion of modified or additional mitigation measures; and
- To provide information to plan and control the timing, location, and level of certain project activities so that their impact is minimized.

The common theme of the above objectives is the proper management of environmental risks and uncertainties. The ESIA predicts the impact of the proposed project based on available information on the environment and the natural processes that link various environmental parameters. Based on this prediction, mitigation measures are introduced such that the predicted residual impact does not exceed acceptable levels. However, there is always an element of uncertainty in such predictions due to an insufficient grasp of the processes, limitations in prediction techniques, or inadequate data on the environment. This is true for the physical, biological, as well as socioeconomic environment. Consequently, it is possible that even if control measures are implemented fully, the negative impact will exceed acceptable limits. The recommended effects monitoring protocols are provided for the pre-construction, construction and operational phases of the proposed project respectively.

A team including the PIBT Environmental Manager will conduct the monitoring program. A senior member of on site management staff will lead the monitoring team. Frequent round / surveillance of the area is to be conducted by the inspector of Independent Monitoring Consultant (IMC) for in-time detection of pollutants / polluter and remedial measures. IMC should also ensure compliance with procedures that are part of mitigating measures, such as low-speed, no engine-idling and no-horn disciplines on the access road.

The objective of post project monitoring will be to determine the level of residual impacts of the project activities on physical, biological and socio-economic

receptors in the project area. The monitoring will start one month after the termination of all project-related activities in the project area. As a part of the post-project monitoring, restoration of sites will also be checked.

E. Changes to the EMP

The ESIA and the EMP have been developed based on the best possible information available at the time of the Assessment. However, it is possible that during the construction and operation phase some aspects of the EMP will need to be changed owing to their non-applicability in a certain area of operation or the need for additional mitigation measures based on the findings of environmental monitoring during the construction and operation phase.

Such changes are elaborated below to make them part of EMP.

i. Change in Operations

Any change in the operation of PIBT if required, will be made in relevance to the EMP and all the impacts associated with changed process will be either similar to the existing impacts and if different, will be assessed and included in the mitigation management plan. This has, on the basis of nature of process change, been distributed into three categories.

First-Order Change: is one that leads to a significant removal of any operation from the project described in the chapter on description of project of this report and consequently requires a reassessment of the environmental impacts associated with the changes. In such an instance, reassessed environmental impacts of the proposed change will be sent to Sindh EPA for approval.

Second-Order Change: is one that entails project activities not significantly different from those described in the ESIA report, and which may result in project impacts whose overall magnitude would be similar to the assessment made in this report. In case of such changes, the environmental impacts of the activity will be reassessed. Additional mitigation measures if required will be identified and documented for being reported to Sindh EPA for their record.

Third-Order Change: is one that is of little consequence to the ESIA findings. This type of change does not result in impact levels exceeding those already assessed in the ESIA report; rather these may be made onsite to minimise the impact of an activity. The only action required in this regard will be to record the details of process change in the record register.

ii. Change in Record Register

A record register will be maintained at project site at the start of construction activity. All the changes to be made will be recorded in this register. This will assist in the step-by-step environmental monitoring and decision-making. Record register will be the responsibility of PIBT Manager HSE, and will be used internally.

iii. Change in EMP

Changes in project design may necessitate changes in the EMP. In this case, the following actions will be taken:

- A meeting will be held between representatives of PIBT, ESIA consultant and contractor, to discuss and agree upon the proposed change to the EMP.
- Based on the discussion during the meeting, a report will be produced collectively, which will include the additional EMP clauses and the reasons for their addition.
- Additional EMP clauses will be added to the original EMP as a second volume which will be distributed among PIBT and construction contractor. All relevant project personnel will be informed of the addition.

Table 8.1: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
1	Dredged Materials Management	1. Attempts will be made to save the trees by replanting them at another site, may be at the fenced boundary. In case they have to be removed, their removal will be compensated by planting four to six numbers for each mature or maturing tree removed. This would cause minimum disturbance to mangrove ecology during the construction and laying of the foundation piles for the trestle. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC.	Pakistan International Bulk Terminal
		2. Turbidity will be monitored during dredging event to ensure compliance with relevant international standards. If the turbidity standard is exceeded, dredging will be slowed down or shut down temporarily, until modifications can be made to the dredging technique to bring the operation back to compliance.	Pakistan International Bulk Terminal
		3. Prior to initiation of dredging activities, material/soil to be dredged will be evaluated for its chemical, biological, and engineering properties to ascertain if the dredged material can be used for reclamation or needs to be disposed of.	Pakistan International Bulk Terminal
		4. Excavation and dredging methods shall be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material, especially if the dredged material includes contaminated soil. There are several dredging methods as discussed in chapter 05; which are commonly used depending on the depth of the sediments and environmental concerns such as the need to minimize sediment suspension and increase dredging accuracy.	Pakistan International Bulk Terminal
		5. Use of techniques (e.g. silt curtains) to minimize adverse impacts on aquatic life from the re-suspension of sediments.	Pakistan International Bulk Terminal
		6. To prevent loss due to erosion, exposed soil materials will be protected by surface treatment such as armoring, pavement and vegetation. No mitigation measures other than those sited above are needed except that the entire operation will be keenly monitored by the proponent and IMC.	Pakistan International Bulk Terminal
		7. Dredged material will be analyzed in order to select appropriate disposal options (e.g. land reclamation, open water discharge, or contained disposal). Beneficial reuse of uncontaminated, dredged material such as that from the 2nd and 3rd layers at the dredging sites will be given priority.	Pakistan International Bulk Terminal
		8. The delivery of fill material to reclamation site at PIBT or site identified by PQA will be organized by spreading and compaction of fill layers to avoid spillage into the water.	Pakistan International Bulk Terminal
		9. Dredged material, in particular the 1st layer at dredging site, will be disposed of into Coffer Dam at the site designated by Port Qasim Authority if the dredge spoil is found contaminated. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) will also be required prior to discharge. Site-specific discharge quality standards will be established in consultation with EPA depending on the type and toxicity of the effluents and the discharge location.	Pakistan International Bulk Terminal
		10. The filling/reclamation material could be provided from offshore sources. These reclamation materials shall be placed by bottom dumping and thereafter by the rain bowing method. Side dams constructed in Christmas-tree fashion from quarried rock or large geo-bags will be used to manage the reclamation plan.	Pakistan International Bulk Terminal

Table 8.1: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
		11. The compacting activity will need to be completed prior to the reestablishment of new near shore habitats around project area. When proposed works are complete, no anticipated adverse long-term operational impacts from site filling and soil settlement are expected.	Pakistan International Bulk Terminal
		12. The shore protection system will be designed to withstand wave and surge conditions associated with the nominal 100-year frequency hurricane event.	Pakistan International Bulk Terminal
		13. Shore protection along the reclaimed site will consist primarily of concrete caissons or equivalent systems. These shore protection systems will be installed in areas that have already been impacted by prior dredging activities. Therefore, no additional impacts are expected due to installation of the shore protection structures.	Pakistan International Bulk Terminal
		14. During operation of the proposed Terminal, periodic bathymetric surveys will be conducted by PQA and PIBT within the berthing and turning basin to estimate changes, if any, in bottom elevation and locate areas of sediment accumulation.	Pakistan International Bulk Terminal
		15. Inspection and monitoring of dredging activities will be conducted through an Independent Monitoring Consultant (IMC) to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.	Pakistan International Bulk Terminal
2	Air Emissions	1. Construction impacts on air quality will be mitigated through construction management practices, including the use of appropriate dust suppression measures. Air quality impacts from operation of the project's power production system will be minimized by appropriate technology to reduce the impact of emissions to confirm to World Bank standards. The power production system will be designed for high-efficiency with advanced combustion controls to minimize fuel consumption and pollutant emissions.	Pakistan International Bulk Terminal
		2. The construction contractor will be mandated to adopt SOPs to control dust emission by e.g. frequent sprinkling of water. Activities such as grading of aggregates which generate too much dust will not be allowed at Project site and will be carried out off site away from populated areas.	Pakistan International Bulk Terminal
		3. During periods when the prevailing wind direction is north-easterly and strong enough to generate airborne dust naturally, consideration would be given to either wetting or avoiding works that would worsen such conditions. It is not likely that dusty conditions would occur often enough to significantly disrupt the construction works.	Pakistan International Bulk Terminal
		4. Fugitive dust emissions will be minimized through the use of dredged fill material, which will be pumped in a slurry form through pipeline into dewatering basins located near the final reclamation areas. Construction equipment used for final grading will handle fill material with high moisture contents and minimal potential to generate fugitive dust. To further minimize emissions of airborne particulates, fugitive dust will be mitigated using the following measures, as necessary: ■ Use of water on areas of exposed soils, if necessary; and ■ Final grading and landscaping of exposed areas as soon as possible.	Pakistan International Bulk Terminal
		5. Emissions from vehicles and other engine-driven construction equipment will be temporary and cease once the project is completed. Nevertheless, mitigation measures including proper maintenance of construction equipment and controlling unnecessary idling of equipment will be implemented.	Pakistan International Bulk Terminal
		6. All emissions from construction and operation must be in compliance with air quality standards in vogue. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant but would continue for the life of the Project. Regular monitoring and evaluation is recommended.	Pakistan International Bulk Terminal

Table 8.1: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
		7. Traffic management plan will be followed to regulate the incoming and outgoing vehicles and also their operation and maintenance.	Pakistan International Bulk Terminal
		8. Pollution control will be achieved by a water sprinkling system that will be installed for dust suppression at PIBT.	Pakistan International Bulk Terminal
		9. Stockpile water spray systems that are designed to be effective in high wind conditions and more efficient where and when sprays are activated, may be adopted for PIBT.	Pakistan International Bulk Terminal
		10. The water sprinkling system will also be in place at transfer stations between conveyors, which form the other source of PM10 emission.	Pakistan International Bulk Terminal
		11. Planting of dense canopy trees	Pakistan International Bulk Terminal
		12. Mitigation measures including proper maintenance of construction equipment and controlling unnecessary idling of equipment will be implemented; contractors and operators will be mandated to use new generators and to regularly maintain them so that the emission levels remain within acceptable range.	Pakistan International Bulk Terminal
		13. Selective Catalytic Reduction or alternative systems would be installed on board the ships to reduce NOx emissions.	Pakistan International Bulk Terminal
3	Wastewater Discharges	1. Careful use of heavy machinery and equipment will minimize the impact due to release of contaminants during this short term activity. 2. Mitigation measures to minimize the impact of sewage effluent will be adopted by having a septic tank/soak pit system at campsite. 3. Disposal at designated site will be keenly monitored to ensure that the dredged spoil does not spill over back into the marine environment. 4. In order to minimize any impacts from losses or spillages of site materials and wastes during construction, the contractor undertaking the construction work will ensure that there are no losses of potentially polluting materials to the water and that any spillage on land is removed and cleaned up immediately. This measure will ensure that substances such as fuels and oils are not left to soak away. A clause to ensure this aspect of SOP will be included in the contract package of the construction works. In addition, before commencing any work that could involve spillages of polluting materials, the contractor will produce an effective plan of prevention and clean-up.	Pakistan International Bulk Terminal
		5. The resident engineer at site will be consulted and would approve such measures.	Pakistan International Bulk Terminal
		6. A further clause in the construction contract would ensure that the contractor keeps all working areas, storage areas, waterways and berths clear of any rubbish, debris and obstructions at all times. All debris and rubbish will be regularly removed from the site.	Pakistan International Bulk Terminal
		7. All possible precautions will be taken to provide for the safe storage and use of fuels, explosives, gas bottles and all other hazardous materials temporarily brought at site by contractor.	Pakistan International Bulk Terminal
		8. Protection bunds shall be constructed along vulnerable stretches to prevent movement of run-off as well as excavated material into adjoining mudflats.	Pakistan International Bulk Terminal

Table 8.1: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
		9. The wastewater and the run-off from coal yard will be stored separately, adequately treated and then discharged at the designated receptacle.	Pakistan International Bulk Terminal
		10. Safe handling and prevention of spills will be of prime concern at PIBT, which has a commitment to meet the emission guidelines for products handled at the facility. The transportation and storage system will be designed for zero leakage at the facility.	Pakistan International Bulk Terminal
		11. The storm runoff will be collected by open drains and discharged to the nearest storm water drain.	Pakistan International Bulk Terminal
		12. A monitoring program needs to be executed by the PQA to keep a close watch on the water and sediment quality and ensure enforcement of NEQS on port users. Monitoring would record any accumulation of contaminants and would be used as an indicator for targeting reduction of contaminating inputs.	Pakistan International Bulk Terminal
		13. Construction of the fuel tank will follow the provisions of the API in having a dyke constructed to contain the spilled contents of the tank.	Pakistan International Bulk Terminal
		14. Sewage effluent will be treated in septic tank before its discharge into PQA sewerage system or creek waters.	Pakistan International Bulk Terminal
		15. The ships calling on PIBT will be required to follow MARPOL 73/78.	Pakistan International Bulk Terminal
		16. PIBT will create facilities for reception of Bulk Cargo carriers and ships bilge water, ballast and solid waste and for their treatment at their onshore facility.	Pakistan International Bulk Terminal
4	Solid Waste Management	1. A record with respect to quantity, quality and treatment/management of solid/hazardous waste shall be maintained.	Pakistan International Bulk Terminal
		2. Centralized waste management facility will be provided to collect all wastes during construction phase.	Pakistan International Bulk Terminal
		3. The stockpiles, construction camps and other facilities will be located to the extent possible on land, which are devoid of vegetation.	Pakistan International Bulk Terminal
		4. Material resulting from clearing and grading will not be deposited on temporary or permanent basis in the approach roads, streams, ditches or on another position which may hinder the passage.	Pakistan International Bulk Terminal
		5. On completion of construction works all temporary structures, surplus materials, construction debris and wastes will be completely removed to avoid future land use incompatibility.	Pakistan International Bulk Terminal
		6. It will be ensured that all waste generated at the construction site and at the labor camps is collected and disposed of in an appropriate manner in a landfill site or recycled for reuse where feasible.	Pakistan International Bulk Terminal
		7. PIBT will dispose of the dredging spoil that comprises the un-useable material of the 1st layer at the proposed jetty site, along with plants and vegetation that will be removed for land clearance to a nearby site where the material will be placed in geo-bags to conserve the marine biota.	Pakistan International Bulk Terminal
		8. PIBT will also recycle the over burden at the proposed storage site and the material contained in the 2nd and 3rd layers at the proposed jetty site for filling the depression.	Pakistan International Bulk Terminal
		9. Standard construction procedure will be implemented to ensure that the impact on surface drainage pattern and soil erosion is kept to the minimum. This will necessarily include avoiding blockage of natural surface drainage and developing appropriate drainage system in areas where it is unavoidable.	Pakistan International Bulk Terminal

Table 8.1: Mitigation Matrix

S.#	Aspect/Impact	Mitigation Measures	Responsibility
5	Noise Emission	1. Noise generating units i.e. generators will be housed in individual enclosures specifically designed housings to reduce impact of noise emission.	Pakistan International Bulk Terminal
		2. As an occupational health and safety measure, the workers will, wherever necessary, be provided with ear protection equipment such as ear plugs and ear mufflers as per specifications to meet the World Bank guidelines.	Pakistan International Bulk Terminal
		3. Periodic maintenance of construction machinery and transportation vehicles should be undertaken to observe low noise level limits.	Pakistan International Bulk Terminal
		4. Transport of construction material to the site should be restricted to daytime operations.	Pakistan International Bulk Terminal
		5. Plantations of dense canopy trees such as the mangrove species that have been planted on the medians on Karachi City Roads, and also the trees that may be uprooted at the 2.5 km strip of mangrove area, can provide a good sound barrier.	Pakistan International Bulk Terminal
6	Ecology	1. The construction contract should include provisions to limit the removal of bushes and mangrove to the bare minimum and restricted to the land area identified by PQA. The bushes and mangrove seedlings may, as far as possible be saved and transferred to the adjacent area. Other plants in the vicinity will need to be protected against damage by construction operations. The areas beyond the limits of site shall not be disturbed or damaged otherwise. Trees and shrubs will be planted around the boundary of the storage area to compensate for the loss of shrubs and shield the development from visual intrusion.	Pakistan International Bulk Terminal
		2. Liquid effluent from offices and the facilities will be domestic sewage and will be treated using an appropriate system such as a septic tank to meet NEQS before discharge into the drainage system.	Pakistan International Bulk Terminal
		3. Coffer dam especially designed to strain water without releasing considerable sediment load back into the marine ecosystem may be built to retain the dredged material for subsequent use of the dredged spoil for reclamation.	Pakistan International Bulk Terminal
		4. Careful and regulated excavation, back filling and quality assured construction methods should be employed by the contractors. The foreign material for filling purposes should be contaminant free.	Pakistan International Bulk Terminal
		5. Loss of mangroves will be compensated by planting mangroves saplings in consultation with IUCN and IMC.	Pakistan International Bulk Terminal
		6. On completion of construction, the temporary canal will be back?filled and mangrove saplings planted to ensure re-colonization.	Pakistan International Bulk Terminal
7	Traffic Management	1. Advanced/automated systems for security checking to avoid unnecessary delays and queuing of vehicles,	Pakistan International Bulk Terminal
		2. Effective utilization of Road signs and markings for better guidance and control of traffic within the complex,	Pakistan International Bulk Terminal
		3. Segregation of vehicular and pedestrian movements, and provision of walkways/footpaths	Pakistan International Bulk Terminal
		4. Provision of designated parking and service areas for different types of vehicles and road connectivity of these areas.	Pakistan International Bulk Terminal
		5. Preparedness/arrangements for incident management, especially in the event of breakdown of vehicles along the circulation areas inside the terminal complex.	Pakistan International Bulk Terminal
		6. Well-designed road lighting system.	Pakistan International Bulk Terminal
		7. Provision of proper turning radii for trucks	Pakistan International Bulk Terminal
		8. Provision of sufficient lateral clearance and standard lane widths of 3.65m (12ft).	Pakistan International Bulk Terminal

Table 8.4- Environmental Monitoring Plan

Stage	Monitoring areas	Parameters and techniques to monitor	Location	Monitoring frequency	Standard	Responsibility	Supervision
CONSTRUCTION	Dredging/Transport and disposal of dredged material	Visual checks to assess the situation	Project Area	Continuous	N.A	Health, Safety & Environment Department.	Independent Monitoring Consultant (IMC)
	Benthic Flora and Fauna	Visual checks to assess the situation	Jetty Construction Area, dredging areas, disposal areas	Continuous	N.A	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Air Emissions	CO, SOx, NOx, PM10, PM2.5, SPM	All construction areas	■ Before start of construction activity ■ Monthly	WHO/USEPA guidelines,	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Sea Water Quality	pH, BOD, COD, TDS, TSS, DO, HG, NH4, coliform, hardness, nitrate, hydrocarbon, Pb, oil and grease, and cyanide	Vicinity of Construction Area	All the sea water quality sampling will be carried out in low and high tide on monthly basis during construction phase.	NEQS NEQS, World Bank guidelines	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Solid Waste	Solid waste quality and quantity and disposal methods/locations Visual checks to assess the situation.	At contractor's camp and construction site	Continuous	N.A	Health Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Wastewater	Primary Pollutants of NEQS	All effluent the discharge points	Monthly	National Environmental Quality Standards (NEQS)	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Noise Levels	Noise Intensity (dBA)	All Construction Areas	■ Start of construction ■ Monthly during construction	OSHA, NEQS, World Bank Guidelines	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Soil	■ Soil contamination (Oil & Grease) ■ Soil erosion & sedimentation	All Construction Areas	Continuous	Baseline Criteria	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)

Table 8.4- Environmental Monitoring Plan

Stage	Monitoring areas	Parameters and techniques to monitor	Location	Monitoring frequency	Standard	Responsibility	Supervision
CONSTRUCTION	Health Safety of workers	■ Accidents ■ PPEs ■ Annoyance ■ Visual checks to assess the situation.	All Construction Areas	Once monthly	Monitoring of the health and safety of workers	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Mangrove Plantation	Visual inspection of plant species survival rate and status of maintenance	At sites where plantation was carried out	1month after plantation, 3months, 6months,and 12 months after Plantation	75 % survival rate	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC) & IUCN
END OF CONSTRUCTION	Restoration of sites	■ Visual analysis ■ Photographic records	All construction sites	End of construction	Previous records	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
OPERATIONS	Benthic Flora and Fauna	Visual checks and sampling of benthic material to assess the situation.	Sea Water	Once in a year	Comparison with previous records	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Waste water	■ Waste water minimization ■ Storage and handling ■ Recycling and reuse ■ Treatment before disposal ■ Primary Pollutants of NEQS	All effluent the discharge points	Monthly	National Environmental Quality Standards (NEQS)	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Sea Water Quality	pH, BOD, COD, TDS, TSS, DO, HG, NH4, coliform, hardness, nitrate, hydrocarbon, Pb, oil and grease, and cyanide	Vicinity of Project Area	All the sea water quality sampling will be carried out in low and high tide on quarterly basis during operation phase.	NEQS, World Bank guidelines	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Solid Waste	Solid waste quality and quantity and disposal methods/locations Visual checks to assess the situation.	Project Area	Quarterly	N.A	Health Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Sub-sea Soil	Monitoring, sampling, laboratory analysis, comparison with previous records (pH, organic, phenol, cyanide, oil &grease, Mn, Fe, Pb, Arsenic, Hg, Cr etc)	Jetty area	Once in a Year	Baseline Criteria	Health Safety & Environment Department	Independent Monitoring Consultant (IMC)

Table 8.4- Environmental Monitoring Plan

Stage	Monitoring areas	Parameters and techniques to monitor	Location	Monitoring frequency	Standard	Responsibility	Supervision
	Fire & Safety	■ Fire Hazards & ■ Safety Protocols	All Operational Areas	Continuous	N.A	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Air Emissions	CO, SOx, NOx, PM10, PM2.5, SPM	All operational areas including storage areas	Monthly	WHO/USEPA guidelines, NEQS	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Noise	Noise intensity measurement	All operational areas	Quarterly	OSHA, NEQS, World Bank Guidelines	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Hazardous spill	■ Spill on Land ■ Spill on Water	All operational areas	Continuous	SOPs	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Traffic management	Traffic Management Plan	Terminal approaches and exits	Continuous	Traffic Management Plan	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Health and Safety of workers	■ Accidents ■ PPEs ■ Annoyance ■ Diseases	Terminal area	On quarterly basis	PIBT health, safety and Environmental manual	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Accidents (Loading & Unloading)	Inspection and record checking.	Port area.	On quarterly basis	PIBT health, safety and Environmental manual, SOPs	Health, Safety & Environment Department	Independent Monitoring Consultant (IMC)
	Compliance monitoring	■ EIA Commitments ■ Mitigation Measures ■ Conditions of Environmental Approval ■ SOPs	All areas	Monthly	Environmental Management & Monitoring Plan (EMMP)	Independent Monitoring Consultant (IMC)	Sindh EPA

8.7 Communication & Documentation

This step is for mandating monitoring and progress evaluation. Following are the steps to be taken to communicate and document environmental matters between construction contractor and staff of PIBT.

8.7.1 Meetings

A kick-off meeting may be arranged at the start of construction phase to communicate the necessity of meeting and documentation to the contractor. EMP will also be provided to the construction contractor for discussion on the steps on implementation.

Manager HSE will arrange departmental meetings regularly on weekly basis throughout the project. The purpose of this meeting is to discuss day-to-day problems arising during the work, steps to be taken to resolve problems, overview of progress of HSE department and contractor with respect to the EMP, overview on monitoring plan and to discuss progress with respect to changes made in operations / documentation / EMP. All the HSE matters will be discussed in detail and if any problem remains unresolved, another meeting will be called to discuss solutions within 2 days time. Weekly meeting will be attended by Manager HSE, HSE officer and contractor's representative. Such meetings will help in effective monitoring, management and documentation of the environmental performance during construction and operations. Any issues that require attention of higher authorities will be communicated to CEO for necessary action and resolution.

8.7.2 Minutes of Meeting

At the end of weekly meetings, minutes will be issued for being incorporated in the record register. Meeting minutes will also be sent to contractor and higher authorities for their own record.

8.7.3 Monthly Reporting

PIBT shall prepare a brief monthly report describing the progress of operations, any changes from the operation for which approval was obtained, the degree to which the recommendations of the ESIA were adhered, any damages to the environment along with mitigation measures provided and monitoring information of scientific or environmental interest, if available. The report shall be submitted to Sindh EPA (SEPA) for their review. Comment received from SEPA will be discussed in the weekly meetings. The report can make use of the first weekly HSE meeting as well.

8.8 Management, Co-ordination and Information

Although PIBT is keen in environmental management practices and already have plans to adopt preventive measures with environmental considerations, it can be said that any weakness in organisational structure, management, communication, lack of information and coordination may lead to environmental risk. The following are some of the guidelines to handle the risks:

- Ensure that management authorities have access to high quality, up-to-date and relevant data for decision-making.
- Ensure that staff associated with implementation work and HSE department have access to relevant data for implementation of EMP.
- Ensure involvement of all associated groups, management authorities and associated staff in the management plan process.
- Ensure highest-level liaison and co-ordination between contractor and PIBT staff.
- Ensure that all the monitoring details are received by Sindh EPA for their review and feedback.
- Ensure that Hazard and Operability (HAZOP) study has been conducted.

Table-8.3: Specific Responsibilities for Management & Coordination

S. #	Strategic Objective	Proposed Implementation Process	Suggested In-charge	Suggested Priority
01	To ensure high level of necessary information exchange.	■ Make review document available to interested parties. ■ Disseminate relevant information held by HSE department among the staff. ■ Produce newsletter for publication annually for general awareness in all staff. ■ Meetings using input from previous reports, advices receive from Sindh EPA, etc.	■ HSE Manager ■ HSE Officer ■ HSE Manager ■ HSE Manager	■ High ■ High ■ On-going ■ High
02	To ensure management plan is implemented, monitored and reviewed.	■ Adopt management structure as proposed. ■ Appoint full-time officer(s) with responsibility for long term management and accurate monitoring. ■ Examine annual progress report and review with respect to the monitoring progress. ■ Conduct self-monitoring regularly and submit report to Sindh EPA.	■ HSE Manager ■ HSE Manager ■ CEO and HSE Manager ■ HSE Manager	■ High ■ High ■ On-going ■ High
03	To improve decision-making process for management.	■ Develop an appropriate form of management process, specific to the environmental issues ■ Develop a fully comprehensive database of impact and mitigation understandable for the management.	■ HSE Officer ■ HSE Manager/ HSE officer	■ High ■ High
04	To ensure co-ordination between contractor and PIBT.	■ Obtain support for a Memorandum-of-Understanding between management of PIBT and Contractor for the implementation of ■ Sindh EPA Requirements ■ EMP ■ Continue regular liaison between management of PIBT and contractor.	■ HSE Manager ■ HSE Officer	■ High ■ On going
05	To develop strategic policies for better environmental management.	Develop strong coordination between HSE department and top management.	■ HSE Manager	■ High

8.9 Environmentally Sound & Safe Working Procedures

1. Contractors, sub-contractors and contract workers will be made aware of Environmental Aspects as well as Emergency Response Plan prior to commencing the work. Prior to leaving the site contractors, sub-contractors and contract workers will ensure that their work area is in safe position. On emergency call they will report in assembly area.

2. Written procedures or standards will be prepared for all activities, where the absence of such procedures and standards could result in not following HSE policy, the law or the contract.

3. Safe Working Procedures will be based on the following four aspects of job safety:

- Safe Place: the work site will be designed or controls put in place to ensure that the working environment provides no significant risk to personnel, property or the environment.
- Safe Equipment: all equipment for any job, including tools, machinery and protective equipment will be specified or designed to ensure that it poses no significant risk to personnel, property or the environment. All equipment will comply with legislative standards of conformity and test.
- Safe Procedure: Procedures will be designed for all aspects of the job to facilitate safe use of equipment at the work site to complete tasks with no significant risk to personnel, property or the environment. Design of a procedure will be based on step-by-step analysis of the tasks involved (Job Safety Analysis), identification of associated hazards and elimination of control of those hazards. Procedures should allow for work in ideal conditions as well as under aggravating conditions e.g. adverse weather.
- Trained Personnel: Suitable job-specific, safety skills and supervision training will be provided to personnel involved in construction and operation activities so that they are able to use the procedure and equipment at the worksite with no significant risk to personnel, property or the environment.
- Safe Working Procedures will be available to contractors and sub-contractors, who will adopt the relevant labour laws of the country.

8.9.1 Responsibility & Authority

EHS Manager in consultation with Environment Specialist will be responsible for the initial identification of environmental aspects. The unit/departmental heads will be responsible, on a regular basis, for identifying and reporting changes in activities and services that may create new environmental aspects to the EHS Manager.

EHS Manager will be responsible for collecting and coordinating information regarding environmental aspects, and for maintaining the records related to environmental aspects and their impacts.

8.9.2 Environmentally Safe Procedure Description

A. Identification of Environmentally Safe Aspects

Environment Specialist/EHS Manager will identify:

- Environmental aspects at the initiation of activities at the site at a workshop, which will help develop Environmental Management Plan in consultation with the departmental heads.
- While identifying environmental aspects, following factors will be considered:

a) Emissions of fugitive dust and gaseous pollutants from vehicles and equipment,

b) Discharges of liquid effluent and seepage to land, and water

c) Disposal of excavated material and mining waste to land and water

d) Solid Waste to land, water and their emissions on combustion to air

e) Noise

f) Odor

g) Consumption of natural resources and energy

h) Emergency releases

Subsequent to the above proceedings, EHS Manager will, in consultation with concerned departmental heads/section heads, review relevant activities and services in the related sections of the activity areas and identify environmental aspects.

B. Environmental Impact Assessment of Safe Procedures

After identifying the environmental aspects, the related impacts will be assessed and the significance of each aspect will be evaluated.

Following factors will be considered for evaluating the impacts:

a) Segments of microenvironment impacted

b) Segments of macroenvironment impacted

c) Whether the impact is beneficial or damaging

d) Severity of impact

e) Frequency and likelihood of impact

f) Existing mitigation measures

g) Adequacy of mitigation measures

h) Concerns of stakeholders/interested parties

i) Regulatory requirements and their compliance

C. Impact rating

Impact rating will be assessed for each identified aspect to determine the significance as significant, partially significant, and insignificant.

8.9.3 Emergency Response Plan

Emergency Response operations will be managed and monitored by the Emergency Response Team headed by the EHS Manager. The Response team will ensure that the operations are carried out in minimal time avoiding any fire, safety and security hazard and affecting the environment. The team will ensure:

- Evaluation of the situation to identify the most important steps, which must be taken first and can have an important bearing on the overall action to be taken.
- Deployment of required manpower and equipment.
- Organizing required logistical support so that there are no bottlenecks hampering the operation.
- See to it that injured persons are cared for.
- Respond to calls for ambulances for shifting the injured persons to neighbourhood hospitals / healthcare units.
- Isolate all sources of ignition and environmental hazard.
- Evacuation of people who are in immediate or imminent danger. EHS Manager and/or in-charge of the Campsite will exert positive leadership and give instructions calmly, firmly, explicitly, and courteously and obtain help of law enforcement agencies, if necessary.
- Block roads if necessary for safety of operations.
- Arrange for emergency notifications of water shed areas, public utilities, and the like to safeguard the public and property.
- Surveillance and monitoring operations.
- Retrieval and disposal of earth/debris and resources affected by the hazard at approximate site.
- Termination of clean-up operation.

8.9.4 Training and Exercises

To ensure effective implementation of the Emergency Response plan, training programs for Disaster response personnel will be organized regularly. The training program will aim at:

- Maintaining the plan and working document to be fully operational.
- Inform the Response Team members and other relevant personnel of their respective duties and procedures to be followed.
- Familiarize all relevant personnel with the use of equipments.

The training program will be structured according to the level of responsibility of the participants. Class room instructions as well as field demonstration will be conducted.

Regular operational exercise/drills will be conducted to ensure that the response organization and other components detailed in the plan function effectively and Response Team members and other relevant personnel assigned specific responsibilities become fully familiar.

A. Training Needs Assessment

In addition to the training specified in the training log, special / additional trainings will be provided during the project activity. The criteria to assess the need of such special training will be based on the following:

- When a specified percentage of staff is newly inducted in to the project;
- When any non-compliance is repeatedly reported, refresher training will be organized addressing the particular issue;
- When any incident / accident of minor or major nature occurs;
- Arrival of new contractor / sub-contractor; and
- Start of any new process / activity.

Training will be provided to project personnel in the following areas:

- Use of safety equipment, including protective clothing;
- Hearing protection, wherever applicable;
- Fire-fighting and emergency response for accidents like oil spills;
- Sampling of wastewater and other effluents;
- Air monitoring, noise and vibration monitoring;
- Project / terminal safety practices;
- Preparation against natural disaster, such as earthquakes and storms;
- Solid Waste Management; and
- Oil spill accidents;
- Pollution Incident and Oil Spill Reporting System.

B. Environmental Training Program

Table 8.4 presents the proposed training program.

Table 8.4: Environmental Training Program

Staff	Training Contents	Timings
Selected management staff of PIBT and the contractor All site personnel (including locally hired staff)	■ Introduction to project EIA and EMP ■ EMP communication, documentation and monitoring and reporting requirements ■ Site induction training on Health Safety and Environment system and requirements ■ Environmental sensitivities of the project area ■ Communication of environmental problems to appropriate officers ■ Hazardous and non-hazardous waste management ■ Waste disposal ■ Protection of Marine life	Prior to start of any project activities At the time of entering Terminal Facility Prior to start of work
Construction supervisors	■ EMP communication, documentation and monitoring requirements ■ Good construction practices ■ Dust emissions prevention and control during construction phase	Prior to start of construction activities
Emergency response teams	■ Fire fighting ■ Emergency response including oil and chemical spill	Prior to start of operation of terminal facility and power plant
Camp staff	■ Camp operations ■ Waste disposal ■ House keeping	At the time of induction of camp staff
Restoration team	■ Restoration requirements ■ Oil spill contingency plan	Prior to start of restoration activities

09 SUMMARY OF FINDINGS AND CONCLUSION

Selection of the preferred alternative system and site for establishment of Coal, Clinker & Cement Terminal at PIBT needs to be based on:

a) Substantial improvement in the current system of handling, storage and transportation of coal, clinker and cement.

b) Urgent need to provide better level of infrastructure service in handling coal, clinker and cement for storage, and shipping to meet the current and future demand for higher calorific value coal available for the cement industry, and to cater to the shipping requirements of clinker and cement export as bulk dry cargo.

The demand for steam coal has grown manifold during the last one decade and is likely to continue for some time beyond the point when other fossil fuel resources will be exhausted. Moreover, the continuous rise in oil prices does not suggest that coal prices would also follow a similar trend. Coal prices, historically, have been more stable than oil prices. In the short term plan therefore steam coal will have to be imported in Pakistan to respond to the growing need for cement production whose export market is now well established.

In the long term plan the local coal will have to be adequately upgraded to the level desired for steam coal. With as much as 178 billion tons of brown coal being available locally, Pakistani coal will be able to take the front stage in global world trade. In the short term plan the terminal will handle import of steam coal and for the long term plan the terminal will be used for export of locally upgraded coal besides the other bulk cargo including clinker and cement.

The preferred site for locating the PIBT is in proximity the PROGAS Terminal and the FOTCO Oil terminal. Locating the PIBT in the proximity of these terminals/jetties would not affect the traffic flow and operational activities of the Port or the navigation channel or the adjacent Terminals.

The preferred site additionally offers the advantage that it will be sited at sufficient distance from the navigation channel but in the same channel that is dedicated to facilities handling LPG by PROGAS and fuel oil by FOTCO. This site duly addresses the security and safety concerns since it is sufficiently distanced from other port installations. It would also offer the following advantages:

- Site is less exposed to open sea;
- PIBT jetty will be at 0.7 km from PROGAS and 1.5 km from FOTCO jetty;
- PIBT trestle will run parallel to PROGAS and will over-pass the land mass between Kadiro Creek and Korangi Creek be separated by distance of about 1 km;
- Other jetties operational in the vicinity of the area are about 8 to 10 km from FOTCO Jetty. Hence locating the PIBT at the preferred site will not affect the traffic flow or the operational activities at the port.

The optimal mitigation measures have been taken into account while selecting the site, which will be offset by adequate distance from PROGAS Terminal and by the land mass that lies between Kadiro Creek and Korangi Creek. The trestle will follow a straight line between the storage area and the jetty, avoiding bends and transfer stations in the middle. The trestle will, while over-passing the said land mass, require removal of as many mangrove trees as the number of piles ~ 400 in number (2 piles at a distance of 12 m over 2.4 km).

The dredging of a berthing pocket adjacent to the existing navigation channel, compared to the maintenance dredging of navigation channel being carried out regularly by port Qasim, will be insignificant. The hydraulic model studies for Port Qasim have extensively

studied the impact of dredging of navigation channel and the spoil areas for over a decade. No significant impact on geology, geomorphology and hydrogeology has so far been identified. The comparatively moderate dredging for the berthing pocket and disposal of spoil in the areas designated by Port Qasim Authority may cause some negative impact on the geomorphology of the channel but this will be confined to the microenvironment and will not be significant.

Potential impacts of establishment of the PIBT facility during the construction and operation phases of the Project on the Physical, Biological and Socio-economic environment have been identified and assessed. Mitigation measures with respect to existing land use and land tenure will not be needed since the land area has been sub-leased officially by PQA to PIBT. Likewise there will be no issues on loss of land, or loss of business; no involuntary resettlement is consequently required and no business may be considered lost on the acquired land.

No obstruction to the main navigation channel will be caused by construction and operation of the project. The site is located in a seismically moderate to major hazard (seismic zone 2B of Pakistan) area and design of all facilities shall be based accordingly.

PIBT Management would try and use the soil obtained from excavation in the construction activities provided that the results of the soil investigation allow the soil to be used as such. However, if it is not of suitable material then it would be transferred to a site designated/identified by PQA. Similarly dredged material if not utilised, will be disposed at site designated by PQA. PQA has been requested to identify the dumping site.

Following measures will further reduce the expected potential impact:

- Dredged material will be disposed of into the terminal area development at the site by constructing protective bunds and at areas designated by Port Qasim Authority. Haulage as well as disposal of dredging spoil will be continuously monitored to ensure that dredge spoil does not spill over into the sea or to the seashore.
- No obstruction or filling up of any drainage or channel in the area is envisaged but close monitoring of the dredging operations will ensure safety of the channel.
- The structural design of facilities to take into account the seismic risk factor of 0.3 for Operational Basis Earthquakes (OBE) and a factor of 1/15 g for Maximum Credible Earthquake (MCE)
- The delivery of fill material to site will be equalized with spreading and compaction of fill layers to avoid spillage into the water
- Spoils from piling works will be disposed outside the channels and in areas designated by the Port Qasim Authority.
- Protection of fill slopes against erosion. During construction the slopes will be protected by sand bags until permanently protected by properly designated stone rip rap. Protective bunds for containment of the dredged material proposed above will be designed to retain the disposed material.
- Construction activities at the project site are not likely to interfere with the natural drainage of the area. The soil proposed to be used as fill will be granular in structure. The fill slopes on the creek side will be protected against erosion by stone pitching. However, spillage of fill material and waste on to the foreshore areas may occur during construction. Standard Operating Procedures will be adopted to limit the impact to level of non-significance.
- The ground water at Project site is highly saline, while the subsoil being fine grained and largely plastic, has very low permeability. Due to the proximity of seawater creeks, the subsoil drainage is towards the creeks. Construction of the PIBT facility, in particular the jetty and the piles, will result in short term increases in the suspended solid load of the creek system.
- The construction of the proposed project is not

expected to interfere with the natural drainage of the creek system of the Project site. The construction of the PIBT Jetty and the trestle will result in short term increase in the suspended material in the water column of the creeks causing increased turbidity. Additionally release of contaminants / wastes, loss of benthic flora and fauna and mangroves may occur and may be cause of degradation of the quality of environment of the PIBT site.

- The re-suspended sediments may be transported and re-deposited elsewhere in the surrounding and this would have negative impact on benthic fauna and fishery resource.
- Direct impacts on water quality arise when the sediments are contaminated. The release of heavy metal, hydrocarbons, or other hazardous chemicals into the water column can induce toxic effects on marine biota. The release of organic wastes could cause localized oxygen depletion in the water column creating stress for aquatic biota.
- During the construction phase some sewage material would be generated at the camp site. The disposal of sewage into the marine environment will have adverse impact of low order on the water quality as well as marine biota.
- Careful use of heavy machinery and equipment will minimize the impact due to release of contaminants during this short term activity.
- Mitigation measures to minimize the impact of sewage effluent will be adopted by having a septic tank/soak pit system at campsite.

Based on the above observations and assessments it is envisaged that the PIBT will be constructed and operated by adopting the mitigation measures for the likely adverse impact caused by different aspects. Environmental Management and Monitoring Plan as well as safety and security measures would ensure that the Project will not create adverse environmental impacts that have not been mitigated or leave the safety and security concerns of the stakeholders unmitigated.

Establishment of PIBT is compatible with the aims and objectives of (a) Sustainable Development in promoting improvement in quality of life through (a) Substantial improvement in the current system of handling, storage and transportation of coal, clinker and cement, (b) provision of better level of infrastructure service in handling coal, clinker and cement for storage, and shipping to meet the current and future demand for higher calorific value coal available for the cement industry, and to cater to the shipping requirements of clinker and cement export as bulk dry cargo, and (c) Infrastructure development for the Energy Sector in making available a sustainable energy source and thus contributing to sustainable economic development in Pakistan.

This ESIA Study finds that establishment of the PIBT at Port Qasim would fulfill the requirements of sustainable development by being socially equitable, and economically viable in improving the quality of life for all citizens of Pakistan, without altering the balance in the resources of the ecosystem of the region.

The Study therefore recommends that the ESIA should be approved with the condition that all mitigation measures recommended in ESIA report, suggestions of stakeholders and recommendations of experts committee will be adhered to by proponent (Pakistan International Bulk Terminal Limited) and the legal requirements as well as the Environmental Management & Monitoring Plan shall be implemented in letter & Spirit. The monitoring shall be conducted by Independent Monitoring Consultant (IMC) in association with stakeholders including relevant active NGOs (like Shehri-CBE) and departments including IUCN & WWF. PIBT Limited shall cooperate with SEPA officers/officials as and when required for confirmation of compliance to approval conditions and commitments made by PIBT in ESIA. The monitoring reports shall be submitted to SEPA on monthly basis.

APPENDIX I

ENVIRONMENTAL MONITORING REPORT



CLIENT: M/S ENVIRONMENTAL MANAGEMENT CONSULTANTS (EMC)

1

APPENDIX I

Abbreviations

COD	Chemical Oxygen Demand
EIA	Environmental Impact Assessment
EEL	Engro Energy Limited
SUPARCO	Pakistan Space &Upper Atmospheric Research Commission
SITE	Sindh Industrial Trading Estate
HSD	High Speed Diesel
IEE	Initial Environmental Examination
MSDS	Material Safety Data Sheets
NEQS	National Environmental Quality Standards
ODS	Ozone Depletion Substances
Site	Oil and Gas Development Corporation Ltd
Pak EPA	Pakistan Environmental Protection Agency
PEPA 1997	Pakistan Environmental Protection Act, 1997
PEPC	Pakistan Environmental Protection Council
PM_{10}	Particulate Matter Smaller than 10 micron
$PM_{2.5}$	Particulate Matter Smaller than 2.5 micron
SPM	Suspended Particulate Matter
SEPA	Sind Environmental Protection Agency
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
WB	World Bank
WHO	World Health Organization
USEPA	United States Environmental Protection Agency

APPENDIX I

Units

dB(A)	Decibel (A-rated)
MMScfd	Million Standard Cubic Feet per day
ha	Hectare
BTU	British Thermal Unit
BTU/scf	British Thermal Unit per Standard Cubic Foot
m	Meter
m^3	Cubic Meter
°C	Degree Celsius
S	Second
ft	Foot
kg	Kilogram
kg/s	Kilogram per Second
Nm^3/h	Normal Cubic Meter per Hour
ppm	Parts Per Million
mg/l	Milligrams per Liter
mg/Nm^3	Milligrams per Normal Cubic Meter
$\mu g/m^3$	Microgram per Cubic Meter
ng/J	Nanograms per Joule

3

APPENDIX I

TABLE OF CONTENTS

Sr. NO	TITLE	PAGE
1.	**Introduction**	2
	1.1 Site Description	3
2.	**Methodology**	4
	2.1 Data Acquisition	4
	2.2 Ambient Air Monitoring Methods	5
	2.3 Work Program	5
	2.4 Data Acquisition Plan	6
	2.5 Site Selection Criteria	6
3.	**Ambient Air Quality Standards**	7
4.	**Ambient Air Quality Monitoring Instrument**	7
5.	**General Discussion and Results**	8
	5.1 Nitrogen Dioxide	8
	5.2 Sulfur Dioxide	9
	5.3 Carbon Monoxide	10
	5.4 Particulate Matter(PM-10)	11
	5.5 Noise	12
6.	**Conclusion**	13
Annexure-I	**Ambient Air Monitoring Data Sheet-Site -I**	14

4

APPENDIX I

1. INTRODUCTION:

Proposed Site is Located at Port Qasim, 35 KM East of Karachi and near Fauji Oil Terminal. Human-made sources cover a wide spectrum of chemical and physical activities and are major contributors to urban air pollution. Also a threat to the clean air is posed by the petrol and diesel fired machinery including generators, engines etc. The burning of these fossil fuels in these machinery results in emission of a wide variety of pollutants, principally carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulphur (SO_x) and particulates (TSP/PM_{10}). The presence of these pollutants in ambient air have an adverse impact on the air quality and health of human being especially those who are exposed to this polluted air. The meteorological conditions (Wind speed, Wind Direction, Temperature, Relative Humidity) affect the dispersion of the emitted pollutants. The expected health impacts associated with the air pollution are asthma, chronic lungs diseases, respiratory problems, structural changes in lungs of animals, heart diseases etc.



Fig: Satellite Image of Proposed Site is Located at Port Qasim Karachi Pakistan

APPENDIX I

1.1 Site Description:

The monitoring sites for Proposed Site is Located at Port Qasim Karachi Pakistan, is surrounded by the industrial area. An oil refinery is situated near the monitoring site is only the major stationary source of air pollution within a radius of 5 km. The ambient air quality measured at the site was typical of clean air, with low detectable sulfur dioxide or nitrogen dioxide (NOx). Measurements of the ambient air quality are presented in Appendix I.



Fig # 1: Environmental Monitering at Proposed Site is Located at Port Qasim Karachi Pakistan

2. METHODOLOGY:

SUPARCO collected the data for ambient air at Proposed Site is Located at Port Qasim Karachi Pakistan, using USEPA designated monitoring equipment.

2.1 Data Acquisition

a) Criteria pollutants CO_2, CO, NOx, SO_2, O_3, PM_{10} as well as Noise level along with meteorological parameters at the sites.

b) The measurements were within the following detection limit (Table 1);

APPENDIX I

Table: 1 Concentration limits of different equipment.

Equipment	Min. Concentration Limits
SO_2 Analyzer	~1 ug/m^3
CO Analyzer	< 0.5 ug.m^3
NOx Analyzer	~ 1 ug/m3
CO_2 Analyzer	<1 %
Ozone (O_3) Analyzer	~ 2 ug/m^3
TSP/PM_{10} Sampler	~ 5 ug/m^3

c) Duration of measurement for each pollutant (CO, CO_2, NOx, SO_2, O3 and PM_{10}) was 24 hours with 15 minutes interval.

d) Units of measurement for air pollutants were ug/m^3 for PM10 while ppm & ppb for gaseous pollutants.

e) USEPA methods/procedures for monitoring the air quality were used (see Table 2).

2.2 Ambient Air Monitoring Methods:

Table 2 Ambient Air Monitoring Methods

Pollutants	Methods	Title of US EPA 40 CFR
NOx	Reference Method in Appendix F of 40 CFR Part 50	Chemiluminescence
SO_2/H2S	Ambient Monitoring Reference & Equivalent Method of 40CFR Part 52	Fluorescence Method
CO	Method in Appendix C of 40 CFR Part 50	IR Gas Filter Correlation
O_3	Method in Appendix D of 40 CFR Part 50	UV Photometry
CO_2	Method in Appendix C of 40 CFR Part 50	IR Gas Filter Correlation
TSP	Reference Method in Appendix B of 40 CFR Part 50	Beta Source
PM10	Reference Method in Appendix J of 40 CFR Part 50	Beta Source

7

APPENDIX I

2.3 Work Program

The work plan followed for data acquisition was as under;

Commencing Date	: 28-03-2011
Completion Date	: 29-03-2011
Duration	: 24 hrs
Ambient Air Monitoring Sites	: Proposed Site Located at Port Qasim Karachi Pakistan,
Field Monitoring Staff	: Muhammad Khalid (Pr. Scientific Asstt.) Abdul Mannan (Sub Eng.)

2.4 Data Acquisition Plan

Site No –I: (Proposed Site is Located at Port Qasim Karachi Pakistan,)

Latitude	24°48'58.57"N
Longitude	67°17'29.27"E

Starting Date:	28-03-2011
Starting Time:	11:30
Completion Date:	29-03-2011
Completion Time:	11:30
Sampling Duration:	24 Hrs

2.5 Site Selection Criteria:

Following consideration was made for site selection;

- Site representative of major contributors of air pollutants.
- Projected area for development.

8

APPENDIX I

3. AMBIENT AIR QUALITY STANDARDS

Table 3 : Ambient Air quality Standards

Pollutants	USEPA		WHO		World Bank		NEQS (Pak EPA)	
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard
SO2	24 HRS	365ug/m^3 (140 ppb)	24 HRS 1 HR	90 ug/m3 (34 ppb) 350 ug/m3	ANNUAL MEAN 24 HRS	100 ug/m3 (38 ppb) 500 ug/m3	ANNUAL MEAN 24 HRS	80 ug/m3 120 ug/m3
CO	8 HRS 1 HR	10 mg/m^3 (9 ppm) 40 mg/m^3	8 HRS	10 mg/m3 (8.7 ppm)	-	-	8 HRS 1 HR	5 ug/m3 10 ug/m3
NOx	ANNUAL MEAN	100 ug/m^3 (53 ppb)	1 HR	190-320 ug/m3	ANNUAL MEAN	100 ug/m3 (50 ppb)	ANNUAL MEAN 24 HRS	40 ug/m3 - 80 ug/m3
O3	1 HRS	235ug/m^3	8 HRS 1 HR	120 ug/m^3 200 ug/m^3	-	-	-	-
TSP PM10	24 HRS 24 HRS	260 ug/m^3 150 ug/m^3	24 HRS -	150-230 ug/m^3 -	ANNUAL MEAN 24 HRS -	100 ug/m3 500 ug/m3 -	ANNUAL MEAN 24 HRS -	400 ug/m3 550 ug/m3 -

4. AMBIENT AIR QUALITY MONITORING INSTRUMENTS

Table 4 Ambient Air Quality Monitoring Instruments

S.No	Name of equipment	Principle of Operation
1.	Ozone Analyzer with Calibrator	Ozone Analyzer determines the amount of ozone in a gas sample by measuring the amount of UV light absorbed by the sample. The measuring range is 0-0.5ppm, 0-1.00ppm &0-5.00ppm.
2.	CO Analyzer with Calibrator	Gas Filter Correlation- sources using infrared radiation. measuring range is 01,2,5,10,20,50,100,200, 500, 1000 ppm.
3.	CO2 Analyzer with Calibrator	Gas Filter Correlation-source using infrared radiation The measuring range is 0-1,2,5,10,20,50,100, 200,500, 1000 ppm
4.	NO, NO2 (NOx) Analyzer with Calibrator	Chemiluminescent Method. The Measuring rang is 0-0.05,0-0.10, 0-0.20, 0-0.50, 0-1.00, 0-2.00,0-0.500 ppm.
5.	H_2S/SO_2 Analyzer with Calibrator	Ultraviolet(UV) fluorescent
6.	Sound Level Meter	Preamplifier detects sound level with the help of microphone. The measuring range is 30 –130 dB.
7.	High Volume Samplers with PM10 and PM2.5 Size Inlet	Gravimetric monitoring

9

APPENDIX I

5. GENERAL DISCUSSION AND RESULTS:

5.1 Nitrogen dioxide (NO_x)

Nitrogen oxides (NO_x), a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), are produced from natural sources, motor vehicles and other fuel combustion processes. Nitric oxide is colourless and odourless and is oxidised in the atmosphere to form nitrogen dioxide. Nitrogen dioxide is an odourous, brown, acidic, highly-corrosive gas that can affect our health and environment. Nitrogen oxides are critical components of photochemical smog — nitrogen dioxide produces the yellowish-brown colour of the smog.

5.1.1 Environmental and Health effects

Nitrogen dioxide is harmful to vegetation, can fade and discolour fabrics, reduce visibility, and react with surfaces and furnishings. Vegetation exposure to high levels of nitrogen dioxide can be identified by damage to foliage, decreased growth or reduced crop yield. Nitric oxide does not significantly affect human health. On the other hand, elevated levels of nitrogen dioxide cause damage to the mechanisms that protect the human respiratory tract and can increase a person's susceptibility to, and the severity of, respiratory infections and asthma. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease. It may also affect sensory perception, for example, by reducing a person's ability to smell an odour.

5.1.2 Potential Sources

All combustion processes produce oxides of nitrogen (NO_X). NO_2 and nitric oxide (NO) are both oxides of nitrogen and together are referred to as NO_X. It is NO_2 which is associated with adverse health effects. Motor vehicles account for about 70% of total Adelaide NO_X emissions. Other sources include the electricity supply and domestic wood burning. NO_X is required in the production of ozone and photochemical smog.

5.1.3 Monitoring results

The measured minimum maximum and mean concentrations of NO_x pollutant was 13 ppb, 23 ppb and 16.2 ppb respectively. These levels of gas pollutants were well also within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference) for ambient air quality like USEPA, WHO and World Bank.

APPENDIX I

5.2 Sulfur Dioxide (SO_2)

SO2 causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Particularly sensitive groups include people with asthma who are active outdoors and children, the elderly, and people with heart or lung disease.

Respiratory Effects from Gaseous SO_2 - Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease.

Respiratory Effects from Sulfate Particles - SO_2 reacts with other chemicals in the air to form tiny sulfate particles. When these are breathed, they gather in the lungs and are associated with increased respiratory symptoms and disease, difficulty in breathing, and premature death.

Visibility Impairment - Haze occurs when light is scattered or absorbed by particles and gases in the air. Sulfate particles are the major cause of reduced visibility.

Acid Rain - SO_2 and nitrogen oxides react with other substances in the air to form acids, which fall to earth as rain, fog, snow, or dry particles. Some may be carried by the wind for hundreds of miles.

Plant and Water Damage - Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. Continued exposure over a long time changes the natural variety of plants and animals in an ecosystem.

Aesthetic Damage - SO_2 accelerates the decay of building materials and paints, including irreplaceable monuments, statues, and sculptures that are part of our nation's cultural heritage.

5.2.1 Monitoring results

The measured minimum maximum and mean concentrations of SO_2 pollutant was 09 ppb, 16 ppb and 11.8 ppb respectively. These levels of gas pollutants were well also within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference) for ambient air quality like USEPA, WHO and World Bank.

APPENDIX I

5.3 Carbon monoxide (CO)

Carbon monoxide, with the chemical formula CO, is a colorless, odorless, and tasteless gas. It consists of one carbon atom covalently bonded to one oxygen atom. Carbon monoxide forms in preference to the more usual carbon dioxide when there is a reduced availability of oxygen present during the combustion process. Carbon monoxide has significant fuel value, burning in air with a characteristic blue flame, producing carbon dioxide. Despite its serious toxicity, CO plays a highly useful role in modern technology, being a precursor to myriad products.

5.Health and Environmental Impacts of CO

Carbon monoxide can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues.

Cardiovascular Effects: The health threat from lower levels of CO is most serious for those who suffer from heart disease, like angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects.

Central Nervous System Effects: High levels of CO can affect even healthy people. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death.

5.3.2 Monitoring results

The measured minimum maximum and mean concentrations of CO pollutant were 1.0 ppm, 2.6 ppm and 1.5 ppm respectively. These levels of gas pollutants were well also within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference) for ambient air quality like USEPA, WHO and World Bank.

5.4 Particulate matter (PM_{10})

5.4.1 Health effects

PM10 refers to particulate matter less than 10 micrometers (μm) in diameter. Particulate air pollution is associated with a range of impacts on health, including effects on the respiratory and cardiovascular systems, asthma and mortality. The most applicable evidence has related

APPENDIX I

daily average concentrations of particles to effects on health, therefore the PM10 NEPM is measured over 24 hours. The NEPM air quality standard is 50 µg/m^3 as a 24-hour average.

5.4.2 Sources

Unlike the individual gaseous pollutants, which are single, well-defined substances, particles (PM10) in the atmosphere are composed of a wide range of materials arising from a variety of sources. Concentrations of PM10 comprise: primary particles, arising from combustion sources (mainly motor vehicles, which in Adelaide contribute 40%); secondary particles, mainly sulphate and nitrate formed by chemical reactions in the atmosphere; and coarse particles, suspended soils and dusts, sea-salt, biological particles and particles from construction work. The relative contribution of each source type varies from day to day, depending on meteorological conditions and quantities of emissions from mobile and static sources. The fine particle fraction (PM2.5) is composed predominantly of primary and secondary particles. Particles in the range from PM2.5 – PM10 generally consist of coarse particles.

5.4.3 Monitoring results

The measured minimum maximum and mean concentrations of PM10 pollutant were 112 µg/m^3,152 µg/m^3 and 124.4 µg/m^3 respectively. These levels of pollutants were well also within limits of USEPA and the prescribed limits of International Standards (see Table 3 for reference) for ambient air quality like USEPA, WHO and World Bank.

5.5 Noise

Noise affects everybody in everyday life--at home, at leisure, during sleep, when traveling, and at work. However, human organisms are not prepared to shut off the noise. Hearing is a permanent process using cortical and subcortical structures to filter and interpret acoustical information; the analysis of acoustical signals is essential for human survival and communication. Noise is detrimental to health in several respects, for example, hearing impairment, sleep disturbance, cardiovascular effects, psycho physiologic effects, psychiatric symptoms, and fetal development (Stansfeld et al. 2000). Furthermore, noise has widespread psychosocial effects including noise annoyance, reduced performance, and increased aggressive behavior [American Academy of Pediatrics 1997; World Health Organization (WHO) 2001].

5.5.1 Health effects

Noise health effects are the health consequences of elevated sound levels. Elevated workplace or other noise can cause hearing impairment, hypertension, ischemic heart disease,

annoyance, sleep disturbance, and decreased school performance. Changes in the immune system and birth defects have been attributed to noise exposure, but evidence is limited. Although some presbycusis may occur naturally with age, in many developed nations the cumulative impact of noise is sufficient to impair the hearing of a large fraction of the population over the course of a lifetime. Noise exposure has also been known to induce tinnitus, hypertension, vasoconstriction and other cardiovascular impacts. Beyond these effects, elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behaviors. The most significant causes are vehicle and aircraft noise, prolonged exposure to loud music, and industrial noise.

5.5.2 Monitoring results

The measured minimum maximum and mean concentrations of Noise was 68dB, 78dB and 74.8 dB respectively. These levels of Noise were well within prescribed limits of International Standards i.e. 80dB.

6. CONCLUSION:

The levels of the ambient air pollutants such as CO, SO_2, NO_x, and PM_{10} were observed within the prescribed limits of Guidelines for ambient air quality like NEQS, USEPA, WHO and World Bank at the monitoring site (Proposed Site Located at Port Qasim Karachi Pakistan)

APPENDIX I

Annexure-I

Pakistan Space and Upper Atmosphere Research Commission
(Ambient Air Quality & Noise Monitoring Data Sheet)

SITE: Proposed Site Located at Port Qasim **DATE:** 28-03-2011

CITY: Karachi

DATE	TIME	SO_2 (ppb)	NO_X (ppb)	CO (ppm)	PM-10 (ug/m^3)	Noise (dB)
28/3/2011	11:00	14	18	2.3	135	78
28/3/2011	11:15	16	17	2.1	126	74
28/3/2011	11:30	15	19	2.5	125	75
28/3/2011	11:45	14	19	2.3	124	78
28/3/2011	12:00	15	18	2.6	126	74
28/3/2011	12:15	14	17	2.2	125	75
28/3/2011	12:30	15	18	2.1	125	74
28/3/2011	12:45	15	19	2.3	124	78
28/3/2011	13:00	14	18	2.5	125	74
28/3/2011	13:15	14	17	2.2	125	77
28/3/2011	13:30	12	18	2.3	126	78
28/3/2011	13:45	15	17	2.1	125	74
28/3/2011	14:00	14	18	2.3	125	75
28/3/2011	14:15	12	17	2.5	124	74
28/3/2011	14:30	12	15	2.3	125	78
28/3/2011	14:45	11	17	2.1	126	74
28/3/2011	15:00	13	15	2.3	125	77
28/3/2011	15:15	15	16	2.1	125	78
28/3/2011	15:30	14	18	1.9	124	74
28/3/2011	15:45	12	17	1.5	126	78
28/3/2011	16:00	12	18	1.8	125	74
28/3/2011	16:15	12	17	1.6	124	78
28/3/2011	16:30	12	18	1.5	125	74
28/3/2011	16:45	12	17	1.6	125	77
28/3/2011	17:00	14	18	1.1	124	78
28/3/2011	17:15	12	17	1.3	125	74
28/3/2011	17:30	12	18	1.2	125	74
28/3/2011	17:45	12	16	1.5	124	78
28/3/2011	18:00	10	16	1.2	126	74
28/3/2011	18:15	12	18	1.6	125	78
28/3/2011	18:30	11	16	1.2	125	74
28/3/2011	18:45	11	16	1.3	126	78
28/3/2011	19:00	12	16	1.2	125	77

15

APPENDIX I

28/3/2011	19:15	11	15	1.5	124	78
28/3/2011	19:30	12	15	1.2	125	74
28/3/2011	19:45	12	15	1.6	125	77
28/3/2011	20:00	12	16	1.5	125	78
28/3/2011	20:15	11	15	1.2	126	77
28/3/2011	20:30	12	15	1.3	135	77
28/3/2011	20:45	11	15	1.5	125	77
28/3/2011	21:00	11	15	1.2	136	78
28/3/2011	21:15	10	15	1.3	136	74
28/3/2011	21:30	10	14	1.6	125	74
28/3/2011	21:45	10	15	1.2	124	78
28/3/2011	22:00	10	14	1.3	125	74
28/3/2011	22:15	12	14	1.2	121	74
28/3/2011	22:30	10	14	1.0	126	78
28/3/2011	22:45	10	14	1.2	125	77
28/3/2011	23:00	11	15	1.3	124	74
28/3/2011	23:15	11	14	1.2	125	78
28/3/2011	23:30	10	15	1.3	126	74
28/3/2011	23:45	10	14	1.2	136	74
29/3/2011	0:00	10	15	1.3	125	74
29/3/2011	0:15	12	14	1.5	116	77
29/3/2011	0:30	10	14	1.3	115	78
29/3/2011	0:45	11	13	1.2	125	77
29/3/2011	1:00	11	15	1.3	124	78
29/3/2011	1:15	10	14	1.2	152	74
29/3/2011	1:30	10	15	1.3	125	74
29/3/2011	1:45	10	15	1.5	124	72
29/3/2011	2:00	10	14	1.2	125	71
29/3/2011	2:15	11	14	1.3	126	72
29/3/2011	2:30	10	14	1.5	120	75
29/3/2011	2:45	11	14	1.2	125	74
29/3/2011	3:00	10	14	1.3	124	72
29/3/2011	3:15	10	15	1.5	122	71
29/3/2011	3:30	10	15	1.2	120	73
29/3/2011	3:45	10	14	1.6	125	71
29/3/2011	4:00	10	15	1.2	124	72
29/3/2011	4:15	10	15	1.3	126	71
29/3/2011	4:30	10	15	1.2	120	74
29/3/2011	4:45	10	14	1.3	125	71
29/3/2011	5:00	9	15	1.2	124	76
29/3/2011	5:15	10	16	1.5	126	74

16

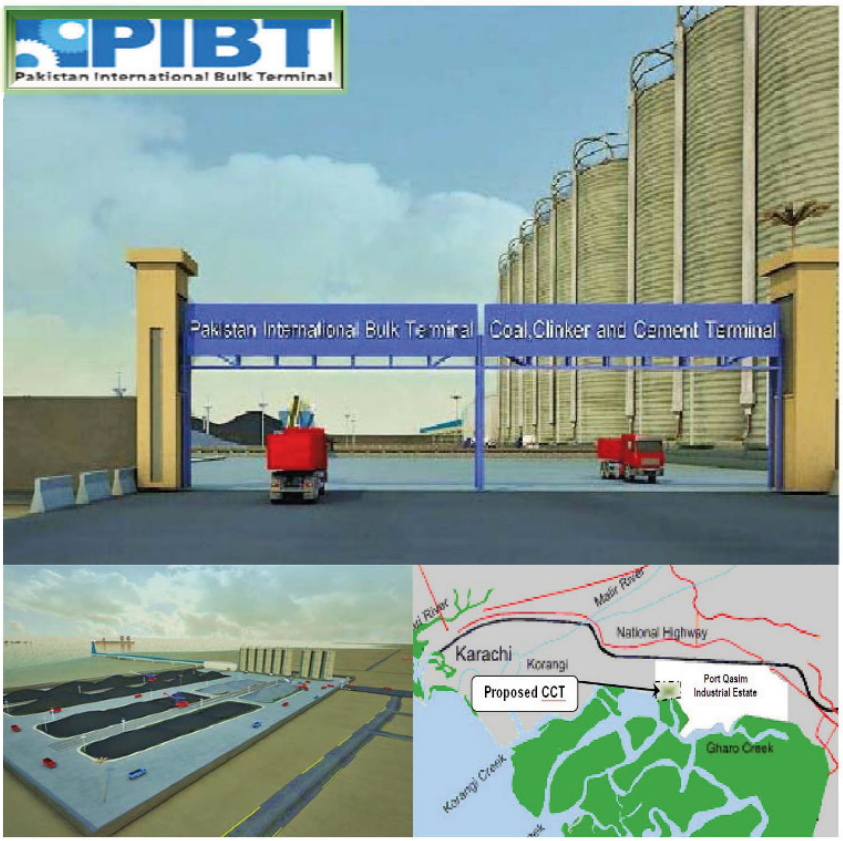
APPENDIX I

29/3/2011	5:30	11	15	1.2	120	75
29/3/2011	5:45	11	14	1.3	116	74
29/3/2011	6:00	9	15	1.2	116	75
29/3/2011	6:15	12	15	1.5	112	74
29/3/2011	6:30	11	14	1.3	125	71
29/3/2011	6:45	10	15	1.5	124	72
29/3/2011	7:00	11	14	1.6	119	75
29/3/2011	7:15	11	15	1.2	116	74
29/3/2011	7:30	11	17	1.6	115	75
29/3/2011	7:45	11	18	1.3	112	74
29/3/2011	8:00	11	19	1.2	125	75
29/3/2011	8:15	13	18	1.5	124	74
29/3/2011	8:30	12	19	1.3	112	69
29/3/2011	8:45	15	18	1.6	119	68
29/3/2011	9:00	14	19	1.2	125	69
29/3/2011	9:15	12	20	1.9	125	68
29/3/2011	9:30	12	18	1.3	125	69
29/3/2011	9:45	15	19	1.5	125	78
29/3/2011	10:00	14	20	1.3	125	74
29/3/2011	10:15	16	21	1.5	124	75
29/3/2011	10:30	15	20	1.3	125	74
29/3/2011	10:45	12	20	1.5	125	75
29/3/2011	11:00	16	23	1.3	124	74

APPENDIX II

PORT QASIM AUTHORITY

CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL



TRAFFIC IMPACT ASSESSMENT REPORT

April 2011

EA Consulting Pvt Ltd Engineering | Architecture | Project Management

Karachi | Islamabad |Lahore | Dubai | Al Ain

AL-9, 15th Lane, Off Khayaban-e-Hilal,
Phase VII, DHA, Karachi - 75500, Pakistan.
Tel: +(92) 21-111-111-584
Fax no. +(92) 21-3584-1825
Email: info@eaworld.com

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL

TRAFFIC IMPACT ASSESSMENT REPORT

Contents

EXECUTIVE SUMMARY 1

1 INTRODUCTION 1

1.1 PROJECT BACKGROUND 1
1.2 LOCATION 2
1.3 PROJECT OBJECTIVES 2
1.4 SCOPE OF TRAFFIC IMPACT ASSESSMENT 3
1.5 SOURCES OF DATA 3
1.6 CONSTRAINTS & LIMITATIONS 4
1.7 ORGANIZATION OF THE REPORT 4
1.8 ACKNOWLEDGEMENTS 4

2 THE PROPOSED PROJECT 5

2.1 GENERAL 5
2.2 CONCEPTUAL DESIGN 5
2.2.1 Terminal Layout 6
2.2.2 Traffic Route outside the Terminal along PQA Road Network 6
2.2.3 Connection beyond PQA Network 6
2.3 TENTATIVE CONSTRUCTION PERIOD 7

3 ANALYSIS OF IMPACTS 8

3.1 COMMENCEMENT OF OPERATIONS 8
3.1.1 Initial Capacity / throughput of the CCT 8
3.1.2 Design Capacity / throughput of the CCT 8
3.2 MARKET POTENTIAL FOR COAL 8
3.2.1 Production and Import of Coal in Pakistan 8
3.3 GENERATION OF PORT TRAFFIC OF COAL 9
3.3.1 Port Qasim's Share in Port Traffic of Coal 9
3.4 MARKET POTENTIAL FOR CEMENT & CLINKER 11
3.4.1 Historic Trends 13
3.5 GENERATION OF PORT TRAFFIC OF CEMENT & CLINKER 14
3.5.1 PQA'S Share in Port Traffic of Cement & Clinker 15
3.6 TOTAL ANTICIPATED TRAFFIC 16
3.6.1 Volume of Truck Traffic 16

APPENDIX II

3.6.2 Volume of other Traffic 16
3.6.3 Total Daily Volume of Traffic due to the Proposed Terminal 17
3.6.4 Alternate Analysis with Articulated Trucks 18

4 CONCLUSION AND RECOMMENDATIONS 19

4.1 GENERAL 19
4.2 RECOMMENDATIONS 19
4.2.1 Mitigation of Internal Impacts 19
4.2.2 Mitigation of External Impacts 20
4.2.3 Incidence Management 20
4.2.4 Interchange for Safer Entry / Exits 20
4.2.5 Pedestrian Facilities 20

APPENDIX II

PORT QASIM AUTHORITY

CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL

TRAFFIC IMPACT ASSESSMENT REPORT

EXECUTIVE SUMMARY

Pakistan International Bulk Terminal (PIBT) is undertaking the construction of Coal, Cement & Clinker Terminal on a BOT basis under a concession agreement with Port Qasim. It is part of an ambitious plan prepared by Port Qasim Authority to enhance the cargo handling capacity of the port in line with the Business Plan of the Port. The project site is located in the North Western Zone identified in the current Master Plan of the Port. Location Plan of the project is shown in Fig.1.2.

Scheduled to be operational by the year 2014, the project shall be Pakistan's first port terminal for mechanized handling of coal, cement and clinker on international standards of efficiency and environmental pollution control. The proposed terminal shall be capable of simultaneously handling two vessels of 75000 DWT and shall have an annual capacity of 8.0 million tones upon completion of the two-phase construction programme. There shall be provision to further enhance the capacity upto 12.0 million tones.

Traffic Impact Assessment for the project presented in this report takes into account the traffic attracted / generated after commencement of operations of the proposed terminal towards the end of the year 2014.The impact was considered vis-à-vis the Port Qasim Master Plan (2000 – 2050) and the operational aspects of the proposed terminal. It was concluded that:

- While the existing road network at Port Qasim can barely accommodate the additional traffic attracted / generated due to construction of the proposed terminal by the year 2014, necessary measures should be taken to avoid severe congestion and delays. These include widening of the main arteries on a priority basis, improvement of intersections and improved traffic control measures including necessary signage and markings. Routing and scheduling of traffic movements should also be considered and the construction vehicles should preferably be moved during off-peak hours along pre-designated routes.

- The road network consisting of 3-lanes proposed to be provided within the terminal complex also has the capacity to handle the traffic attracted / generated at the terminal in the beginning of its commercial operations. However, as the terminal attains its design capacity by the year 2019, an additional lane would be required for a smooth flow of traffic and avoidance of traffic congestion, delays, environmental pollution and economic losses. Some additional measures have also been recommended in section 4 of the report.

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Port Qasim, being the first industrial and commercial port in the country operating under landlord concept, caters for around 40% of the shipping requirements of the national economy. Over the last five years, there has been a marked improvement in cargo handling at the Port and its average annual growth has been around 13% necessitating the development of new berths / terminals for capacity enhancement.

Cargo Handled by KPT and PQA (During 1997-98 to 2008-09)

Year	Total Cargo Handled				
	KPT		PQA		Total
	(000 ton)	%	(000 ton)	%	(000 ton)
1997 - 98	22684	60.25%	14967	39.75%	37651
1998 - 99	24053	63.32%	13933	36.68%	37986
1999 - 00	22762	60.37%	14941	39.63%	37703
2000 - 01	25982	65.66%	13588	34.34%	39570
2001 - 02	26692	66.71%	13317	33.29%	40009
2002 - 03	25882	63.14%	15109	36.86%	40991
2003 - 04	27813	66.32%	14123	33.68%	41936
2004 - 05	28615	59.55%	19437	40.45%	48052
2005 - 06	32270	59.93%	21573	40.07%	53843
2006 - 07	30846	55.88%	24350	44.12%	55196
2007 - 08	37193	58.46%	26424	41.54%	63617
2008 - 09	38732	60.74%	25030	39.26%	63762
Average	28627	61.31%	18066	38.69%	46693

Source: Tables 14.6 and 14.7, Economic Survey of Pakistan, 2009-10

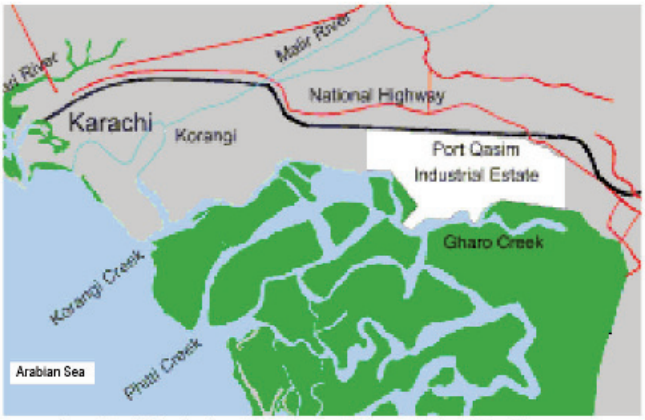
Therefore the Port Qasim Authority (PQA) has embarked upon an ambitious development plan for enhancing the cargo handling capacity from the present 40 million tons per annum to about 86 million tons per annum by the year 2013.

Among the eight new private sector projects being undertaken by PQA, is a dedicated Coal, Cement & Clinker Terminal with a handling capacity of 8 million tonnes per annum and a

APPENDIX II

storage capacity of 0.9 million tons. An Implementation Agreement was signed to this effect between PQA and PIBT (Pakistan International Bulk Terminal) on November 6, 2010 providing the framework for establishing a modern and first ever dirty bulk cargo terminal at Port Qasim to meet the industry's demand for mechanized handling of dirty bulk cargo. It would also be the first and only Dirty Cargo Terminal in Pakistan with State of the Art mechanized handling of cargo on international standards of efficiency and environmental pollution control thereby ensuring a pollution free environment at the Port. It would be directly connected to the hinterland through the National Highway and the railway network.

PIBT is being sponsored by Pakistan International Container Terminal Ltd. (PICT) which is part of the Marine Group of Companies. It is being financed by the IFC- the private sector arm of the World Bank Group. It is expected to become operational within next three years.



1.2 LOCATION

The proposed Coal, Cement & Clinker Terminal is located in the area identified as North Western Zone in the Port Qasim Master Plan. It is below the OIL / LPG Area as shown in Fig.1.2: Location Plan. The Phitti Creek Channel, approximately 45km in length, connects it to the Arabian Sea.

1.3 PROJECT OBJECTIVES

The main objective of the construction of the proposed terminal is to provide a new facility for import and export of Coal, Cement & Clinker by developing a dedicated terminal incorporating state-of-the art bulk handling technology with reliable and proven internationally accepted safety design features and strict environmental controls making it a green terminal.

In addition, the project would provide employment opportunities and generate other economic activities during its construction and operation.

APPENDIX II

1.4 SCOPE OF TRAFFIC IMPACT ASSESSMENT

The Traffic Impact Assessment presented in this Report is mainly focused on the traffic attraction / generation related with the proposed Coal, Cement & Clinker Terminal, the Pakistan International Bulk Terminal (PIBT) and the road network provided inside the terminal complex since the PQA Master Plan (2000 – 2050) has already considered the external effects of the new developments planned for enhancing the capacity of the Port. As such the data regarding the traffic movements other than those attracted / generated by the PIBT has been taken from the Strategic Planning Report of PQA.

Furthermore, it has been assumed that the various improvement measures recommended therein for the existing road network and transport system within the PQA limits and outside it (along the National Highway, N-5, for instance) would be implemented in due course of time thereby making the entire system capable of accommodating the additional traffic in a smooth way.

1.5 SOURCES OF DATA

The Report is based on data mainly obtained from the following sources:

- Final Report on Strategic Planning Study for Port Qasim, Port Qasim Authority, Ministry of Ports and Shipping, Govt. of Pakistan.
- Port Qasim Master Plan (2000 – 2050), Port Qasim Authority, Ministry of Ports and Shipping, Govt. of Pakistan.
- Port Qasim Business Plan 2006-07 – 2011-12, Port Qasim Authority, Ministry of Ports and Shipping, Govt. of Pakistan.
- Economic Survey of Pakistan (2009 – 10) published by the Ministry of Finance, Govt. of Pakistan
- Final Report on Business Plan for Development of the Coal and Clinker / Cement Terminal at Port Qasim, prepared by HPC for Pakistan International Container Terminal (PICT)
- Traffic Studies for various projects undertaken by EA in Karachi.
- Transport & Communications Department, (T&CD) City District Govt. , Karachi.
- National Highway Authority, Ministry of Communications, Govt. of Pakistan.
- Observations made during various visits to the project site at Port Qasim.

APPENDIX II

1.6 CONSTRAINTS & LIMITATIONS

The main constraints and limitations during the preparation of this report included:

- Non-availability of detail of traffic movements within the PQA limits, the traffic volumes moving along different arteries at different times of the day and on different days of the week.
- Non-availability of segregated / route-wise traffic data for heavy vehicles, public transport, para-transit and personal transport.
- The data available from the Final Report on Port Qasim Strategic Planning Studies dates back to 1999-2000.
- Non-availability of design details and the corresponding quantities of the various materials of construction which limited the assessment of the construction traffic associated with the project.

1.7 ORGANIZATION OF THE REPORT

The Report is organized into a professional format spread over the following 4 sections:

1. *Introduction*
2. *The Proposed Project*
3. *Analysis Of Traffic Impacts*
4. *Conclusion And Recommendations*

Figures, tables and annexures to the Report are appended thereafter.

1.8 ACKNOWLEDGEMENTS

The Consultants acknowledge with deep gratitude the cooperation extended by the concerned officials of the Port Qasim Authority especially for the valuable data and information provided for the preparation of this Report.

Acknowledgement is also due for the various data and information received from other sources including the T&CD, CDGK, NHA, and the aforementioned sources of secondary data.

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

2 THE PROPOSED PROJECT

2.1 GENERAL

The proposed project consists of terminal development works including construction of a jetty, storage areas for coal, cement and clinker, trestle bridge connecting the jetty with the storage areas, terminal office building, parking area, gate-office, road network, security / surveillance system, and provision of necessary machinery and equipment for the fully mechanized operation of the terminal. The salient features of these elements are briefly given in this section.

2.2 CONCEPTUAL DESIGN

The PQA has proposed to establish a dedicated coal and clinker/cement terminal, capable of handling large size bulk carriers of 75,000 dead-weight tonnage (dwt), in accordance with the provisions of PQA Master Plan 2000. It will be a greenfield development for a concession period of 30 years on Build, Operate and Transfer (BOT) basis, extendable for a period of another 30 years on mutually agreed terms and conditions. It shall be a mechanised facility equipped with unloaders, loaders, conveyors, silos stock piles and transportation equipment for handling of material from the ship to/from the consignee s destination. All handling equipment/operations shall qualify for environment-friendly requirements.

The conceptual design of the proposed project comprises the following features:

JETTY

- The Terminal development comprises of building a jetty of 460 meters in length for simultaneously operating two vessels of up to 75,000 DWT.
- It will have 2 Nos. ship unloading cranes and an additional crane for unloading of Cement & Clinker.

TRESTLES

- The jetty shall be connected to the Storage Area by a trestle bridge spanning almost two and half kilometers in length.
- The trestle will have two covered conveyors, one for coal imports and the other for Cement exports.
- The trestle will have capacity to add one more conveyor for enhanced handling in the future.
- Trestle piles are designed to support an Access Bridge for maintenance, fire fighting and other services.

STORAGE AREA

The Storage Area shall be located on reclaimed land spread over twenty five hectares or sixty two acres.

Cement and Clinker Storage

- There will be 9 cement silos of 6000 tons capacity each, located at the western side of the storage area.
- Cement silos trucks will interface to discharge cement directly to the silos for onward pumping through the cement conveyor; and on to the vessels for export of cement.
- The total cement handling capacity shall be 45,000 tons.
- The Terminal will also have capacity to stack three hundred and fifty thousand 350,000 Tons of Clinker at any given time.
- Clinker storage capacity shall be around 350,000 tons.

Coal Storage

- Storage Area will have capacity to store about 600,000 Tons of coal at any given time stacked in heaps of about fifteen meters height.
- Two stackers will run in between the coal piles to stack coal being discharged from the ship and fed through the conveyor.
- Dust suppression water sprinklers will be located in the coal piles to contain coal dust.

2.2.1 Terminal Layout

The preliminary layout proposed for the terminal is shown in Fig. 2.2.1 along with the road network connecting different functional areas.

2.2.1.1 Road Network Within The Terminal

The road network within the terminal complex consists of 3-lane roads around the periphery of the terminal connecting the different functional areas to the main gate of the terminal.

2.2.1.2 Entry / Exit System

A gate-controlled entry / exit system shall be provided with necessary security arrangements, video camera surveillance system and computerized inventory management.

2.2.2 Traffic Route outside the Terminal along PQA Road Network

The traffic route outside the CCT complex follows the PQA Road Network. The main access road from the National Highway, N-5 is a single 2-lane carriageway at present. However, it is planned to be dualized into a 4-lane divided road. The intersections are also proposed to be improved along with the various Port Development schemes being implemented at Port Qasim.

2.2.3 Connection beyond PQA Network

Beyond the PQA network, the project shall be connected with the various areas in Karachi and upcountry through the National Highway and the railway network. The PQA access road

connects the proposed terminal to the National highway, N-5 which runs from Karachi to Peshawar and onwards to Afghanistan. From the National Highway, N-5 branch off different routes along National Highways leading to various other cities in the country. A link road starting near Steel Town connects the National Highway, N-5 with the Superhighway / Motorway, M-9 system near Kathore.

Main line of Pakistan Railways, running almost parallel to National Highway, N-5, links Port Qasim to other areas in the country especially to the Thar Parkar region providing opportunities for carriage of Coal and Clinker to the proposed terminal. However, development of a railway link between the proposed terminal and Pipri Marshalling Yard shall be required for making it a convenient and commercially attractive cargo movement facility.

2.3 TENTATIVE CONSTRUCTION PERIOD

The proposed Coal, Cement and Clinker Terminal is scheduled to be constructed in a period of 36months tentatively starting from November 2011 and completing by November 2014. Since the project is at the early stage of planning, any definitive construction schedule is not yet available.

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

3 ANALYSIS OF IMPACTS

3.1 COMMENCEMENT OF OPERATIONS

The proposed terminal is scheduled to commence its operations by November 2014.

3.1.1 Initial Capacity / throughput of the CCT

The initial capacity / throughput of the proposed terminal is planned to be 8,000,000 metric tones / year at the start of its commercial operations.

3.1.2 Design Capacity / throughput of the CCT

The design capacity / throughput of the proposed terminal shall be 12,000,000 metric tones / year. However, the scale of commercial operations and consequent demand for additional capacity would determine as to when the design capacity would be provided by increasing the throughput from 8,000,000 metric tones / year to the maximum 12,000,000 metric tones / year.

3.2 MARKET POTENTIAL FOR COAL

Based on the fact that Pakistan has extensive coal reserves, estimated at over 185 billion tones including 175 billion tones identified at Thar coalfields in Sindh, the market for coal not only exists but also has the potential to expand with the passage of time. However, the vast natural resource has mostly remained unexploited and the maximum local production during the last 10 years has been 4.871million tones in 2005-06. Therefore the country has to import coal from other countries in order to meet the local demand for coal which averaged to 6690 million tons during 2000-09 and was more than 10 million tones in 2007-08 as shown in the following section.

3.2.1 Production and Import of Coal in Pakistan

The following table extracted from the Economic Survey of Pakistan (2009-10) shows the historic trend in the production and import of coal in Pakistan:

Table 13.6: Production of Coal (000 tonnes)

Year	Imports	Production	Total
2000-01	950	3,095	4,045
2001-02	1,081	3,328	4,409
2002-03	1,578	3,312	4,890
2003-04	2,789	3,275	6,064
2004-05	3,307	4,587	7,894
2005-06	2,843	4,871	7,714
2006-07	4,251	3,643	7,894
2007-08	5,987	4,124	10,111
2008-09	4,652	3,738	8,390
July-March			
2008-09	3,000	1,822	4,822
2009-10 (e)	3,600	1,704	5,304

e: Estimated *Source: M/o Petroleum Natural Resource, Hydrocarbon Development Institute of Pakistan*

APPENDIX II

3.3 GENERATION OF PORT TRAFFIC OF COAL

The generation of port traffic of coal is presently due to imports for its large scale consumption in the country by cement industry (about 40% of the total coal available) and by brick clins (more than 58% of the total coal available). Due to price differential between coal and furnace oil, almost the whole cement industry has switched over to coal from furnace oil. Although the consumption of coal for power generation / energy supply is very low at present, it may increase with the passage of time considering the rising prices of furnace oil and the minimal utilization of other sources of power generation in the country.

During the 10 years period between the years 2000 – 2009, the average yearly import of coal has been 3,049, 000 metric tones and the maximum import was 5,987,000 metric tones in the year 2007-08. With an optimistic approach regarding the exploitation of coal reserves in the country in the near future, which is an essential requirement for economic development and meeting the increasing shortfall of energy in the country, the capacity requirements of the dedicated port terminal may be pragmatically estimated considering the average volume of import and export of coal at around 6,000,000 metric tones / year during the analysis period.

3.3.1 Port Qasim's Share in Port Traffic of Coal

Keeping in view the present share of Port Qasim in fulfilling the shipping requirements of the national economy, the average volume of import and export of coal through the port may be estimated at around 2,400,000 metric tones / year. This works out to around 200,000 metric tones / month and around 8,000 metric tones / day if 25 working days are considered per month on an average basis. Since the share of railways in the movement of goods has been declining over the last few decades and bulk of the inland cargo movement (>96% of goods) takes place by road, it is safer to assume, for the purpose of this analysis, that the calculated volume of coal to be handled at the proposed dedicated terminal would also be moved inland by means of trucks.

The payload capacity of the two predominant types of rigid trucks (2-Axles single, 69%; 3-Axles rear tandom, 23%) being used for carriage of goods in the country was assessed on the basis of data published by the National Transport Research Centre (NTRC) in the "Axle Load Study on National Highways" in July 1995. The analysis for the average pay load carried by the above referred types of trucks surveyed on the three inland routes between Karachi and upcountry is summarized in the Table 3.2.3.1.

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

ESTIMATION OF PAYLOAD CAPACITIES OF PREDOMINANT TRUCK TYPES IN KARACHI

Table 3.2.3.1

Route		2-Axle Rigid Trucks (1.2) (Average load in tonnes)			3-Axle Rigid Trucks (1.22) (Average load in tonnes)		
		Gross Weight (Loaded trucks)	Gross Weight (Empty trucks)	Payload carried	Gross Weight (Loaded trucks)	Gross Weight (Empty trucks)	Payload carried
1	Karachi – Gadani (Along RCD Highway)	19.31	6.42	12.89	40.53	10.84	29.69
2	Karachi – Hyderabad (Along Superhighway)	16.25	7.15	9.10	31.19		20.35
3	Karachi – Thatta (Along National Highway, N-55)	15.36	6.69	8.67	33.61		22.77
Trucks carrying Fuel & Lubricants including coal		16.35	-	-	29.04	-	-
Trucks carrying mining & quarrying materials including coal		18.04	-	-	34.28	-	-
Average Estimated Pay Load Capacity (tonnes)		17.16	6.75	10.41	33.73	10.84	22.89

Source:

NTRC Report on Axle Load Survey on National Highways - July 1995,

Tables 6.8.1, 6.8.1-A, 6.8.1.3, 6.8.3, 6.8.3-A and 5.8.3.3 presented at the Statistical Appendix.

The average payload capacity for the aforementioned predominant types of rigid trucks was calculated to be 10.41 tonnes and 22.89 tonnes respectively. Based on the above analysis of trucking industry and the average payload capacity of trucks generally used for carrying coal, the average daily truck volume of coal carrying trucks was calculated as under:

Estimated Traffic of Coal at the Proposed Terminal (metric tones)		Truck traffic generated at Port Qasim		
		Rigid Trucks 2-Axles Single (1.2) 10.5 tonnes capacity	Rigid Trucks 3-Axles Rear Tandem (1.22) 23 tonnes capacity	Total Truck Volume Generated
Yearly	2,400,000			
Monthly	200,000			
Daily	8,000	534	105	639
(Assuming 25 working days per month)				

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

3.4 MARKET POTENTIAL FOR CEMENT & CLINKER

Pakistan is abundant in cement raw material and its cement industry having 29 units with a total installed capacity of around 47 million metric tones is among the major industries. The market potential for cement and clinker may be assessed from the historical data on the availability and performance of cement / clinker plants in the country and the export of cement and clinker to different countries around the World. The data available from All Pakistan Cement Manufacturers' Association (APCMA) and the Economic Survey of Pakistan 2009-10 shows up-to-date progress of the industry with a clear indication of the huge demand for cement and clinker in the country as well as for export to other countries including neighboring countries like India,



Afghanistan, Iraq and Russian States besides the markets of various GCC and African countries which are new markets for the Country. The following sections present an overview of the market leading to the estimation of Port Traffic generated by Cement & Clinker exports after a statement of production capacity of the various cement producing units in the country based on APCMA data as presented hereunder in Table 3.4:

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

Table 3.4: Statement of Production Capacity

Upto April - 2011

Sr. No.	Name Of Unit	Installed Capacity		Operational Capacity	
		Clinker	Cement	Clinker	Cement
North Zone					
1	Askari Cement Limited - Wah	1,050,000	1,102,500	1,050,000	1,102,500
2	Askari Cement - Nizampur	1,500,000	1,575,000	1,500,000	1,575,000
3	Bestway Cement Limited - Hattar	1,170,000	1,228,500	1,170,000	1,228,500
4	Bestway Cement Limited - Chakwal	3,428,571	3,600,000	3,428,571	3,600,000
5	Bestway-Mustehkum Cement Limited - Hattar	1,035,000	1,086,750	1,035,000	1,086,750
6	Cherat Cement Company Limited-Nowshera	1,000,000	1,050,000	1,000,000	1,050,000
7	Dancot Cement Limited - Jehlum	480,000	504,000	480,000	504,000
8	Dewan Hattar Cement Limited - Hattar	1,080,000	1,134,000	1,080,000	1,134,000
9	D.G.Khan Cement Limited - D.G.Khan	2,010,000	2,110,500	2,010,000	2,110,500
10	D.G.Khan Cement Limited - Chakwal	2,010,000	2,110,500	2,010,000	2,110,500
11	Fauji Cement Company Limited - Fateh Jang	1,110,000	1,165,500	1,110,000	1,165,500
12	Fecto Cement Limited - Sangjani	780,000	819,000	780,000	819,000
13	Flying Cement Limited - Lilla	1,140,000	1,197,000	600,000	630,000
14	GharbiWal Cement Limited - Jehlum	2,550,000	2,677,500	2,010,000	2,110,500
15	Kohat Cement Company Limited - Kohat	2,550,000	2,677,500	2,550,000	2,677,500
16	Lucky Cement Limited - Pezu	3,725,714	3,912,000	3,725,714	3,912,000
17	Maple Leaf Cement Factory Limited - Daudkhel	3,510,000	3,912,000	3,210,000	3,370,500
18	Lafarge Pakistan Cement Company Limited - Chakwal	1,950,000	2,047,500	1,950,000	2,047,500
19	Pioneer Cement Limited - Khushab	1,933,571	2,030,250	1,933,571	2,030,250
	Sub Total (North Zone)	**34,012,857**	**35,713,500**	**32,632,857**	**34,264,500**
South Zone					
1	A.C. Rohri Cement Limited - Rohri	230,000	241,500	-	-
2	Al-Abbas Cement Limited - Nooriabad, Dadu	450,000	472,500	450,000	472,500
3	Attock Cement Pakistan Limited - Hub Chowki, Lasbela	1,710,000	1,795,500	1,710,000	1,795,500
4	Dadabhoy Cement Industries Limited - Nooriabad, Dadu	504,762	530,000	-	-
5	Dewan Cement Limited - Dhabeji	750,000	787,500	750,000	787,500
6	Javedan Cement Limited	600,000	630,000	-	-
7	Lucky Cement Limited, - Indus Highway, Karachi	3,428,571	3,600,000	3,428,571	3,600,000
8	Pakistan Slag Cement Limited	-	157,500	-	-
9	Thatta Cement Limited - Thatta	300,000	315,000	300,000	315,000
10	Zeal Pak Cement Limited - Hyderabad	342,857	360,000	-	-
	Sub Total (South Zone)	**8,316,190**	**8,889,500**	**6,638,571**	**6,970,500**
	Grand Total (North+South)	**42,329,047**	**44,603,000**	**39,271,428**	**41,235,000**
	Fauji Cement 2010-2011	2,160,000	2,268,000	2,160,000	2,268,000
	Projected 2010-2011	**44,489,047**	**46,871,000**	**41,431,428**	**43,503,000**

Source: All Pakistan Cement Manufacturer's Association, APCMA

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

3.4.1 Historic Trends

Historical Analysis of Cement Production Capacity & Despatches (Operational Units Data)

July to June	Production Capacity (Mn. Tonnes)	% age Incr/(Dec)	Local Despatches (Mn. Tonnes)	% age Incr/(Dec)	Exports (Mn. Tonnes)	% age Incr/(Dec)	Total Despatches (Mn. Tonnes)	% age Incr/(Dec) (Tota)	Capacity Utilization % age	Surplus Capacity (Mn. Tonnes)
1990-1991	8.891	0.00%	7.290	0.00%	-	0.00%	7.290	0.00%	81.99%	1.601
1991-1992	8.891	0.00%	7.712	5.79%	-	0.00%	7.712	5.79%	86.74%	1.179
1992-1993	8.891	0.00%	8.324	7.94%	-	0.00%	8.324	7.94%	93.62%	0.567
1993-1994	9.048	1.77%	8.136	-2.26%	-	0.00%	8.136	-2.26%	89.92%	0.912
1994-1995	10.173	12.43%	8.380	3.00%	-	0.00%	8.380	3.00%	82.37%	1.793
1995-1996	10.173	0.00%	9.431	12.54%	-	0.00%	9.431	12.54%	92.70%	0.743
1996-1997	12.504	22.91%	9.650	2.33%	-	0.00%	9.650	2.33%	77.17%	2.855
1997-1998	15.528	24.18%	9.193	-4.73%	-	0.00%	9.193	-4.73%	59.20%	6.335
1998-1999	16.410	5.68%	9.621	4.65%	-	0.00%	9.621	4.65%	58.63%	6.790
1999-2000	16.379	-0.19%	9.937	3.29%	-	0.00%	9.937	3.29%	60.67%	6.442
2000-2001	15.534	-5.16%	9.933	-0.04%	-	0.00%	9.933	-0.04%	63.95%	5.600
2001-2002	15.723	1.22%	9.833	-1.01%	0.107	100.00%	9.940	0.06%	63.22%	5.783
2002-2003	16.321	3.81%	10.980	11.66%	0.472	342.53%	11.452	15.21%	70.16%	4.869
2003-2004	16.936	3.77%	12.545	14.25%	1.118	137.02%	13.663	19.31%	80.68%	3.272
2004-2005	17.909	5.75%	14.788	17.88%	1.565	39.96%	16.353	19.69%	91.32%	1.555
2005-2006	20.955	17.01%	16.907	14.33%	1.505	-3.83%	18.412	12.59%	87.87%	2.543
2006-2007	30.251	44.36%	21.034	24.41%	3.213	113.50%	24.248	31.69%	80.16%	6.003
2007-2008	37.157	22.83%	22.577	7.33%	7.717	140.13%	30.293	24.93%	81.53%	6.863
2008-2009	41.76	12.39%	20.533	-9.05%	10.752	39.34%	31.285	3.28%	74.92%	10.475
2009-2010	44.662	7.00%	23.538	14.63%	10.657	-0.89%	34.195	9.30%	76.53%	10.467
2010-2011 9 Months	41.236	-7.71%	16.017	-7.86%	6.724	-14.46%	22.742	-9.91%	73.53%	8.185

Source: All Pakistan Cement Manufacturer's Association, APCMA

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

3.5 GENERATION OF PORT TRAFFIC OF CEMENT & CLINKER

A comparison of the export of Cement and Clinker from Pakistan via land routes and via sea is presented in the following table reflecting upon the available capacity and the generation of port traffic related with Cement and Clinker exports:

Export of Cement and Clinker From Pakistan

Financial Years	Cement			Clinker	Total
	Afghanistan	India	Other Countries	Other Countries	
	Via Land	Via Sea & Land	Via Sea	Via Sea	Exports
	Quantity in Metric Tons				
2001-2002	106,620	-	-	-	106,620
2002-2003	430,332	-	-	41,500	471,822
2003-2004	1,118,293	-	-	-	1,118,293
2004-2005	1,407,900	-	157,270	-	1,565,170
2005-2006	1,413,994	-	91,165	-	1,505,159
2006-2007	1,725,526	-	1,096,995	390,973	3,213,494
2007-2008	2,777,826	786,672	3,045,995	1,106,127	7,716,620
2008-2009	3,148,306	634,455	6,061,035	908,690	10,752,486
2009-2010	4,013,671	722,967	5,637,163	283,436	10,657,235
2010-2011 9 Months	3,277,159	382,271	2,905,338	159,289	6,724,057

Source: All Pakistan Cement Manufacturer's Association, APCMA

The above data shows that the maximum export of Cement and Clinker from the country during the last five years was around 10.753 million metric tons in 2008-09 out of which the sea-borne exports were over 6.97 million metric tons i.e., over 65% of the total quantity exported.

APPENDIX II

3.5.1 PQA'S Share in Port Traffic of Cement & Clinker

Although the existing share of Port Qasim in the port traffic of cement and clinker has been less than 30% as shown in the following table, it is envisaged that after the construction of the dedicated terminal proposed at the Port, it would attract more traffic due to its fully mechanized modern facility, better road connectivity and large storage area available.

Port Throughput of Cement & Clinker

Financial Year	2006-07	2007-08	2008-09	2009-10
Export of Cement & Clinker (metric tonnes)				
Karachi Port	1,074,136	3,285,605	4,312,828	3,307,537
Port Qasim	326,000	546,000	1,318,000	1,296,000
Total	1,400,136	3,831,605	5,630,828	4,603,537
Share of Port Qasim	23.28%	14.25%	23.41%	28.15%

Source: Table 8, Final Report on Business Plan for Development of the Coal & Clinker / Cement Terminal at Port Qasim, December 2010 by HPC Hamburg Port Consulting GmbH.

Therefore around 30% additional market share was estimated for Port Qasim keeping in view the storage and handling capacity of the proposed facility and the volume of cement and clinker at the proposed terminal was forecast to be around 2.2million metric tones in the year 2014, the first year of operation and around 4.3million metric tones by the year 2018 and thereafter assuming the terminal to be at its full capacity as presented in Table 16 of the above referred Final Report on the Business Plan for the proposed terminal. The split between cement and clinker was assumed to be constant during the analysis period.

By applying the payload capacity of the two predominant types of trucks in Karachi estimated above in Table 3.2.3.1, the average daily truck traffic to be generated at Port Qasim due to the export of cement and clinker from the proposed terminal was estimated assuming an average of 25 working days per month, as shown in the following table:

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

Year	Estimated Traffic of Cement & Clinker at the Proposed Terminal (metric tones)	Truck traffic generated at Port Qasim		
		Rigid Trucks 2-Axles Single (1.2) 10.5 tonnes capacity	Rigid Trucks 3-Axles Rear Tandem (1.22) 23 tonnes capacity	Total Daily Truck Volume Generated
2014	2.201	490	96	586
2015	3.271	727	143	870
2016	3.705	824	162	986
2017	4.125	917	180	1097
2018	4.250	945	185	1130
2019 & Beyond	4.300	956	187	1143

3.6 TOTAL ANTICIPATED TRAFFIC

3.6.1 Volume of Truck Traffic

The total volume of heavy traffic anticipated due to the operation of the proposed facility was estimated by summing up the traffic generated due to port traffic of coal, cement and clinker as shown hereunder:

Year	Port Traffic Generation Scenarios	Truck traffic generated at Port Qasim		
		Rigid Trucks 2-Axles Single (1.2) 10.5 tonnes capacity	Rigid Trucks 3-Axles Rear Tandem (1.22) 23 tonnes capacity	Total Daily Truck Volume Generated
2014	Combined Traffic for Coal, Cement and Clinker	1024	201	1225
2015		1261	248	1509
2016		1358	267	1625
2017		1451	285	1736
2018		1479	290	1769
2019 and onwards assuming full capacity		1490	292	1782

3.6.2 Volume of other Traffic

It is envisaged that in addition to the above truck traffic, the operations at the proposed terminal would also generate other forms of traffic consisting mainly of motorcycles, cars, pickups, vans,

APPENDIX II

coasters, minibuses and buses, etc. used for the transportation of port staff /workers and other visitors. This traffic was estimated on the basis of the existing traffic at Port Qasim taking into account the anticipated commercial activity at the proposed facility. The Final Report on Strategic Planning Study for Port Qasim presents the following data for traffic flows on PQA Roads in May 2000:

Road	Motor Cycles	Cars / Wagons	Buses	Mini buses	Pickups	Rigid Trucks	Trucks + trailers	Total All Vehicles
Main Access Road	292	1566	828	284	540	1505	365	5380
Eastern Access Road	84	104	58	26	52	164	58	546

Source: Table 2.3.1: Daily Existing Flows on PQA Roads – Final Report on Strategic Planning Study for Port Qasim, Volume 3, May 2001.

Furthermore, the external traffic to and from Port Qasim was estimated in the above Report to be around 8700 vehicles per day in the year 2010.

For the purpose of this analysis, about 20% of this traffic volume was assumed to be due to the proposed facility and was further projected over the analysis period with an average yearly growth rate of 6.0% for cars and motorcycles, 4.0% for the heavy pickups and minitrucks and 3.0% for the minibuses and buses. The growth in vehicles registered in Karachi and the development of commercial activities at the proposed terminal were duly considered while selecting these average traffic growth rates.

3.6.3 Total Daily Volume of Traffic due to the Proposed Terminal

The total daily volume of traffic due to the proposed terminal at Port Qasim was estimated to be:'

Year	Motorcycles	Cars, Jeeps, Vans, Taxis, Light pickups	Minibuses, Coasters, Coaches	Heavy Pickups / Mini trucks	Buses	Rigid Trucks 2-Axles Single (1.2)	Rigid Trucks 3-Axles Rear Tandem (1.22)	Total Anticipated Volume	
								Vehicles	PCU's
2014	121	651	118	225	345	1024	201	2685	5864
2015	128	690	122	234	355	1261	248	3038	6827
2016	136	731	126	243	366	1358	267	3227	7276
2017	144	775	130	253	377	1451	285	3415	7715
2018	153	822	134	263	388	1479	290	3529	7916
2019	162	871	138	274	400	1490	292	3627	8062
and onwards assuming the proposed terminal to be working at full capacity									
Passenger Car Equivalents	0.50	1.00	1.50	1.50	2.50	3.00	3.50		

APPENDIX II

PORT QASIM AUTHORITY
CONSTRUCTION OF COAL, CEMENT & CLINKER TERMINAL
TRAFFIC IMPACT ASSESSMENT REPORT

3.6.4 Alternate Analysis with Articulated Trucks

An alternate analysis was also carried out to determine the total daily volume considering about 70% Articulated Trucks used for the movement of coal, cement and clinker. The volume of truck traffic generated under this scenario is presented below:

Alternate Analysis with Articulated Trucks

Year	Port Traffic Generation Scenarios	Truck traffic generated at Port Qasim		
		Articulated Trucks 6-Axles Tandem Tridem (1.2-222) 35.33 tonnes capacity	Rigid Trucks 3-Axles Rear Tandem (1.22) 23 tonnes capacity	Total Daily Truck Volume Generated
2014	Combined Traffic for Coal, Cement and Clinker	305	201	506
2015		376	248	624
2016		404	267	671
2017		432	285	717
2018		440	290	730
2019 & Onwards *		443	292	735
* Assuming the terminal to be operating at full capacity				

The total volume of traffic generated this scenario is summarized at Annexure-A. The analysis shows that the total volume would be around 2,000 vpd (about 3,700 pcu's) in the year 2014 increasing to about 2,600 vpd (about 5,000 pcu's) by the year 2009 when the terminal is expected to be working at full capacity.

APPENDIX II

4 CONCLUSION AND RECOMMENDATIONS

4.1 GENERAL

On the basis of Traffic Impact Assessment carried out for the project, it is concluded that:

- Upon completion of the two phases of the project, the terminal would have a capacity to handle about 8,000,000 metric tons of the dirty bulk cargo consisting of coal, cement & clinker,
- Keeping in view the historical trends in the import and export of coal, cement and clinker to / from Pakistan, the future prospects, and the max. loading capacity of the prevalent truck types, it is forecast that heavy traffic consisting of about 1800 trucks per day would be generated during peak operating conditions.
- The total additional volume due to the proposed terminal is estimated to be around 3000 vehicles per day (vpd) or 5900 passenger car units (pcu's) per day in 2014 to about 3600vpd or 8100 pcu's per day in 2019 and beyond when the terminal would be operating at its full design capacity.
- While the initial traffic volume of 5900 pcu's can be accommodated on the circulation area consisting of 3-lane roads provided in the terminal complex, necessary measures shall be required to avoid queuing of vehicles and resulting congestion and delays and addition of another lane shall be required by the year the terminal starts operating at its full design capacity.
- Under an alternate scenario (summarized at Annexure-A) considering about 70% articulated trucks having a capacity of about 35.33 metric tons pay load, only 3-lanes shall be required for the movement of traffic in the terminal complex by the year 2019 and beyond.

4.2 RECOMMENDATIONS

4.2.1 Mitigation of Internal Impacts

Mitigation of internal impacts of traffic movements would require various measures to be taken inside the proposed terminal complex including:

- Advanced / automated systems for security checking to avoid unnecessary delays and queuing of vehicles,
- Effective utilization of Road signs and markings for better guidance and control of traffic within the complex,
- Segregation of vehicular and pedestrian movements, and provision of walkways / footpaths
- Provision of designated parking and service areas for different types of vehicles and road connectivity of these areas.
- Preparedness / arrangements for incident management, especially in the event of breakdown of vehicles along the circulation areas inside the terminal complex.

- Well-designed road lighting system.
- Provision of proper turning radii for trucks
- Provision of sufficient lateral clearance and standard lane widths of 3.65m (12ft).

4.2.2 Mitigation of External Impacts

Mitigation of external impacts would require various measures to be taken by PQA outside the boundary of the proposed terminal complex including:

- Widening of the approach roads for carrying the additional traffic
- Provision of necessary guide signs and markings for better traffic control and, if necessary,
- Rerouting / scheduling of traffic movements to avoid traffic conflicts, congestion and delays within the PQA limits.
- Prioritization of the construction of flyovers / bridges planned within the PQA limits.
- Plantation of more trees to overcome air pollution due to vehicular exhausts.

4.2.3 Incidence Management

The additional traffic movements would call for greater preparedness for incidence management along the road network inside the PQA limits. Eventualities especially to be considered include:

- Breakdown of vehicles along main travel corridors / arteries causing queuing of vehicles, congestion and delays, and
- Traffic control under bad weather conditions such as heavy rains and poor visibility/fog in order to avoid accidents and losses.

4.2.4 Interchange for Safer Entry / Exits

Provision of interchange along the National Highway, N-5 for safer entry / exit movements is highly desirable and should be considered by PQA alongside the implementation of capacity enhancement programme since enhanced capacity would attract / generate more vehicular traffic, most of which would consist of heavy vehicles. Therefore the interchange planned at the entrance from N-5 should be prioritized in order to avoid unnecessary delays, congestion, environmental pollution, economic losses and any traffic accidents due to conflicting traffic movements.

4.2.5 Pedestrian Facilities

Although pedestrian movements shall be on a limited scale, pedestrian facilities shall be required inside the proposed terminal for safer movement of people walking around different terminal areas. Designated walkways / footpaths should be provided for movement of people from the gate of the terminal to various areas and proper signage and marking should be used for enhancing the pedestrian safety features.

APPENDIX II

APPENDIX II

ANNEXURE "A" SUMMARY OF ALTERNATE ANALYSIS WITH 70% ARTICULATED TRUCKS - 6 AXLE TRAILERS

Year	Motorcycles	Cars, Jeeps, Vans, Taxis, Light pickups	Minibuses, Coasters, Coaches	Heavy Pickups / Mini trucks	Buses	Articulated Trucks 6 Axles Tandem Tridem (1.2.222) 35.33 tonnes capacity	Rigid Trucks 3-Axles Rear Tandem (1.22)	Total Anticipated Volume	
								Vehicles	PCU's
2014	121	651	118	225	345	305	201	1966	3707
2015	128	690	122	234	355	376	248	2153	4172
2016	136	731	126	243	366	404	267	2273	4414
2017	144	775	130	253	377	432	285	2396	4658
2018	153	822	134	263	388	440	290	2490	4799
2019 & Onwards *	162	871	138	274	400	443	292	2580	4921
Passenger Car Equivalents	0.50	1.00	1.50	1.50	2.50	3.00	3.50		

* Assuming the proposed terminal to be working at full capacity

APPENDIX II

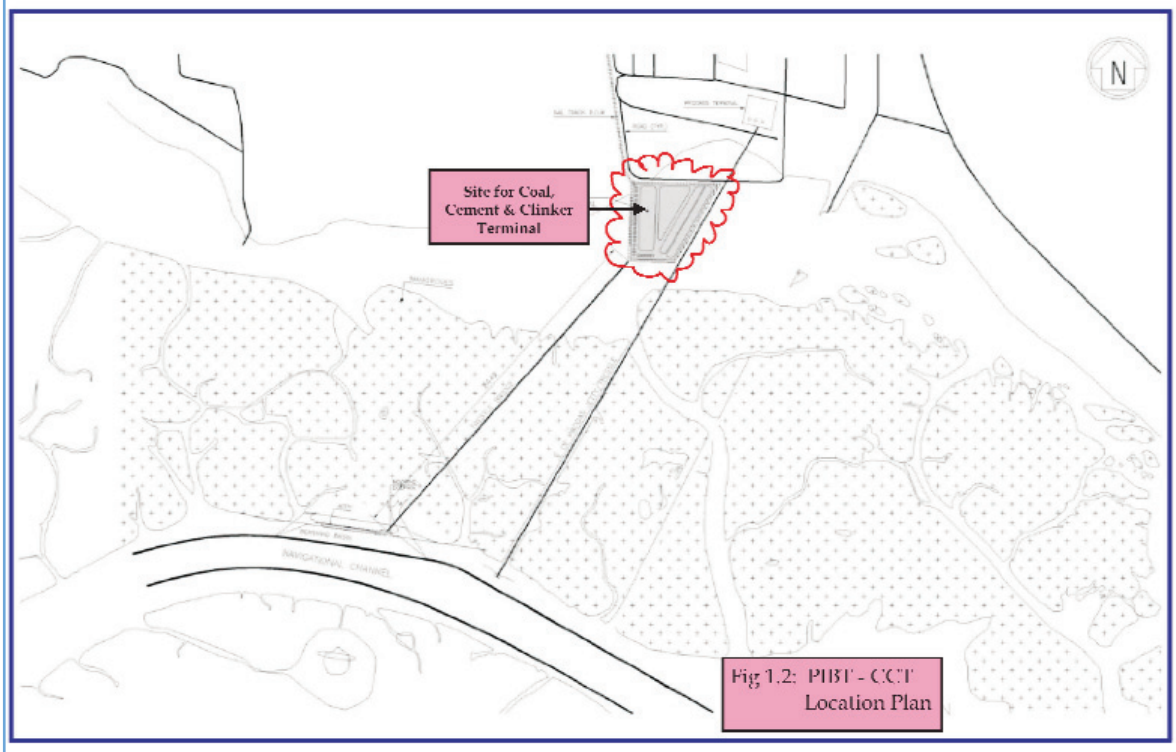


Fig 1.2: PIBT - CCT Location Plan

APPENDIX II

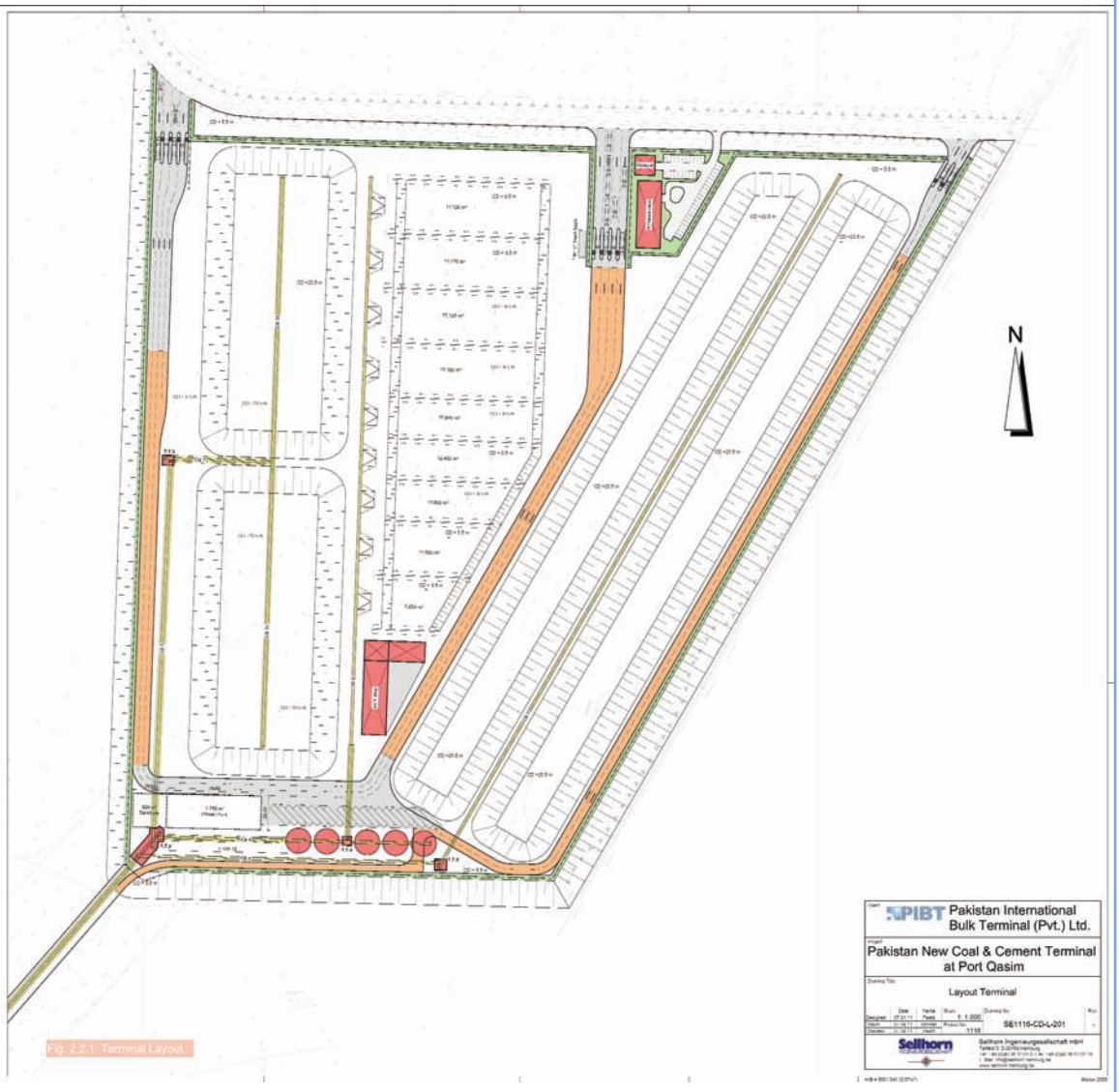


Fig. 2.2.1: Terminal Layout

APPENDIX III

The Gazette of Pakistan

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, SATURDAY,, DECEMBER 6,1997

PART I

Acts, Ordinances, President's Orders and Regulations

SENATE SECRETARIAT

Islamabad, the 6th December, 1997

No. F. 9(46)/97-Legis.- The following Acts of Majlis-e-Shoora (Parliament) received the assent of the Acting President on 3rd December, 1997 are hereby published for general information :-

Act No. XXXIV OF 1997

An Act to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development

WHEREAS it is expedient to provide for the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution, promotion of sustainable development, and for matters connected therewith and incidental thereto;

1. Short title, extent and commencement.---(1) This Act, shall be called the Pakistan Environmental Protection Act, 1997

(2) It extends to the whole of Pakistan.

(3) It shall come into force at once.

2. Definitions. In this Act, unless there is anything repugnant in the subject or context,

(i) "adverse environmental effect" means impairment of, or damage to, the environment and includes—

(a) impairment of, or damage to, human health and safety or to biodiversity or property;

APPENDIX III

(b) pollution; and

(c) any adverse environmental effect as may be specified in the regulations;

(ii) "agricultural waste" means waste from farm and agricultural activities including poultry, cattle farming, animal husbandry residues from the use of fertilizers, pesticides and other farm . chemicals;

(iii) "air pollutant" means any substance that causes pollution of air and includes soot, smoke, dust particles, odour, light, electro-magnetic, radiation, heat, fumes, combustion exhaust, exhaust gases, noxious gases, hazardous substances and radioactive substances;

(iv) "biodiversity" or "biological diversity" means the variability among living organisms from all sources, including inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems;

(v) "Council" means the Pakistan Environmental Protection Council established under section 3;

(vi) "discharge" includes spilling, leaking, pumping, depositing, seeping, releasing, flowing out, pouring, emitting, emptying or dumping;

(vii) "ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit;

(viii) "effluent" means any material in solid, liquid or gaseous form or combination thereof being discharged from industrial activity or any other source and includes a slurry, suspension or vapour;

(ix) "emission standards" means the permissible standards established by the Federal Agency or a Provincial Agency for emission of air pollutants and noise and for discharge of effluent and waste;

(x) "environment" means—

(a) air, water and land;

(b) all layers of the atmosphere;

(c) all organic and inorganic matter and living organisms;

(d) the ecosystem and ecological relationships;

(e) buildings, structures, roads, facilities and works;

APPENDIX III

(f) all social and economic conditions affecting community life; and

(g) the inter-relationships between any of the factors specified in sub-clauses (a) to (f);

(xi) "environmental impact assessment" means an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, mitigatory and compensatory measures, formulation of environmental management and training plans and monitoring arrangements, and framing of recommendations and such other components as may be prescribed;

(xii) "Environmental Magistrate" means the Magistrate of the First Class appointed under Section 24 ;

(xiii) "Environmental Tribunal" means the Environmental Tribunal constituted under section 20 ;

(xiv) "Exclusive Economic Zone" shall have the same meaning as in the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976);

(xv) "factory" means any premises in which industrial activity is being undertaken;

(xvi) "Federal Agency" means the Pakistan Environmental Protection Agency established under section 5, or any Government Agency, local council or local authority exercising the powers and functions of the Federal Agency;

(xvii) "Government Agency" includes

(a) a division, department, attached department, bureau, section, commission, board, office or unit of the Federal Government or a Provincial Government;

(b) a developmental or a local authority, company or corporation established or controlled by the Federal Government or Provincial Government; and

(c) a Provincial Environmental Protection Agency. ; and

(d) any other body defined and listed in the Rules of Business of the Federal Government or a Provincial Government.

(xviii) "hazardous substance" means

(a) a substance or mixture of substances, other than a pesticide as defined in the Agricultural Pesticides Ordinance, 1971 (II of 1971), which, by reason of its chemical activity or toxic, explosive, flammable, corrosive, radioactive or other characteristics,

APPENDIX III

causes, or is likely to cause, directly or in combination with other matters an adverse environmental effect; and

(b) any substance which may be prescribed as a hazardous substance;

(xix) "hazardous waste" means waste which is or which contains a hazardous substance or which may be prescribed as hazardous waste and includes hospital waste and nuclear waste;

(xx) "historic waters" means such limits of the waters adjacent to the land territory of Pakistan as may be specified by notification under section 7 of the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976);

(xxi) "hospital waste" includes waste medical supplies and materials of all kinds, and waste blood, tissue, organs and other parts of the human and animal bodies, from hospitals, clinics and laboratories;

(xxii) "industrial activity" means any operation or process for manufacturing, making, formulating, synthesising, altering, repairing, ornamenting, finishing, packing or otherwise treating any article or substance with a view to its use, sale, transport, delivery or disposal, or for mining, for oil and gas exploration and development, or for pumping water or sewage, or for generating, transforming or transmitting power or for any other industrial or commercial purpose;

(xxiii) "industrial waste" means waste resulting from an industrial activity;

(xxiv) "initial environmental examination" means a preliminary environmental review of the reasonably foreseeable qualitative and quantitative impacts on the environment of a proposed project to determine whether it is likely to cause an adverse environmental effect for requiring preparation of an environmental impact assessment;

(xxv) "local authority" means any agency set up or designated by the Federal Government or a Provincial Government, by notification in the official Gazette, to be a local authority for the purposes of this Ordinance;

(xxvi) "local council" means a local council constituted or established under a law relating to local government;

(xxvii) "motor vehicle" means any mechanically propelled vehicle adapted for use upon land whether its power of propulsion is transmitted thereto from an external or internal source, and includes a chassis to which a body has not been attached, and a trailer, but does not include a vehicle running upon fixed rails;

(xxviii) "municipal waste" includes sewage, refuse, garbage, waste from abattoirs, sludge and human excreta and the like;

APPENDIX III

(xxix) "National Environmental Quality Standards" means standards established by the Federal Agency under clause (c) of sub-section (1) of section 6 and approved by the Council under clause (c) of sub-section (1) of section 4;

(xxx) "noise" means the intensity, duration and character of sounds from all sources, and includes vibration;

(xxxi) "nuclear waste" means waste from any nuclear reactor or nuclear plant or other nuclear energy system, whether or not such waste is radioactive;

(xxxii) "person" means any natural person or legal entity and includes an individual, firm, association, partnership, society, group, company, corporation, co-operative society, Government Agency, non-governmental organization, community-based organization, village organization, local council or local authority and, in the case of a vessel, the master or other person having for the time being the charge or control of the vessel;

(xxxiii) "pollution" means the contamination of air, land or water by the discharge or emission of effluent or wastes or air pollutants or noise or other matter which either directly or indirectly or in combination with other discharges or substances alters unfavourably the chemical, physical, biological, radiational, thermal or radiological or aesthetic properties of the air, land or water or which may, or is likely to make the air, land or water unclean, noxious or impure or injurious, disagreeable or detrimental to the health, safety, welfare or property of persons or harmful to biodiversity;

(xxxiv) "prescribed" means prescribed by rules made under this Act;

(xxxv) "project" means any activity, plan, scheme, proposal or undertaking involving any change in the environment and includes

(a) construction or use of buildings or other works;

(b) construction or use of roads or other transport systems;

(c) construction or operation of factories or other installations;

(d) mineral prospecting, mining, quarrying, stone-crushing, drilling and the like;

(e) any change of land use or water use; and

(f) alteration, expansion, repair, decommissioning or abandonment of existing buildings or other works, roads or other transport systems, factories or other installations;

(xxxvi) "proponent" means the person who proposes or intends to undertake a project;

(xxxvii) "Provincial Agency" means a Provincial Environmental Protection Agency established under section 8;

APPENDIX III

(xxxviii) "regulations" means regulations made under this Act;

(xix) "rules" means rules made under this Act;

(xl) "sewage" means liquid or semi-solid wastes and sludge from sanitary conveniences, kitchens, laundries, washing and similar activities and from any sewerage system or sewage disposal works;

(xli) "standards" means qualitative and quantitative standards for discharge of effluent and wastes and for emission of air pollutants and noise either for general applicability or for a particular area, or from a particular production process, or for a particular product, and includes the National Environmental Quality Standards, emission standards and other standards established under this Act and the rules and regulations;

(xlii) "sustainable development" means development that meets the needs of the present generation without compromising the ability of future generations to meet their needs;

(xliii) "territorial waters" shall have the same meaning as in the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976);

(xliv) "vessel" includes anything made for the conveyance by water of human beings or of goods; and

(xlv) "waste" means any substance or object which has been, is being or is intended to be, discarded or disposed of, and includes liquid waste, solid waste, waste gases, suspended waste, industrial waste, agricultural waste, nuclear waste, municipal waste, hospital waste, used polyethylene bags and residues from the incineration of all types of waste.

3. Establishment of the Pakistan Environmental Protection Council.— (1) The Federal Government shall, by notification in the official Gazette, establish a Council to be known as the Pakistan Environmental Protection Council consisting of

(i) Prime Minister or such other person as the Prime Minister may nominate in this behalf.		Chairperson
(ii) Minister incharge of the Ministry or Division dealing with the subject of environment.		Vice Chairperson
(iii) Chief Ministers of the Provinces.	.....	Members
(iii) Ministers Incharge of the subject of environment in the Provinces.	.....	Members
(iv) Such other persons not exceedingthirty-five as the federal Government may appoint, of which at least		Members

APPENDIX III

twenty shall be non-officials including five representatives of the Chambers of Commerce and Industry and industrial associations and one or more representatives of the Chambers of Agriculture, the medical and legal professions, trade unions, and non-governmental organizations concerned with the environment and development, and scientists, technical experts and educationists	
(v) Secretary to the Government of Pakistan, incharge of the Ministry or Division dealing with the subject of environment	Member/ Secretary

(2) The Members of the Council, other than ex-officio members, shall be appointed in accordance with the prescribed procedure and shall hold office for a term of two years.

(3) The Council shall frame its own rules of procedure.

(4) The Council shall hold meetings, as and when necessary, but not less than two meetings, shall be held in a year.

(5) The Council may constitute committees of its members and entrust them with such functions as it may deem fit, and the recommendations of the committees shall be submitted to the Council for approval.

(6) The Council, or any of its committees, may invite any technical expert or representative of any Government Agency or non-governmental organization or other person possessing specialized knowledge of any subject for assistance in performance of its functions.

4. Functions and powers of the Council. (1) The Council shall

(a) co-ordinate and supervise enforcement of the provisions of this Act; and

(b) approve comprehensive national environmental policies and ensure their implementation within the framework of a national conservation strategy as may be approved by the Federal Government from time to time;

(c) approve the National Environmental Quality Standards;

(d) provide guidelines for the protection and conservation of species, habitats, and biodiversity in general, and for the conservation of renewable and non-renewable resources.

APPENDIX III

(e) co-ordinate integration of the principles and concerns of sustainable development into national development plans and policies;

(f) consider the National Environment Report and give appropriate directions thereon;

(2) The Council may, either itself or on the request of any person or organization, direct the Federal Agency or any Government Agency to prepare, submit, promote or implement projects for the protection, conservation, rehabilitation and improvement of the environment, the prevention and control of pollution, and the sustainable development of resources or to undertake research in any aspect of environment.

5. Establishment of the Pakistan Environmental Protection Agency.----(1) The Federal Government shall, by notification in the official Gazette, establish the Pakistan Environmental Protection Agency to exercise the powers and perform the functions assigned to it under this Act and the rules and regulations made thereunder.

(2) The Federal Agency shall be headed by a Director-General who shall be appointed by the Federal Government on such terms and conditions as it may determine.

(3) The Federal Agency shall have such administrative, technical and legal staff, as the Federal Government may specify, to be appointed in accordance with such procedure as may be prescribed.

(4) The powers and functions of the Federal Agency shall be exercised and performed by the Director-General.

(5) The Director-General may, by general or special order, delegate any of the powers and functions to staff appointed under sub-section (3).

(6) For assisting the Federal Agency in the discharge of its functions the Federal Government shall establish Advisory Committees for various sectors and appoint as members thereof eminent representatives of the relevant sector, educational institutions, research institutes and non-governmental organizations.

6. Functions of the Federal Agency.—(1) The Federal Agency shall—

(a) administer and implement this Act and the rules and regulations made;

(b) prepare, in co-ordination with the appropriate Government Agency and in consultation with the concerned sectoral Advisory Committees, national environmental policies for approval by the Council;

(c) take all necessary measures for the implementation of the national environmental policies approved by the Council;

APPENDIX III

(d) prepare and publish an annual National Environment Report on the state of the environment;

(e) prepare, establish and revise the National Environmental Quality Standards with approval of the Council:

Provided that before seeking approval of the Council, the Federal Agency shall publish the proposed National Environmental Quality Standards for public opinion in accordance with the prescribed procedure; and

(f) ensure enforcement of the National Environmental Quality Standards;

(g) establish standards for the quality of the ambient air, water and land, by notification in the official Gazette in consultation with the Provincial Agency concerned:

Provided that

(i) different standards for discharge or emission from different sources and for different areas and conditions may be specified;

(ii) where standards are less stringent than the National Environmental Quality Standards prior approval of the Council shall be obtained;

(iii) certain areas, with the approval of the Council, may exclude from carrying out specific activities, projects from the application of such standards;

(h) co-ordinate environmental policies and programmes nationally and internationally;

(i) establish systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation, research, inspection and audit to prevent and control pollution, and to estimate the costs of cleaning up pollution and rehabilitating the environment in various sectors;

(j) take measures to promote research and the development of science and technology which may contribute to the prevention of pollution, protection of the environment, and sustainable development;

(k) certify one or more laboratories as approved laboratories for conducting tests and analysis and one or more research institutes as environmental research institutes for conducting research and investigation for the purposes of this Act.

(l) identify the needs for and initiate legislation in various sectors of the environment;

APPENDIX III

(m) render advice and assistance in environmental matters including such information and data available with it as may be required for carrying out the purposes of this Act:

Provided that the disclosure of such information shall be subject to the restrictions contained in the proviso to sub-section (3) of section 12;

(n) assist the local councils, local authorities, Government Agencies and other persons to implement schemes for the proper disposal of wastes so as to ensure compliance with the standards established by it;

(o) provide information and guidance to the public on environmental matters;

(p) recommend environmental courses, topics, literature and books for incorporation in the curricula and syllabi of educational institutions;

(q) promote public education and awareness of environmental issues through mass media and other means including seminars and workshops;

(r) specify safeguards for the prevention of accidents and disasters which may cause pollution, collaborate with the concerned person in the preparation of contingency plans for control of such accidents and disasters, and co-ordinate implementation of such plans;

(s) encourage the formation and working of non-governmental organizations, community organizations and village organizations to prevent and control pollution and promote sustainable development;

(t) take or cause to be taken all necessary measures for the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution and promotion of sustainable development; and

(u) perform any function which the Council may assign to it.

(2) The Federal Agency may—

(a) undertake inquiries or investigation into environmental issues, either of its own accord or upon complaint from any person or organization;

(b) request any person to furnish any information or data relevant to its functions;

(c) initiate with the approval of the Federal Government, requests for foreign assistance in support of the purposes of this Act and enter into arrangements with foreign agencies or organizations for the exchange of material or information and participate in international seminars or meetings;

APPENDIX III

(d) recommend to the Federal Government the adoption of financial and fiscal programmes, schemes or measures for achieving environmental objectives and goals and the purposes of this Act, including—

(i) incentives, prizes awards, subsidies, tax exemptions, rebates and depreciation allowances; and

(ii) taxes, duties, cesses and other levies;

(e) establish and maintain laboratories to help in the performance of its functions under this Act and to conduct research in various aspects of the environment and provide or arrange necessary assistance for establishment of similar laboratories in the private sector; and

(f) provide or arrange, in accordance with such procedure as may be prescribed, financial assistance for projects designed to facilitate the discharge of its functions.

7. Powers of the Federal Agency.—Subject to the provisions of this Act, the Federal Agency may

(a) lease, purchase, acquire, own, hold, improve, use or otherwise deal in and with any property both moveable and immovable;

(b) sell, convey, mortgage, pledge, exchange or otherwise dispose of its property and assets;

(c) fix and realize fees, rates and charges for rendering any service or providing any facility, information or data under this Act or the rules and regulations;

(d) enter into contracts, execute instruments, incur liabilities and do all acts or things necessary for proper management and conduct of its business;

(e) appoint with the approval of the Federal Government and in accordance with such procedures as may be prescribed, such advisers, experts and consultants as it considers necessary for the efficient performance of its functions on such terms and conditions as it may deem fit;

(f) summon and enforce the attendance of any person and require him to supply any information or document needed for the conduct of any enquiry or investigation into any environmental issue;

(g) enter and inspect and under the authority of a search warrant issued by the Environmental Court or Environmental Magistrate, search at any reasonable time, any land, building, premises, vehicle or vessel or other place where or in which, there are reasonable grounds to believe that an offence under this Act has been, or is being, committed;

APPENDIX III

(h) take samples of any materials, products, articles or substances or of the effluent, wastes or air pollutants being discharged or emitted or of air, water or land in the vicinity of the discharge or emission;

(i) arrange for test and analysis of the samples at a certified laboratory;

(j) confiscate any article used in the commission of the offence where the offender is not known or cannot be found within a reasonable time:

Provided that the power under clauses (f), (h), (I) and (j) shall be exercised in accordance with the provisions of the Code of Criminal Procedure, 1898 (Act V of 1898). or the rules made under this Act and under the direction of the Environmental Court or Environmental Magistrate; and

(k) establish a National Environmental Co-ordination Committee comprising the Director-General as its chairman and the Director Generals of the Provincial Environmental Protection Agencies and such other persons as the Federal Government may appoint as its members to exercise such powers and perform such functions as may be delegated or assigned to it by the Federal Government for carrying out the purposes of this Act and for ensuring inter provincial co-ordination in environmental policies.

8. Establishment, powers and functions of the Provincial Environmental Protection Agencies. (1) Every Provincial Government shall, by notification in the official Gazette, establish an Environmental Protection Agency, to exercise such powers and perform such functions as may be delegated to it by the Provincial Government under sub-section (2) of section 26.

(2) The Provincial Agency shall be headed by a Director-General who shall be appointed by the Provincial Government on such terms and conditions as it may determine.

(3) The Provincial Agency shall have such administrative, technical and legal staff as the Provincial Government may specify, to be appointed in accordance with such procedure as may be prescribed.

(4) The powers and functions of the Provincial Agency shall be exercised and performed by the Director-General.

(5) The Director General may, by general or special order, delegate any of the powers and functions to staff appointed under sub-section (3).

(6) For assistance of the Provincial Agency in the discharge of its functions, the Provincial Government shall establish Sectoral Advisory Committees for various sectors and appoint members from amongst eminent representatives of the relevant sector, educational institutions, research institutes and non-governmental organizations.

APPENDIX III

9. Establishment of the Provincial Sustainable Development Funds. (1) There shall be established in each Province a Sustainable Development Fund.

(2) The Provincial Sustainable Development Fund shall be derived from the following sources, namely:

(a) grants made or loans advanced by the Federal Government or the Provincial Governments;

(b) aid and assistance, grants, advances, donations and other non-obligatory funds received from foreign governments, national or international agencies, and non-governmental organizations; and

(c) contributions from private organizations and other persons.

(3) The Provincial Sustainable Development Fund shall be utilized in accordance with such procedure as may be prescribed for—

(a) providing financial assistance to the projects designed for the protection, conservation, rehabilitation and improvement of the environment, the prevention and control of pollution, the sustainable development of resources and for research in any aspect of environment; and

(b) any other purpose which in the opinion of the Board shall help achieve environmental objectives and the purposes of this Act.

10. Management of the Provincial Sustainable Development Fund. (1) The Provincial Sustainable Development Fund shall be managed by a Board known as the Provincial Sustainable Development Fund Board consisting of—

(i) Chairman, Planning and Development Board/Additional Chief Secretary Planning and Development Department	Chairperson
(ii) such officers of the Provincial Governments, not exceeding six, as the Provincial Government may appoint including Secretaries incharge of the Finance, Industries and Environment Departments	Members
(iii) such non-official persons not exceeding ten as the Provincial Government may appoint including representatives of the Provincial Chamber of Commerce and Industry, non governmental organizations, and major donors.	Members
(iv) Director-General of the Provincial Agency	Member/Secretary

APPENDIX III

(2) In accordance with such procedure and such criteria as may be prescribed, the Board shall have the power to

(a) sanction financial assistance for eligible projects;

(b) invest moneys held in the Provincial Sustainable Development Fund in such profit-bearing Government bonds, savings schemes and securities as it may deem suitable; and

(c) take such measures and exercise such powers as may be necessary for utilization of the Provincial Sustainable Development Fund for the purposes specified in sub-section (3) of section 9.

(3) The Board shall constitute committees of its members to undertake regular monitoring of projects financed from the Provincial Sustainable Development Fund and to submit progress reports to the Board which shall publish an Annual Report incorporating its annual audited accounts and performance evaluation based on the progress reports.

11. Prohibition of certain discharges or emissions. (1) Subject to the provisions of this Act and the rules and regulations no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards or, where applicable, the standards established under sub-clause (l) of clause (g) of sub-section (1) of section 6.

(2) The Federal Government may levy a pollution charge on any person who contravenes or fails to comply with the provisions of sub-section (1), to be calculated at such rate, and collected in accordance with such procedure as may be prescribed.

(3) Any person who pays the pollution charge levied under sub-section (2) shall not be charged with an offence with respect to that contravention or failure.

(4) The provisions of sub-section (3) shall not apply to projects which commenced industrial activity on or after the thirtieth day of June, 1994.

12. Initial environmental examination and environmental impact assessment. (1) No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof.

(2) The Government Agency shall subject to standards fixed by the Federal Environmental Protection Agency

APPENDIX III

(a) review the initial environmental examination and accord its approval, or require submission of an environmental impact assessment by the proponent; or

(b) review the environmental impact assessment and accord its approval subject to such conditions as it may deem fit to impose, require that the environmental impact assessment be re-submitted after such modifications as may be stipulated or reject the project as being contrary to environmental objectives.

(3) Every review of an environmental impact assessment shall be carried out with public participation and no information will be disclosed during the course of such public participation which relates to—

(i) trade, manufacturing or business activities, processes or techniques of a proprietary nature, or financial, commercial, scientific or technical matters which the proponent has requested should remain confidential, unless for reasons to be recorded in writing, the Director General of the Federal Agency is of the opinion that the request for confidentiality is not well-founded or the public interest in the disclosure outweighs the possible prejudice to the competitive position of the project or its proponent; or

(ii) international relations, national security or maintenance of law and order, except with the consent of the Federal Government; or

(iii) matters covered by legal professional privilege.

(4) The Government Agency shall communicate its approval or otherwise within a period of four months from the date the initial environmental examination or environmental impact assessment is filed complete in all respects in accordance with the prescribed procedure, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations.

(5) Subject to sub-section (4) the appropriate Government may in a particular case extend the aforementioned period of four months if the nature of the project so warrants.

(6) The provisions of sub-sections (1), (2), (3), (4) and (5) shall apply to such categories of projects and in such manner as may be prescribed.

(7) The Government Agency shall maintain separate registers for initial environmental examination and environmental impact assessment projects, which shall contain brief particulars of each project and a summary of decisions taken thereon, and which shall be open to inspection by the public at all reasonable hours and the disclosure of information in such registers shall be subject to the restrictions specified in sub-section (3).

APPENDIX III

13. Prohibition of import of hazardous waste. No person shall import hazardous waste into Pakistan and its territorial waters, Exclusive economic Zone and historic waters.

14. Handling of hazardous substances.—Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous substance except

(a) under a licence issued by the Federal Agency and in such manner as may be prescribed; or

(b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.

15. Regulation of motor vehicles.---(1) Subject to the provisions of this Act, and the rules and regulations, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the National Environmental Quality Standards, or where applicable the standards established under clause (g) of sub-section (1) of section 6.

(2) For ensuring compliance with the standards mentioned in sub-section (1), the Federal Agency may direct that any motor vehicle or class of vehicles shall install such pollution control devices or other equipment or use such fuels or undergo such maintenance or testing as may be prescribed.

(3) Where a direction has been issued by the Government Agency under subsection (2) in respect of any motor vehicles or class of motor vehicles, no person shall operate any such vehicle till such direction has been complied with.

16. Environmental protection order.---(1) Where the Federal Agency or a Provincial Agency is satisfied that the discharge or emission of any effluent, waste, air pollutant or noise, or the disposal of waste, or the handling of hazardous substances, or any other act or omission is likely to occur, or is occurring, or has occurred, in violation of the provisions of this Act, rules or regulations or of the conditions of a licence, and is likely to cause, or is causing or has caused an adverse environmental effect, the Federal Agency or, as the case may be, the Provincial Agency may, after giving the person responsible for such discharge, emission, disposal, handling, act or omission an opportunity of being heard, by order direct such person to take such measures that the Federal Agency or Provincial Agency may consider necessary within such period as may be specified in the order.

(2) In particular and without prejudice to the generality of the foregoing power, such measures may include—

APPENDIX III

(a) immediate stoppage, preventing, lessening or controlling the discharge, emission, disposal, handling, act or omission, or to minimize or remedy the adverse environmental effect;

(b) installation, replacement or alteration of any equipment or thing to eliminate, control or abate on a permanent or temporary basis, such discharge, emission, disposal, handling, act or omission;

(c) action to remove or otherwise dispose of the effluent, waste, air pollutant, noise, or hazardous substances; and

(d) action to restore the environment to the condition existing prior to such discharge, disposal, handling, act or omission, or as close to such condition as may be reasonable in the circumstances, to the satisfaction of the Federal Agency or, Provincial Agency.

(3) Where the person, to whom directions under sub-section (1) are given, does not comply therewith, the Federal Agency or Provincial Agency may, in addition to the proceedings initiated against him under this Act, the rules and regulations, itself take or cause to be taken such measures specified in the order as it may deem necessary and may recover the reasonable costs of taking such measures from such person as arrears of land revenue.

17. Penalties. (1) Whoever contravenes or fails to comply with the provisions of sections 11, 12, 13 or section 16 or any order issued thereunder shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues:

Provided that if contravention of the provisions of section 11 also constitutes contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2) only.

(2) Whoever contravenes or fails to comply with the provisions of section 14 or 15 or any rule or regulation or conditions of any licence, any order or direction, issued by the Council or the Federal Agency or Provincial Agency, shall be punishable with fine which may extend to one hundred thousand rupees, and in case of continuing contravention or failure with an additional fine which extend to one thousand rupees for every day during which such contravention continues.

(3) Where an accused has been convicted of an offence under sub-sections (1) and (2), the Environmental Court and Environmental Magistrate, as the case may be, shall, in passing sentence, take into account the extent and duration of the contravention or failure constituting the offence and the attendant circumstances.

(4) Where an accused has been convicted of an offence under sub-section (1) and the Environmental Court is satisfied that as a result of the commission of the offence

APPENDIX III

monetary benefits have accrued to the offender, the Environmental Court may order the offender to pay, in addition to the fines under sub-section (1), further additional fine commensurate with the amount of the monetary benefits.

(5) Where a person convicted under sub-sections (1) or sub-section (2) had been previously convicted for any contravention under this Act, the Environmental Court or, as the case may be, Environmental Magistrate may, in addition to the punishment awarded thereunder—

(a) endorse a copy of the order of conviction to the concerned trade or industrial association, if any, or the concerned Provincial Chamber of Commerce and Industry or the Federation of Pakistan Chambers of Commerce and Industry;

(b) sentence him to imprisonment for a term which may extend to two years;

(c) order the closure of the factory;

(d) order confiscation of the factory, machinery, and equipment, vehicle, material or substance, record or document or other object used or involved in contravention of the provisions of the Act:

Provided that for a period of three years from the date of commencement of this Act the sentence of imprisonment shall be passed only in respect of persons who have been previously convicted for more than once for any contravention of sections 11, 13, 14 or 16 involving hazardous waste;

(e) order such person to restore the environment at his own cost, to the conditions existing prior to such contravention or as close to such conditions as may be reasonable in the circumstances to the satisfaction of the Federal Agency or, as the case may be, Provincial Agency; and

(f) order that such sum be paid to any person as compensation for any loss, bodily injury, damage to his health or property suffered by such contravention.

(6) The Director-General of the Federal Agency or of a Provincial Agency or an officer generally or specially authorised by him in this behalf may, on the application of the accused compound an offence under this Act with the permission of the Environmental Tribunals or Environmental Magistrate in accordance with such proceedure as may be prescribed.

(7) Where the Director-General of the Federal Agency or of a Provincial Agency is of the opinion that a person has contravened any provision of Act he may, subject to the rules, by notice in writing to that person require him to pay to the Federal Agency or, as the case may be, Provincial Agency an administrative penalty in the amount set out in the notice for each day the contravention continues; and a person who pays an administrative

APPENDIX III

penalty for a contravention shall not be charged under this Act with an offence in respect of such contravention.

(8) The provisions of sub-sections (6) and (7) shall not apply to a person who has been previously convicted of offence or who has compounded an offence under this Act who has paid an administrative penalty for a contravention of any provision of this Act.

18. Offences by bodies corporate.— Where any contravention of this Act has been committed by a body corporate, and it is proved that such offence has been committed with the consent or connivance of, or is attributed to any negligence on the part of, any director, partner, manager, secretary or other Officer of the body corporate, such director, partner, manager, secretary or other officer of the body corporate, shall be deemed guilty of such contravention along with the body corporate and shall be punished accordingly:

Provided that in the case of a company as defined under the Companies Ordinance, 1984 (XLVII of 1984), only the Chief Executive as defined in the said Ordinance shall be liable under this section.

Explanation. For the purposes of this section, "body corporate" includes a firm, association of persons and a society registered under the Societies Registration Act, 1860 (XXI of 1860), or under the Co-operative Societies Act, 1925 (VII of 1925).

19. Offences by Government Agencies, local authorities or local councils. Where any contravention of this Act has been committed by any Government Agency, local authority or local council, and it is proved that such contravention has been committed with the consent or connivance of, or is attributable to any negligence on the part of, the Head or any other officer of the Government Agency, local authority or local council, such Head or other officer shall also be deemed guilty of such contravention along with the Government Agency, local authority or local council and shall be liable to be proceeded against and punished accordingly.

20. Environmental Tribunals. (1) The Federal Government may, by notification in the official gazette, establish as many Environmental Tribunals as it consider necessary and, where it establishes more than one Environmental Tribunals, it shall specify territorial limits within which, or the class of cases in respect of which, each one of them shall exercise jurisdiction under this Act.

(2) An Environmental Tribunal shall consist of a Chairperson who is, or has been, or is qualified for appointment as, a judge of the High Court to be appointed after consultation with the Chief Justice of the High Court and two members to be appointed by the Federal Government of which at least one shall be a technical member with suitable professional qualifications and experience; in the environmental field as may be prescribed.

APPENDIX III

(3) For every sitting of the Environ mental Tribunal, the presence of the Chairperson and not less than one Member shall be necessary.

(4) A decision of an Environmental Tribunal shall be expressed in terms of the opinion of the majority of its members, including ;the Chairperson, or if the case has been decided by the Chairperson and only one of the members and a there is a difference of opinion between them, the ;decision of the Environmental Tribunal shall be expressed in terms of the opinion of the Chairperson.

(5) An environmental Tribunal shall not, merely be reason of a change in its composition, or the absence of any member from any sitting, be bound to recall and rehear any witness who has given evidence, and may act on the evidence already ;recorded by, or produced, before it.

(6) An Environmental Tribunal may hold its sittings at such places within its territorial jurisdiction as the Chairperson may decide.

(7) No act or proceeding of an Environmental Tribunal shall be invalid by reason only of the existence of a a vacancy in, or defect in the constitution, of, the Environmental Tribunal.

(8) The terms and conditions of service of the Chairperson and members of the Environmental Tribunal shall be such as may be prescribed.

21. Jurisdiction and powers of Environmental Tribunals.—(1) An Environmental Tribunal shall exercise such powers and perform such functions as are, or may be, conferred upon or assigned to it by or under this Act or the rules and regulations made thereunder.

(2) All contravention punishable under sub-section (1) of section 17 shall exclusively be triable by an Environmental Tribunal.

(3) An Environmental Tribunal shall not take cognizance of any offence triable under sub-section (2) except on a complaint in writing by--

(a) the Federal Agency or any Government Agency or local council; and

(b) any aggrieved person, who has given notice of not less than thirty days to the Federal Agency, or the Provincial Agency concerned, of the alleged contravention and of his intention to make a complaint to the Environment Tribunal.

(4) In exercise of its criminal jurisdiction, the Environmental Tribunals shall have the same powers as are vested in Court of Session under the Code of Criminal Procedure, 1898 (Act V of 1898).

APPENDIX III

(5) In exercise of the appellate jurisdiction under section 22 the Environmental Tribunals shall have the same powers and shall follow the same procedure as an appellate court in the Code of Civil Procedure, 1908 (Act V of 1908).

(6) In all matters with respect to which no procedure has been provided for in this Act, the Environmental Tribunal shall follow the procedure laid down in the Code of Civil Procedure, 1908 (Act V of 1908).

(7) An Environmental Tribunal may, on application filed by any officer duly authorised in this behalf by the Director-General of the Federal Agency or of Provincial Agency, issue bailable warrant for the arrest of any person against whom reasonable suspicion exist, of his having been involved in contravention punishable under sub-section (1) of Section 17:

Provided that such warrant shall be applied for, issued, and executed in accordance with the provisions of the Code of Criminal Procedure, 1898 (Act V of 1898):

Provided further that if the person arrested executes a bond with sufficient sureties in accordance with the endorsement on the warrant he shall be released from custody, failing which he shall be taken or sent without delay to the officer in-charge of the nearest police station.

(8) All proceedings before the Environmental Tribunal shall be deemed to be judicial proceedings within the meaning of section 193 and 228 of the Pakistan Penal Code (Act XLV of 1860), and the Environ mental Tribbunal shall be deemed to be a court for the purpose of section 480 and 482 of the Code of Criminal Procedure, 1898 (Act V of 1898).

(9) No court other than an Environmental Tribunal shall have or exercise any jurisdiction with respect to any matter to which the jurisdiction of an Environmental Tribunal extends under this Act, the rules and regulations made thereunder.

(10) Where the Environmental Tribunal is satisfied that a complaint made to it under sub-section (3) is false and vexatious to the knowledge of the complainant, it may, by an order, direct the complainant to pay to the person complained against such compensatory costs which may extend to one hundred thousand rupees.

22. Appeals to the Environmental Tribunal.—(1) Any person aggrieved by any order or direction of the Federal Agency or any Provincial Agency under any provision of this Act, and rules or regulations may prefer an appeal with the Environmental Tribunal within thirty days of the date of communication of the impugned order or direction to such person.

(2) An appeal to the Environmental Tribunal shall be in such form, contain such particulars and be accompanied by such fees as may be prescribed.

APPENDIX III

23. Appeals from orders of the Environmental Tribunal.---(1) Any person aggrieved by any final order or by any sentence of the Environmental Tribunal passed under this Act may, within thirty days of communication of such order or sentence, prefer an appeal to the High Court.

(2) An appeal under sub-section (1) shall be heard by a Bench of not less than two Judges.

24. Jurisdiction of Environmental Magistrates.—(1) Notwithstanding anything contained in the Code of Criminal Procedure, 1898 (Act V of 1898), or any other law for the time being in force, but subject to the provisions of this Act, all contravention punishable under sub-section (2) of section 17 shall exclusively be triable by a judicial Magistrate of the first class as Environmental Magistrate especially empowered in this behalf by the High Court.

(2) An Environmental Magistrate shall be competent to impose any punishment specified in sub-sections (2) and (4) of section 17.

(3) An Environmental Magistrate shall not take cognizance of an offence triable under sub-section (1) except on a complaint in writing by

(a) the Federal Agency, Provincial Agency, or Government Agency or a local council; and

(b) any aggrieved person.

25. Appeals from orders of Environmental Magistrates. Any person convicted of any contravention of this Act or the rules or regulations by an Environmental Magistrate may, within thirty days from the date of his conviction, appeal to the Court of Sessions whose decision thereon shall be final.

26. Power to delegate. (1) The Federal Government may, by notification in the official Gazette, delegate any of its or of the Federal Agency's powers and functions under this Act and the rules and regulations to any Provincial Government, any Government Agency, local council or local authority.

(2) The Provincial Government may, by notification in the official Gazette, delegate any of its or of the Provincial Agency's powers or functions under this Act and the rules and regulations to any Government Agency of such Provincial Government or any local council or local authority in the Province.

27. Power to give directions.—In the performance of their functions under this Act-

(a) the Federal Agency and Provincial Agencies shall be bound by the directions given to them in writing by the Federal Government; and

APPENDIX III

(b) a Provincial Agency shall be bound by the directions given to it in writing by the Provincial Government.

28. Indemnity.—No suit, prosecution or other legal proceedings shall lie against the Federal or Provincial Governments, the Council, the Federal Agency or Provincial Agencies, the Director-Generals of the Federal Agency and the Provincial Agency, members, officers, employees, experts, advisers, committees or consultants of the Federal or Provincial Agencies or the Environmental Tribunal or Environmental Magistrates or any other person for anything which is in good faith done or intended to be done under this Act or the rules or regulations made thereunder.

29. Dues recoverable as arrears of land revenue.—Any dues recoverable by the Federal Agency or Provincial Agency under this Act, or the rules or regulations shall be recoverable as arrears of land revenue.

30. Act to override other laws.—The provisions of this Act shall have effect notwithstanding anything inconsistent therewith contained in any other law for the time being in force.

31. Power to make rules. The Federal Government may, by notification in the official Gazette, make rules for carrying out the purposes of this Act including rules for implementing the provisions of the international environmental Agreements, specified in the Schedule to this Act.

32. Power to amend the Schedule.__The Federal Government may, by notification in the official Gazette, amend the Schedule so as to add any entry thereato or modify or omit any entry therein.

33. Power to make regulations.---(1) For carrying out the purposes of this Act, the Federal Agency may, by notification in the official Gazette and with the approval of the Federal Government, make regulations not inconsistent with the provisions of this Act or the rules made thereunder.

(2) In particular and without prejudice to the generality of the foregoing power, such regulations may provide for—

(a) submission of periodical reports, data or information by any Government agency, local authority or local council in respect of environmental matters;

(b) preparation of emergency contingency plans for coping with environmental hazards and pollution caused by accidents, natural disasters and calamities;

(c) appointment of officers, advisers, experts, consultants and employees;

APPENDIX III

(d) levy of fees, rates and charges in respect of services rendered, actions taken and schemes implemented;

(e) monitoring and measurement of discharges and emissions;

(f) categorization of projects to which, and the manner in which, section 12 applies;

(g) laying down of guidelines for preparation of initial environmental examination and environmental impact assessment and Development of procedures for their filing, review and approval;

(h) providing procedures for handling hazardous substances; and

(i) installation of devices in, use of fuels by, and maintenance and testing of motor vehicles for control of air and noise pollution.

34. Repeal, savings and succession.—(1) The Pakistan Environmental Protection Ordinance 1983 (XXXVII of 1983) is hereby repealed.

(2) Notwithstanding the repeal of the Pakistan Environmental Protection Ordinance, 1983 (XXVII of 1983), any rules or regulations or appointments made, orders passed, notifications issued, powers delegated, contracts entered into, proceedings commenced, rights acquired liabilities incurred, penalties, rates, fees or charges levied, things done or action taken under any provisions of that Ordinance shall, so far as they are not inconsistent with the provisions of this Act be deemed to have been made, passed, issued, delegated, entered into, commenced, acquired, incurred, levied, done or taken under this Act.

(3) On the establishment of the Federal Agency and Provincial Agencies under this Act, all properties, assets and liabilities pertaining to the Federal Agency and Provincial Agencies established under that Ordinance shall vest in and be the properties, assets and liabilities, as the case may be, of the Federal Agency and Provincial Agency established under this Act.

APPENDIX III

SCHEDULE

(See section 31)

1. International Plant Protection Convention, Rome, 1951.

2. Plant Protection Agreement for the South-East Asia and Pacific Region (as amended), Rome, 1956.

3. Agreement for the Establishment of a Commission for Controlling the Desert Locust in the Eastern Region of its Distribution Area in South-West Asia (as amended), Rome, 1963.

4. Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971 and its amending Protocol, Paris, 1982.

5. Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), 1972.

6. Convention on International Trade in Endangered Species of Wild Funa and Flora (CITES), Washington, 1973.

7. Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979.

8. Convention on the Law of the Sea, Montego Bay, 1982.

9. Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985.

10. Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987 and amendments thereto.

11. Agreement on the Network of Agriculture Centres in Asia and the Pacific, Bangkok, 1988.

12. Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, Basel, 1989.

13. Convention on Biological Diversity, Rio de Janeiro, 1992.

14. United Nations Framework Convention on Climate Change, Rio De Janeiro, 1992.

APPENDIX IV

PAKISTAN ENVIRONMENTAL PROTECTION AGENCY (REVIEW OF IEE AND EIA) REGULATIONS, 2000

S.R.O. 339 (1)/2001. - In exercise of the powers referred by section 33 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), Pakistan Environmental Protection Agency, with the approval of the Federal Government is pleased to make the following Rules, namely : -

1. Short title and commencement

(1) These regulations may be called the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000.

(2) They shall come into force at once.

2. Definitions

(1) In these regulations, unless there is anything repugnant in the subject or context –

(a) "Act" means the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997);

(b) "Director-General" means the Director-General of the Federal Agency;

(c) "EIA" means an environmental impact assessment as defined in section 2(xi);

(d) "IEE" means an initial environmental examination as defined in section 2(xxiv); and

(e) "section" means a section of the Act.

(2) All other words and expressions used in these regulations but not defined shall have the same meanings as are assigned to them in the Act.

3. Projects requiring an IEE

A proponent of a project falling in any category listed in Schedule I shall file an IEE with the Federal Agency, and the provisions of section 12 shall apply to such project.

4. Projects requiring an EIA

A proponent of a project falling in any category listed in Schedule II shall file an EIA with the Federal Agency, and the provisions of section 12 shall apply to such project.

APPENDIX IV

5. Projects not requiring an IEE or EIA

(1) A proponent of a project not falling in any category listed in Schedules I and II shall not be required to file an IEE or EIA:

Provided that the proponent shall file –

(a) an EIA, if the project is likely to cause an adverse environmental effect;

(b) for projects not listed in Schedules I and II in respect of which the Federal Agency has issued guidelines for construction and operation, an application for approval accompanied by an undertaking and an affidavit that the aforesaid guidelines shall be fully complied with.

(2) Notwithstanding anything contained in sub-regulation (1), the Federal Agency may direct the proponent of a project, whether or not listed in Schedule I or II, to file an IEE or EIA, for reasons to be recorded in such direction:

Provided that no such direction shall be issued without the recommendation in writing of the Environmental Assessment Advisory Committee constituted under Regulation 23.

(3) The provisions of section 12 shall apply to a project in respect of which an IEE or EIA is filed under sub-regulation (1) or (2).

6. Preparation of IEE and EIA

(1) The Federal Agency may issue guidelines for preparation of an IEE or an EIA, including guidelines of general applicability, and sectoral guidelines indicating specific assessment requirements for planning, construction and operation of projects relating to particular sector.

(2) Where guidelines have been issued under sub-regulation (1), an IEE or EIA shall be prepared, to the extent practicable, in accordance therewith and the proponent shall justify in the IEE or EIA any departure therefrom.

7. Review Fees

The proponent shall pay, at the time of submission of an IEE or EIA, a non-refundable Review Fee to the Federal Agency, as per rates shown in Schedule III.

8. Filing of IEE and EIA

(1) Ten paper copies and two electronic copies of an IEE or EIA shall be filed with the Federal Agency.

APPENDIX IV

(2) Every IEE and EIA shall be accompanied by

(a) an application, in the form prescribed in Schedule IV; and

(b) copy of receipt showing payment of the Review Fee.

9. Preliminary scrutiny

(1) Within 10 working days of filing of the IEE or EIA, the Federal Agency shall –

(a) confirm that the IEE or EIA is complete for purposes of initiation of the review process; or

(b) require the proponent to submit such additional information as may be specified; or

(c) return the IEE or EIA to the proponent for revision, clearly listing the points requiring further study and discussion.

(2) Nothing in sub-regulation (1) shall prohibit the Federal Agency from requiring the proponent to submit additional information at any stage during the review process.

10. Public participation

(1) In the case of an EIA, the Federal Agency shall, simultaneously with issue of confirmation of completeness under clause (a) of sub-regulation (1) of Regulation 9, cause to be published in any English or Urdu national newspaper and in a local newspaper of general circulation in the area affected by the project, a public notice mentioning the type of project, its exact location, the name and address of the proponent and the places at which the EIA of the project can, subject to the restrictions in sub-section (3) of section 12, be accessed.

(2) The notice issued under sub-regulation (1) shall fix a date, time and place for public hearing of any comments on the project or its EIA.

(3) The date fixed under sub-regulation (2) shall not be earlier than 30 days from the date of publication of the notice.

(4) The Federal Agency shall also ensure the circulation of the EIA to the concerned Government Agencies and solicit their comments thereon.

(5) All comments received by the Federal Agency from the public or any Government Agency shall be collated, tabulated and duly considered by it before decision on the EIA.

APPENDIX IV

causes, or is likely to cause, directly or in combination with other matters an adverse environmental effect; and

(b) any substance which may be prescribed as a hazardous substance;

(xix) "hazardous waste" means waste which is or which contains a hazardous substance or which may be prescribed as hazardous waste and includes hospital waste and nuclear waste;

(xx) "historic waters" means such limits of the waters adjacent to the land territory of Pakistan as may be specified by notification under section 7 of the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976);

(xxi) "hospital waste" includes waste medical supplies and materials of all kinds, and waste blood, tissue, organs and other parts of the human and animal bodies, from hospitals, clinics and laboratories;

(xxii) "industrial activity" means any operation or process for manufacturing, making, formulating, synthesising, altering, repairing, ornamenting, finishing, packing or otherwise treating any article or substance with a view to its use, sale, transport, delivery or disposal, or for mining, for oil and gas exploration and development, or for pumping water or sewage, or for generating, transforming or transmitting power or for any other industrial or commercial purpose;

(xxiii) "industrial waste" means waste resulting from an industrial activity;

(xxiv) "initial environmental examination" means a preliminary environmental review of the reasonably foreseeable qualitative and quantitative impacts on the environment of a proposed project to determine whether it is likely to cause an adverse environmental effect for requiring preparation of an environmental impact assessment;

(xxv) "local authority" means any agency set up or designated by the Federal Government or a Provincial Government, by notification in the official Gazette, to be a local authority for the purposes of this Ordinance;

(xxvi) "local council" means a local council constituted or established under a law relating to local government;

(xxvii) "motor vehicle" means any mechanically propelled vehicle adapted for use upon land whether its power of propulsion is transmitted thereto from an external or internal source, and includes a chassis to which a body has not been attached, and a trailer, but does not include a vehicle running upon fixed rails;

(xxviii) "municipal waste" includes sewage, refuse, garbage, waste from abattoirs, sludge and human excreta and the like;

APPENDIX IV

(b) before commencing operation of the project, obtain from the Federal Agency written confirmation that the conditions of approval, and the requirements in the IEE/EIA relating to design and construction, adoption of mitigatory and other measures and other relevant matters, have been duly complied with.

14. Confirmation of compliance

(1) The request for confirmation of compliance under clause (b) of sub-regulation (2) of Regulation 13 shall be accompanied by an Environmental Management Plan indicating the measures and procedures proposed to be taken to manage or mitigate the environmental impacts for the life of the project, including provisions for monitoring, reporting and auditing.

(2) Where a request for confirmation of compliance is received from a proponent, the Federal Agency may carry out such inspection of the site and plant and machinery and seek such additional information from the proponent as it may deem fit:

Provided that every effort shall be made by the Federal Agency to provide the requisite confirmation or otherwise within 15 days of receipt of the request, with complete information, from the proponent.

(3) The Federal Agency may, while issuing the requisite confirmation of compliance, impose such other conditions as the Environmental Management Plan, and the operation, maintenance and monitoring of the project as it may deem fit, and such conditions shall be deemed to be included in the conditions to which approval of the project is subject.

15. Deemed approval

The four-month period for communication of decision stipulated in sub-section (4) of section 12 shall commence from the date of filing of an IEE or EIA in respect of which confirmation of completeness is issued by the Federal Agency under clause (a) of sub-regulation (1) of Regulation 9.

16. Extension in review period

Where the Federal Government in a particular case extends the four-month period for communication of approval prescribed in sub-section (5) of section 12, it shall, in consultation with the Federal Agency, indicate the various steps of the review process to be taken during the extended period, and the estimated time required for each step.

17. Validity period of approval

(1) The approval accorded by a Federal Agency under section 12 read with Regulation 12 shall be valid, for commencement of construction, for a period of three years from the date of issue.

APPENDIX IV

(2) If construction is commenced during the initial three year validity period, the validity of the approval shall stand extended for a further period of three years from the date of issue.

(3) After issue of confirmation of compliance, the approval shall be valid for a period of three years from the date thereof.

(4) The proponent may apply to the Federal Agency for extension in the validity periods mentioned in sub-regulations (1), (2) and (3), which may be granted by the Federal Agency in its discretion for such period not exceeding three years at a time, if the conditions of the approval do not require significant change:

Provided that the Federal Agency may require the proponent to submit a fresh IEE or EIA, if in its opinion changes in location, design, construction and operation of the project so warrant.

18. Entry and inspection

(1) For purposes of verification of any matter relating to the review or to the conditions of approval of an IEE or EIA prior to, during or after commencement of construction or operation of a project, duly authorized staff of the Federal Agency shall be entitled to enter and inspect the project site, factory building and plant and equipment installed therein.

(2) The proponent shall ensure full cooperation of the project staff at site to facilitate the inspection, and shall provide such information as may be required by the Federal Agency for this purpose and pursuant thereto.

19. Monitoring

(1) After issue of approval, the proponent shall submit a report to the Federal Agency on completion of construction of the project.

(2) After issue of confirmation of compliance, the proponent shall submit an annual report summarizing operational performance of the project, with reference to the conditions of approval and maintenance and mitigatory measures adopted by the project.

(3) To enable the Federal Agency to effectively monitor compliance with the conditions of approval, the proponent shall furnish such additional information as the Federal Agency may require.

20. Cancellation of approval

(1) Notwithstanding anything contained in these Regulations, if, at any time, on the basis of information or report received or inspection carried out, the Federal Agency is of the opinion that the conditions of an approval have not been complied with, or that the information supplied by a proponent in the approved IEE or EIA is incorrect, it

APPENDIX IV

shall issue notice to the proponent to show cause, within two weeks of receipt thereof, why the approval should not be cancelled.

(2) If no reply is received or if the reply is considered unsatisfactory, the Federal Agency may, after giving the proponent an opportunity of being heard:

(i) require the proponent to take such measures and to comply with such conditions within such period as it may specify, failing which the approval shall stand cancelled; or

(ii) cancel the approval.

(3) On cancellation of the approval, the proponent shall cease construction or operation of the project forthwith.

(4) Action taken under this Regulation shall be without prejudice to any other action that may be taken against the proponent under the Act or rules or regulations or any other law for the time being in force.

21. Registers of IEE and EIA projects

Separate Registers to be maintained by the Federal Agency for IEE and EIA projects under sub-section (7) of section 12 shall be in the form prescribed in Schedule VIII.

22. Environmentally sensitive areas

(1) The Federal Agency may, by notification in the official Gazette, designate an area to be an environmentally sensitive area.

(2) Notwithstanding anything contained in Regulations 3, 4 and 5, the proponent of a project situated in an environmentally sensitive area shall be required to file an EIA with the Federal Agency.

(3) The Federal Agency may from time to time issue guidelines to assist proponents and other persons involved in the environmental assessment process to plan and prepare projects located in environmentally sensitive areas.

(4) Where guidelines have been issued under sub-regulation (3), the projects shall be planned and prepared, to the extent practicable, in accordance therewith and any departure therefrom justified in the EIA pertaining to the project.

23. Environmental Assessment Advisory Committee

For purposes of rendering advice on all aspects of environmental assessment, including guidelines, procedures and categorization of projects, the Director-General shall constitute an Environmental Assessment Advisory Committee comprising –

(a) Director EIA, Federal Agency ... Chairman

APPENDIX IV

(b)	One representative each of the Provincial Agencies	...	Members
(c)	One representative each of the Federal Planning Commission and the Provincial Planning and Development Departments	...	Members
(d)	Representatives of industry and non-Governmental organizations, and legal and other experts	...	Members

24. Other approvals

Issue of an approval under section 12 read with Regulation 12 shall not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law for the time being in force.

APPENDIX IV

SCHEDULE I
(*See* Regulation 3)

List of projects requiring an IEE

A. Agriculture, Livestock and Fisheries

1. Poultry, livestock, stud and fish farms with total cost more than Rs.10 million
2. Projects involving repacking, formulation or warehousing of agricultural products

B. Energy

1. Hydroelectric power generation less than 50 MW
2. Thermal power generation less than 200 KW
3. Transmission lines less than 11 KV, and large distribution projects
4. Oil and gas transmission systems
5. Oil and gas extraction projects including exploration, production, gathering systems, separation and storage
6. Waste-to-energy generation projects

C. Manufacturing and processing

1. Ceramics and glass units with total cost more than Rs.50 million
2. Food processing industries including sugar mills, beverages, milk and dairy products, with total cost less than Rs.100 million
3. Man-made fibers and resin projects with total cost less than Rs.100 million
4. Manufacturing of apparel, including dyeing and printing, with total cost more than Rs.25 million
5. Wood products with total cost more than Rs.25 million

D. Mining and mineral processing

1. Commercial extraction of sand, gravel, limestone, clay, sulphur and other minerals not included in Schedule II with total cost less than Rs.100 million
2. Crushing, grinding and separation processes

APPENDIX IV

3. Smelting plants with total cost less than Rs.50 million

E. Transport

1. Federal or Provincial highways (except maintenance, rebuilding or reconstruction of existing metalled roads) with total cost less than Rs.50 million

2. Ports and harbor development for ships less than 500 gross tons

F. Water management, dams, irrigation and flood protection

1. Dams and reservoirs with storage volume less than 50 million cubic meters of surface area less than 8 square kilometers

2. Irrigation and drainage projects serving less than 15,000 hectares

3. Small-scale irrigation systems with total cost less than Rs.50 million

G. Water supply and treatment

Water supply schemes and treatment plants with total cost less than Rs.25 million

H. Waste disposal

Waste disposal facility for domestic or industrial wastes, with annual capacity less than 10,000 cubic meters

I. Urban development and tourism

1. Housing schemes

2. Public facilities with significant off-site impacts (e.g. hospital wastes)

3. Urban development projects

J. Other projects

Any other project for which filing of an IEE is required by the Federal Agency under sub-regulation (2) of Regulation 5

APPENDIX IV

SCHEDULE II
(*See* Regulation 4)

List of projects requiring an EIA

A. Energy

1. Hydroelectric power generation over 50 MW
2. Thermal power generation over 200 MW
3. Transmission lines (11 KV and above) and grid stations
4. Nuclear power plans
5. Petroleum refineries

B. Manufacturing and processing

1. Cement plants
2. Chemicals projects
3. Fertilizer plants
4. Food processing industries including sugar mills, beverages, milk and dairy products, with total cost of Rs.100 million and above
5. Industrial estates (including export processing zones)
6. Man-made fibers and resin projects with total cost of Rs.100 M and above
7. Pesticides (manufacture or formulation)
8. Petrochemicals complex
9. Synthetic resins, plastics and man-made fibers, paper and paperboard, paper pulping, plastic products, textiles (except apparel),printing and publishing, paints and dyes, oils and fats and vegetable ghee projects, with total cost more than Rs.10 million
10. Tanning and leather finishing projects

C. Mining and mineral processing

1. Mining and processing of coal, gold, copper, sulphur and precious stones
2. Mining and processing of major non-ferrous metals, iron and steel rolling
3. Smelting plants with total cost of Rs.50 million and above

APPENDIX IV

D. Transport

1. Airports
2. Federal or Provincial highways or major roads (except maintenance, rebuilding or reconstruction of existing roads) with total cost of Rs.50 million and above
3. Ports and harbor development for ships of 500 gross tons and above
4. Railway works

E. Water management, dams, irrigation and flood protection

1. Dams and reservoirs with storage volume of 50 million cubic meters and above or surface area of 8 square kilometers and above
2. Irrigation and drainage projects serving 15,000 hectares and above

F. Water supply and treatment

Water supply schemes and treatment plants with total cost of Rs.25 million and above

G. Waste Disposal

1. Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)
2. Waste disposal facilities for domestic or industrial wastes, with annual capacity more than 10,000 cubic meters

H. Urban development and tourism

1. Land use studies and urban plans (large cities)
2. Large-scale tourism development projects with total cost more than Rs.50 million

I. Environmentally Sensitive Areas

All projects situated in environmentally sensitive areas

J. Other projects

1. Any other project for which filing of an EIA is required by the Federal Agency under sub-regulation (2) of Regulation 5.
2. Any other project likely to cause an adverse environmental effect

APPENDIX IV

SCHEDULE III
(See Regulation 7)

IEE/EIA Review Fees

Total Project Cost	IEE	EIA
Upto Rs.5,000,000	NIL	NIL
Rs.5,000,001 to 10,000,000	Rs.10,000	Rs.15,000
Greater than Rs.10,000,000	Rs.15,000	Rs.30,000

APPENDIX IV

SCHEDULE IV
[*See* Regulation 8(2)(a)]

Application Form

1.	Name and address of proponent		Phone: Fax: Telex:	
2.	Description of project			
3.	Location of project			
4.	Objectives of project			
5.	IEE/EIA attached?	IEE/EIA :	Yes/No	
6.	Have alternative sites been considered and reported in IEE/EIA?		Yes/No	
7.	Existing land use		Land requirement	
8.	Is basic site data available, or has it been measured?	(only tick yes if the data is reported in the IEE/EIA)	Available	Measured
		Meterology (including rainfall)	Yes/No	Yes/No
		Ambient air quality	Yes/No	Yes/No
		Ambient water quality	Yes/No	Yes/No
		Ground water quality	Yes/No	Yes/No
9.	Have estimates of the following been reported?		Estimated	Reported
		Water balance	Yes/No	Yes/No
		Solid waste disposal	Yes/No	Yes/No
		Liquid waste treatment	Yes/No	Yes/No
10.	Source of power		Power requirement	
11.	Labour force (number)	Construction: Operation:		

Verification. I do solemnly affirm and declare that the information given above and contained in the attached IEE/EIA is true and correct to the best of my knowledge and belief.

Date _____

Signature, name and _____
designation of proponent
(with official stamp/seal)

14

APPENDIX IV

SCHEDULE V
[*See* Regulation 12]

Decision on IEE

1. Name and address of proponent _____

2. Description of project _____

3. Location of project _____

4. Date of filing of IEE _____

5. After careful review of the IEE, the Federation Agency has decided

   (a) to accord its approval, subject to the following conditions:

   _____
   _____

   or (b) that the proponent should submit an EIA of the project, for the following reasons

   _____
   _____

   [Delete (a) or (b), whichever is inapplicable]

Dated _____

Tracking no.___

Director-General
Federal Agency
(with official stamp/seal)

APPENDIX IV

SCHEDULE VI
[*See* Regulation 12]

Decision on EIA

1. Name and address of proponent _____

2. Description of project _____

3. Location of project _____

4. Date of filing of EIA _____

5. After careful review of the EIA, and all comments thereon, the Federation Agency has decided –

   (a) to accord its approval, subject to the following conditions:

   _____

   or (b) that the proponent should submit an EIA with the following modifications-

   _____
   _____

   or (c) to reject the project, being contrary to environmental objectives, for the following reasons:

   _____
   _____

   [Delete (a)/(b)/(c), whichever is inapplicable]

Dated _____

Tracking no.___

Director-General
Federal Agency
(with official stamp/seal)

APPENDIX IV

SCHEDULE VII
|*See* Regulation 13(2)|

Undertaking

I, (full name and address) as proponent for (name, description and location of project) do hereby solemnly affirm and declare that I fully understand and accept the conditions contained in the approval accorded by the Federal Agency bearing tracking no. dated _____, and undertake to design, construct and operate the project strictly in accordance with the said conditions and the IEE/EIA.

Date _____

Signature, name and _____
designation of proponent
(with official stamp/seal)

Witnesses
(full names and addresses)

(1)

(2) _____

APPENDIX IV

S. No.	Description	Relevant Provisions
1	2	3
1.	Tracking number	
2.	Category type (as per Schedules I and II)	
3.	Name of proponent	
4.	Name and designation of contact person	
5.	Name of consultant	
6.	Description of project	
7.	Location of project	
8.	Project capital cost	
9.	Date of receipt of IEE/EIA	
10.	Date of confirmation of completeness	
11.	Approval granted (Yes/No)	
12.	Date of approval granted or refused	
13.	Conditions of approval/reasons for refusal	
14.	Date of Undertaking	
15.	Date of extension of approval validity	
16.	Period of extension	
17.	Date of commencement of construction	
18.	Date of issue of confirmation of compliance	
19.	Date of commencement of operations	
20.	Dates of filing of monitoring reports	
21.	Date of cancellation, if applicable	